National Symposium on

# Weed Threat to Environment, Biodiversity and Agricultural Productivity

**2-3 August, 2009**

**Venue : Tamil Nadu Agricultural University, Coimbatore**

# Abstracts

Jointly Organised by

**Tamil Nadu Agricultural University, Coimbatore (Tamil Nadu)**

**Indian society of Weed Science, Jabalpur (M.P.)**

**Directorate of Weed Science Research, Jabalpur (M.P.)**

# Weedy rice and its management

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Rice is the world's most important crop which feeds majority of the people in Africa, Asia and Latin America. "Weedy rice" or red rice (Oryza sativa f. spontanea) is a serious threat to production of drilled as well as transplanted rice crop in more than 50 countries in Africa, Asia and Latin America. This weed not only reduces the production but deteriorates quality of produce and increases the cost of production. The weedy rice form has been developed due to natural hybridization between the cultivated rice (O. sativa) and wild rice species *viz. O. granulata, O. officinalis, O. nivara, O. meyeriana, O. sativa f. spontanea, O. rufipogon, O. balunga, and O. perennis,* which grow in the vicinity of cultivated rice fields. The hybrids back cross both ways and several intermediate weedy rice forms are developed which have early emergence, vigorous growth habit, longer culm, early maturity, easier shattering of spike lets, grain with red pericarp, awned or awn less, open or compact panicle with other variable characters. Weedy rice is spread primarily as a contaminant in rice seeds. Suh et al., (1992) collected 1,113 lines of weedy rice from farmers' fields through out the Korean peninsula.

The losses up to 74% in productivity was reported in Malaysia in heavily infested weedy rice fields ( Watanabe *et al* ,1996), while 40% losses in Sri Lanka ( Marambe and Amarsinghe, 2000). Smith (1988) recorded that early competition from low infestation (10-20 plant/$m^2$ ) of weedy rice may result in crop losses up to 50% .In Latin America it has been estimated that 24 plants m-2 may cause yield losses up to 75% (Fischer and Ramirez, 1993). In Africa both *O.barthii* (annual type) and *O. longistaminata* (perennial type) pose major problems to cultivated rice. Fajardo and Moody (1995) estimated red rice infestation level to the range form 1% to 30% in Philippines. 60% fields had off type's rice and 49% had red rice. In India, a study conducted by DWSR, Jabalpur revealed that almost all rice fields are heavily infested by weedy rice. The extent of infestation was found in the range of 5 to 60% in different states of India, whereas, it was observed at 11.32 to 44.28% under cultivators fields both under direct seeded and transplanted at Jabalpur. Ten types of weedy rice were found in rice fields and two types in the ponds and tanks. Considering mean 10% infestation, the average loss in rice production has been assessed to the extent of 9.15 million tons per year in India. The damage is likely to increase exponentially in subsequent years, if not managed effectively challenging the rice production system in the country.

These weedy rice are difficult to control at early stage because they mimic the cultivated rice plant. They can be identified only at panicle emergence by that time sufficient loss has already occurred. Control of weedy rice has become more challenging and no single technique can effectively manage weedy rice because of reemergence of weedy rice after controlling the first flush. Chin (1997) reported that weedy rice is dangerous because the seed bank in the soil increases over time. Self regeneration is difficult to contain and no selective herbicide is effective for controlling weedy rice. Preventive measures viz., use of clean and certified seeds, proper land preparation, appropriate variety, crop rotation and water management, can check substantially the weedy rice infestation whereas direct control measures such as manual weeding and herbicides can control the weedy rice problem up to a certain extent. Intensive research efforts are needed to manage weedy rice problem in the country.

# Current status of parasitic weeds and their management in India

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Parasitic weeds are those plants which require growth stimulants for germination and host plant to support growth and development and to complete their life cycle. Parasitic weeds are gaining importance in recent times in view of their wide spread occurrence or host-specific occurrence and difficulty in managing them. Parasitic weeds have certain specific characteristics like prolific seed production potential, competitiveness and aggressiveness with the host plants, prolonged seed viability, troublesome and very difficult to control by normal weed control measures. Parasites are of two types based on occurrence on – a) root parasite like *Striga* being partial parasite occurring on sorghum, maize, sugarcane, and *Orobanche* being complete parasite occurring on tobacco, tomato, brinjal, potato, mustard, *etc.*; and b) stem parasite like *Cuscuta* being complete parasite occurring on Lucerne, fennel, niger, bengal gram, plantation crops, hedge plants, *etc.* and *Dendropthae* being partial parasite occurring on timber crops, fruit trees, plantation crops, *etc*.

*Orobanche* spp. (broomrape) belongs to family Orobanchaceae, is a complete root parasite with about 130 species occurring only on wide range of hosts comprising food leguminous crops, oilseed crops, solanaceous crops and medicinal plants belonging to families – Solanaceae, Chenopodiaceae and Asteraceae. The four virulent species are O. *cernua,* O. *ramosa*; O. *aegyptiaca* and O. *crenata.* In India, *O. cernua* and *O. aegyptiaca* is occurring on crops – tobacco, cumin, mustard, Plantago, Lentil, potato, brinjal and tomato and cause losses from 30-35% in tobacco to more than 80% in solanaceous vegetables, where solanaceous crops are grown in succession. Broomrape also infests weeds like *Parthenium hysterophorus*, *Solanum kasianum* and *Physalis minima* and thus perpetuate by forming numerous seeds The broomrape is distributed in Karnataka, Andhra Pradesh, Tamil Nadu, Gujarat, Maharashtra, Rajasthan, and Haryana states causing greater concern among farmers. Broomrape is an annual, host specific parasitic herb propagated by seeds.

The broomrape can be managed by methods like avoiding the use of seeds from infested areas and of clean seeds; deep ploughing; soil solarisation with the use of 0.05 mm thick white polyethylene sheets for 30 to 40 days during hot summer, flooding of the field around 20-25 days after planting; physical removal of emerged shoots of parasite and burning them; desiccate the shoots by repeated directed application of 1 to 2 drops of mineral oils – diesel, kerosene or plant oils – coconut, neem, caster, cottonseed, gingili or linseed on emerging shoots before flowering and prevent seed formation; passing spear or iron blade below the host plant to cut young shoots of parasites followed by manual removal of shoots with in the rows, collecting and burning them; use of trap crops – pepper, Amaranthus, cowpea, green gram, black gram, pigeon pea, use of these as intercrops in areas having lower infestation of parasite; soil application of analogue of Strigol – GR-24 or GR-7 at 0.3 kg/ha in acid soil to 1.5 kg/ha in alkaline soil about 6 weeks before sowing of host crops induce suicidal germination of the parasite; use of pre-emergence herbicides relevant to the host crops will delay and lower the emergence of broomrape.

*Striga (w*itch weed**),** Scrophlariaceae, an annual, partial root parasite propagated through tiny dust like seeds with 41 species having wide distribution. Of these, 11 species occur on important

tropical cereals (maize, sorghum, pearl millet, finger millet, upland rice and sugarcane) and many grasses. Of these, only four species are considered noxious inflicting greater losses to the cultivators - *Striga asiatica* (= *S. lutea*), *S. hermonthica, S. gesnerioides* and *S. densiflora*. Management strategies are deep plowing; uprooting and burning shoots of *Striga*; use of clean seeds; crop rotation, use of trap crops or inter crops (cotton, sunflower, cowpea, gram, red gram, sesamum, groundnut, castor and melons); use of resistant crops/ varieties may be useful in preventing and reducing the menace of *Striga*; improving soil fertility; use of high fertilizer dose; directed applications of 2,4-D Na salt at 1.50 to 2.0 kg/ha; use of stimulants like Strigol, GR 7, GR 45, ethylene as pre-plant incorporation at 0.1 to 1.0 kg/ha; suitable legislation to prevent movement of infested seed material from one place to another place.

*Cuscuta,* (dodder), family Convolvulaceae, is an invasive, obnoxious, complete stem parasitic weed that attaches itself to stem and leaf of wide varieties of host plant species. There are about 100 species of genus *Cuscuta*, among them *Cuscuta chinensis*, *C. reflexa*, *C. compestris* and *C. trifolii* are more common in India. The *Cuscuta* is widely distributed in our country in cropped and non cropped areas. This parasite poses a serious problem in niger in Orissa, Chattisgarh and parts of M.P.; pulses in Andhra Pradesh, Tamil Nadu, Orissa, Chhattisgarh and parts of Madhya Pradesh where rice-fallow cropping system; lucerne and berseem in Gujarat and some parts of M.P; linseed, lentil, chickpea, onion, sugar beet, carrot, *hina* and citrus. Management strategies are deep ploughing; burning; use of *Cuscuta* free crop seed; use of resistant crops/varieties; crop rotation and inter cropping (cereals, forage grasses), mechanical weeding; spraying non-selective herbicides like paraquat (1% spray) and glyphosate (1%) on Cuscuta in patches; pre-emergence herbicides fluchloralin, trifluralin or pendimethalin at 0.75 to 1.50 kg/ha (relevant to crops).

*Dendrophthoe* (= *Loranthus*), Loranthaceae, is a semi stem parasite of certain tropical and subtropical trees and bushes like teak, rosewood, sandalwood, tea, mango, citrus, sapota, jackfruit. In India, about 60 species of *Dendrophthoe* have been recorded on various trees and plantations. Of these *D. longiflorus* var. *falcatus* is the most damaging and occurring on various trees. The seeds of parasite are spread by birds to fresh tree branches. In Karnataka, it occurs on all most all forest trees except tamarind. Management strategies are- to bore two rows of holes down the infected tree, reaching the sap wood and add a mixture of 8 g copper sulphate and 1 g 2,4-D powder; to lop off the branch infested with *Dendrophthoe* to prevent further growth and spread in the initial stage itself.

# Alien weeds in the humid tropics and their management

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The humid tropical regions of India, including the Western Ghats region which is one of the hot spots of biodiversity, is under severe threat of invasion by many alien weeds, most of which have their origin in the "New World Tropics" (North America). In the aquatic areas, *Eichhornia crassipes* and *Salivinia molesta* are the major weeds invading most of the aquatic areas. They cause problems to agriculture, water transport and aqua culture. In hydro electric projects, the aquatic weeds cause loss of water through transpiration and chock the turbines. As they harbour mosquitoes, incidence of Chickun guinea, Dengie fever and Filariasis is more in the low lying back water areas. *Limnocharis flava*, *Ipomoea carnea* and *Alternanthera philoxeroides* are comparatively recent introductions, becoming serious problems in shallow water, uncultivated areas, in the rice fields, sewage canals and their shore areas which are generally moist in nature.

In the terrestrial areas, *Lantana camara* (lantana), *Mimosa pudica* (touch-me-not) and *Chromolaena odorata* (Siam weed) were the earlier introductions. New invaders include the thorny weed *Mimosa invisa* (*M. diplotricha*) (giant sensitive plant) and the climbers *Mikania micrantha* (mile – a - minute) and *Merremia vitifolia* (grape leaf morning glory). *Chromolaena* is a problem in the plantation crops like coconut and rubber, in the lower altitudes, whereas Lantana is so in the higher altitude areas. *Mikania* and *Merremia* twine and climb over the shrubs and trees and smother them by blocking sunlight. *Mimosa pudica* was introduced about a century back where as *Mimosa invisa* is a more recent introduction. The thorny nature of these weeds causes difficulties in intercultural operations in the infested areas. In addition, *Mimosa invisa* has high content of mimosine, a non protein amino acid, which is toxic to animals feeding on *Mimosa*.

*Parthenium hysterophorus* (congress grass, carrot weed) has not yet become wide spread in the high rainfall areas. However, localized infestation of *Parthenium* is now seen in the railway stations and bus stations. It has spread to more areas in Palakkad, Wayanad, Idukki and Trivandrum districts which have road connections to the neighbouring states of Tamilnadu and Karnataka, where Parthenium is a problem. Other alien weeds seen spreading in this region are *Alternenthera bettzickiana*, *Axonopus compressus* and *Spilanthes radicans*.

Different methods of control are practiced against these weeds. Aquatic weeds, *Eichhornia* and *Salvinia* are removed with the help of JCBs mounted on floating platforms. *Chromolaena* and Lantana are pulled out or slashed manually. Herbicides like paraquat, 2-4,D and glyphosate have been successful against these weeds. Against aquatic weeds also, these herbicides are used, especially for the pre - plant control in the rice fields.

Biocontrol with the weevils *Neochetina eichhorniae* and *N. bruchi* as well as the fungi *Cercospora rodmanii* and *Fusarium equiseti* have shown promise against *Eichhornia*. In Kerala, infestation of *Salvinia* in about 40,000 ha area in Kuttanad could be controlled by releasing *Cyrtobagous salviniae* and *C. singularis*. Other bio agents which are being tested are *Procecidochares utilis* against *Chromolaena*, *Puccinia spegazzinii* against *Mikania* and *Agasicles hygrophila* against *Alternanthera philoxeroides*.

# Role of adjuvants in increasing herbicide use efficiency

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The increased costs of new compound discovery and regulatory compliance have reduced the introduction of new herbicides. In addition, the introduction of herbicide resistant plants will bring a change in pattern of herbicide use, with a dependence on small number of chemicals. Weed numbers will not fall, so the remaining herbicide s will need to be more effective and over a wide spectrum. This requirement to increase efficacy and reduce environmental pollution, can be achieved by improved application and formulation technologies. Spray formulation efficacy can be expressed as function of deposition, retention, uptake, translocation and a.i. toxicity, where deposition is the mass of herbicide applied to an area; retention is the mass captured and retained on the target plant; translocation is the movement (for systemic herbicides) to the site of action; and active ingredient toxicity is the biochemical activity of the herbicide. An adjuvant is something which is added to spray solution to increase the effectiveness of the active ingredient. They may be packed and formulated with the herbicide product or they may be added to spray solution as a tank mix. Generally spray adjuvant are used with post-emergence herbicides to overcome the barriers that impede the movement of herbicides from leaf surface to the anterior of the cell. Adjuvant optimize the activity of the herbicide molecule but do not act themselves as pesticide. Some adjuvants reduce the surface tension of water/spray fluid, resulting in rapid spreading of spray droplets and better spray retention. Others enhance the absorption, penetration and translocation of herbicides into and through out host the plant by aiding herbicide movement through the cuticle. The use of adjuvant by growers was not significant in earlier times due to limited commercial availability. However, over the last 25 years adjuvants have enhanced the performance of post emergence herbicide application.

# Weeds under climatic change

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Impact of climatic change on plant biology and its link with public health is of a great interest to public. Adequate diet and nutrition remain key agents of global health. Agricultural productivity depends on prevailing $CO_2$, temperature and water that are the key inputs. Pests, diseases and nutrient deficiency regulate negatively the productivity. Weeds being major pests competing for basic inputs with crop and being aggressive have developed all strategies to combat change in climate than crop. Amongst various changes occurring due to climate change, rise in $CO_2$, ambient temperature plays havoc on drastic change in plant biology especially in weeds owing to wide genomic characteristics to adapt to the nature. $CO_2$ being the sole supplier of carbon for photosynthetic process $CO_2$ stimulate the plant growth especially of $C_3$ types rather than $C_4$ and CAM types. However, simultaneous raise in temperature increase dark respiration and thus the biomass production was reduced to certain extent. Hence $C_3$ weeds becomes more aggressive compete with crop may pose a big threat for food production. Apart from this herbicide efficacy gets altered due to change in leaf surface morphology, change in fatty acid quantity and composition of cuticle which affect entry or dilution affect due to enhanced biomass production thus alters the enzymes and herbicide concentration. Seeds and plants being the major food source for rodents and mosquitoes, which are the animal vectors for disease and pollens of weeds production enhancement cause quadrupling of asthma. To protect them from animals secondary metabolites production enhanced and exudates from surface glandular trichomes (waxy hairness) and cause contact dermatitis. These issues were discussed apart from policy matters.

# Weed management in perennial palms

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Coconut, arecanut and oil palm are the important perennial palm species of commercial importance cultivated in the tropical regions of the country. They are widely spaced, the spacing combined with slow growth less canopy coverage, and non branching nature results in higher weed population which in turn affect the growth of plantation crops more in the initial years of planting. The weed population in plantation crops include *Settaria grass,* shrubs/ herbs (*Clerodendrum paniculatum)*, and trees especially in the new planted areas of higher rainfall zone of West Coast region. The Venetian structure of the coconut crown and the orientation of leaves allow significant part of the incident solar radiation to pass through the canopy and fall on the ground. The leaves in a coconut palm crown are not randomly distributed, but clumped around few widely spaced growing points. It is estimated that as much as 56 per cent of the sunlight was transmitted through the canopy during the peak hours (10-16 hours) in palms aged around 25 years. The diffused sunlight facilitates luxurious weed growth when coconut grown as a monocrop. Based on the growth habit of the palm and the amount of light transmitted through its canopy, the life span of plantation crops could be divided into three distinct phases from the point of view of weed management.

1. Juvenile phase (about 5- 8 years): Good light transmission to the ground which decreases with age.
2. The second stage where the canopy coverage is maximum and poor light transmission to the ground when the weed population is less.
3. Third stage where the canopy size gets reduced and more light transmission to the ground compared to the second stage but less than the first stage.

Based on this weed management is more meaningful during juvenile phase and third stage for plantation crops. Monocropping in perennial crops invites more weeds and where the horizontal and vertical space utilization is not justified during the first stage (juvenile phase) Thus intercropping, mixed cropping; high density cropping system brings down the weed population. Further practice of growing green manure crops, mulching in the basin area reduce weeds and increase productivity. Other practice of weed control in plantation crop includes mechanical and chemical weed control. Irrigation method also reduce the weed population. Chemical weed control is comparatively cheaper to hand weeding especially in places where the labour charges are high. Other advantage of chemical weed control in high rainfall zone and sloppy terrains is the weeds even after killing by chemical remain in the same place, which forms a cover for the soil. This cover prevents the soil from beating effect of rain (where the rainfall intensity is high) then the soil and nutrient loses by the run off water is prevented. Out of the various treatments tried at CPCRI, the chemical treatments had advantage over the hand weeding in terms of economics labour availability and also in terms of soil and water conservation measurers. Glyphosate sprays one in the month of May/June and second application in the month of September was found to be better than all other treatments including/hand weeding twice. For arecanut, scything weeds twice a year and mulching back in the garden is the common weed control method followed in arecanut gardens. This will check soil and water erosion in rainy season in high rainfall areas and also adds organic matter to soil. Studies on chemical methods of weed control are not attempted in arecanut. Similarly only in early years of cocoa development, weeds have to be controlled by scything in the basin of the crop. But at later stages cocoa suppresses the weed growth. Thus growing inter/mixed crops in arecanut garden is one of the methods to control weeds also. Following drip irrigation method for irrigation of palms also helps in checking the weed growth compared to sprinkler method of irrigation.

# Invasive alien weeds - biological invasion affecting ecosystem and posing problems in agriculture in india

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Alien weeds are new weeds recorded in the new area other than home land and in due course of time, these weeds naturalise and might become invasive in the land other than home land. Thus, Alien Invasive Weeds (AIW) are those that invade new area from their home land (native habitat), naturalise in the absence of their co-evolved predators and parasites, spread rapidly causing tremendous harm to environment, economy and in some cases to human health. Biological invasion of alien weeds refers to intrusion of alien weeds which are not present and altogether new one to our ecosystem, knowingly or unknowingly. Thus, alien species become invasive after adaptation to the local environment and affect the biodiversity by altering other species growing in the area. Those weed often referred to as Invasive Alien species (IAS). Alien Invasive Species are the biggest threat to biodiversity next only to human settlement. Annual losses caused by AIW's are to an extent of $ 117 billion in India, only next to $ 137 billion in USA. Thus, alien invasive weeds are causing huge loss in agriculture and concerted effort should be made to restrict the entry of such weeds

Civilisation has helped human being to domesticate and cultivate new plants to meet the demand of the man for food, fodder, fibre and fuel. In the process of domesticating new plants as crops, man unintentionally started spreading new unwanted plants to the newer areas. This was the first step in the spread of plants from one continent to the other continent and one place to the other place.

**Weeds of Quarantine importance in India**

The spread of the newer weeds in to Indian sub continent will be still more complicated in view of free flow of seeds from one continent to other continent, as result of new policy on Seed development by the Govt. of India owing to WTO agreement. Considering these problems in Indian sub continent, Department of Plant Quarantine & Storage, Govt. of India has enlisted 61 alien weeds which are quarantine in nature and their entry is prohibited to India from other countries, where the weed has attained serious status as pest.

**Biological Invasion of Alien Weeds to India and have naturalised posing problems**

Large scale movement of biological resources mediated by humans in the recent past in contrast to a smaller scale in the distant past, largely for natural reasons. In the recent times, human mediated major events of biological invasion either inadvertently as admixture with food grains (*Argemone mexicana, Parthenium hysterophorus, Phalaris minor*), or accidentally with human movement (*Chromolaena odorata*), or intentionally for their ornamental value (*Lantana camara, Eichhornia crassipes*) or to Botanical Gardens of India for study purpose (*Salvinia molesta*) or as cover crop (*Mikania micrantha*) for the newly established tea plantations in the eastern and southern hills of our country. In the forest ecosystem particularly in Western Ghats, fire resistant weeds are *Chromolaena odorata, Mikania micrantha* and *Lantana camara*, in view of well developed root – stocks/ fire adapting expansion mechanism, and are becoming menace, healthier than before to suppress the native flora.

A number of weed species, which were introduced along with imported agricultural commodities, have spread menacingly in our country. In this paper, major Alien Invasive Weeds introduced to India and have naturalised have been listed along with nativity, problems posed to agriculture, affecting biodiversity, health and our fragile ecosystem. They can also be used as medicinal herbs as means of mitigating their menace in our ecosystem. Alien Invasive species naturalised and occurring on large stretch of land are *Chromolaena odorata* (L.) Kings & Robins (native of Central and South America and Caribbean Islands); *Celosia argentea* L. (native of tropical America); *Cynodon dactylon* Pers. (native of East Africa); *Cyperus rotundus* L. (native of Eurasia); *Echinochloa colona* (L.) Link/ *crusgalli* (L.) Beauv./*glabrascens* L./*oryzoides* L. (native of Central America); *Eichhornia crassipes* (Mart.) Solms (native of South America); *Ipomoea carnea* L (native of South America); *Lantana camara* L. (native of tropical America); *Mikania micrantha* (L.) Kunth (native of tropical and subtropical zones of North, Central and South America); *Mimosa pudica* L. (native of Brazil); *Orobanche* spp (native of Southern and Central Europe); *Parthenium hysterophorus* L. (native of Mexico, West Indies, South and North America); *Phalaris minor* L. (native of Mediterranean region); and *Salvinia molesta* Mitchell (South Eastern Brazil). These weeds cause loss in agriculture, affects aquatic system and posing problems to human/ animal health. Other alien weeds naturalised and occurring in the field of agriculture are *Acanthospermum hispidum* DC, *Ageratum conyzoides* L., *Alternanthera philoxeroides* (Mart.) Griseb., *Amaranthus spinosus* L. A. viridis L.( all native of tropical America); *Argemone mexicana* L. (native of Mexico, and West Indies); *Agropyron repens* L. Beauv. (native of Eurasia); *Avena fatua* L. (native of Europe); *Alternanthera echinata* Sm. (native of south America); *Bidens pilosa* L. (tropical America); *Chloris barbata* (L.) Sw. (native of South, West and Central America); *Commelina benghalensis* L (native of Europe); *Cuscuta* spp (*chinensis, reflexa, campestris, trifolii*) (native of Eurasia, Africa), *Dactyloctenium aegyptium* (L.) Willd. (native of old world tropics); *Eleusine indica* (L.) Gaertn. (Africa); *Eragrostis pilosa* (L.) Beauv. (native of southern Europe and old world); and *Striga asiatica* (= *S. lutea* Lour.) (native of Africa and Asia).

Recently due to import of 6.3 million tons of wheat during 2006-07, the weed seeds of five alien quarantine weeds namely *Ambrosia trifida* L.*, Viola arvensis* Murry*, Cynoglossum officinale* L. (all from Russia), *Cenchrus tribuloides* L. and *Solanum carolinense* L. (from Australia) have been intercepted by the Directorate of Plant Quarantine Officials. This imported wheat has been distributed to non-traditional wheat growing areas – Karnataka, Kerala, Tamil Nadu, Andhra Pradesh, Maharashtra, Gujarat, Madhya Pradesh, Orissa, Chattisgarh and West Bengal through Public Distribution System. Ministry of Agriculture, Govt. of India has sanctioned National Invasive Weeds Surveillance Program to survey, monitor and to take suitable steps to contain these weeds in the initial stage itself, without allowing them to become invasive. This is a healthy sign on the part of administration in understanding the implications that these alien weeds might become invasive, if suitable steps are not taken in the beginning itself. There is need for creating awareness to all the concerned to take suitable steps to contain these weeds, before these attain invasiveness. In some parts of Karnataka, Solanum carolinense type has been recorded near garbage areas, School and around Agricultural labours around village settlements in some pockets of southern Karnataka.

# Present status of herbicide residues in India

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Herbicides have played a key role in the worlds rising crop yields. Due to intensive research in herbicide discovery and mode of action, many new molecules are available at g/ha level to cater the farmers need. It has only been a half century since better weed control technology allowed most of us to escape from the drudgery of stoop labour. In 1958, India was producing over 5000 metric tonnes of pesticides which increased to 1,00,000 metric tonnes in 2007-08. Herbicide consumption has increased to approximately 20,000 metric tones in 2007-08 and occupies approximately 20% Indian pesticide market. Despite the fact that the consumption of herbicides in India is still very low, about 16 % of herbicides against 45-80 % in advanced world. In India, currently 49 herbicides are officially registered for weeds control which includes various formulations and combination of herbicides. Apart from this, many herbicides which are not registered or refuse to register are still being used in a large scale. Thus data on residues/residual toxicity of herbicides become indispensable for approving a herbicide for large scale commercial use, environment safety and human health.

Although there has been a widespread contamination of food commodities with pesticide residues, but cases of food/crop contamination due to herbicide residues are uncommon. Among currently used herbicides, 18.6 % are responsible for residues above the maximum residue level mainly in rice and wheat, followed by soybean. However 72 % herbicides showed faster dissipation by various means and only 9.3 % herbicides are responsible for residues below the maximum residue limit. However, contamination of soil due to herbicides is not common in India, but some reports showed adverse effects/toxicity to soil, succeeding crop and non-target organisms which includes soil micro flora and fauna.

Herbicides dissipate slowly in water and thus increase risk of contamination and adverse effect on aquatic organisms. Not much work has been documented in India in biological samples such as fishes, eggs, and other animal products. Few laboratories and field studies showed bioaccumulation of residues in fishes. It has been also observed that herbicides long-term, low-dose exposure are increasingly linked to human health effects such as diminished intelligence, hormone disruption, immune-suppression, reproductive abnormalities, suffocation, cancer *etc.* High dose exposure (intake) of few commonly used herbicides such as paraquat and 2,4-D even caused death in some cases. Apart from this many processes are involved during production of herbicides and this lead to formation of many intermediate products/metabolites/vapours which also causes air pollution and health hazards.

# Weed management in spices crops

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Spices are important group of commercial crops. ISO recognized 109 plants as spice, however, in India we grow around 50 spice crops, each state cultivate one or other spices. Because of the varying climates - from tropical to sub-tropical to temperate-almost all spices grow splendidly in India and considered as 'Land of Spices'. Spices cultivated in an area of 2.6 million ha with a production of around 3.2 million tonnes valued at approximately 4 billion US $, and holds a prominent position in world spice production and trade. The spices export from India during 2008-09 has been 4,70,520 tonnes valued Rs.5300.25 crores (US $1168.40 million). Spices are classified as major spices, seed spices, tree spices, herbal spices *etc.* In this paper result of weed management experiments in spice crops conducted at different locations are reviewed and presented. The perennial spices like black pepper, cardamom, nutmeg, and cinnamon are grown in wider spacing. In general interspaces managed by growing intercrops/cover crops in these plantations. As these crops are cultivated under high rainfall zone, weeding is done by slashing in the interspaces and hand weeding near the base as in case of pepper is common. Application of herbicide for checking weed growth also found advantages. Ginger and turmeric are annual spices stay in the field for about eight months, weed management is very essential during emergence phase of crop. In general, hand weeding/has been practiced traditionally but due to less agricultural labour availability in many places, usages of herbicides are recommended. Weed control with herbicides in turmeric showed that oxyfluorfen (0.15 kg/ha) gave the highest rhizome yield, followed by oxadiazon (1.0 kg/ha), fluchloralin (1.5 kg/ha) and pendimethalin (1.0 kg/ha). In ginger pre-emergence application of 2, 4-D at 1 kg/ha or atrazine at 1.5 kg/ha was effective. Mixtures of alachhor + chloramben or fluometuron at 0.75 + 0.75 kg/ha provided effective control of some weed species and resulted in the higher yields. In seed spices, several weed management experiments herbicides have been conducted. In fenugreek, hand weeding, followed by pendimethalin at 0.75 kg/ha gave maximum seed yield and it was statistically at par with two hand-weddings, pendimethalin 0.75 kg/ha + hand-weeding and fluchloralin 1.25 kg/ha, but was significantly better than all individually applied herbicides and the control. In cumin, pre-plant incorporation of fluchloralin (1.0 kg/ha), pre-emergence application of pendimethalin, trifluralin (1.0 kg/ha) and linuron (0.5 kg/ha) and post emergence application of linuron (0.5 kg/ha) effectively controlled weeds. In fennel, maximum benefit:cost ratio of 3.35 was obtained under weed-free condition, followed by pendimethalin at 1.0 kg/ha supplemented with hand weeding once (2.75). Pre-emergence application of oxadiazon at 0.5 kg/ha was most effective in controlling weeds in coriander.

# Weeds problem in sugarcane and their management

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Sugarcane requires a tropical or sub-tropical climate with a continuous or long growing season, high soil fertility, and abundant rainfall or irrigation. Under these conditions, all types of weeds flourish—annuals, biennials, and perennials. After planting, weeds must be controlled with cultivation and herbicides until the row middles are covered by sugarcane foliage. The performance of the sugarcane crop that has suffered due to weed competition in the initial stage after planting or at the initial ratoon stage has been observed to be always poor. Therefore, the weed control method selected for adoption in sugarcane need to be very effective so as to give a weed free environment for the crop from planting or ratooning onwards as the case may be, up to at least 90 – 100 days. More than 200 weed species are reported to infest the sugarcane fields in India. However, the composition of the weed species varies widely depending upon the climatic conditions of the location, soil type, cropping systems followed, ecological conditions of the location and management practices adopted for controlling weeds and cultivation of crops. The major yield determinant character in sugarcane is the number of millable canes per unit area at harvest. This is largely determined by adequate number of germinants and production of early tillers. Wider spacing between rows and frequent irrigations favour the growth of competitive weeds causing shade at lower nodal portions which affects tillering as well as early growth. This leads to fewer number of millable canes at harvest and result in poor cane yield. Studies have shown that if weeds are not controlled satisfactorily in the initial stages, the loss in cane yield could be anything between 17.5 and 23.7 t/ha. When twining weeds infest sugarcane fields, they twine around clumps and affect the cane growth and final yield loss is as high as 25%. Although weeds infest the sugarcane crop throughout the cropping season, their competition is harmful to sugarcane only during a particular stage. Studies were carried out at Sugarcane Breeding Institute, Coimbatore, both in plant and ratoon sugarcane to identify the critical period of crop-weed competition. In each case, there were two different treatment groups. In the first group, the weed competition was removed at different stages while in the second group, weed free conditions were maintained up to certain stages and then weeds were left uncontrolled. The results indicated that the critical period of crop-weed competition in tropical conditions is from 30 to 45 days after planting, and 30 days after ratoon initiation (DARI) to 90 DARI for the plant and ratoon crops respectively. Management of the fields weed free during the fallow period helps in low weed infestation in the crop. In the fallow period, weeds could be managed either by ploughing (during summer) or by application of non-selective herbicides like glyphosate and paraquat (during rainy season) when the weeds are in vegetative stage and before they could flower and set seed. If the fallow period is longer, the ploughing and/or herbicide application may have to be repeated so as to keep the weeds under check. In fields where heavy infestation of weeds is expected immediately after the planting of the crop, weeds can be induced to grow by giving irrigation and can be controlled before planting the crop. If the dominant weed species are only annuals, post emergence spray of paraquat (2.5 ml product per litre of water) would be able to control them. In case there is the problem of perennial weeds like *Cynodon dactylon* and *Cyperus rotundus*, post emergence spray of glyphosate (2.5 ml product per litre of water) would help to reduce their infestation in the crop. Two to three weeks after the herbicide application, the field can be prepared and the crop can be planted. Recently, it was observed that application of post emergence application of ethoxysulfuron at 3 g per litre of the product effectively controlled the *Cyperus* sp in sugarcane.

As pre-emergence application, only root absorbed selective herbicides which do not cause any harm to the crop could be used. Simazine (1.5 – 2.5 kg/ha), atrazine (2.0 – 2.5 kg/ha), metribuzin (1.0 – 2.0 kg/ha), ametryne (2.0 kg/ha), diuron (1.25 – 2.50 kg/ha), oxyfluorfen (0.3 kg/ha), oxadiazon (0.4 kg/ha) and pendimethalin (2.0 kg/ha) have been found to be useful for pre-emergence weed control in sugarcane. Of them, atrazine has been found to be the most suitable in view of its efficacy in wide range of conditions, low cost and easy availability. Atrazine controls both broadleaf weeds and grasses germinating from seeds. It does not control weeds like *Cynodon* and nutgrass that emerge from vegetative parts. However, atrazine cannot be used in intercropped sugarcane, as many of the common intercrops are susceptible to atrazine. In intercropped sugarcane, metribuzin (0.5 kg/ha) or oxyfluorfen (0.3 kg/ha) or pendimethalin (2.0 kg/ha) or oxadiazon (0.4 kg/ha) can be used as pre-emergence herbicide. Manual hoeing and weeding thrice at 30, 60 and 90 days after planting/has been found to be an effective post emergence weed management practice in sugarcane. However, it is very costly. A commonly used post-emergence herbicide in sugarcane is 2,4-D. The recommended dosage vary from 1.0 to 2.5 kg/ha depending on the intensity of weeds. However, it controls only broad leaved weeds but not grasses. Hence it will be of use only in situations where broad leaved weeds are dominant. There is no suitable selective post emergence herbicide for the control of grassy weeds in sugarcane. Non selective contact herbicides like paraquat and foliage absorbed translocated herbicides like glyphosate are useful as directed spray using a Knapsack or Bak Pak sprayer with hooded nozzle for controlling weeds in the inter-row spaces in sugarcane. This will be of much use even in fields with the problem of perennial weeds like *Cynodon* and nutgrass. At the time of fertilizer application, earthing up is done to cover the fertilizers applied. Earthing up incidentally brings up the weed seeds in lower soil layers to the surface. The weed seeds thus brought to the surface will germinate and give rise to a second/third flush of weeds. To control them, a directed spray of atrazine (1.0 to 2.0 kg/ha) could be given to the soil surface just before the second irrigation after the earthing up operation. In order to increase the weed control efficiency and to have better control of wide spectrum of all weeds in sugarcane, combined use of herbicides were tried and scientists were successful in identifying certain combinations. Combined pre-emergence spray of simazine and 2,4-D amine (each at 2.0 kg/ha) secured freedom from all monocot and dicot weeds. A weed mortality of 63 and 72 per cent, respectively was obtained when atrazine and 2,4-D were used singly, while a mixture of the two herbicides (atrazine 1.21 + 2,4-D 1.0 kg/ha) gave 72 to 98 per cent mortality of weed species. Pre-emergence application of alachlor and atrazine gave good control of *Cyperus* spp., grasses and broadleaved weeds in sugarcane. Best results were obtained with the use of dalapon in various combinations with 2,4-D, paraquat, bromacil and terbacil (each at 5 kg/ha) by killing more than 90 per cent of the *Panicum repens* in cane field. Application of diuron and 2,4-D (1.25 + 1.875 kg/ha), atrazine + dalapon (1.25 + 2.5 kg/ha) after 7 and 25 days as pre and post emergence application gave higher yield than absolute control and normal cultural practices. Two applications of paraquat + 2,4-D at 15 and 45 days after planting effectively controlled weeds in cane. Other topics covered in this paper are use of herbicides in ratoon crop, herbicide application technology, factors influencing the efficiency of herbicides, chemical composition of the herbicide, time of chemical treatment:, method of application, concentration of the herbicides, rate of absorption of chemicals, Plant efficiency, persistence of herbicides, microbial degradation chemical degradation, photo degradation, weed dynamics in continuous use of herbicide, weed management through cropping systems, control of *Striga* species (Witch weed), Weed dynamics in new sugarcane areas and integrated weed management.

# Weed management in organic production systems

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Weed management in organic production systems is a huge challenge because it is so complex from the biological perspective. By definition, as well as practices, organic agriculture aims at promoting and enhancing agro-ecosystem health, including biodiversity, biological cycles, and soil biological activity. It emphasizes, the use of management practices in preference to the use of off-farm inputs, taking into account that regional conditions require locally adapted systems. This is accomplished by using, wherever possible, agronomic, biological, and mechanical methods, as opposed to using synthetic materials, to fulfill any specific function within the system, including weed management.

Organic growers are prevented from using synthetic herbicides for weed control. Instead, they have to rely on various cultural, mechanical and biological practices. In fact, this factor is one of the deterrents for conventional farmers to readily take up organic production, especially in arable cropping systems, because putting an end to herbicides may cause a potential increase in weed population and negatively affect crop yields and profitability.

However, proper organic weed management can alleviate these potential problems. Under an organic production system, it is important to appreciate that our objective should never be to eliminate weeds but only to keep them at a threshold that is both economical and manageable. Simultaneously, we have to avoid the practices that are capable of destroying the weeds which are harmless to crops, and resulting in a potential decrease in biodiversity of farm. An effective approach should aspire to address the 'causes' and not the 'symptoms'. For this an organic farmer must be intimately familiar with the types of weeds, their relative competitive ability, seed dispersal mechanisms and growth habits to determine which control method to employ.

The objectives of weed management in organic production systems may be achieved by careful integration of any of the following approaches:

**Thermal Weed Control –** Thermal weed control involves the use of flaming equipment to create direct contact between the flame and the plant.

**Soil Solarization –** During hot summers, a clear plastic film is placed over the area, tightly sealed at the edges, after the soil has been tilled. Heat created under the film becomes intense enough to kill many of the weed seeds.

**Mulching –** Providing a soil cover with different kinds of mulches, such as; live mulch (cover crops), organic mulch (crop residues, composted materials, agro-industry wastes etc.) and black polyethylene mulch, can prevent the germination of weed seeds and their growth in inter-row spaces, mainly by blocking light transmission.

**Mechanical Weed Management –** Mechanical destruction and removal of targeted weeds is both time consuming and labour intensive but it is also most effective and popular method. The choice of implementation, timing and frequency play a very critical role in its efficacy and are determined mainly by structure and nature of the crop, planting geometry, and type and density of weeds.

**Stale Seedbed –** The stale or false seedbed technique works by depleting the soil seed bank.

Creation of proper moisture conditions and cultivation of soil 2-3 weeks before sowing of crop, stimulate the emergence of weeds. The emerged weeds are killed by light cultivation. This technique reduces subsequent emergence of weeds in main crop.

**Crop Rotation –** Crop rotation helps in disruption of weed's life cycle and has been at the heart of the organic weed management system due to its proven effects on weed populations.

**Competition –** Growing of competitive crop species and varieties, relatively high seeding rates, timely seeding relative to soil conditions and weed emergence, narrow seed spacing/ cross seeding, and companion/intercropping help in physical suppression of weeds. Make sure that crops emerge first to give them a head start in their competition with weeds.

Farm Sanitation – It is important to maintain proper sanitation on the farm to reduce the multiplication, introduction and spread of weed seeds. Composting and proper decomposition of animal manures, use of clean seeds, and removal of weeds before they set the seeds are the important practices, which may help in reducing the multiplication, introduction and spread of weed seeds.

**Allelopathy** – Allelopathy is an alternative and organic approach to weed control that uses allelochemicals that are excreted from a plant and enter into the rhizosphere to cause either direct or indirect harm to targeted weeds by adversely affecting their germination, growth or developmental processes.

**Biological Weed Management** – May be defined as the intentional use of living organisms (plant pathogens, insects, nematodes *etc.*) and/or products derived from them (microbial toxins, allelochemicals *etc.*) to reduce the vigour, reproductive capacity, density or impact of weeds. The strategies for biological control of weeds include three approaches, namely; classical or inoculative, bioherbicide or inundative and system management or conservative approaches. Natural enemies (bio-agents), plant pathogens and bio-herbicides are some of the biological tools for weed control. Strict host specificity requirement of bio-agents, technical difficulties in their mass production, formulation development and delivery, dependency upon weather factors for best performance, slow rate of control and absence of bio-agents for broad spectrum of weeds that exist in arable cropping systems; are some limitations of biological weed control.

It has only been in the past one decade that organic farming/has gained the credibility to attract widespread scientific investigations. Over the next decade or so we hope to see an exponential growth in research on this aspect.

# Weed management in vegetable crops- issues and strategies

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Role of vegetables in human diet is important because of their high nutritive values. More than 40 types of vegetables are grown in different parts of India. India is next only to China in world vegetable production. During the year 2007-08, India produced about 122 million tonnes of vegetables from an area of 7.73 million ha with an average productivity of 15.8 tonnes per hectare. However, according to one estimate the production has to be increased to 250 million tonnes by the year 2025 to meet the country's demand. Looking into various constraints in bridging the gaps to achieve the production targets, weed infestation emerges as an important one. The problems of weed management in vegetable crops are different from other field crops. They are usually grown in input intensive systems characterized by heavy doses of manures and fertilizers and more number of irrigations. These conditions also favour luxuriant growth of weeds in associated crops. No single method of weed management is adequate for optimum weed control. An integrated weed management strategy involving preventive, cultural, mechanical, chemical and biological methods has to be applied in vegetable crops. It is a well known fact that herbicide options are not as many as in other field crops. Herbicide industry has to play a greater role in developing selective herbicides for vegetable crops which are safe to the environment. Herbicide resistant cultivars can be of great help in managing weeds. However, few concerns like higher cost of cultivation and weed flora shifts have been expressed on use of HRCs. Organically grown vegetables are sold at premium prices. Weed management techniques in organic cultivation of vegetables need to be standardized.

# Use of weeds for vermicomposting

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Now-a-days the crop production is facing great problem of low organic carbon in the fields resulting low yield and poor quality. The other cause for low yield is due to heavy infestation of weed, while weeds are major source of organic matter which may be utilized for compost making through worms. The biomass of weeds (including abnoxius and problematic weeds) may be utilized for vermicomposting in both way (in sity and ex situ) Earth worm act as grinders crushers, aerators, biodecomposer and chemical degrader in the soil as well as in the organic waste deposited in pit. Earth worms produce well decomposed, odour free compost from organic wastes like, cow dung, kitchen wastes, Animal litters, agricultural byproducts, crop residues, weeds, city wastes and other industrial wastes. The composts are odour free and have the property of antibacterial and anti fungus characters. The earth worms secret enzymes, proteases, anylases, lipases, cellulases and chitinises during the conversion of organic waste into compost. Peronyx excavatus (Indian) Eudrilus euginae (African) and Elsinia foetida (Australian) are main identified worm which were used in vermicomposting word wide. However E. euginae is found to have higher feeding and bio-degradation ability. Various problematic weeds like Parthenium ipomae camee, Eichhornia crassipes, Cassia tora, Lantane camera pose a grate problem in crop production and can be sustainably used for environment vermin-composting materials. Vermicompost prepared from these materials being neutral in reaction is found to increase the organic matter and nutrient status of the soil and significant increase in soil microbial population. Vermicompost prepared from weed biomass takes only 1.5-2 months compared to 8-12 months required for other farm wastes. Hence, the vermicompost prepared can easily replace the FYM which have become scare due to decreasing cattle population. However, the nutrient content in the vermicompost is quite superior over other compost.

# Strategies and management of broomrape in tobacco in India

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Bidi tobacco is one of the non-Virginia tobacco being cultivated in Nippani (India) for the 40 years under rainfed condition. Orbanche cernua is a holo-parasite and the most pernicious parasitic species in the tobacco crop in India. The severity of the broomrape problem in the Nippani area is increasing because of mono-cropping of tobacco crop and, hand weeding is the only present practice in controlling the parasite.

Among different chemicals tested GR24 induced 58% germination of the broomrape seeds under laboratory conditions. The positive interaction between GR24 (1ppm) and the root exudates of some crops deserves further attention. In a trap crop experiment, sun hemp and green gram crops reduced broomrape population by 68% and 45% increase in tobacco yields at 90 days after transplanting (DAT). Glyphosate and imazaquin at 0.50 and 0.09 a.i./ha respectively reduced the number and dry weight of broomrape spikes; however, tobacco yields were significantly higher in the hand weeding treatment.

In the present investigation, attempts were made to control the parasite by cultural and chemical approaches We suggest the following packages to obtain higher tobacco yields and minimize the Orbanche cernua population in the soils for the Nippani tobacco areas and areas of similar conditions. a) Grow trap crops (sun hemp /green gram) in the early spring and incorporate in-situ 45 days after sowing. b) Transplant tobacco after 15-20 days c) Take up general weeding with in 45 days after transplanting. d) Apply glyphosate at 60 DAT at 0.50 kg a .i ./ha (or less) and e) Remove the remaining few broomrape spikes by hand or apply plant oils to prevent seed formation.

Integrated management of broomrape is one of the best strategies where in, at high infestation levels should include growing a trap crop, chemical control by a selective herbicide and control of remaining spikes by hand weeding or plant oils. At low levels of infestation, use of herbicides can be omitted. Late hand weeding remains essential, even at very low level of infestation.

Development of herbicide resistant crop cultivars through genetic engineering will enhance the use of selective herbicides to control parasitic weeds is another strategy.

# Herbicide tolerant genetically modified crops-prospects in India

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Imparting herbicide resistance to normally herbicides susceptible crops to produce herbicide tolerant crops (HTCs) has been the most extensively exploited area of plant biotechnology. The herbicides to which the GM crops are tolerant are 'broad spectrum' weed killers, which mean they can be sprayed over the entire field, killing all plants apart from the GM crop. HTGM crops will allow farmers total control of weeds. The global area of transgenic crops has increased by 73fold, from 1.7 million hectares in 1996 to 125 million hectares in 2008. Of which, 63% (79 m/ha) were tolerant to specific herbicide. HT crops are gaining farmers' acceptance because of several advantages such as increased flexibility to manage problem weeds, prevention of multiple use of herbicides, reduction in total herbicide use, greater adoption of conservation tillage, less herbicide carry over *etc.*, However, there are several concerns and apprehensions about the use of HT crops and their subsequent impact such as changes in the genetic diversity of crops, invasion of the HTCs beyond the farm boundary, escape of transgenes from HTCs, non-selective herbicides wipe out all vegetation except the HTCs, development of herbicide resistance in weeds, shift in weed flora *etc.*, In India the HTCs are not yet been introduced commercially. A section of the people claims that HTCs are not suited or relevant to India. They fear that HTCs replace labour and deny rural women the livelihood as most of the weeding is done by them. In this context several deliberations were held in India over the introduction of GMHT crops such as Roundup ready soybean and corn. Directorate of Weed Science Research, Jabalpur is taking up field studies on HT corn under the guidelines of Review Committee on Genetic Manipulation (RCGM). If the HT crops are successful in India, they will emerge as an important component of integrated weed management (IWM).

# Biological control of weeds through insects: current status and future prospects in India

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Biological control forms a part of any 'natural control' and is defined as 'the action of parasitoids, predators or pathogens in maintaining another organism's population density at a lower level than would occur in their absence. The successful weed suppression by means of another living organism which are encouraged and disseminated by man is called biological weed suppression (biocontrol). Biological control of weeds, using insects and pathogens is a well established technique. However, the procedures for implementing biological control are relatively complex. The increasing awareness of the dangers of pesticides has greatly stimulated the need for alternative control measures. Biological control is however perfect to situations where exotic weeds become aggressive and dominate large areas that are uncontrolled by the other methods. Mainly three approaches like classical, conservation and augmentation are generally employed in biological control. Among all these approaches, classical biological control by the introduction of exotic control organisms from the native range of weed is most frequently used method in biological

control of weeds. In recent years, augmentation approach using periodic release and or redistribution of native natural enemies has attained certain importance, particularly of native natural enemies. In conservation approach, effect of existing native or exotic control organism can be enhanced by manipulation of environment, which has not received much attention..

In the history of biological control of weeds in the world, the first example may be quoted of large scale destruction of *Opuntia vulgaris* in central and northern India by an insect *Dactylopius ceylonicus* introduced from Brazil in the mistaken belief that it was *D. coccus*, a species cultured as a source of carmine dye. The first successful example of biological control by insect occurred in Australia where the Argentinean moth *Cactoblastis cactorum* released in 1925, brought complete control of *O. inermis* and *O. stricta* from 24 million hectares of formerly infested land by 1935 and restoring the same to agricultural use. This amazing success, aroused interest in biological control throughout the world. Although many known alien weeds occur in India, only a few sporadic biological control attempts were made until 1980. Initial work was started on Lantana with the introduction of seed fly *Ophiomyia lantanae* from Hawaii in 1921 followed by introduction of gall fly *Procecidochares utilis* in 1963 against *C. adenophorra*, in 1973 against *Chromolaena odorata*.. In 1980s, concentrated efforts were made against waterhyacienth, waterfern, *C. odorata* and *Parthenium hysterophorus*.

**Successful example of biological control through insects in India:** Although, first example of biological control in the world happened in India but it was not by the deliberate efforts of man rather it was a natural incident. Following are some deliberate successful attempts to control weeds in India:

**Lantana:** So far 9 species have been imported in India since 1921 to 1982 but none was found successful except little success by a tinged bug Teleonemia scrupulosa imported from Australia.

**Parthenium***:* Out of three insect species, only one species Zygogramma bicolorata imported from mexico in 1983, is most successful bioagent so far. This species has brought large Parthenium infested area under control and restored native vegetation. In many states, this insect has established and controlling Parthenium on sustainable basis.

**Water fern (*Salvinia molesta*) D.S. Mitchel (Salviniaceae):** Water fern or *Salvinia molesta* is a free floating water weed of Brazilian origin. Earlier efforts to control this weed with the introduced grass hopper *Paulinia acuminata* De Geer failed. In 1982, the curculionid weevil *Cyrtobagous salviniae* of Brazilian origin was introduced from Australia. Currently this weevil has made many water bodies free from the water fern from Kerela and adjoining states of south India.

**Waterhyacinth:** Two speies of weevil Neochetina spp. and one mite species were introduced in 1982 agaisnt water hyacienth. All the species have well established in many states of India. This weevil has made successful control in Bangalore, Jorhat, Loktak lake, Jabalpur and in many lakes in Uttar Pradeshe.

**Future prospects in India :** Although successful example of biological control are only few in India but such examples opens the way of introduction of new bioagents against many more weed species. For example, there are possibilities of importation and further testing of some more species against Parthenium, which were introduced in Australia. A flea beetle, *Agasicles hygrophila* has been successfully introduced into USA and Australia from Argentina and has spread rapidly through out the water sheds. Introduction of this beetle into India merits consideration. There are immense possibilities of integration of bioagent with other control measures to reduce the time taken alone by the bioagent to control.

# Weeds threat to rainfed crops

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In India, rainfed regions cover 177 districts and exist in all agro-climatic zones, mostly concentrated in arid and semi-arid areas. Rainfed regions account for 68 per cent (86 million ha) of the total net sown area in the country. On an average, the rainfed regions of the country such as Western Rajasthan, eastern Rajasthan, Gujarat, western Uttar Pradesh, Tamil Nadu, Kashmir and Andhra Pradesh are most vulnerable to droughts, suffering once in every three years. As the growth rate in productivity in rainfed regions never exceeded 1 per cent and there is a projected demand and supply of food grain in India from 219 MT (2007-08) as against the projected demand of 307 MT in 2020. There is a gap of almost 90 MT to be met and minimum balance required demand of 30 mt (37 % share) from rainfed agriculture only. Thus, the increased yield must come from rainfed areas. But, rainfed areas are ecologically extremely fragile, even though they sustain substantial populations. Analysis shows that major coarse cereals are grown in rainfed areas. Coarse cereals are still the main source of food for India's poor. For instance, 92 per cent, 94 per cent and 80 per cent of the total area under Jowar, Bajra, and Maize respectively is rainfed. Similarly, 86 per cent of the area under pulses is rainfed. Eighty three per cent groundnut and 99 per cent soybean are grown under rainfed conditions. About 73 per cent area under cotton is also rainfed. Of the total area under rainfed, rice accounts only 26.8 m ha. Though rainfed areas contribute in a major way to Indian agriculture. The difference between the output of rainfed and irrigated areas is remarkable and this is cited as a major reason for increasing regional disparity in India. For example, the rice productivity in irrigated situation is above 3.8 t/ha, while rainfed rice is only between 0.9 -2.2 MT.

Present rate of population increase is very much alarming i.e. 2% per annum and the yield under rainfed situations are generally so low coupled with total crop failure due to vagaries of monsoon. Weeds are a problem in Indian agriculture, as elsewhere, in the world. So far the emphasis has been given on developing weed management technology in irrigated crops but considering the facts of availability of water for agriculture will be the crucial and be only the limiting factor in future. About one billion people depend on rainfed lowland rice in South and Southeast Asia where the productivity levels are very low and unstable. A modest increase by half a ton/ hectare in rice yield in rainfed ecosystem can add about 10 m.t. of extra rice to meet the target of rice production. As it is well understood that weeds being a better competitor, are one of the major constraints that play a key role in limiting the crop productivity in rainfed situations. Weeds in aerobic soil, optimum temperature and moisture in upland condition of rainfed situation encourage the germination and growth of diverse weed flora. The weeds that come up in upland conditions are highly competitive because of most of them are C4 types with higher drought tolerance, offering severest competition with the crops and cause about 33-74% or sometime total failure of crop depending upon the types of weeds and their intensities. Weeds compete with crops for moisture and nutrients. Loss of yield due to weed infestation is variable and is more pronounced in crops grown under rainfed

conditions. The major weeds of rainfed eco-systems are *Echinochloa colona, E. crusgalli, E. glabrescence, Eleusine indica, Cynodon dactylon, Digitaria ciliaris, Dactyloctanium aegypticum* and *Setaria intermedia* in grasses; *Cyperus rotundus, C. iria in sedges* and *Ageratum conyzoides, Amaranthus viridis, Euphorbia hirta, Commenliuna benghalensis, Alternanthera sessilis, Caesulia axillaries, Physalis minima etc.* in broadleaved weeds. Some parasitic weeds draw water and nutrients from crop plants and can inflict severe damage. Further, weeds serve as alternate hosts to pathogens and also harbour pests. Control of weeds during early stages of crop growth, when the young seedlings of crop plants are unable to compete with hardy weeds, is crucial for capturing yield potential. Studies have shown that mulches such as crop residues and other plant waste products maintained at adequate levels conserved soil moisture content and reduced the evaporation losses. Research efforts should be made according to farmers' situation by using suitable cultivar selection, short duration varieties, time and method of seeding, double or intercropping, use of mulches, application of recommended pre- and post emergence herbicides integrated with mechanical and manual weeding etc. so as to control weed efficiently and raise the crop productivity in rainfed ecosystem.

## Biological control of weeds through pathogens and mycoherbicides in India

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One of the major threats to all ecosystems around the globe is invasion by alien species, which include plants, animals and microbes. Conventional methods of control of invasive plants are uneconomical, environmentally hazardous and impractical. In such situations, classical biological control which is environmentally friendly, economical and effective in majority of the cases becomes an attractive option. Over the past century, more than 600 insect biocontrol agents have been released around the world but the use of fungal pathogens is still a new concept. However, high success rates have been achieved through the use of 20 or so fungal agents released till date. Thus, use of fungal pathogens to control invasive weeds is now widely accepted option. Notable examples of biocontrol using fungal pathogens are: control of *Ageratina riparia* in Hawaii using *Entyloma ageratinae*, *Chondrilla juncea* in Australia by *Puccinia chondrillinae*, and *Acacia saligna* in South Africa by *Uromycladium tepperianum.* Trials are underway inseveral parts of the world to control *Parthenium hysterophorus*, *Cryptostegia grandiflora* and *Lantana camara* using fungal pathogens. In India, classical biological control of invasive plants using insects has been attempted in several instances. Some of these attempts were successful and others not successful as expected. However, use of fungal pathogens is a fairly new initiative. The first attempt towards this was use of a rust fungus *Puccinia spegazzinii* de Toni, imported from Trinidad, to control the neotropic invasive weed *Mikania micrantha* which is major threat to natural and plantation forests and agricultural systems in southwest and northeast India. The fungus was released in tea gardens in Assam in October 2005 and agricultural systems in Kerala in August 2006. The paper will discuss the results of these releases.

# Impact of establishment methods and weed management on weed dynamics in rice-wheat system

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Rice and wheat are the major cereals in India, grown on an area of about 43 and 26 million ha, respectively. The continued adoption of rice-wheat system for over 3 decades has posed a serious threat to the sustainability in relation to soil structure, build up of abnoxious weeds, declining productivity, receding water table, development of multiple nutrient deficiencies required huge energy and increase cost of cultivation. Since the transplanting operation is usually performed by migratory labour that increase the seasonality and becoming a serious concern for the timely transplanting of rice in Indo-Gangetic Plains. Nearly 30% of the total water used in rice culture and its consumption occur mainly in puddling and transplanting. In conventional system (puddle transplanted) of rice need 4,000 L of water for producing 1 kg of rice, whereas, wheat requires only 800 L of water to produce 1 kg of grain. Therefore, a key concern is that how the water requirement of rice culture with low monetary inputs to sustain the rice-wheat system. Direct dry seeded rice and zero tillage wheat is an alternative which reduces the overall water demand and able to sustained the production in rice - wheat system.

In recent years, direct seeded rice followed by zero-till wheat has shown tremendous scope for acceptability to adopt the conservation agriculture system in rice-wheat production areas. A long term trial on different establishment methods of rice and its impact on tillage system of wheat were studied since 2000. The objective of these studies was to determine the impact of different establishment practices on crop performance and weed growth and weed shifting. Average of eight years data revealed that wet seeded rice recorded highest grain yield followed by transplanted and direct dry seeded rice with best wet methods (Pre-emergence herbicide *fb* two hand weeding) of weed control. Among the rice establishment method, direct seeded rice with a prior stale seed bed (DSF) reduced densities of *Cynotis* Spp., *Leptochloa chinensis* and *Cyperus iria*. The abundance of *Cyperus rotundus* was promoted under DSF rice and elevate by zero tillage wheat. Zero tillage wheat recorded higher/ comparable grain yield over the conventional tillage under different establishment system of rice. Rice establishment through direct dry seeding yielded higher grain yield of wheat over the transplanting and wet seeding. Through adoption of zero-tillage in wheat, if coupled with wet seeded rice not only improved the productivity but also reduce the cost and time spent on hand weeding in rice particularly to control the *E. colona*. Also timely harvests are not the only benefit with direct seeded rice but also less water requirement.

# Soil Solariazation- an effective tool for weed management in cash crop.

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Innovative approaches to control the pests including weeds are in great demand around the world, particularly those which are cost effective and less harmful to environment. Use of herbicides for controlling weeds is very effective and economical but due to associated residue hazard, evolution of resistant biotypes and polluting the ecosystem have necessitated development of alternate non- hazardous means of weed management. In recent years, there has been increasing concern regarding the hazards of chemicals to the environment, the farmers and the consumers. Therefore, interest in non-chemical approaches which aim to reduce pesticide usage is growing. In this light harvesting of solar energy through soil solarization for controlling soil-borne pests including weeds, pathogens and nematodes will be the key preposition to reduce the dependency on chemicals. Soil solarization is a hydrothermal process, which brings about thermal and other physical, chemical and biological changes in the moist soil during, and even after mulching. This involves mulching of the moistened soil with clear plastic films so as to trap the solar heat in the surface soil. The resultant temperature increase would be lethal to emerging weed and soil weed seed reserves as well as soil pathogens and nematodes. This is a simple technique that captures the radiant heat energy from the sun, thereby causing physical, chemical and biological changes in the rhizosphere. This can be done by placing transparent plastic polyethylene sheet on moist soil, because moisture increases heat conduction and makes weed seeds more sensitive to heat and keeping it for 2-6 weeks during hottest month of the year. The increasing interest towards soil solarization as a method of weed management is due to its effect on soil weed seed reserves, which is main source of weed menace. Typical mean maximum soil temperatures in solarization plots are 8 to 12° C higher than in corresponding non-solarized plots. Due to elevated temperature in soil following solarization treatment, it results in reduction in the population of soil borne pathogens, nematodes and weeds.

Several studies over many years have revealed that many rainy and winter season annuals are susceptible to soil solarization. The dominant weeds *viz*. *Trianthema monogyna*, *Dactyloctenium aegyptium*, *Acrachne racemose*, *Digera arvensis* *Echinochloa colona*; *Digitaria* spp., *Eleusine indica,*and *Commelina* spp. in rainy season and *Avena ludoviciana*, *Phalaris minor*, *Chenopodium album*; *Rumex dentatus*, *Fumaria indica*, *Solanum* spp,. *Xanthium* sp. etc. of winter season were highly sensitive to solarization treatment. However, *Cyperus rotundus*, *Melilotus indica* and *Convolvulus arvensis* were tolerant, though the seed-borne sedges were highly susceptible. Soil solarization was also found to be highly effective against parasitic weeds like broom rape (*Orobanche* spp.) for which other control methods failed. Soil solarization controlled *Orobanche* by 90 % in Israel, 72-100% in Sudan in the faba bean and tomato field. As soil solarization has tremendous effect on soil-borne pathogens, nematodes and weeds, the treatment enables the crop to grow and yield better as compared to non-solarized field. Being in the tropical regions, majority of the area of country experiencing more than 40 °C mean daily temperature from April to June, most importantly crop free period is suitable for solarization. Many parts of India laying in states of Maharastra,

Rajasthan, Uttar Pradesh, Madhya Pradesh,, Andhra Prades, Karnataka,, Gujrat, Tamilnadu, Delhi have great potential to utilize soil solarization. Results of several studies in many parts of the country revealed that Control of weeds alone due to solarization increased the yield of, sesamum and soybean by 72% and 77-78% (at Madhya Pradesh and Delhi), direct seeded rice by 49% (Sriniketan, WB), Okra by 50 % (Anand, Gujarat), wheat by 33 % (Bikaner, Rajasthan). Besides reducing problems of weed, soil borne fungi, bacteria, nematodes, it also involves limitation and difficulties. It can only be used in regions where the climate is suitable and the land is free of crops for about more than a month. Secondly, cost of treatment is high. Therefore, this technique could be profitably practiced in nursery beds and high value crops. The cost of the treatment can considerably be reduced by 50 % through its reuse as mulch or to solarize the other area of the field in the same summer. In spite of its limited applicability, solarization is safe, eco-friendly and effective means of pest control that may reduce the necessity of chemical application to soil.

## Weed management in tuber crops

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Major tropical tuber crops *viz.*, cassava, sweet potato, yams, elephant foot yam, taro and tannia are widely grown in India for use as secondary staple food, animal feed and as raw material for industries. Among these, cassava is largely grown in States like Tamil Nadu, Andhra Pradesh, Kerala, Maharashtra, Gujarat and North Eastern States in a total area of 240 x $10^3$ ha under irrigated or rainfed conditions with an annual production of 6200 x $10^3$ tonnes tubers. In a cassava pure stand, because the crop has slow initial growth and requires wide spacing (90 cm x 90 cm) to accommodate later growth, its early growth period (1-4 months) provides space for weeds to flourish. Addition of cow dung manure, non-availability of labourers for timely intercultural operations and lack of proper land preparation attribute for weed growth in cassava fields. Cassava tuber yield losses due to weeds may go upto100%. In a survey conducted in the cassava growing fields of Tamil Nadu, several weed species were recorded among which *Cyperus rotundus*, *Cynodon dactylon, Panicum repens* were the dominant weeds. In Tamil Nadu, farmers do up to 5 weeding, costing Rs. 10500 $ha^{-1}$. Suppression of weed growth during the initial growth period (3-4 months) is important for cassava production. In Kerala, two weeding and intercultural operations are recommended for cassava at 45 days and 75 days after planting respectively. In India, sweet potato is grown in an area of 136 x $10^3$ ha with annual production of 1125 x $10^3$ tonnes tubers. It is mostly grown in Bihar, Orissa and Uttar Pradesh under rainfed and irrigated conditions. Sweet potato is a short duration crop of 3-3.5 month duration and it covers the soil quickly and suppresses most weeds. Weeding and earthing up at $15^{th}$ and $30^{th}$ day after planting recorded higher tuber yield. Weed growth beyond 45 days significantly reduced sweet potato yield. Weed infestation is also a serious problem in other tuber crops like yam, elephant foot yam, and taro. Raising short duration, short stature crops like cowpea, black gram, groundnut, onion *etc.*, as intercrops can be practiced in all the tuber crops for weed management as well as for additional income and improving soil fertility.

# Current status of invasive weeds of montane temperate regions and their management

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Montane climatic regions of India comprising of Jammu and Kashmir, Himachal Pradesh, Uttranchal, Sikkim and Arunachal Pradesh are located latitudinally in the north temperate zone comprising of large area having temperate like conditions due to altitudinal variations ranging between 1500 to 2500 m above the mean sea level. Jammu & Kashmir is India's northernmost state, lying between six mountain ranges and covering an area of 2,22,236 sq. kilometers. It is located between 32°17' and 36°58' North latitude, and between 37°26' and 80°30' East longitude. Himachal Pradesh, Uttranchal, Sikkim and Arunachal Pradesh lie between 26°30' and 33°22' N latitude and 75°47' and 97°30' E longitude covering a total area of 1,97,637 sq. kilometres. In the Himalayan mountains the temperature falls by 0.6°C for every 100 m rise in altitude and this gives rise to a variety of climates from nearly tropical in the foothills to tundra type above the snow line. One can also observe sharp contrast between temperatures of the sunny and shady slopes, high diurnal range of temperature, inversion of temperature, and variability of rainfall based on altitude. The great Himalayan range witnesses heavy snowfall during winter months of December to February at altitudes above 1500m. The changes in these regions between summer and winter are generally subtle, warm or cool, rather than extreme. However, a temperate climate can have very unpredictable weather. The states of Jammu and Kashmir, Himachal Pradesh, Uttarakhand and Sikkim experience this kind of weather. Jammu & Kashmir has three distinct regions viz. Ladakh, Jammu and Kashmir valley offering a rich diversity in landscapes, religions and people. The state comprises of 22 districts with 10 districts of Kashmir valley having temperate climate covered by forested mountains, lakes, waterways and terraced fields. The Jammu region comprises of plains, mountains and foothills boasting of famous hill top shrine of Mata Vaishno Devi and temperate pockets in Doda, Poonch, Rajouri, Kistawar and parts of Kathua, Reasi, Ramban and Udhampur. There are many low lying valleys viz. Tawi Valley, Chenab Valley, Poonch Valley, Sind Valley and Liddar Valley, but the main Valley is the valley of Kashmir which is 100 kms wide and 15520.3 sq. kms in area. The average height of valley is about 1700 metres above sea level. The soil of Jammu & Kashmir are generally loamy with little clay contents comprising of illite type of clay rich in K naturally. Most of the people of temperate areas of J & K are agricultural-dependent producing crops like rice, maize, pulses (green gram and cowpea), oilseeds (mustard) vegetables(knol-khol, cabbage, cauliflower, turnip, raddish, spinach, tomatoes, potatoes, chillies, all cucurbits,), fodders (barley, oats, jowar, turnip, cowpea), high value-low volume crop like all famous saffron, *kala zeera* and horticultural crops like apple, pear, peach, cherry, plum, chestnut, areca nut, pecan nut, almonds and walnut etc. Weeds pose some of the serious threats to biological diversity. These silent green invaders constantly encroach in the crop and non-crop areas as well as the water bodies especially so in the temperate areas where the main land utility is for aesthetic beauty for tourism. Among the various weed species some are of very offensive nature whether native or of exotic (invasive weeds) origin that erode the native biodiversity and eventually result in extinctions of endemic strains. The impacts of these species are immense, insidious and usually irreversible. They may be as damaging to native species and eco-systems on a global scale as the loss and degradation of habitats. Over the past several years, there has been a heightened concern at the national and international levels about the impacts of habitat destruction on biodiversity. In recent years the impact of invasive species has also become a major concern.

# Microorganism and herbicides: relevance in weed management

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Intensive cultivation necessarily employs chemical herbicides for effective control of various weeds. In recent days contamination of environment by these toxic xenobiotics and their consequence on food quality and human health has raised serious concerns all over the world. Despite these concerns newer herbicide molecules are being added regularly. This is likely to increase pollution levels in soil and water. Therefore, issues concerning degradation, detoxification of applied herbicides and use of eco-friendly weed management strategies will receive greater attention now than ever before. Apart from causing pollution, the applied herbicides also have an impact on non- target soil organisms. Soil microorganisms (SMOs) form the most important and dynamic phase of soil. Hence, the impact of herbicide application on SMOs and their activity should be an important consideration for employing herbicide in weed management. The SMOs comprise of metabolically diverse groups of bacteria, fungi and actinomycetes that can act on the herbicide directly or indirectly. The impact of herbicide on SMOs however depends on the type of soil, the existing environment and the chemical complexity of herbicide molecule. The effect of herbicides on SMOs is assessed by tracking the population variations due to herbicide application, changes in soil such as enzyme activity, respiration and recently developed analysis of ribosomal RNA gene finger prints. The herbicide molecules in soil may eventually alter these charecteristsics of SMOs. Cyanobacteria, a vital group of SMOs, known for their photosynthetic and nitrogen fixing abilities are severely affected by herbicide application. This apart, most herbicides when applied at normal rates to soil have no major or long-term effect on either total number of SMOs or gross soil microbial activity. Application of certain specific herbicide may bring about direct and indirect qualitative and quantitative changes in soil microbial populations. Glyphosate with least mammalian toxicity is known to interfere with the microbial enzymes catalyzing the shikimate pathway. Alteration in population of bacteria, fungi or actinomycetes results in the structural and functional changes of soil microbial communities. The i*n- vitro* culturing of SMOs in presence of herbicide reveled that with increased concentration of herbicide the population and activity of culturable soil microorganisms greately reduced. Extrapolation of these results to field studies may not be meaningful due to the fact that herbicides are applied at much lower rates. Further, the availability of herbicide in soil pool is influenced by its adsorption on soil particles and the action by other biotic and abiotic factors. Soil microorganisms act upon herbicide molecule directly attacking its structure and diffusing it eventually to derive C, N and or P. Also routinely produced enzymes may act on side chains and chemical bonds diffusing the parent molecule by a process called co-metabolism. Strategies for effective weed management must take into account the effect of herbicide on soil borne pathogens, plant growth promoting microorganisms and their saprophytic survival. The involvement of microbial endophytes of weeds needs thorough investigation as their role in conferring protection and ecological fitness in grasses has been demonstrated conclusively. Studies to identify SMOs that degrade weed seed and significantly reduce seed bank must be initiated. Identification and development of native microorganisms with ability to kill weeds either directly or by production of secondary metaboilites with herbicidal property will have relevance in eco-friendly weed management strategies. Concerted research effort is required to understand the role of rhizospheric and endophytic microorganisms associated with plants in developing herbicide resistance. Employing sensitive molecular techniques such as analysis of ribosomal gene finger prints, application of proteomics may be useful to understand the impact of herbicide on both culturable and non-culturable SMOs. Understanding the mechanisms and the role of non-culturable microorganisms in degradation of herbicides may be useful for sustainable weed management.

# Productivity and profitability of rice-wheat cropping system as influenced by tillage and weed management practices in the lateritic belt of West Bengal

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A field experiment was conducted during *kharif* and *rabi* season of 2005-06 and 2006-07 at Agricultural Farm of Institute of Agriculture, Visva-Bharati, with rice variety IR-36 and wheat variety Sonalika. The experiment comprising of four main plot treatments applied in rice ($M_1$ - hand weeding-twice at 25 and 45 DAT, $M_2$ - metsulfuron-methyl (10 %) + chlorimuron-ethyl (10 %) (Almix 20 WP) at 4 g/ha at 7 DAT, $M_3$ - pyrazosulfuron-ethyl at 30 g/ha at 3 DAT + hand weeding at 45 DAT, $M_4$ - butachlor at 1 kg/ha at 3 DAT + hand weeding at 45 DAT), two sub-plot treatments (zero tillage and conventional tillage) and three sub-sub-plot treatments *viz*. weedy check, carfentrazone (0.75 %) + isoproturon (50 %) [Affinity 0.75 WP] at 1.5 kg/ha at 30 DAS and pendimethalin at 1 kg/ha at 3 DAS + hand weeding at 35 DAS) in wheat, was laid out in a split-split-plot design with three replications. Experimental findings revealed that the most predominant weeds were *Hydrolea zeylanica, Cyperus iria* and *Echinochloa colona* in rice and *Polygonum plebeium*, *Echinochloa colona* and *Cyperus rotundus* in wheat. Pyrazosulfuron-ethyl at 30 g/ha at 3 DAT + hand weeding at 45 DAT significantly reduced the density and dry weight of weeds and recorded higher yield and net return in rice. In wheat integrated use of zero tillage along with pendimethalin 1.0 kg/ha + hand weeding registered significantly lower density and dry matter of weeds and higher values of growth and yield attributes, higher yield and net return as well as return per rupee invested of wheat. In rice-wheat cropping system integrated use of pyrazosalfuron ethyl 30 g/ha and one hand weeding in transplanted *kharif* rice and zero tillage along with pendimethalin 1.0 kg/ha + one hand weeding in wheat may be recommended for managing weeds and obtaining higher productivity of crops and net return in rice-wheat system in the lateritic belt of West Bengal.

# Effect of pre and post emergence herbicides on rainfed pigeonpea

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A field trial was conducted at Coimbatore during *kharif*, 2008 to study the effect of pre and post emergence herbicides on weed management in Co 6 pigeonpea. The soils of the experimental field was clay loam in texture, low in available N (193 kg/ha), low in available P (15.3 kg/ha) and high in available K (528 kg/ha). Ten treatments were tried in RBD with three replications. The results revealed that the weed density of grasses, sedges and broad leaved weeds were significantly lowered with weed free treatment than all other treatments. This was at par with application of imazethapyr 75 g/ha (15-20 DAS) + paraquat 0.40 kg/ha at 6 WAS. On 70 DAS, application of PE pendimethalin 0.75 kg/ha + paraquat 0.40 kg/ha at 6 WAS recorded a total weed dry weight of 344.6 g/$m^2$ and was on par with application of imazethapyr 75 g/ha + paraquat 0.40 kg/ha at 6 WAS. The weed control efficiency on 50 DAS was higher (64.3%) in plots applied with PE pendimethalin 0.75 kg/ha and was followed by application of PE pendimethalin 0.75 kg/ha + imazethapyr 75 kg/ha apart from weed free plot. Pigeonpea yield was the highest (1080 kg/ha) in weed free plot and was on par with the yield obtained from plots treated with PE pendimethalin 0.75 kg/ha +one HW(1058 kg/ha).

# Management strategies for rehabilitation of wild sage (*Lantana camara*) infested forest pastures of foothill Shivaliks of J&K

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Jammu and Kashmir, a North-Western hill state of India occupies 2, 22,236 sq km with an altitude range of 307 to 4,700 m above MSL. The physiographic features of Jammu and Kashmir state can be compared to a three fold plateau on the basis of altitudinal variations for *Shivaliks,* middle Himalaya and the Greater Himalaya ranging from 307 to 615 m, 921 to 1,228 m and 4,300 to 4,700 m, respectively. The state is agrarian in character and about 75 per cent of its population is engaged in various agriculture and live-stock related pursuits. However, the distribution of cultivable waste land and forest cover in the three regions vary. Out of a total sub-tropical area of about 585 thousand hectares in J&K around 268 thousand hectares is uncultivated which has been under the threat by the invasion of aggressive, native as well as exotic weed species particularly exotic *Lantana camara* which is making inroads in forest pastures and grasslands. Out of total weed invaded area of sub tropical belt of Jammu region, around 193 thousand hectares is heavily infested with exotic weed species and amongst them Lantana has been taking hold of most of the area under natural forests as under canopy weeds. The alarming situation arising out of such invasions particularly by the *Lantana camara* which has almost dwindled the ecology of the forest ecosystems turning the lush green productive and economically viable forest pastures into unproductive degraded lands a scientific intervention was direly needed. Keeping these in view a study on the management of *Lantana* invaded under-canopy forest pastures of *Shivalik* foot-hills was initiated during April 2006 with the objectives of finding out the most effective and economical techniques for rendering these land pockets ability to at least provide some forage for local consumption and meanwhile not having much competition with native vegetation like those of the endemic types which face extinction due to biotic environmental stress. The treatments of the study included manual cuttings followed by 1% glyphosate application on 30-35 cm regenerated growth and grubings, followed either by the planting of *Setaria* or hybrid napier slips. Salient findings of the study revealed a reduction in fresh bio-mass of *Lantana* to the tune ranging from 66 to 99 per cent under different treatments over its initial fresh bio-mass values (28 kgs/ 25 sq m). Application of 1% glyphosate on about 30-35 cm regenerated growth of *Lantana* bushes and grubbing of *Lantana* followed by planting either of hybrid napier or *Setaria* besides providing good soil cover and forage yield (napier yield of 181 to 207 q/ha and *Setaria* yield of 98 to 102 q/ha) were found equally effective but significantly better than repeated *Lantana* cutting treatment in reducing *Lantana* biomass by 94.20 to 99.03 per cent. However, herbicidal treatment was found economically better with a net saving of rupees 5,500/ha over the grubbing of *Lantana.* It could be safely concluded from the study that if these degraded areas were kept free of invasive species, the overall productivity and ecology of all under forest canopies can be improved for the well being of the local inhabitants in particular and for the trans Himalayan region as a whole.

# Effect of sole and sequential application of herbicides on weed growth and productivity of transplanted *kharif* rice in the lateritic belt of West Bengal

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Field experiment was conducted during the *kharif* season of 2007 at Agricultural Farm of Institute of Agriculture, Visva Bharati, Sriniketan, Birbhum, West Bengal with rice, variety IR-36 to study the effect of sole and sequential application of herbicides on weeds and productivity of transplanted *kharif* rice. The experiment comprising of twelve treatments was laid out in a randomized block design with three replications. From the experimental findings it revealed that *Echinochloa colona,* among the grasses; *Cyperus iria, Cyperus difformis,* among the sedges and *Ludwigia parviflora,* among the broadleaved weeds were predominant throughout the cropping period. The loss of grain yield of transplanted *kharif* rice due to weed infestation was to the tune of 30.8%. Lower values of weed density, total weed dry weight and weed index, higher values of growth and yield attributes of rice, weed control efficiency, net return as well as return per rupee invested were registered with sole application of pyrazosulfuron ethyl at 20 g/ha, sequential application of pretilachlor at 1.0 kg/ha at 3 DAT and 2, 4-D at 0.5 kg/ha at 40 DAT and Almix alone and in sequence with butachlor at 1.0 kg/ha. Sole application of pyrazosulfuron ethyl 20 g/ha at 3 DAT or sequential application of pretilachlor at 1.0 kg/ha at 3 DAT and 2, 4-D at 0.5 kg/ha at 40 DAT or sequential application of butachlor at 1.0 kg/ha at 3 DAT and metsulfuron-methyl + chlorimuron-ethyl (Almix) 4 g/ha at 10 DAT appeared to be best for weed management of transplanted *kharif* rice in the lateritic belt of West Bengal.

# Evaluation of doses and time of application of metamifop 10 EC for management of grassy weeds in direct seeded upland rice

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A field experiment was conducted during *kharif* 2008 and summer 2009 at Agricultural Research Station, Kathalagere, Davanagere District in Southern Transition Zone, under the jurisdiction of University of Agricultural Sciences, Bangalore. Different doses and time of application of new graminicide, metamifop 10 EC applied at 50, 75, 100 and 125 kg/ha as early post-emergence at 2-3 leaf stage of grasses were compared with metamifop 10 EC applied at 50, 75, 100 and 125 kg/ha as post-emergence, 5-6 leaf stage of grasses in comparison to the recommended graminicide, cyhalofop-p-butyl (Clincher 10 EC) 100 kg/ha and hand weeding, as farmers' practice in direct seeded upland rice. These herbicides were applied using 500 litres water/ha with a flat fan nozzle attached to a knapsack sprayer. Mean of two seasons indicated that paddy yields in plots treated with metamifop at 100 to 125 kg/ha as early post-emergence (14.1 to 14.8 q/ha) and post-emergence (13.5 to 14.0 q/ha) were higher than the application of cyhalofop-p-butyl at 100 kg/ha – 15 DAS (10.9 q/ha), but lower than hand weeding (16.6 q/ha). Further, lower doses of metamifop at 50 to 75 kg/ha – 12 DAS gave slightly lower paddy yield (8.7 to 10.2 q/ha), owing to less control of grasses, but comparable to cyhalofop-p-butyl 100 kg/ha. Unweeded control lowered the yield by 90.4%, as a result of severe competition offered by grasses. The pattern of variation in number of panicles/$m^2$ and straw yield was similar to that of grain yield. Unweeded control lowered the straw yield as well as number of panicles/$m^2$ due to competition from grasses and other weeds.

# Conservation Technologies in Rice-Wheat System and Their Weed Management Features

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In India, rice-wheat cropping system is practiced in about 12 m ha in the Indo-Gangetic plains and contributes about 73% of the total food grain requirement of the country. In recent years, the major emphasis in the rice-wheat system has been an alternative resource-conservation technologies (RCTs) for both rice and wheat to reduce the cost of cultivation and energy consumption, to sustain productivity and to enhance the economic viability of farms and to improve rural livelihoods. Traditionally rice is transplanted at the end of the dry season (May/June) after the land has been flooded and puddle and wheat is sown in rabi season (Nov/Dec). Nearly 30% of the total water used in rice culture and its consumption occur mainly in puddling and transplanting. In conventional system (puddle transplanted) of rice need 4,000 L of water for producing 1 kg of rice, whereas, wheat requires only 800 L of water to produce 1 kg of grain. Therefore, a key concern is that how the water requirement of rice culture with low monetary inputs to sustain the rice-wheat system. Constraints related to these traditional practices include the shortage of labour, increasing labour cost, the relative fertilizer, fuel and late sowing of wheat. Whereas, the adoption of DSR avoids puddling, retain soil structure and also to facilitate early wheat planting. However, weeds are the major problem which is not effectively managed in this system. Thus, in view of the above fact, a long term trial had been conducted on DSR and Zero tillage wheat at GBPUAT, Pantnagar to find out the impact of these technologies towards the weed management of the rice-wheat system. Five rice establishments in main plot and two weed management practices were compared in strip plot design. After harvesting of rice, wheat was sown by Pant zero-till ferti -seed drill without any tillage and conventional tillage. Average of 6 years data revealed that WSR recorded the highest grain yield followed by TPR and DSR in weed free situation. In zero tillage rice crops became completely failure due to weeds in weedy situation. However, one hand weeding had significant impact on yield losses due to weeds which reduced the yield losses to the turn of 98% to 29.6 percent in zero tillage rice. Pedimethalin was applied at 1.0 kg/ha within three days after sowing in DSR, DSFR and ZTR for controlling the weeds in the field. Almost similar grain yield was recorded in DSR and stale seed bed technique. In wheat, higher grain yield was recorded in zero tillage (3.76 t/ha) as compared to conventional tillage (3.74 t/ha) in all the establishment methods of rice except in transplanting. Differences in grain yield were highest in DSR in these establishment methods of wheat due to weeds. The five years data revealed that among the rice establishment methods net return was highest (Rs. 13,350/ha) in DSR methods which may be due to its comparatively lowest production cost (Rs. 19787/ha).

# Study on efficacy of triasulfuron 20 wg (Logran) against weeds in transplanted rice and residual effects on test crops

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The field experiment was carried out during *kharif* 2008 and Summer 2009 in red loamy soil at Agricultural Research Station, Kathalagere, Channagiri taluk, Davangere district coming under the southern transitional zone of Karnataka. The present investigation was taken up to know the bioeffectiveness of Triasulfuron 20 WG (LOGRAN) and other weedicides in comparison with hand weeding on weeds control, crop safety and grain yield of transplanted rice. The field experiment was laidout in RCBD with 10 treatments. Application of triasulfuron at 10.0 kg/ha recorded higher grain and straw yield of paddy (6521 and 6899 kg/ha, respectively) mainly due to effective control of *Cyperus sps., Scirpus rayali*, *Fimbristyles miliacea*e, *Ludwizia parviflora*, *Lindernia vernicaefolia*, *Glinus oppositifolia* and *Marselia quadrifolia* among the weedicidal treatments. Application of Triasulfuron at lower dose (8 kg/ha) recorded lower grain yield mainly due to competition from weeds. The Triasulfuron at higher doses (12 and 24 kg/ha) also recorded lower grain yield mainly due to phytotoxic effect of herbicide on crop. The residual effect of weedicides on test crops was not significantly differed among the treatments. However, application of Pyrazosulfuron 10 WP at 20 kg/ha recorded lower lower dry weight and seed yield of test crops *viz.*, greengram, blackgram and cowpea. The dry weight and seed yield of test crops among the residual effect of triasulfuron doses also not varied significantly.

# Effect of interval between glyphosate application and tillage on control of *Cyperus rotundus*

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A field experiment was conducted at Agricultural Research Station, Reddipalli, in scarce rainfall zone of Andhra Pradesh during *kharif*, 2004 and 2005, to study the effect of glyphosate spray followed by rotovation at different intervals on mortality and growth of *Cyperus rotundus,* an obnoxious weed. The experiment was laid out in a randomized block design replicated four times. The different treatments include rotovation done at 2 days after glyphosate spray on nutsedge *viz.,* Rotovation at 2 days, 4 days, 7 days and 14 days after glyphosate spraying along with control *i.e.* rotovation only without spraying. The results indicated that at 15 days after rotovation, significantly lower dry weight of regrowth of *Cyperus rotundus* was recorded when rotovation was done one week after spraying of glyphosate followed by rotovation done two weeks after spraying when compared to rotovation done one two and four days after spraying or rotovation done without glyphosate spraying. The regeneration (%) of *Cyperus rotundus* was the lowest when rotovation was done one week after glyphosate application followed by that when rotovation was done two weeks after spraying. The rate of regeneration of *Cyperus rotundus* was greater when only rotovation was done or rotovation was done 2 days after spraying as compared to that of rotovation at four days or one week or two weeks after spraying.

# Ecobiological quantification and integrated management of *Striga asiatica* (l.) in planted sugarcane (S*accharum officinarum*.l)

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Sugarcane (*Saccharum officinarum* L) is one of the most important cash crops and plays a pivotal role in both agricultural economy. Weed infestation is one of the most dominant constraints and *S. asiatica* remove nutrients and extract water and the effect of this parasitic weed has been so devastating, leading to complete crop failure. Hence, an experiment was conducted to quantify the biological characteristics of *S. asiatica* and its integrated management in sugarcane. Biological characters of *S. asiatica* indicated that the seeds took on an average 49 days for emergence after cane planting with mean maximum and minimum dry weight of 0.695 g and 0.530 g/ plant at seedling stage (15 DAE) and recorded maximum of 1.746 g and minimum of 1.135 g/plant dry weight at active vegetative growth stage (30 DAE). Tiller production varied from 4 to 6 tillers with an average of 4.6 per plant. Flower initiation period of *S. asiatica* varied from 26 to 32 DAE. Capsule production capacity was very high with an average of 306 capsules/plant and with average dry weight of 0.304 g/capsule, with each capsule containing thousands of seeds. Results of integrated management of *S. asiatica* revealed that pre-emergence application of atrazine 1.0 kg/ha on 3rd days after planting (DAP) + hand weeding on 45 DAP + earthing up on 60 DAP combined with post-emergence spraying of 2,4-D sodium salt 5 g/lre (0.5%) + urea 20 g/lre (2%) on 90 DAP for effective control of *Striga asiatica* and for higher productivity and profitability in sugarcane.

# Persistence of 2,4-D and paraquat in aquatic system and its effect on dissolved oxygen and fish mortality

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Experiments were conducted in concrete tubs to study the persistence and fate of herbicides *viz*., paraquat and 2,4-D applied to control the water hyacinth and its effect on dissolved oxygen and fish mortality. Each tub was released with fifteen fishes (common carp- weighing 0.75-1.25 g) after attaining the full growth of water hyacinth. One week after the introduction of fishes, the herbicides were applied at the recommended level and double the recommended level. Paraquat was determined using UV spectrophotometer and 2,4-D was determined using GC equipped with ECD detector. Both the herbicides were effective in controlling water hyacinth during the study period of 45 days. Paraquat content in water showed a declining trend with time and 89 per cent of the applied paraquat degraded from the aquatic system before 10 days of its application. Paraquat was below detectable limit at both the levels (0.5 and 1 kg/ha) at 20 days after herbicide application in the presence of water hyacinth and at 25 days after herbicide application in the absence of water hyacinth. 2,4-D residue content in water was below detectable limit at both the levels (1 and 2 kg/ha) at 45 days after herbicide application. Half life for the applied 2,4-D is lesser than 10 days irrespective of the presence or absence of water hyacinth and the calculated mean half life for the applied concentration of 2,4-D is 7.3 days. Dissolved oxygen content in water was decreased from 0 to 10 days and the decrease was more in the presence of water hyacinth. About 10 to 15 percent fish mortality was recorded at double the recommended dose of paraquat in the presence of water hyacinth.

# Evaluation of glyphosate on herbicide resistant corn hybrids (Event NK 603) for crop safety and weed control efficiency

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Glyphosate resistance is the dominant transgenic trait, cultivated in 114 mha across 23 countries. As an initiative on transgenic crop, glyphosate resistant event (NK 603) corn hybrids evolved by Monsanto India (Pvt.) Ltd., were evaluated during w*inter* 2008-09 at experimental site of Tamil Nadu Agricultural University; Coimbatore. Glyphosate was applied as early POE application at 900, 1800 and 3600 g ae/ha in Hishell and 900 M Gold transgenic corn hybrids compared with non transgenic counterparts with PE atrazine at 0.5 kg/ha + HW on 40 DAS. Broad leaved weeds constituted 88%, grasses 9% and sedges 3% before POE herbicide spraying. Early POE application of glyphosate at 900, 1800 and 3600 g ae/ha registered lower weed density in transgenic Hishell and 900 M Gold corn hybrids and was on par with PE atrazine at 0.5 kg/ha +HW on 40 DAS in non-transgenic hybrids. Glyphosate at all the doses recorded significantly lesser weed dry weight and higher weed control efficiency with no crop phytotoxicity in transgenic corn. Complete drying of all the weeds was observed at 10 DAHS except *Commelina benghalensis, Portulaca oleraceae* , *Amaranthus polygamous* and *Cyperus rotundus* developed chlorotic and drying symptoms at 20 DAHS with 1800 and 3600 g ae/ha. Higher grain and stover yields were recorded with POE application of glyphosate at 900, 1800 and 3600 g/ha in Hishell and 900 M Gold transgenic corn hybrids with average yield of 10 t/ha and 8 t/ha in conventional corn hybrids.

# Effect of pre and early post emergence herbicides on weed dynamics and productivity of rainfed groundnut

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A field experiment was carried out at Oil Seed Research Station, Tindivanam during *rabi*, 2008 to study the effect of pre and early-post emergence herbicides on weed dynamics and productivity of groundnut under rainfed a*lfisol* condition. Treatments were consist of five pre emergence herbicides (alachlor -1.0 kg/ha, metalachlor-0.75 kg/ha, pendimethalin-1.0 kg/ha, fluchloralin-1.0 kg/ha, oxyflorfen-0.125 kg/ha), two early post emergence herbicides (imazithapyr-0.075 kg/ha and quizalofop ethyl-0.075 kg/ha), hand weeding twice at 25 and 45 DAS and unweeded control. The experiment was laid out in randomized block design with three replications. Groundnut variety TMV 7 was used for this experiment. Results revealed that pre-emergence application of fluchloaralin at 1.0 kg/ha registered the minimum weed density (30 Nos./$m^2$), followed by metalachlor at 0.75 kg/ha, pendimethalin at 1.0 kg/ha and alachlor at 1.0 kg/ha at 15DAS. All the plots which were not received pre-emergence herbicides recorded more weed density. At 30 ADS, hand weeding plots registered lower weed density (35 Nos./$m^2$), followed by early post emergence application of quizalofop ethyl at 0.075 kg/ha(96 Nos./$m^2$). All pre-emergence herbicides applied plots showed higher weed density at 30DAS and the maximum weed density was recorded under alachlor applied plots. Lower total weed dry matter was noticed under application of alachlor at 1.0 kg/ha followed by fluchloaralin at 1.0 kg/ha at 15 DAS. At 30 DAS, lower weed DMP was recorded under oxyflorfen (0.125 kg/ha) application and it was comparable with other herbicidal treatments. Higher dry pod yield was recorded with pre emergence application of metalachlor at 0.75 kg/ha followed by hand weeding twice.

# Conservation of resources under integrated weed management in cultivation of crops in Tamil Nadu

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Farmers use various methods of weed management like cultural, mechanical and chemical methods. Encompassing all weed management methods is known as integrated weed management. Studies have proved that herbicidal weed control was the most effective method. Practice must be looked upon from the view point of economics by studying the labour use and yield levels of crops. Objective was to compare the profitability of farms that are using herbicides as one of the control measure and otherwise. Study was carried out during 2008-09 with a sample of 120 farms each using herbicide and otherwise, covering Paddy, Maize and Sugarcane. Details on cultivation aspects, yield particulars and income realized were collected from the sample farmers belonging to both the categories. Results were subjected to tabular and percentage analysis. It could be seen from the analysis that the usage was lesser by about 43 hours, 33 hours and 80 hours in paddy, maize and sugarcane respectively in herbicidal farms for weeding operations. It is seen that productivity was more by about nine quintals in paddy, four quintals in maize and 100 quintals in sugarcane in herbicide applied farms. It is also seen that the profit was higher per quintal of yield in herbicide applied farms than the non-herbicide farms. It could be concluded that application of herbicides to control weeds in paddy, maize and sugarcane is an efficient way of weed control in terms of labour use, yield and profits.

# Diclosulam-a novel herbicide for management of weeds in soybean

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Diclosulam, a Dow AgroSciences (DAS) proprietary active ingredient belonging to triazolopyrimidine sulfonanilide group is an ALS inhibitor and controls plant growth by inhibiting enzyme required to synthesize amino acids required for plant growth. Diclosulam, a broad-spectrum herbicide with major activity on Broad Leaved Weeds (BLW), is translocated via both the xylem and phloem streams, accumulates in the meristematic tissue and causes death of the plants. In India, this product is under evaluation in some key crops. During *kharif* 2008, diclosulam 84% WDG was evaluated for its efficacy and crop injury in soybean ecosystem in the key soybean growing district of Ujjain in Madhya Pradesh and Ahmed Nagar district of Maharashtra. Diclosulam was applied as pre-emergence (PE) at 18, 22 and 26 g/ha and compared with performance of commercial standard check herbicides imazethapyr (75 g/ha) and quizalofop-ethyl (50 g/ha) both applied as post emergence (POSTE). The PE and POSTE applications were made between 0-3 Days After Sowing (DAS) and 14-21 DAS, respectively. Common soybean weeds *viz*., *Commelina benghalensis, Echinocloa* spp*., Digera arvensis, Euphorbia heterophylla, Acalypha indica* and *Parthenium hysterophorus* were observed across different trials. Application of diclosulam at 22-26 g/ha resulted in superior control of weeds (85.9 - 90.6% control) of total weeds over untreated) compared to application of standard check herbicide imazethapyr 75 g/ha (75.8% control of total weeds over untreated). Diclosulam showed good suppression of *Commelina benghalensis* and *Echinocloa* spp. None of the treatments showed phytotoxic effect or injury to soybean crop in any of the trials. Results indicate that diclosulam when launched will serve as a valuable tool for management of major key weeds in soybean.

# Penoxsulam 24% SC: A new rice herbicide

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Penoxsulam 24% SC, a member of triazolopyrimidine sulfonamide family, highly active on grasses, sedges and broad leaf weeds in transplanted rice was evaluated during *kharif* 2008 in Haryana (Karnal), Maharashtra (Karjat) and Andhra Pradesh (Guntur). Efficacy of Penoxsulam 24% SC against rice weeds and the requirement of labour for manual weeding at 25 - 30 Days After Transplanting (DAT) in these treatments were compared with standard checks. Penoxsulam treatments include application of 22.5 g/ha at 0-3 DAT as pre-emergence and 20 g/ha at 8-12 DAT as post-emergence. These treatments were compared with 0 to 3 DAT application of Pretilachlor 50 EC 625 g/ha, Bensulfuron methyl 0.6% + Pretilachlor 6% G 660 g a.i/ha and Pyrazosulfuron-ethyl 10% WP 20 g/ha in different trials. Penoxsulam 20 g/ha applied at 8-12 DAT demonstrated good control of *Echinochloa* spp. (78%) and *Cyperus difformis* (79%) compared to penoxsulam 22.5 g/ha applied at 0-3 DAT (57 and 58%) and standard check pretilachlor 625 g a.i./ha (50 and 54 %) in Haryana. Similarly in Andhra Pradesh, 100 % control of *Cyperus iria* and 89% control of Broad Leaf Weeds (BLW) *viz*., *Nicandra physalodes, Cyanotis axillaris, Eclipta alba* and *Asteracantha longifolia,* were recorded with application of penoxsulam 20 g/ha at 8-12 DAT. Pretilachlor and Bensulfuron methyl 0.6% + Pretilachlor 6% G recorded 35 and 31% control of *Cyperus iria* and 29 and 21% control of BLWs in the same trials, respectively. In Maharashtra, penoxsulam 22.5 g/ha applied at 0-3 DAT provided more than 95% control of *Echinochloa* spp., *Cyperus iria, C. difformis* and BLWs *viz.*, *Sphenoclea zeylanica, Ludwigia octovalvis, Fimbristylis miliacea and Monochoria vaginalis* which was on par with penoxsulam 20 g/ha applied at 8-12 DAT. Labour required for manual weeding at 25-30 DAT was reduced by 43 to 57% in plots treated with penoxsulam at 8–12 DAT compared to plots treated with standards. This could be attributed to the better efficacy of penoxsulam apart from its unique nature of both pre-emergence as well as post-emergence activity while also providing residual weed control. Multi-location trials in key rice growing geographies of India indicate that penoxsulam 24% SC can be applied as pre-emergence (0-3 DAT) or post-emergence (8-12 DAT) applications for excellent weed management in transplanted rice. Further, application of penoxsulam at 8-12 DAT resulted in better residuality and reduction in the need for labour for hand weeding at 25 to 30 DAT. This novel product with both pre-emergence and post-emergence activity provides a new weed management solution for Indian rice growers.

# Direct and residual effect of herbicides on weeds in soybean-wheat cropping system

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Soybean- wheat is one of the most important cropping systems after rice-wheat. But its productivity is not being sustained due to severe crop-weed competition, resulting in yield losses up to 77 % and 7-50 % in soybean and wheat, respectively ( Singh *et al*, 2001 and Sharma and Pahuja, 2001 ). The information for weed management in individual crop is available in plenty. However, the information on residual effect of low dose, high potent and soil active herbicides applied in soybean on weeds and productivity of wheat grown in sequence is almost lacking in India. Hence an experiment was conducted to study the influence of herbicide application to soybean and its residual effect on wheat.

# Weeding operation – changing scenario due to paradigm shift in rice cultivation

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At global level 2.7 billion people mostly from Asian countries rely on rice as major source of food in their daily diet. As per IRRI (International Rice Research Institute) estimation , it would cross 3.9 billion people depending on rice as a major source of food by 2025 A.D. Among different rice growing countries in the world, India stands first in rice area, second in total rice production and eighth in rice productivity (Rice Almanac, FAO). Out of the total population in India, women constitute 48 per cent of agricultural force, of which 78 per cent are economically active in agriculture and its allied activities. In agricultural sector, agricultural labour activities and farm cultivation are the major areas of economic activity for Indian women. In rice cultivation women's contribution is more than eighty per cent in cultural operations such as sowing, transplanting, weeding, harvesting and storage. Regular rice cultivation which was mainly for self consumption has now lead to business oriented cultivation in recent past. Among the different cultural operation weeding forms one of the most important operations in rice cultivation to increase its productivity and at the same it is the most tedious and back braking operation. The changes occuring in weeding operation and perceptions among women folk who perform the task with the changing scenario in rice cultivation has been discussed in detail in this paper from the outcome of the survey study conducted by group of scientists in department of Rice during crop season through POS (Production Oriented Survey) programme covering the major rice growing districts of Tamil Nadu under AICRIP (All India Co-ordinated Rice Improvement Project) at Coimbatore centre , Tamil Nadu Agricultural University.

# Influence of weed management practices in aerobic rice

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Field experiments were conducted at the Central Farm Wetlands of TNAU, Coimbatore during *rabi* and *kharif* season of 2006-07. The weed management practices *viz*., hand weeding twice (25 and 45 DAS), mechanical weeding twice (25 and 45 DAS), pre-emergence application of pendimethalin at 0.75 kg/ha followed by one hand weeding on 45 DAS and pre-emergence application of pretialchlor plus safener at 0.4 kg/ha followed by one hand weeding on 45 DAS were tested . Predominant weed flora found in the experimental field were *Cynodon doctylon, Echinochloa colonum, Dactyloctenium aegyptium* , *Chloris barbata* , *Alternanthra pungens, Portulaca oleraceae, Cleome chelidoni, Parthenium hysterophorus, Eclipta alba, Tridax procumbens* and *Cyprus rotuntus* Pre-emergence application of pendimethalin at 0.75 kg/ha with one hand weeding on 45 DAS registered higher WCE. It was followed by pretialchlor plus safener at 0.4 kg/ha with one hand weeding on 45 DAS. Both the herbicides might have controlled the emerging weeds in the initial stages and so the WCE was higher in these treatments. At 60 DAS, hand weeding twice recorded higher WCE followed by pre-emergence application of pretilachlor plus safener with one hand weeding on 45 DAS and then by pre-emergence application of pendimethalin at 0.75 kg/ha with one hand weeding on 45 DAS. Mechanical weeding twice at 25 and 45 DAS resulted in the least WCE. Higher grain yield was obtained with pre-emergence application of pendimethalin at 0.75 kg/ha followed by one hand weeding on 45 DAS.

# Bio-intensive weed management in direct-sown rainfed lowland rice (*Oryza sativa* L.)

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The problems associated with weeds in rice fields are mounting dramatically due to reduced availability of affordable labour, shortage of irrigation water and shift in crop establishment from transplanting to direct seeding. It has led to a more reliance on the use of herbicides. However, continuous use of herbicides leads to the development of herbicide-resistant weeds. Besides, it also poses a threat to human health and the environment. Bio-intensive weed management, by combining ecological/ cultural, mechanical and biological control measures, can provide the scope to attain acceptable weed management with minimal use of safest low dose-high efficacy herbicides in improving and sustaining the rice productivity. Efforts have been made at the Central Rice Research Institute to develop an effective approach of bio-intensive weed management in rainfed lowland direct-sown rice. Some of the important findings are highlighted below.

It was found that rice varieties like Moti, Gayatri and Savitri having weed-smothering character in shallow to intermediate lowlands and Dugra in deep water rice ecology were performed well (48-69% yield advantage over traditional varieties). Some genotypes like Soniya, NCS 132, NCS 134, AUS 257, AUS 196 and Agnisal and Narendra 97 were showed higher weed competitiveness and could be used as potential donors in future breeding program. Stale seedbed technique was found to be useful for enhancing rice yield up to 22% in areas with severe problem of grassy weeds at early stages. It was also observed that timely sowing (last week of May to early June) in 20 cm apart rows either by seed drill or behind the plough with a relatively moderate seed rate of 75-80 kg/ha and escaping basal dose of N fertilizer ensures better crop stand (15-22% more population) and better canopy cover, and thereby reduces weed growth up to 34% in direct-sown rice fields. In light-textured soils, operation with finger weeder once at 20 days after sowing(DAS) in moist field combined with removal of weeds within rice rows was found cost effective with weed control efficiency (WCE) 69%. Operation of cono-weeder at 30 DAS followed by removal of uprooted weeds within rice rows also found effective under water depth of 10-15 cm in rice field with WCE 76%. It was found that aqueous extract (5%) of *Cleistanthus collinus* leaves reduced 82% of the total biomass of *Chara zeylanica* at 28 days after application in deep water rice ecology. The reduction of total biomass of *Chara* by incorporation of *Cleistanthus collinus* leaves (50 g/m) was 59%. Among the safest low dose high efficacy herbicides, azimsulfuron at 40 g/ha was found most effective in controlling broad spectrum of weeds with WCE 88%. Inclusion of weed smothering crops like cowpea, greengram and blackgram or fodder crops like sorghum, berseem or oat after rice also helped in minimizing the problem of rice weeds. Thus, there are ample possibilities of improving rice productivity through a bio-intensive weed management strategies under rainfed lowland direct-sown rice fields.

# Characterization of vermicompost in relation to weed biomass and earthworm species

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The weeds in Assam have tremendous potential for biomass production both under cropped and non-cropped situations. The residues of weed biomass offer a huge source of nutrient elements. The conversion of weed biomass into value-added compost may have the potential to improve soil fertility and crop productivity. However, the amount and quality of compost harvested varies with weed species. Similarly, earthworm species have been shown to have differential ability of composting owing to feed preference and adaptability. Accordingly, an experiment was conducted in concrete tanks (1m x 1m x 1m: l x b x h) during summer 2008 taking 5 species of weed biomass and 3 species of earthworm with complete randomization of the treatments. The tanks were filled with sun dried weed biomass (5 kg) and cow dung (3.4 kg) as per recommended practice. Twenty five grams each of three different earthworm species were released in each tank and the residue was composted following standard method and compost was harvested after recording pertinent observations, and analysed for total contents of nutrients. The highest production of compost was obtained with Ipomoea carnea followed by Chromolaena odorata and Eichhornia crassipes, all three being statistically at par. Significantly lower compost production was observed with Mikania micrantha and Parthenium hysterophorous. Parthenium hysterophorous also produced lowest earthworm both in terms of number and weight per unit area. However, Mikania micrantha and Parthenium hysterophorous showed fastest decomposing behaviour compared to other weed species. Compost recovery was highest in case of Ipomoea carnea followed by Chromolaena odorata and lowest in Parthenium hysterophorous. Eudrilus eugeniae was found to be the fastest decomposer among the species. The total contents of nutrients (N, P, K) in harvested compost showed that compost from Ipomoea carnea contained highest contents of the nutrients, while Parthenium hysterophorous showed the lowest values. Irrespective of weed biomass or earthworm species, the C: N ratio was not affected significantly.

## P-1 Seed production potential of major weeds of rice – mustard – sesame cropping system in lateritic Belt of West Bengal

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Enrichment of soil seed bank depends on the number of weeds present upto the harvesting of crop and production of seeds by the weeds of the concerned area. An investigation was carried out throughout the year 2008 in the lateritic belt of West Bengal to find out the seed production potential of major weeds in rice – mustard – sesame cropping system. Experimental findings revealed that *Cyperus iria, Eclipta prostrata, Echinochloa colona* and *Commelina nudiflora* in rice; *Anagallis arvensis* and *Chenopodium album* in mustard; *Trianthema portulacastrum* and *Digitaria sanguinalis* in sesame took major part in building up rich seed bank in the soil. Despite management of weeds through mechanical method by the farmers, these weed species remained alive and their seed production potential computed at harvesting of crop revealed that average number of seeds production was recorded as 4175, 928, 1422 and 54/$m^2$ in *Cyperus iria, Eclipta prostrata, Echinochloa colona* and *Commelina nudiflora* respectively in rice ; 864 and 2650/$m^2$ in *Anagallis arvensis* and *Chenopodium album* respectively in mustard; 1152 and 2052/$m^2$ in *Trianthema portulacastrum* and *Digitaria sanguinalis*, respectively in sesame. Seed rain (number of seeds deposited/$m^2$) was computed as high as 6500 in rice, 3500 in mustard and 3200 in sesame. Monocot weeds usually produced higher number of seeds than that of dicots.

## P-2 Weed flora of wheat in Hisar and Sirsa districts of Haryana

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A survey of weed flora of wheat in Hisar and Sirsa districts of South-Western Haryana was conducted during 2006. Forty two and 53 sites were surveyed in districts Hisar and Sirsa, resectively. Total 27 and 21 weed species were found to infest wheat fields in Hisar and Sirsa respectively. *Phalaris minor* was the most dominant weed in both the districts representing 40.2 and 53.7 % of total weed density. This weed occurred at 97% locations in Hisar where as 100 per cent sites in Sirsa were infested with this weed. After *P. minor, C. album, M. indica, Coronopus didymus, Rumex retroflexus* and *Fumaria parviflora* were the important weeds found to infest wheat crop in both the districts. In Sirsa, density of wild oat was more (4.1 plants/$m^2$) as compared to Hisar. *Malwa Parviflora* (button weed) a new emerging dicotyledonous weed was found to infest wheat fields in both Sirsa and Hisar districts. Moisture loving weeds like *Poa annua, Anagallis arvensis* and R*umex retroflexus* were more in Sirsa with a density of 2.2, 7.5, 3.4 and 5.1 plants/$m^2$ due to higher moisture content and heavy texture of soil. *Asphodelus tenuifolius* with a density of 4.4 plants/$m^2$ was found to infest wheat crop in Hisar district at 18 % of sites surveyed where as this weed occurred at only 7 % of sites surveyed.

**P-3**

# Key for weed seedling identification

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The recognition of weed species at seedling stage, more particularly just after emergence, is very important for adoption of effective and eco-friendly management practices. However, identification of weeds at this stage up to the rank of genus and species is very difficult because of very underdeveloped organs of the plants and very fast changing morphological features. Hence, a taxonomic method is of utmost importance to recognize the weed seedlings in the field condition. Altogether 16 species of very common weeds of summer and winter seasons have been studied at seedling state. The newly emerged seedlings were morphologically characterized just at the stage of development of the primary leaves. Weed seedlings were observed from the top in the field condition. Photographs of the critical organs were taken in digital camera and the snaps were transferred to the PC for detail interpretation of the characters. After successful completion of this pioneering work a protocol has been developed to maintain uniformity in developing the weed seedling database and to develop a useful taxonomic key for the weed species of the country as a whole. The protocol for study of weed seedlings is described bekow:

1. Pots filled with soil should be made weed free by following stale seed bed technique.
2. Seeds of known weed species are to be sown in the pots, and regularly watered.
3. After emergence of primary leaves (not at cotyledonary leaf state) snaps are to be taken from the top preferably with digital camera. Then the images are to be transferred to a PC. (Seedling photographs are to be correlated with the mother plant – so good photographs of the mother plants at flowering state should also be collected).
4. Morphological characters can be recorded from the images. If required, that can be confirmed by observing the life specimens.
5. Characters to be studied are:
   - i. Phyllotaxy
   - ii. Number of young leaves arises from the axis
   - iii–iv. Lamina shape and length-width ratio
   - v-vii. Lamina apex, base and margins
   - viii. Lamina colour
   - ix. Lamina surface (hairy/ glabrous, etc.)
   - x. Lamina texture (membranous/ succulent/ fleshy, etc.)
   - xi. Venation (Reticulate/ Parallel)
   - xii. Number of primary basal nerves.
6. The KEY for identification of the species is to be developed by compiling all the information of the country.

## P-4 Weed dynamics in direct seeded autumn rice – transplanted winter rice sequence

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The study of emergence behaviour and population dynamics of weeds in a specific agro-ecosystem generates useful information to develop efficient weed management strategy. Therefore, the present investigation was undertaken for two consecutive years in 2003 and 2004 in the Instructional cum Research Farm of the Assam Agricultural University with the objective to study the weed dynamics in upland direct seeded autumn rice-transplanted rice. The most dominant weed flora in direct seeded autumn rice comprised of *Cynodon dactylon* and *Digitaria ciliaris* among grasses, *Cyperus iria* among sedges and *Ageratum houstonianum* and *Borreria articularis* amongst the broad leaved species. The general distribution pattern of *Cynodon dactylon* and Digitaria *ciliaris* were similar. Population density increased up to 25 DAS, thereafter, it continuously decreased up to 75 DAS. *Cyperus iria* was observed from 35 DAS till harvest of the crop. Dominance of *Borreria articularis* and *Ageratum houstonianum* was significant during 35 to 65 DAS with peak at 45 DAS. Grasses were dominant at early stage while broadleaved weeds were dominant at later stage. The dominant weed species observed in the transplanted winter rice were *Leersia hexandra*, *Echinochloa crussgalli* and *Panicum repens* among grasses; *Scirpus juncoides*, among sedges and *Fissendocarpa linifolia* and *Monochoria vaginalis* and among broad-leaved weeds. Two emergence peaks of *Leersia hexandra* between 15-25 and 55-85 DAT were observed. The highest population of *Echinochloa crussgalli* was recorded at 25 DAT which gradually decreased thereafter. The occurrence of *Panicum repens* was highest at 45 DAT. *Scirpus juncoides* was found between 15-65 DAT with its peak at 35 DAT. Density of *Fissendocarpa linifolia* increased from 15 DAT to 75 DAT and other broadleaved weed *Monochoria vaginalis* emerged between 15-75 DAT with the peak emergence at 45 DAT.

## P-5 Competitiveness of *Eichinochloa glabrascens* in rice

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*Eichinochloa glabrascens* is one of the most competitive weeds in the rice fields. A trial was undertaken in the Agricultural Research Station, Mannuthy for two years to assess the competitiveness of the weed and also fix a threshold limit for weeding. The population of *E. glabrascens* in the field was maintained at 0,4,8,16,32 ad 64 weeds per sq. m. and the loss in yield of rice was estimated. The result of the study revealed that at low population levels of the weed, the competition from the weed did not contribute to significant reduction in yield. When the weed population was 8 weeds per sq. m., it contributed to a marginal yield loss and this was found to be the threshold value for weeding the crop. A quantum decline in yield was noticed when the population increased to 16 weeds per sq. m. At this stage the weed experiences both intra specific and inter specific competition. Beyond this level the weed gets the upper hand and the competition from the weed is significant. A hyperbolic equation relating yield loss to weed density was fitted to the grain and straw yield data. The predicted yield loss and the observed yield loss were found to be on par.

## P-6 Weed flora of sugarcane (ratoon) in Haryana

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To study the floristic composition of weeds in sugarcane, 68 fields were surveyed in 14 districts of state during June–July,2008. Keeping it in view of soil type, rainfall, available irrigation facilities and climatic conditions, area to be surveyed was divided in to different Zones State. In zone 1 (Ambala, Karnal, Kurukshetra, Kaithal, Panchkula, Yamuna Nagar and Panipat districts ), total 25 major weed species were found to infest this crop of which 6 were grasses, one sedge and 16 are broadleaf weeds. Among grassy weeds *E.colona* was most dominating weed with 29.9 plants/$m^2$ and IVI of 27.2 %, Crow foot grass (*Dactyloctenium aegypticum)* was the second most important grassy weed infesting the crop with a relative density of 5.06 %. Out of 16 broadleaf weeds, *Ipomoea lacunosa* was the most dominant weed found to infest sugarcane crop with an IVI of 15.54%. *Conyza canadensis* was the second most important broadleaf weed with relative frequency of 7.85% and IVI value of 14.02 %. *Cyperus rotundus* the only sedge was most dominant weed of zone with a density of 28.8 plants/$m^2$ with IVI value of 29.5 %. In zone 2 ( Hisar, Fatehbad and Jind districts), total 22 weed species were present out which 7 were grassy, 15 were broadleaf weeds and only one sedge *C.rotundus*. *Trianthema portulacastrum* with IVI vale of 33.8 %, *Cyperus rotundus* (24.72%) *E.colona* (23.95%), *Dactyloctenium aegypticum* (22.5%) *and Ipomoea lacunosa* (12.9%) were the major five weeds. Fields in which trash was not burnt were more infested with climber *Ipomoea lacunosa* as compared to trash burnt fields where as density of *C.rotundus* was more in fields where trash was burnt. In zone 3 (Sonepat, Rohtak, Jhajjar, Palwal districts), 23 weed species were present out which 7 were grassy, 15 were broadleaf weeds and one sedge *C.rotundus*. *Cyperus rotundus* with IVI of 46.7% was the most dominant weed followed by *Trianthema portulacastrum* with IVI value of 20.4%, *Dactyloctenium aegypticum* (14.92%), *Ipomoea lacunosa* (11.82%) and *Conyza canadensis* (11.64%) were the major five weeds. Grassy weed *Setaria verticillata* with a IVI value of 10.02 % was one of the major competing weed of this zone which was not present in zone 1 and zone 2.

## P-7 Influence of soil drying and rewatering cycle of *Phylanthus amarus* on its active ingredient (Phyllanthin), growth and nutrient content

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Secondary metabolites phyllanthin the most important active ingredient of *Phyllanthus amarus* though increased during stress at all stages but concentration varied at different type of stresses. When stress was given once at different DAP and was rewatered again and observed at harvest there was decrease in concentration of *phyllanthin* because plant may have recovered from stress till harvest. But it was observed that *phyllanthin* content was more when plant after giving stress where immediately brought for analysis. It was confirmed that stress had increase the *phyllanthin* content when plant had undergone three stresses followed by two stresses than single stress. It was seen that the nutrients content generally decreased in stress condition. Stress induced growth reduction resulted into reduced root activity that in term resulted into decreased uptake of nutrients.

## P-8 Weed flora in Osmanabad and Solapur districts of scarcity zone in Maharashtra

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The weed survey was carried out in Osmanabad and Solapur Districts of Scarcity zone of Maharashtra during *kharif* 2008. In Osmanabad district, Bhum, Paranda, Osmanabad,Tuljapur, and Vashi tahsils were surveyed. In these tahsils pearl millet, cotton, pigeon pea and pigeon pea + pearl millet cropping system were surveyed. The prominent weeds observed in Osmanabad district were *Parthenium hystrephorus,,Tridax procumbens, Celosia argentia, Cyperus rotundus, Argimone maxicana, Eragrasstis major, Eragrasstis minor, Euphorbia hirta, Cynadon dactylon ,Achanthospermum hispidum* and *Amaranthus viridis*. The weed species like *P. hystroephorus, T. procumbens, C. dactylon* and *P. isachimi* were observed in Pearl millet and *P. hystrophorus, C. dactylon, Lactua runeiata, A. maxicana* and *C. rotundus* in cotton, *Cynadon dactylon, Tridax procumbens, Panicum isachimi, Celosia argentia, Phyllanthus ntruri, Amaranthus polygamus* and *Achanthospermum hispidum* in pigeon pea and *P. hystrophorus ,Celosia argentia, Cynadon dactylon, Sonchus arvensis, Argimone maxicana, Cyperus rotundus ,Lactua runuiata* were reported in pigeon pea + pearl millet cropping system. In Solapur District weed survey was carried out in Karmala, Pandharpur, Malshiras, Solapur and Akkalkot tahsils and maize, Sugarcane, Sunflower and pigeon pea crops were surveyed. The prominent weeds observed in Solapur District were *Parthenium hystrophorus*, *Tridax procumbens, Celosia argentia, Cyperus rotundus, Argimone maxicana, Eragrasstis major , Eragrasstis minor, Euphorbia hirta, Cynadon dactylon, Achanthospermum hispidum, Tridax procumbens,Amaranthus Polygamus* and *Amaranthus viridis*. The weed species like *Argimone maxicana, Celosia argentia, Cynadon dactylon, Cyprus rotundus, Eragrasstis major, Eragrasstis minor, Euphorbia hirta, Parthenium hystrophorus* and *Tridax procumbens* in maize and *Amaranthus Polygamus, Argemone maxicane, Celosia argentia Cynadon dactylon, Lactua runeiate* and *Parthenium hystroephorus* in sugarcane, and *Argimone maxicana, Celosia argentia, Cynadon dactylon, Eragrasstis minor* and *Parthenium hystrophorus* in sunflower and *Celosia argentia, Cynadon dactylon, Cyprus rotundus* and *Parthenium hystrophorus* in Pigeon pea were observed.

## P-9 Studies on economic threshold value of *Echinocloa colonum* in rice under North Bihar condition

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A field experiment was conducted at crop Research Centre of Rajendra Agricultural University on young alluvial calcareous saline sandy loam soil to determine the economic threshold value of *Echinocloa colonum* in rice under North Bihar condition. Maximum reduction in yield was recorded in *Echinocloa colonum* population of 520 plants per square meter. Reduction in yield was started with the increase in *Echinocloa colonum* density. A significant reduction in rice yield was started with the *Echinocloa colonum* population of 15 plants per square metre. Therefore, it indicates that *Echinocloa colonum* population of 15 plants per square metre is threshold level in rice under North Bihar ecosystem.

## P-10 Weed flora in Beed and Ahmednagar districts of scarcity zone in Maharashtra

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The weed survey was carried out in Beed and Ahmednagar Districts of scarcity zone in Maharashtra during *kharif* 2008. In Beed district Ashti, Patoda, Beed, Dharur, Kej and Wadwani tahsils were surveyed for weeds in pearl millet and cotton crops. The prominent weeds observed in Beed District were *Parthenium hysterophorus,*,*Tridax procubens, Celosia argentia, Cyperus rotundus, Argimone maxicana, Eragrostis magor ,Eragrostis minor, Euphorbia hirta, Cynadon dactylon ,Achanthospermum hispidum* and *Amaranthus viridis.* The *Amaranthus Polygamus, Argimone maxicana, Celosia argentia and Cynadon dactylon, Cyperus iria* and *Xanthium srumarium* were observed in pearl millet and *Achyranthes aspera, Alternathra triandra, Amaranthus Polygamus* and *Cyperus iria* in Cotton were reported. In Ahmednagar district Kopergaon, Rahata, Shrirampur, Rahuri, Newasa, Sangamner, Akole, Shewgaon, Pathardi, Ahmednagar, Parner and Shrigonda tahsils were surveyed and in these tahsils pearl millet, ground nut and maize crops were surveyed. The prominent weeds observed in Ahmednagar District were *Parthenium hysterophorus*,*Tridax procubens, Celosia argentia, Euphorbia hirta, Cynadon dactylon , Achanthospermum hispidum, Amaranthus viridis Cyperus rotundus, Argimone maxicana, Eragrostis major* and *Eragrostis minor. Argimone maxicana, Celosia argentia ,Cynadon dactylon* and *Parthenium hysterophorus* in pearl millet , *Cynadon dactylon, Celosia argentia and Erogrostis minor* in groundnut and *Alternathra triandra*, *Argimone maxicana, Celosia argentia and Digera alternifolia* in maize were reported.

## P-11 Shifts in the dominance of weeds in rubber plantation crop in Kerala

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Rubber (*Hevea brasiliensis*) is a widely cultivated plantation crop in Kerala. Under the National Invasive Weeds Surveillance Programme, a detailed survey was conducted during 2008 to study the weed flora of rubber gardens. Totally, 210 rubber gardens were surveyed. The data for the most dominant 15 weeds from each district were pooled and analyzed for their dominance in the state as a whole. The average density, relative frequency, relative density and SDR were calculated for the individual weed species. Out of 50 frequently occurring weed species, 12 species have SDR values above 3 and together they account for SDR of 74.36. The most dominant weeds were *Axonopus compressus*, *Cyathula prostrata*, *Oplismenus burmannii, Synedrella nodiflora, Chromolaena odorata, Mimosa pudica, Borreria hispida, Clerodendrum infortunatum, Ischaemum indicum, Oplismenus compositus, Ageratum conyzoides* and *Mikania micrantha*. Among these, *Axonopus compressus, Chromolaena odorata*, *Mimosa pudica* and *Mikania micrantha* are alien invasive weeds of concern to the farmers. *Mimosa pudica* is a serious problem because of its spiny nature, causing difficulties for the cultural operations. *M. micrantha* cause damage by climbing over the trees and shrubs and smothering them. *Lantana camara* is a major weed in the Kannur and Kasargod districts. Over the last decade the problems of *Axonopus* has increased, while that of *C. odorata* decreased. *Mimosa invisa* and *Mikania micrantha* are recent introductions, spreading fast in the rubber gardens.

## P-12 Weed flora in Assured rainfall zone of Maharashtra.

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The weed survey was carried out in Auranagabad and Jalgaon districts of Assured rainfall zone of Maharashtra during *kharif* 2008. Auranagabad, Gangapur,Khultabad, Vaijapur, Kannad, Soyagaon ,Sillod ,Phulambri and Paithan tahsils were surveyed from Auranagabad Distrct. In these tahsils pearl millet, cotton, ginger and pigeon pea crops were surveyed. The prominent weeds observed in Auranagabad District were *Parthenium hysterophorus,Acalypha indica,Commelina communis,Celosia argentia, Cyperus rotundus, Argimone maxicana, Euphorbia hirta ,Euphorbia geniculata, Cynadon dactylon* and *Amaranthus viridis.* The weed species like *Amaranthus polygamus,Celosia argentia*, *Parthenium hysterophrus, Cleome viscosa,Commelina communis,Cynadon dactylon* and *Cyperus rotundus* in pearl millet, *Acalypha indica, Amaranthus polygamus*, *Parthenium hysterophorus, Cynadon dactylon,Commelina communis* and *Cyperus rotundus* in maize, *Commelina communis, Commelina nudifola, Cynadon dactylon, Cyperus rotundus,Euphorbia geniculata, Parthenium hysterophorus and Euphorbia hirta* in ginger crop and *Parthenium hysterophrus, Celosia argentia, Cynadon dactylon, Sonchus arvensis, Cyperus rotundus, and Acalypha indica* were observed in cotton. In Jalgaon District weed survey was carried out in Jalgaon,Bhusaval, Yaval,Chopada,Amalner ,Muktainagar,Raver,Bhadgaon,Earandol and Jamner tahsils in Banana,cotton , *kharif* sorghum crops. The prominent weeds observed in Jalgaon District were *Parthenium hysterophorus,,, Celosia argentia, Cyperus rotundus, , Euphorbia geniculata, Cynadon dactylon, Acalypha indica , Amaranthus polygamus* and Commelina communis. The weed species like *Acalypha indica, Cynadon dactylon, Cyperus rotundus,, Euphorbia geniculata* and *Parthenium hysterophorus* in Banana, *Amaranthus polygamus, Celosia argentia,Cynadon dactylon,* and *Parthenium hysterophrus* in cotton and Cyperus rotundus, *Cynadon dactylon* Commelina communis, Sonchrus arvensis and *Parthenium hysterophrus were* observed in *kharif* sorghum.

## P-13 Weed flora in Pune District of Maharashtra

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The weed survey was carried out in Junnar, Rajgurunagar, Daund,Saswad,Baramati,Bhor and Haveli tahsils of Pune District. In these tahsils pearlmillet ,groundnut,maize,paddy, soyabean and sugarcane were surveyed during *kharif* 2008. The prominent weeds observed were *Celosia argentia,Argimoe maxicana, Parthenium hysterophorus and Cynadon dactylon.* The weed species like *Amaranthus polygamus, Argimone maxicana,Celosia argentia,Cynadon dactylon, Parthenium hysterophorus,* in pearlmillet, *Celosia argentia, Digeria alternifolia, Parthenium hysterophorus, Tridax procubens ,Xanthium strumium,* in maize *Celosia argentia, Cynadon dactylon, Eragrostis minor and Parthenium hysterophorus were noticed in groundnut p and Amaranthus polygamus, Argimone maxicana, Celosia argentia, Cynadon dactylon ,Panicum isachimi, Parthenium hysterophorus and Xanthium strumarium in paddy, Amaranthus polygamus, Argimone maxicona, Celosia argentia, Cynadon dactylon,Panicum isachimi, Parthenium hysterophorus and, Tridax procubens in soyabean and Argimone maxicana, Celosia argentia, Cynadon dactylon, , Cyperus rotundus, and Lactua runeiate were observed in sugarcane grown in* Pune district.

## P-14 Weed flora of coconut gardens in Kerala

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Coconut (*Cocus nucifera*) is one of the important perennial crops belonging to the family Palmae. It is a widely cultivated crop in Kerala, occupying an area of 8.19 lakh hectares in 2007-08. A survey was conducted as part of the National Invasive Weeds Surveillance Programme during 2008 to study the weed flora of coconut gardens in Kerala in 193 coconut gardens. The data on the most dominant 15 weeds from each district were pooled and analyzed for their dominance in the state as a whole. The average density, relative frequency, relative density and SDR were calculated for the individual weed species. Out of 63 frequently occurring weed species, 10 species have SDR values above 3 and together they account for SDR of 59.70. These most dominant weeds were *Axonopus compressus, Synedrella nodiflora, Mimosa pudica, Ischaemum rugosum, Ischaemum indicum, Chromolaena odorata, Ageratum conyzoides, Desmodium triflorum, Borreria hispida* and *Hyptis suaveolens*. Among these *Axonopus compressus, Mimosa pudica* and *Chromolaena odorata* are alien invasive weeds of concern to the farmers. *Parthenium hysterophorus* which was earlier distributed in the border areas of Kerala and Karnataka is seen spreading to new areas in Kerala, especially in the coconut gardens of Palghat district. *Alternanthera philoxeroides* was seen in coconut gardens of Alleppey district, which has lot of coastal areas.

## P-15 Biochemical Response of free living soil microorganisms under elevated and ambient $CO_2$

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The Population of rhizosphere micro flora Fungi, Bacteria and Actinomycetes were recorded from rhizosphere of crops, weeds and crop weed combined both at ambient and elevated $CO_2$ conditions.There was wide variation seen in Bacteria and Actinomycetes population. The fungal population did not show much variability under different Crop- weed associations. At the initial stage of growth only following fungal species were present Aspergillus, Penicillium, Trichoderma, Mucor, Rhizopus, Chladosporium and Alternaria. But latter as the $CO_2$ Concentration increased resulted in growth of plants only rhizopus and mucor colonies predominated. Fungal biomass of different crops and weed species was more or less at par and showed not much variation. A biochemical test of Azospirillum, Azotobacter, Pseudomonas (phosphate solubilizing Bacteria), Pseudomonas fluorescence was carried out in which it was observed that the glucose & sucrose were more fermented by all the strains which was comparatively more under elevated $CO_2$ than ambient $CO_2$. All strains show negative fermentation with lactose. In TSI test all strains show strongly positive test in elevated $CO_2$ than ambient $CO_2$. And the strains produce more H2S in elevated $CO_2$ than ambient. In Indole test only Pseudomonas phosphate solubilizing Bacteria produce tryptophanase enzyme under elevated $CO_2$ & showed positive test & in ambient $CO_2$ it shows negative test, but Pseudomonas fluorescence showed negative test both in elevated & ambient $CO_2$. In Citrate utilization test all the strains utilize more citrate in elevated than ambient $CO_2$. All strains were MRVP negative in ambient& elevated $CO_2$. All the strains gave strong positive test of catalase under elevated $CO_2$ than ambient it means they undergoes aerobic respiration. The strains hydrolysed starch because of the production of amylase enzyme. All strains showed negative gelatin & urease test because of the absence of enzyme protease & urease.

**P-16**

# Relative abundance of weeds as influenced by rice establishment techniques and weed management practices

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Rive production system has seen a change from earlier direct seeding to transplanted rice and now again due to various constrains there is now shift towards direct seeding. Shift from transplanting to the direct seeding also comes with change in the rice environment from puddled one to the unpuddled (dry seeding) or puddled (wet seeding) one. In every case there is change in the pattern of competition between rice and the weeds and has its impact on the rice yields eventually. In the transplanted rice, rice seedlings have distinct 20-25 days advantage over weeds and in turn they are in position to smother weeds, while it is not the case in the dry or wet seeded rice. In the wet seeded rice though weeds are buried in the soil at the time of puddling, in dry seeding on the other hand rice faces intense weed competition.

Five establishment systems transplanting, wet seeding, dry seeding, dry seeding (stale seed bed) and zero tillage dry seeding were tested at Pantnagar with three weed management practices *i.e.* unweeded check, one hand weeding at 28 days and best bet herbicide control where best bet herbicides (butachlor at 1.5 kg/ha as pre emergence for transplanting, anilofos at0.4 kg/ha as early post emergence for wet seeding and pendimethalin at 1.0 kg/ha for dry seedings) for different establishment techniques were used followed by two hand weedings as 28 and 56 days after sowing. In the following *rabi* season wheat was taken as zero tillage and conventional tillage.

Data of three years (2005, 2006 and 2007) reveal that weeds at 56 days after sowing show a particular trend in terms of the establishment technique. All the weed species were almost negligible in transplanting. In wet seeding too, weed infestation was less and in the dry seeded rice they were comparatively in large number. *Cyperus rotundus*, *Cyperus iria* among sedges; *Echinochloa colonum* and *Ischaemum rugosum* among grasses and *Caesulia axillaris, Commelina diffusa* and *Cynotis axillaris* among broad leaved weeds were the dominant weeds. *Cyperus iria* was the most abundant weed among seven abundant weed species during all three years. Its infestation was highest in the dry seeded rice. *Iscaemum rugosum* was comparatively low in the unpuddled condition than under puddled condition. It was the most dominant weed among grasses in 2005 but subsequently *E colonum* was more populous. The infestation of *Cyperus rotundus* and *Commelina diffusa* was more in the zero tillage dry seeded rice. The number of *C axillaris* was relatively stable during all three years and it was more in the dry seeded rice establishment.

Study reveals that transplanting is the only potent establishment technique under minimum weed management *i.e.* one hand weeding. Weeds cause more problems under direct seeding compared to transplanting. Among weeds, sedges and broad leaved weeds pose greater threat to productivity than grassy weeds. Knowledge of weed dynamics and relative abundance under different establishment techniques warrant their better management.

## P-17 Studies on Weed Flora of Okra and its Management in the Lateritic Zone of West Bengal

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A survey of weed flora in okra growing areas of the lateritic zone of West Bengal conducted in summer 2007 revealed that 27 weed species under 13 families infested the crop. *Poaceae* was largest family with 4 species followed by *Asteraceae* with 4 species; *Cyperaceae, Amaranthaceae* and *Euphorbiaceae* with 3 species each; *Apiaceae* with 2 species and rest with one species each. Altogether 12 species had 'C' class frequency and their individual IVI ranged from 4.48 to 8.25. Another 12 species had 'D' class frequency and their IVI ranged from 8.05 to 20.26. Two species had 'E' class frequency and their IVI were as much as 33.33. Only one species had 'B' class frequency and IVI 3.03. *Cyperus rotundus* was recorded as the most dominant with IVI 42.01 followed by *Croton bonplandianum* with IVI 33.33 and *Trianthema portulacastrum* with IVI 20.26. Most of the farmers use mechanical method (hand weeding) to control weeds. Subsequently a field investigation was conducted in a randomized block design with 8 treatments replicated thrice during summer 2008 at Bhedia, Burdwan to find out a suitable management practice of dominant weed flora of okra. The application of pendemethalin and fluchloralin alone and integrated with one hoeing controlled all categories of weeds effectively. Pendimethalin at 0.75 kg/ha integrated with one hoeing at 40 DAS recorded maximum yield of 9435 kg/ha followed by fluchloralin at 0.75 kg/ha + hoeing (9417 kg/ha) and three hoeing operations (9415 kg/ha). In unweeded control 79.4 % loss in yield was recorded as compared to that of 0.75 kg pendimethalin + one hoeing.

## P-18 Seed Production potential of major weeds of rice – mustard – sesame cropping system in lateritic belt of West Bengal

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Enrichment of soil seed bank depends on the number of weeds present upto the harvesting of crop and production of seeds by the weeds of the concerned area. An investigation was carried out throughout the year 2008 in the lateritic belt of West Bengal to find out the seed production potential of major weeds in rice – mustard – sesame cropping system. Experimental findings revealed that *Cyperus iria, Eclipta prostrata, Echinochloa colona* and *Commelina nudiflora* in rice; *Anagallis arvensis* and *Chenopodium album* in mustard; *Trianthema portulacastrum* and *Digitaria sanguinalis* in sesame took major part in building up rich seed bank in the soil. Despite management of weeds through mechanical method by the farmers, these weed species remained alive and their seed production potential computed at harvesting of crop revealed that average number of seeds production was recorded as 4175, 928, 1422 and 54/$m^2$ in *Cyperus iria, Eclipta prostrata, Echinochloa colona* and *Commelina nudiflora* respectively in rice ; 864 and 2650/$m^2$ in *Anagallis arvensis* and *Chenopodium album* respectively in mustard; 1152 and 2052/$m^2$ in *Trianthema portulacastrum* and *Digitaria sanguinalis* respectively in sesame. Seed rain (Number of seeds deposited/$m^2$) was computed as high as 6500 in rice, 3500 in mustard and 3200 in sesame. Monocot weeds usually produced higher number of seeds than that of dicots.

# P-19 Nitrogen uptake and energy consumption of weeds in wet seeded rice

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A field experiment was conducted on clay soil at the research farm of Directorate of Rice Research, with the objectives of determining the nitrogen composition and uptake of weeds and crop at critical growth stages, working out the energy consumption of weeds and crop and weed indices. The treatments included unweeded check and hand weeding twice along with 10 herbicides/combinations treatments. Relative density of weeds has shown that grasses dominate the weed population compared to sedges and broad leaved weeds. Treatments with Fenoxaprop-p-ethyl, anilophos+ethoxysulfuron and butachlor + propanil recorded higher mean plant height. Tiller no./$m^2$ was higher with butachlor+propanil and butachlor+safener. Dry matter production of crop was maximum with butachlor+safener, anilophos +ethoxysulfuron and butachlor+propanil and the same combinations showed minimum dry biomass indicating their effectiveness over the weed population. Non weeded control recorded significantly minimum plant height, tiller no./$m^2$ , dry matter production, nitrogen harvesting and energy utilization by rice crop and vice versawith weeds. Treatments with Butachlor+propanil, butachlor+safener recorded maximum nitrogen harvesting by crop and minimum uptake and energy utilization by weeds whereas anilophos + ethoxysulfuron, fenoxaprop-p-ethyl recorded higher solar energy utilization and nitrogen harvesting by weeds.

# P-20 New record of alien S*olanum* species in southern Karnataka

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Southern Karnataka comprises of 17 districts with varying agro-climatic zones. Surveillance was made to identify the occurrence of new weed species in cropped, non-cropped and garbage areas, in view of distribution of contaminated wheat grains under public distribution system. Six types of *Solanum* species have been noticed in different parts of Southern Karnataka covering Eastern dry zone, Southern dry zone, Central Dry zone, Southern Transition zone and Hilly zone. The six types of *Solanum* tentatively identified are *Solanum violaceum* Ortega (Syn. *S. indicum* L.), *Solanum elaeagnifolium* Cav., *Solanum torvum* Sw., *Solanum virginianum* L., *Solanum surrattense* Burm. f. (Syn. *Solanum xanthocarpum* Schard & Wendl.) and *Solanum carolinense* L. (3 types).

*Solanum violaceum* Ortega *(Syn. Solanum indicum L.)* was noticed in all places around villages in Southern Karnataka. *Solanum elaeagnifolium*. was noticed in Channapatna, Ramanagara District near garbage area since 6 months and has colonised nearly two square m area. *Solanum torvum* occurred sparingly here and there on road sides and wastelands in dry zones. *Solanum viriginianum* L. - annual herb, spreading up to 45- 60 cm usually found here and there near villages and compost pits in central dry zone. *Solanum surrattense* Burm. F. (Syn. *Solanum xanthocarpum* Schard & Wendl) occurred here and there in dry zones. Three type of alien weed *Solanum carolinense* were recorded. Type – 1 – erect herb growing up to 60 cm to 1.0 m, becomes woody, root grows up to 3.0 to 3.5 feet; appears to be perennial; dark pink spines on stem; small and minute hairs on stem and leaves; leaves are simple, alternate, lobed at three sides, prickles are on midribs on both sides; flowers initially purplish and subsequently yellowish to whitish; flowers are cymose, initially in clusters 5 to 8; young plants have more than one flowers; five petals and stamens; fruits are single, whitish stripes, spiny calyx, fruit on maturity becomes yellow and shrink forming wrinkles; seeds are yellowish in colour, and round. Type - 2 – similar to Type 1 except having yellowish prickles on stem and leaves; flowers are white, cymose, 5 to 10 flowers; 5 lobed, calyx copular without prickles; berries are greenish, white stripes, turn golden yellow on ripening; seeds are yellowish brown coloured, and round. Type – 3 – similar to Type 1, except having yellowish prickles on stem and leaves; flowers are pinkish, cymose, 3 to 10 flowers; 5 lobed, calyx cupular, pubescent hairs and do not have prickles; berries are greenish, white stripes, turn golden yellow on ripening; seeds are yellowish brown coloured and round. The description and other details are similar to as provided in the literature. This variation was perhaps due to changes in the ecological conditions. Thus, one of the alien weed – *Solanum carolinense* has been observed around garbage areas near village settlement and school areas in Central dry zone, Eastern dry zone, Southern dry zone, Hilly zone and Southern transition zones of Southern Karnataka.

# P-21 Ecological weed survey in Dry Zones of Southern Karnataka

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Based on the geographical situations, topography, soil, altitude and variation in climate and cropping pattern, six agro climatic zones comes under the preview of Southern Karnataka. Out of six, intensive weed survey work was carried out in dry regions covering Central, Eastern and Southern dry zones. The data generated from ecological weed survey revealed the diversified weed flora prevailing in each zone under habitats of cropped, non-cropped and garbage areas during 2008-2009.

In Central dry zone, cropped fields were highly infested with variety of weed species. The predominant weeds observed in the zone were, *Digitaria marginata*, *Cynodon dactylon, Echinochloa colona* (among grasses); *Digera arvensis, Ageratum conyzoides*, *Ocimum canum*, *Leucas aspera* (among broad leaved weeds) and *Cyperus difformis* (among sedges) in cropped areas. The weeds like *Cynodon dactylon*, *Parthenium hysterophorus* and *Tridax procumbens* in non-cropped area and *P. hysterophorus, C. dactylon, Acalypha indica* and *Sida acuta* in garbage areas showed prominence.

In Eastern dry zone, the major weeds like, *Echinochloa colona, Cynodon dactylon, Echinochloa oryzoides, Eleusine indica, Chloris barbata, Digitaria marginata* (among grasses); *Eclipta alba, Celosia argentea, Borreria hirta, Ageratum conyzoides, Portulaca oleracea, Parthenium hysterophorus, Acanthospermum hispidum* (among broad leaved weeds), *Cyperus rotundus* and *C. iria* (among sedges) were predominant in cropped areas. *Parthenium hysterophorus*, *Cynodon dactylon*, *Cyperus rotundus*, *Mimosa pudica, Achyranthus aspera* in non-cropped areas and *C. dactylon*, *P. hysterophorus, Sida acuta* and *C. rotundus* in garbage areas were the most dominant weeds.

The major weed flora observed in cropped areas of southern dry zone were, *Echinochloa colona, Echinochloa oryzoides, Panicum flavidum, Cynodon dactylon, Dactyloctenium aegyptium* (among grasses); *Euphorbia hirta, Ageratum conyzoides, Centella asiatica, Vernonia cinerea, Portulaca oleracea, Celosia argentea, Digera arvensis, Ocimum canum, Alternanthera sessilis* (among broad leaved weeds), *Cyperus rotundus* and *C. iria* (among sedges). *Parthenium hysterophorus, Croton sparsiflorus, Celosia argentea* and *Cynodon dactylon* in non-cropped area and *Mimosa pudica, Xanthium strumarium, Boerhaavia errecta* and *Solanum xanthocarpum* in garbage area were the major weeds observed in Southern dry zone.

# P-22 Ecological weed survey in high rainfall regions of southern Karnataka

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Southern Karnataka covers six agro climatic zones based on the geographical situations, topography, soil, altitude and variation in climate and cropping pattern. Out of this six zones, intensive weed survey work were carried out in three high rainfall regions covering Southern transitional zone, Hilly zone and Coastal zone (annual average rainfall ranges from 800 mm up to 4000 mm). The data generated from ecological weed survey revealed the diversified weed flora prevailing in each zone habitat wise *viz.*, cropped, non-cropped and garbage areas.

In Southern transitional zone, the predominant weed species were *Cynodon dactylon, Dactyloctenium aegyptium, Echinochloa oryzoides, Echinochloa colona* (among grasses); *Marselia quadrifoliata, Parthenium hysterophorus, Acalypha indica, Commelina benghalensis, Spilanthes acmella* (among broad leaved weeds); *Cyperus rotundus* and *C. difformis* (among sedges) in cropped areas. *Parthenium hysterophorus, Alternanthera sessilis, Abutilon indicum* and *Cynodon dactylon* in non- cropped areas and *Mimosa pudica, Parthenium hysterophorus, Xanthium strumarium* and *Calotropis gigantea* in garbage areas were the major weeds.

In Hilly zone of Karnataka, *Cynodon dactylon, Brachiaria reptans, Echinochloa colona, Echinochloa oryzoides, Digitaria marginata*, *Chloris barbata* (among grasses); *Bidens pilosa, Portulaca oleracea, Solanum kasianum, Ageratum conyzoides, Amaranthus viridis* (among broad leaved weeds) and *Cyperus iria* (among sedges) were predominant weeds in cropped areas. *Hyptis suaveolens, Amaranthus viridis, Sida acuta* and *Solanum xanthocarpum* in non-cropped areas and *Ipomoea sp*., *Digitaria marginata, Cynodon dactylon*, and *Cassia tora* in garbage areas showed dominance.

In Coastal zone, *Cynodon dactylon, Chloris barbata, Dactyloctenium aegyptium (among grasses); Wadhelia chinensis, Amaranthus viridis, Hyptis suaveolens, Bidens pilosa, Mimosa pudica* (among broad leaved weeds); *Cyperus rotundus* and *Cyperus difformis* (among sedges) were dominant weeds in cropped areas. *Achyranthus aspera, Dactyloctenium aegyptium, Cynodon dactylon* and *Cyperus rotundus* in non-cropped areas and *Parthenium hysterophorus, Cassia tora, Mimosa pudica* and *Sida acuta* in garbage areas were the predominant weeds.

# P-23 Phyto-sociological association of *Parthenium* in major agro climatic zones of Orissa

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*Parthenium hysterophorus* popularly known as congress grass, carrot grass has taken the most dreaded position among the various weeds of the world. It is considered as an exotic poisonous, allergic and aggressive weed creating threat to environment and bio diversity. It was believed to enter Orissa during seventies and was confined to both the sides of the railway tracks. Gradually it spread unnoticed to other thrust areas like wild fire such as waste lands of urban areas, sides of the canals and roads, industrial and mining areas of the state.

Preliminary studies on distribution, phyto-sociological association and alleopathic aspects of *Parthenium* was under taken during 2007-08 in four major agro climatic zones of the state *viz*- North Coastal Plain, East and South Eastern Coastal Plain, Central Table Land and Eastern Ghat High Land zone with an elevation gradient of 150m to 1300m above MSL.The density of *Parthenium* in both cropped and non-cropped areas per square meter was recorded at 10 km intervals. The weed population was observed to be more in non-cropped areas like railway tracks, roadsides, wastelands of urban areas, canal embankments, in East and South Eastern Coastal Plain zone and industrial belts of Central Table Land and Eastern Ghat High Land zone. The high intensity of invasion might be due to continuous deposition of *Parthenium* seeds and lack of adequate knowledge on ill effect of *Parthenium*.

The survey also revealed the appearance of *Cassia tora*, *Tephrosia purpurea*, *Sida acuta* checked the growth of *Parthenium* significantly in the road sides, waste lands and canal embankments of Coastal plain zone. This might be due to the allelopathic effects of the above plants.

In order to reduce the spread of *Parthenium*, a field experiment was conducted in the waste land of Bhubaneswar city during pre-*rabi* season of 2008. The treatment combinations were glyphosate 0.75 kg/ha, sodium salt of 2,4-D 1.5 kg/ha, metribuzin 0.25 and 0.5 kg/ha, manual uprooting and burning and weedy check. All the herbicides were applied as post-emergence spray before and after flowering of the weed. It was found that application of metribuzin 0.5 kg/ha and glyphosate 0.75 kg/ha were equally effective in controlling the *Parthenium* at both stages followed by application of 2,4-D sodium salt. Manual uprooting and burning in controlling *Parthenium*, was not economically viable.

# P-24 Occurrencde of *Tithonia rotundifolia,* an invasive poisonous weed in western zone of Tamil Nadu

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*Tithonia rotundifolia* is an invasive poisonous weed belongs to the family Asteracea, native of Northern America commonly called as Mexican-sunflower. *Tithonia rotundifolia* is an annual monocarpic plant and seeds exhibit a period of dormancy before germinating. Entire or lobed dark green leaves (3-12" long) with hairy undersides are generally ovate to triangular in shape with serrate to crenate margins. *T. rotundifolia* produces small-sized and many seeds. and high reproductive effort of *T. rotundifolia* ensures its early vigorous start in seedling growth, quick establishment, longer survival and to grow more aggressive.

*Tithonia rotundifolia* (Mill.) is identified from the black soils of Sulur areas of Coimbatore district. Leaves are spindled shape with shallowly incised at the base. They are thinly hairy in nature with parallel venation. Leave arrangements are alternate and opposite. Stem is succulent and angular. Flowers are with yellow colour petals and ray florets. Flowers are solitary and terminal heads. Roots are adventitious and runners. This species is cultivated as an ornamental; has been reported from Sri Lanka under cultivation but not reported from Tamil Nadu so far. Possibly this species must have been introduced either from other parts of India or from Sri Lanka through flights or horticultural plants as it being invaded in and around the vicinity of Coimbatore Civil Aerodrome. It is further reported that when this plant is grazed by the livestock, it is found to be fatal. Hence an attempt has been made to control this obnoxious weed by herbicides like glyphosate, metribuzin and 2,4-D under non-crop situation. The results revealed that post emergence application of glyphosate 10 ml+ 2,4-D 6g+soap solution 2 ml / litre of water could reduce the *Tithonia* density as well as biomass considerably.

## P-25 Alien invasive weeds in high ranges of Kerala

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Geographically, Wayanad and Idukki districts, situated at an altitude of 2500-5000 ft above MSL, are considered as high-range areas in Kerala. Weed flora in this region is quite different from that of the plains. The weed frequency varies from region to region with altitude. *Ageratiana adenophora* (formerly *Eupatorium glandulosum*) is found in areas above 4000 feet whereas *Chromolaena odorata*, a weed of lower region, is totally absent. *Lantana camara,* with flower of various colour is found in both cultivated and non cultivated areas and road sides forming dense stands that shade and crowd out other herbaceous plants. *Drymaria cordata* and *Crassocephalum crepidoides* are the dominant weeds in Tea. *Crassocephalum crepidoides* and *Bidens pilosa* are dominant in Coffee and *Drymaria cordata* and *Crassocephalum crepidoides* in carrot. *Mikania micrantha* and *Tithonia diversifolia* are found in almost all the areas of high ranges. *Parthenium hysterophorus* and *Xanthium strumanium* are found in borders of Kerala with Tamilnadu and Karnataka irrespective of altitude. Spread of *Parthenium* is mainly by goods vehicles and through the cow dung brought for crops from *Parthenium* affected areas of Tamilnadu and Karnataka. The biodiversity of native the flora is seriously affected by the competition and displacement of weeds by invasive ones. *Lantana camara* and *Ageratiana adenophora* are very aggressive and dominant where ever they get established. Flowers of most of these weeds, especially *Lantana camara*, *Bidens pilosa* and *Tithonia diversifolia,* have ornamental value and it is attracting tourists to these hilly areas.

## P-26 Alien weeds from the genus *Alternanthera* in Kerala

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A survey conducted during 2008 under the National Invasive Weed Surveillance Programme on weed flora of Kerala revealed that the genus Alternanthera (Family – Amaranthaceae) accounts for many fast spreading alien weeds, adapted to diverse habitats in Kerala. *A. sessilis* (Sessile joy weed), reported as early as in 1692 by Rheede in his '*Hortus Malabaricus*' was the common species in Kerala. Other species are subsequent introductions from Tropical America. *A. bettzichiana* (Joy weed) is spreading fast in the non cultivated areas and roadsides of Kerala. It is found as a major weed in 11 out of the 14 districts in the state. *A. philoxeroides,* commonly known as the alligator weed, was first noted in India inWest Bengal and Bihar in 1964, from where it has quickly spread to other parts of the country. It is now seen spreading fast all along the aquatic areas in Kerala, displacing the native flora. *A. braziliana* which was introduced as an ornamental plant during 1990's, has become as a problem weed in the shaded areas. *A. pungens (A. echinata),* known as Khaki weed, which was reported first in 1946 from Bangalore, is seen in the dry regions of Palakkad and Idukki districts of Kerala. *A. paronychioides* prefers dry climate and is seen only in a few locations of Thrissur and Palakkad during summer season. *A. tenella* is a garden escape seen in Malapuram and Thrissur districts.

## P-27 Morning glories (*Ipomoea* spp.) – a threat to biodiversity

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Morning glories belong to the family Convolvulaceae. Because of their fast growth, twining/habit and tolerance for poor fertility soils, they cause serious threat to the biodiversity of the state. As per the survey under National Invasive Weed Surveillance Programme (NIWSP) during 2008, the common *Ipomoea* species were *I. carnea* ssp. *fistulosa* (gramaphone plant), *I. aquatica* (water spinach), *I. pescaprae* ssp. *pescaprae* (goat's foot creeper/beach morning glory), *I. pestigridis* (bind weed), *I. purpurea* (common morning glory) and *I. palmata* (railway creeper). Among these *Ipomoea carnea* ssp. *fistulosa* is a shrub invading the wet lands and shallow ponds. *I. aquatica* invades mostly the aquatic canals and ponds. These two species are invading the aquatic areas in Kerala and replacing other weeds. *I. palmata* is present in the non cropped areas in most of the districts. It is a competitive plant against *Mikania micrantha* and *Merremia vitifolia*, because of its fast spreading and twining nature. *I. pestigridis* is a serious problem in the coconut gardens in Kollam district. *I. pescaprae* ssp. *Pescaprae*, which is a native of Florida, is now seen in all tropical regions. It invades the sandy soils in the beaches and river beds and reduce their recreation value. However, it is known to protect the soil from the erosion action of the waves. *I. purpurea*, a native of Tropical America, is spreading in the higher altitudes in Idukki district.

## P-28 *Rottboellia cochinchinensis,* a thorny problematic grass weed in black clay soils of Tamil Nadu

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*Rottboellia cochinchinensis* (Lour.) a $C_4$ species, is a most problematic weed under rainfed conditions in crops like sorghum, pearlmillet, pulses and cotton. and common on contour banks and roadsides. Thorny nature of this weed produces many seeds, which shatter easily. Grows and flowers throughout the year. These characteristics, combined with rapid growth and sharp irritating/hairs, make it very competitive. An annual grass with vigorous growth supported by roots. Leaf blade broadly linear. Culms stout, occasionally branching. Inflorescence a simple raceme, spike-like, contracting at the tip, cylindrical. Fruit is a cylindrical caryopsis.

It also occurs in moister areas, up to an altitude of 1, 800 m. The weed is one of the primary colonizers of disturbed ground and is of some value for grazing. It is an extremely vigorous competitor in upland crops due to its rapid growth and spreading/habit and heavy infestation can cause total crop loss. The plant reproduces entirely by seeds and can continue to flower and seed year-round when moisture conditions are favorable a single plant can bear 2,000 seeds. The weight of 1,000 seeds is 10.6 g and there are 94 seeds g. This weed is observed to invade black soils of Madurai, Coimbatore and Tirunelveli districts. Thorny nature of this weed hinders manual removal warranting herbicidal control. Pre-emergence application of pendimethalin 1.5 kg/ha in cropped fields and post-emergence spraying of glyphosate 3.0 kg/ha under non crop or fallow seasons could control this effectively.

## P-29 Identification and assessment of invasive weeds in Trichy district of Tamil Nadu

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During National Invasive Weed Surveillance (NIWS) programme, survey was made in 294 villages in 15 blocks in cropped and non cropped eco systems. 10 samples each from cropped and non cropped eco system covering an area of one square meter were taken. Survey is being conducted on a continuous basis in Trichy district covering villages in 11 community development blocks. During the survey the major alien weeds like *Ageratum conyzoides*, *Lantana camara, Commelina communis* and *Parthenium hysterophorus* were observed in both cropped and non cropped eco system. Among these, *Parthenium hysterpohorus* density was higher (4.32 no/$m^2$ )and calculated relative density of 15.69% in non cropped eco system.

## P-30 Identification of invasive weeds in cropped and non-cropped eco system of Dharmapuri district, Tamil Nadu

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During National Invasive Weed Surveillance (NIWS) programme, survey was made in 251 villages in 8 blocks have been surveyed of Dharmapuri district. The invasive weeds *viz*. *Parthenium hysterophorus, Ageratum conyzoides, Solanum carolinense* and *Lantana camara* were observed in both cropped and non cropped ecosystem. Among these weeds, *Parthenium hysterophorus* recorded higher relative density of 9.90% and density of 10.46 No.$m^2$ in cropped eco system. During the survey, an invasive weed species namely *Solanum carolinense* was identified in roadside at Kambainallur village of Morrappur block, Dharmapuri district. *Solanum carolinense* belongs to *Solanceae* family and is native of Gulf States.

## P-31 Assessment of intensity on invasive weeds under cropped and non-cropped conditions in Namakkal district of Tamil Nadu

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During National Invasive Weed Surveillance (NIWS) programme, survey was made in 327 villages in 15 blocks in cropped and non cropped eco systems. 10 samples each from cropped and non cropped eco system covering an area of one square meter were taken. The invasive weeds *viz*. *Parthenium hysterophorus, Ageratum conyzoides* and *Commaline communis* were observed in both cropped and non cropped eco system. The relative density of *Parthenium hysterophorus* has recorded higher (7.63%) and weed density (9.13 No/m) respectively in non cropped eco system among all other weeds.

## P-32 Effect of human intervention on invasion of weeds - a case study in Sasthamkotta lake

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Sasthamkotta lake is the biggest fresh water lake in Kerala, spread over an area of about 4 $km^2$. About 90% of land surrounding, the lake is uninhabited area under the control of Government of Kerala. The shore areas of the lake are devoid of clay, silt and organic matter and contain only gravels so that establishment of weeds is not favoured. There are no vegetation along the margins as well as in the water. The lake, well known for crystal clear water free of aquatic weeds, is now under threat of pollution from human wastes, deposition of drainage water and soil eroded from the surrounding agricultural fields around the human settlements. As a consequence of human intervention and contamination, lot of aquatic weeds have started invading the lake. In marginal areas first appear annuals like *Fimbrystylis, Oldenlandia, Lindernia etc*. Then appears perennial weeds such as *Panicum repens, Cassia alata* and emergent weeds *Monochoria vaginalis*, *Nymphoides indica etc*. The Fisheries Department has established a fish breeding site in the lake. The fish excreta and detergents from households change the pH, which promote the rampant growth of submersed aquatic plants like *Hydilla verticillata* and floating weeds like *Salvinia molesta*. Unless quick remedial action is taken, this fresh water lake enlisted among the Ramsar site, will lose its name and fame as a source for good quality drinking water. In some areas the land above the lake is inhabited.

## P-33 Spread of prominent invasive weeds in non-cropped and garbage areas

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A survey of weed flora in non-cropped and garbage area in Kharif and *rabi* season (2008-09) was conducted in 9 districts *viz.* Bhind, Morena, Gwalior, Sheopur, Shivpuri, Datia, Guna, Rajgarh and Vidisha district of Madhya Pradesh, during survey total invasive weed species were recorded in study area to enhance preparedness to exotic weeds invasion. Result revealed that *Pathenium hysterophorous* was dominant weed in all 9 district in non-cropped and garbage econsystem of Kharif season. Similarly, *Pathenium hysterophorous* was found dominant in Gwalior, Bhind, Morena, Sheopur and Vidisha district, while *Lantana camara* was found dominant in Datia and Rajgarh district and *Ipomoea carnia* in Guna district and *Argemone maxicana* were found dominant in Shivpuri district in non-cropped ecosystem during *rabi* season.

*Pathenium hysterophorous* was found dominant weed in Gwalior, Bhind, Morena and Vidisha district, while *Ageratum conyzoides* was found dominant weed in Sheopur, Guna and Rajgarh district and *Argemone maxicana* in Shivpuri and *Lantana camara* in Datia district was found dominant in garbage ecosystem during *rabi* season.

## P-34 Impact Assessment of Weeds in MPTs based Agroforestry System

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Multipurpose Tree Species (MPTs) such as *Albizia procera, Acacia nilotica, Dalbergia sissoo, Ailanthus excelsa* (NFTs) and *Tectona grandis* and *Gmelina arborea* (Verbenaceae groups) has got wide acceptability by the farmers of Central India due to its multifarious applications such as sequester carbon, provide fuelwood, fodder and fibre and besides improving soil regime through Nitrogen fixation. In MPTs based agroforestry system , yield primarily depends upon factors such as compatibility/interaction especially between overstorey and understorey (its associates) crops, inputs like nutrients,moisture, radiation and biochemical adoption. The rate and extent to which biophysical resource are captured and utilized by the components of an agroforestry system are determined by the nature and intensity of interaction between tree component on the one hand and soil fertility, changes in microclimate, natural resources (sunlight and water) availability, its utilization and harmful/beneficial affects of associate crops (Allelopathy) on the other hand. Trees in boundary planting compete with crops for above and below ground resources. This paper reviews the enormous direct or indirect harmful effect of noxious weeds *viz. Parthenium hysterophorus* L.(carrot grass) and *Lantana camera* L. , to the agroforestry system . Lantana competes with young trees for resources in the plantation and gradually suppressed the young trees . This weed is highly susceptible to fire through its dry leaves and twigs and fire spreads to the boles and crowns of tree through its straggling shoots t resulting into severe forest fire and ultimately damaging standing crop during summer season. Another worst weed is *P. hysterophorus* which dominates agricultural fields, plantation areas and also in agroforestry system causing low yield to the overall system besides with blockage of common pathway and orchards and reduces aesthetic value of parks and residential areas and also causes soil fertility reduction on long term basis. The potential yield losses due to these weeds can be 65-70 per cent depending upon the associate crop ,type of weed and rate of weed infestation.

## P-35 Pre-dominance of invasive weed flora in Coimbatore district of Tamil Nadu

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Imported food grain may be major source of alien weed species. NIWS program was launched to counter the entered alien weed species. Under this, a survey program was launched in Coimbatore district. The program is to cover 327 villages in 17 blocks of the district. *The* sample places consistsed of 10 each from cropped and non cropped area covering an area of one square meter per place. The sampling was done in 4 plots to cover one square meter and the population of weeds was counted using quadrate method. The data was recorded and subjected to further analysis. Following invasive weed species were recorded: *Parthenium hysterophorus, Solanum carolensis, Solanum elangifolium, Cenchrus triffodes, Viola arvensis, Ambrosia trifida, Cynoglossum officinale and Ageratum conyzoide.* Weed species *viz. Parthenium hysterophorus, Solanum carolinense, Solanum elaeagnifolium, Lantana camara*, was identified. The result reveals that *Parthenium hysterophorus* has registered higher relative density (15.44%) in cropped eco system.

# P-36 Impact of Invasive Alien weeds *Lantana camara* and *Parthenium hysterophorus* on Indigenous Medicinal Herbs

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The indigenous medicinal herbs are extensively used in Indian System of Medicines namely Ayurveda, Sidha and Unani form thousands of years. The demand of these herbs is increasing all over world due to increased awareness regarding curative values of the herbs and after effect of allopathic drugs. However, the availability of the high value herbs is decreasing tremendously from their natural habitats. There are several reasons for decreased, availability of these herbs *viz.* deforestation, regular unscientific extraction of herbs without caring for their regeneration, mining, use of land for several human activities, natural calamities like drought, floods, epidemics of pests and diseases and uncontrolled spread of invasive alien weeds. Among invasive alien weeds the spread of *Lantana camara* and *Parthenium hysterophorus* in the natural habitats of indigenous medicinal herbs ie. forests of India is severe threat to survival of medicinally important biodiversity. The reduction on the population of indigenous herbs is directly related to the increase in *Lantana camara* population. The regeneration of high value medicinal herbs viz,; *Chlorphytum borivillianum, Chlorophytum tuberosum, Curcuma angustifolia, C.aromatica, C.amada, C.caesia, Rauvolfia serpentine, Costus speciosa, Convolvulus pluricaulis, Evolvovulus alsinoidis, Cassia angustifolia, C.alata, C.tora, Curculigo orchiodes, Eclipta alba, Phyllanthus amarus, Abelmoschus moschatus, urginea indica, Ocimum gratissimus, O.viridi, Andrographis paniculata, Sweratia chirata, Leucos aspera, Tephrosia purpurea, Achyranthus aspera, Tridax procumbens, Uraria picta, Desmodium gangaticum, Solanum xanthocarpum, S.indicum etc*. is inhibited under the *Lantana* bushes. The climbers namely *Asparagus racemosus, A.officinalis A. adscendens, Dioscoria alata, D.hispida, D. pentaphylla, Abrus precatorius, Pueraria tubrosa, Gymnema sylvestre, Hemidesmus indicus, Aristolochia bracteolata, A.indica, Gloriosa superba, Tinospora cordifolia, Celastrus paniculata* etc. also could not grow under bushes of *Lantana camara.* The shrubs *viz.*; *Helicteris isora, Carissa carandas, Nyctenthes arbor-tristis, Woodfordia fruiticosa, Gymnospermum montana, Adhatoda vasica* etc. have found eliminated under the *lantana camara* bushes. The regeneration of high value aromatic and medicinal grasses *viz.*, *Cymbopogon martinii, C.flexuosus, Vetivaria zaziniodes* and sedge *viz. Cyperus rotundus* is total inhibited under the *Lantana bushes*. The germination of other economic annual and perennial grasses is also inhibited. The spread of *Parthenium hysterophorus* resulted in gradual elimination of the perennial aromatic and economic grasses and herbs in the process of natural succession. The herbs having the short life cycle are eliminated very fast due to allelopathic and competitional effects of this alien invasive weed, due to its wide ecological adaptation and survival capacity in different seasons. The germination and growth of the tree species also heavily affected by the spread of *Lantana camara* and population is reducing gradually. The regeneration of *Satalum album, Acacia catechu, Aegle marmelose, Annoa squamosa, Emblica officinalis, Strychnos potatorum, Soymadia febrifuga, Holarrhena antidysenterica, Anogeissus latifolia, Terminalia bellirica, Terminalia chebula, Terminalia tomentosa, Litsea glutinosa, Gmelina arborea, Oroxylum indicum, Stereospermum chelonoides, Clerodendrum phillomidis, Garuga pinnata, Bacanania lunjan, Crataeva nurvala, Semecarpus anacardium, Sympolcas racemosa, Alingium salvifolium, Bombax malabarica* and several other economic tree species is inhibited drastically.

## P-37 Evaluation of post emergence herbicide imazethapyr against weeds in blackgram (*Vigna mungo* L. Hepper)

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In North Eastern transition zone of Karnataka, blackgram is a major *kharif* pulse crop accounting for 65 per cent of the area in the state. It is a short duration crop and weeds are to be controlled in the first 30 days after sowing (DAS). Because of incessant rains and/or scarcity of labour during weeding period, hand weeding (HW) or inter-cultivation (IC) is delayed which is one of the bottlenecks in its production. When monsoons commence, farmers are usually busy in completing sowing of different crops to exploit the short lived optimum conditions. They can think of weeding, only after 15-25 DAS. It is too early to take up HW or IC at 15-20 DAS. During this period, some post emergent herbicides can be thought of. With this background, an experiment was conducted at Agricultural Research Station, Bidar to evaluate post emergence herbicide imazethapyr at different doses against weeds in balckgram during *kharif* seasons of 2000 and 2002. Averaged over two years, the grain yields were significantly higher with pre-emergence application of either fluchloralin 1 kg/ha or pendimethalin 1kg/ha with one IC and one HW (770 and 768 kg/ha, respectively), when compared to different doses of imazethapyr and and farmers' method of weed control. Post-emergence application of imazethapyr at lower doses (50, 75 or 100 g/ha) resulted in significantly higher yield (704,664 and 643 kg/ha, respectively) over higher doses of 125 g/ha (525 kg/ha) and 200 g/ha (456 kg/ha), which was because of phytotoxic effects of higher doses on the crop resulting in chlorosis, scorching and wilting based on the scoring. The yield with lower doses of 50 g/ha and 75 g/ha were on par with the yields in farmers' practice, indicating the importance of application of post emergence herbicide between 15 to 25 DAS to overcome the problem of delayed weeding either due to incessant rains or scarcity of labour during the period of critical weed crop competition.

## P-38 Growth and nutrient uptake of transplanted *rabi* rice, weeds as influenced by different weed management practices

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A field experiment was conducted at the College Farm, college of Agriculture, Rajendranagar, Hyderabad during *rabi* 2005. The soil of the experimental site was sandy clay loam in texture with a medium content of organic carbon, nitrogen and phosphorus, high in available potassium status and slightly alkaline in reaction (pH 8.1). The experiment was laid out in a randomized block design replicated thrice with 12 weed control treatments. The results indicate that hand weeding at 20 and 40 DAT recorded highest plant height , dry matter production, tillers/$m^2$, nutrient uptake by crop and lowest nutrient uptake by weeds through out the crop growth period. Among the herbicidal treatments during active tillering stage (around 25 DAT) the pre-emergence application of anilophos 0.4 kg/ha and oxadiargyl at 70g/ha was effective in recording higher growth parameters, while at later stages (maximum tillering to harvest) anilophos 0.3 kg/ha + one HW at 25 DAT and oxadiargyl 50 g/ha + one HW at 25 DAT were the best treatments. The highest grain and straw yield was registered by hand weeding at 20 and 40 DAT followed by anilophos 0.3 kg/ha + one HW at 25 DAT and oxadiargyl 50 g/ha + one HW at 25 DAT.

## P-39 Evaluation of pre and post emergence herbicides on growth and yield of soybean under middle Gujarat conditions

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A field experiment was conducted during *kharif s*easons of 2007 and 2008 at DWSR Anand Centre, Anand to find out most efficient and economical weed management practices in soybean. The soil of the experimental field was sandy loam having pH 8.10 with 0.023 % nitrogen, 59 kg $P_2O_5$/ha and 310 kg $K_2O$/ha. The experiment was laid out in randomized block design with four replications. The predominant weeds of soybean crop were *Dactyloctenium aegyptium*, *Eragrostis major*, *Phyllanthus niruri*, *Commelina benghalensis*, *Cyperus rotundus*, *Molugo nudicuulis*, *Oldenlandia umbellata* and *Digera arvensis*. Significantly lower dry weed bio mass was recorded at harvest in twice inter culturing and hand weeding (IC & HW) treatment which was at par with pre-emergence application of fluchloralin 1.00 kg/ha *fb* HW at 30 DAS, pre-emergence application of Pendimethalin 0.75 kg/ha *fb* HW at 30 DAS and post emergence application of quizalofop-p-ethyl 50 and 100 g/ha *fb* HW at 30 DAS. Weed control efficiency varied between 52 to 91%. Plant stand of soybean recorded at 15 DAS was non-significantly influenced by weed management practices in soybean. Significantly higher grain yield was recorded in twice IC & HW treatment which was at par with pre-emergence application of fluchloralin 1.00 kg/ha *fb* HW at 30 DAS, pre-emergence application of pendimethalin 0.75 kg/ha *fb* HW at 30 DAS, post emergence application of quizalofop-p-ethyl 50 g/ha *fb* HW at 30 DAS and post emergence application of quizalofop-p-ethyl 100 g/ ha alone and *fb* HW at 30 DAS. Plant population recorded at 15 DAS and plant height recorded at 30 DAS of succeeding wheat and sorghum was not significantly influenced by residual effect of herbicides applied in soybean. The results revealed that post-emergence application of quizalofop-p-ethyl 50 to 100 g/ha *fb* HW at 30 DAS or pre emergence application of fluchloralin 1.00 kg/ha or pendimethalin 0.75 kg/ha *fb* HW at 30 DAS is the substitute of twice IC & HW carried out at 20 and 40 DAS in soybean crop for efficient weed management and better yield.

## P-40 Pinoxaden, an effective herbicide against herbicide resistant *Phalaris minor*

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After development of resistance in *P. minor* against isoproturon, some alternate herbicides namely clodinafop, sulfosulfuron, and fenxaprop-*p*-ethyl were recommended. A long-term study has shown reduced efficacy of fenoxaprop-*p*-ethyl and clodinafop against *P. minor*. Pinoxaden, a new herbicide was tested against herbicide resistant populations of *P. minor* during 2007-08. Ten isoproturon resistant populations of *P. minor* were sown in paired rows and herbicides namely isoproturon, clodinafop, sulfosulfuron, fenxaprop-*p*-ethyl and pinoxaden were sprayed across the rows after 35 DAS. The results showed that Pinoxaden (0.05 kg/ha) resulted into complete mortality in all the ten populations of *P. minor* and not a single plant could survive to produce seed. Whereas there were many survivors under rest of the herbicides and produced seed. Since Pinoxaden is recommended in wheat, it holds a great promise to control herbicide resistant populations of *P. minor* and reduce its soil seed bank.

## P-41 Efficacy of chlorimuron alone and in mixture with quizalofop-p-ethyl against weeds in soybean

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A field experiment was conducted at Livestock farm, JNKVV, Jabalpur during rainy (*kharif*) season of 2008, to study the efficacy of chlorimuron alone and in mixture with quizalofop-p-ethyl against weeds in soybean. Among the weed flora, the monocot weeds like *Echinochloa colona* (23.5%), *Cyperus rotundus* (22.4%) and *Dinebra retroflexa* (19.4%) and dicot weeds *viz.*, *Eclipta alba* (12.8%) and *Alternenthera philoxeroides* (21.9%) were predominant in the experimental field at 40 days after sowing. The efficacy of chlorimuron (12 g/ha) was good against dicot weeds only but fail to control grassy weeds. However, combined application of chlorimuron 9 g/ha + quizalofop 75 g/ha with surfactant 750 g/ha gave satisfactory control of both grassy and broad leaved weeds as it paralyzed the weed growth identically (80.42%), gave higher seed yield (15.20 q/ha) and proved more remurative (NMR Rs.14241.8 ha and B:C ratio 1.88) Hand-weeding twice although produced the maximum seed yield (16.27q/ha) but fetched less net monetary returns (Rs.10775/ ha) and B:C ratio (1.49) due to higher investment on weed control in soybean.

## P-42 Weed management in rice using herbicide halo-sulfuran methyl- a micro herbicide

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Rice is the principle staple food of 65% of the population in India. Rice occupies 34% of the area under food crops with production accounting for 42% of the total food grains. Average productivity of rice in India is only 2.69t/ha , far lower than Japan, China and Korea. The low productivity in rice is attributed to infestation of weeds, pests and diseases. Weeds account for 43.5 to 55.5% reduction in yield apart from depletion of soil nutrients like nitrogen, phosphorous and potassium. Nowadays, there is an increasing trend in usage of herbicides, repeated usage of same herbicides will result in weed resistance and weed shift. In context to this background, an experiment was conducted to study the efficacy of microherbicide halo-sulfuran methyl under different dosages (7.5g /ha to 45.0g/ha) and time of application (6DAT -12DAT) under trans-planted wetland rice eco-system against the control of butachlor, hand weeding and unweeded check. The varieties selected were Co 43 and ADT 43. Application of micro- herbicide at 50.0g/ha at 6 DAT was found to be effective by giving higher grain yield of 3.4t/ha. The nutrient uptake by the crop in this treatment was significantly higher with 113.32 g/ha, 31.05 kg/ha, 97.73 kg/ha of N, $P_2O_5$, and $K_2O$ chemical fertilizer, respectively. The post harvest available nitrogen, phosphrous and potassium status of soil was also analysed at concentration 50 g/ha at 6DAT. Micro herbicide application recorded the reduced available nutrients indicating higher uptake of nutrients by the crop due to reduced weed density. Higher weed control efficiency of 78% was achieved at 50 kg/ ha at 6DAT. It was better for the effective management of grasses, sedges and broad leaved under transplanted wet land rice eco-system.

## P-43 Post-emergence herbicidal management of *Solanum elaeagnifolium* in crop fallow conditions under rainfed ecosystem

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*Solanum elaegnifolium* (Silver leaf nightshade) is a perennial weed that has become increasingly troublesome over the past several decades. Extensive use of soil-applied herbicides, accompanied by a reduction in annual weed competition and reduced tillage, has contributed to its spread and establishment as a noxious weed in cultivated fields. It is a typical agronomic weed in that weed competes with crops, exudes plant inhibitors, interferes with animal husbandry and harvesting practices and acts as an alternate host for phytophagous insects and plant diseases. The vegetative shoots of this weed appear early in the monsoon seasons and grow rapidly due to the food reserves stored in the well-developed rootstock. Its problem is more aggressive in black clay soils where the dominant crops are cotton, maize and sunflower. Hence, an on-farm trail was carried out in farmers holding with an objective to evaluate an efficient herbicidal management technique for controlling *Solanum elaegnifolium* in block clay loam soils. Treatments were glyphosate 20 ml + urea 20 g + soap solution 2 ml/l of water, glyphosate 10 ml + 2,4-D 6 g + soap solution 2 ml per litre of water, 2,4-D 10 g + soap solution 2 ml/l of water, unweeded control. Results revealed that the *Solanum elaeagnifolium* was effectively controlled by glyphosate 10 ml + 2,4-D 6 g + soap solution 2 ml per litre of water was more effective in reducing weed density and dry weight. Weed control efficiency was higher in glyphosate 10 ml + 2,4-D 6 g + soap solution 2 ml/l of water and it was followed by glyphosate 10 ml + 2,4-D 6 g + soap solution 2 ml/l of water. The effect was more pronounced of beyond 15 DAH. Post-emergence application of glyphosate 10 ml +2, 4-D 6 g+soap solution 2ml/l of water was found to reduce the infestation of *Solanum elaegnifolium*.

## P-44 Chemical Weed Control in Soybean

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A field experiment was conducted to study the chemical weed control in soybean with application of imazethapyr 50,75,100 and 200 kg/ha, Kloben 9.37 g/ha Whipsuper 67.5 kg/ha, pendimethalin 750 g/ha, fluchloralin 1 kg/ha.Application of imazethapyr, Kloben and Whispuper early post (*i.e.* at 2-3 leaf stage of weeds), pendimethalin and fluchloralin was applied as pre-plant incorporation (PPI). The weed intensity and weed dry weight were significantly reduced due to early post application of imazethapyr 200 g/ha, Kloben 9.37 k/ha and Whipsuper 67.5 g/ha. Maximum weed control efficiency was recorded under imazethapyr 200 g/ha (89.26 %) followed by imazethapyr 100 g/ha (83.65%), Kloben 9.37 g/ha (82.71%) and Whipsuper 67.5 g/ha (81.31 %). Lowest weed index was recorded in imazethapyr 200 g/ha and highest under weed control treatment (30.84%) and pendimethalin 750 g/ha (27.38%). The highest soybean yield was obtained under imazethapyr 200 g/ha (27.75 q/ha) followed by imazethapyr 100 g/ha (27.00 q/ha), Kloben 9.37 g/ha (25.00 q/ha) and Whipsuper 67.5 g/ha (24.80 q/ha).

## P-45 Time of sowing and weed control methods in direct wet seeded rice

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Rice is the number one food crop in India, which assures food security for more than half of the total population (1.03 billion) in the country. Its cultivation has spread over to 43 million ha with a total production of 83 mt and productivity of 1.9 t/ha in India. Weed infestation is one of the major constraints and they contribute heavily for the loss of rice yields. Yield losses caused by weeds in low land rice fields vary with time of weed infestation and planting method. Field experiment was conducted at Wetland Farms, Department of Central Farm TNAU, Coimbatore during 2008 and laid out in split plot design with three replication. Treatments in main plot, the time of sowing includes before and after onset on monsoon and in sub-plot, the weed control methods includes PE pretilachlor-S 0.5 kg/ha, PE butachlor 1.5 kg/ha + 1 HW, POE fenoxaprop 60 g/ha or Almix 4 g/ha or tank mix of both, *Sesbania* (broadcast) + 2,4-D 0.5 kg/ha at 30 DAS, unweeded and weed free check. Among the different time of sowing, the lowest density and dry weight of weeds with higher WCE, yield and economic returns were recorded in after onset of monsoon than before onset of monsoon. Among the weed control methods, the lower density and dry weight of weeds were recorded in PE butachlor 1.5 kg/ha + 1 HW. The weed control efficiency, yield parameters, yield and economic returns were higher in the same treatment.

## P-46 Post-emergence herbicidal management of perennial sedge in banana

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*Cyperus rotundus* is a perennial from rhizomes and tubers that may reach 60-75 cm in height. *Cyperus rotundus* is reproducing by tubers and rhizomes, very little reproduction by seeds. Rhizomes and tubers occur on the same plants. It thrives in moist soils and is spread by flood water and cultivation. It is a common weed in agronomic and horticultural crops, nurseries. Tubers are round, ridged, initially white in color, eventually turning brown or black, and are sweet to the taste. It is not controlled by most commonly used herbicides. Hence, an on-farm trial was carried out in farmer's holding with an objective to evaluate the efficacy of herbicidal management of *Cyperus rotundus* in banana. Experiment was conducted in randomized block design with three replications. Treatments were glyphosate 41% SL (Roundup) 15 ml/l, glyphosate 71% G (Mera) 6 g/l, glyphosate 71% G (Mera) 9 g/l, metribuzin 70% WP (Sencor) 3 g/l and unsprayed control. Results revealed that *Cyperus rotundus* was effectively controlled by glyphosate 41% SL (Roundup)15 ml/l of water by reducing the weed density and weed dry weight considerably. The effect of granular formulation of glyphosate in containing *Cyperus rotundus* was better than metribuzin but less than liquid formulation of glyphosate. Yield of banana was higher in glyphosate 41% SL (Roundup) 15 ml/l of water and it was followed by glyphosate 71% G (Mera) 9 g/l of water. Although metribuzin 70% WP (Sencor) 3 g/l of water was effective in controlling *Cyperus rotundus* to certain extent, the yield of banana was fairly less due to moderate phytotoxicity of herbicide on banana. Gross return, net return and B:C ratio were higher with glyphosate 41% SL (Roundup) 15 ml/l of water, even though the cost of cultivation was higher.

## P-47 Post - emergence non selective herbicidal management of *Portulaca quadrifida* in banana

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*Portulaca quadrifida,Linn*. is an annual weed with small prostrate or sub-erect fleshy leaves with many brittle branches that root at the nodes, when they touch the ground; the nodes are clothed with long/hairs. It multiplies with seeds as well as vegetative fragments with inter-nodes. It is a common weed in garden land crops like banana, grapes, tapioca, cotton and chillies and other vegetable crops. Hence, an on-farm trial was carried out in farmer's holding with an objective to evaluate the efficacy of herbicidal management of *Portulaca quadrifida* in banana. Experiment was conducted in randomized block design and replicated thrice. Treatments were glyphosate 41% SL (Roundup) 15 ml/l, glyphosate 71% G (Mera) 6 g/l, glyphosate 71% G (Mera) 9 g/l, metribuzin 70% WP (Sencor) 3 g/l and unsprayed control. Results revealed that *Portulaca quadrifida* was effectively controlled by metribuzin by reducing weed density and weed dry weight. Compared to metribuzin, granular formulation of glyphosate was less effective in containing *Portulaca quadrifida.* Weed control efficiency of *Portulaca quadrifida* found to be higher in metribuzin 70% WP (Sencor) 3 g/l of water and it was followed by metribuzin 70% WP (Sencor) 3 g/l of water. Yield of banana was higher in glyphosate 41% SL (Roundup)15 ml/l of water and it was followed by glyphosate 71% G (Mera) 9 g/l of water. Although metribuzin 70% WP (Sencor) 3 g/l of water was effective in controlling *Portulaca quadrifida. T*he yield of banana was fairly less due to moderate phytotoxicity of herbicide on banana. Gross return, net return and benefit cost ratio were higher with glyphosate 41% SL (Roundup) 15 ml/l of water, even though the cost of cultivation was higher in this treatment.

## P-48 Bio efficacy of metamitron 70 SC and ethofumesate 50 SC in tropical sugarbeet

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Sugarbeet is the major biennial sugar producing tuber crop in the world. Weed is the major problem in sugarbeet production which affects the growth and yield of sugarbeet, considerably. The crop should be maintained weed free upto 75 days. The chemical method of weed management is more effective than the mechanical method because of less labour and cost requirements. Eventhough several herbicides are effective against weeds in sugarbeet, there is always a possibility of development of resistant of weeds for continuous use of same herbicide. Keeping this in view an experiment was conducted to evaluate new herbicides. The consisted of four doses of two herbicides (metamitron 70 SC 3.50, 7.00, 2.00 and 4.00 kg/ha and ethofumesate 50 SC 0.99, 1.98, 1.00 and 4.00 kg/ha), two doses of tank mix of above herbicides (0.50 + 0.98 and 1.0 + 0.98 kg/ha ethofumesate and metamitron, respectively) and were compared with PE pretilachlor 50 EC 0.50 kg/ha and unweeded control. First two doses of individual herbicides were sprayed in three splits at 2, 4 – 6 and 8 – 10 leaf stages of weeds. The new herbicides were not phyto toxic to sugarbeet. Lower total weed density and total weed dry weight, higher weed control efficiency at 45 DAS and higher root yield were recorded in PE pretilachlor 50 EC 0.50 kg/ha and metamitron 70 SC 7.00 kg/ha in three spilts.

## P-49 Chemical weed control in wheat

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Heavy infestation of weeds is one of the major constrains to successful cultivation of wheat. Under the present conditions of non-availability of labour during crop season and high cost involved therein, it has become extremely difficult to maintain crops free from weeds. Wheat being a closely spaced crop, mechanical/cultural weed control is often difficult to carry out. Moreover, in order to get desired degree of weed control, the operation has to be repeated but several times, manual operation tough effective becomes difficult due to the aforesaid facts. The present investigation was carried out to evaluate the comparative efficacy of metsulfuron methyl and 2,4-D applied alone and in combination, in terms of weed control and yield performance of wheat crop at Agronomy Farm, Dept. of Agronomy, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during 2007-08. Present investigation was carried out in Randomize Block Design with three replication and eight treatments having gross plot size with 8.0m x 1.8m and net 7.0m x 1.4m. Variety selected for this experiment was AKAW-3722. Sowing of wheat crop was done on 11$^{th}$ November, 2007 with spacing of 22.5cm. Hand weeding twice at 20 and 40 DAS resulted in maximum weed control efficiency and recorded significantly higher grain yield (42.07 q/ha). However, it was at par with treatment of pendimethalin PRE 500 g/ha + metsulfuron methyl POE 2 g/ha with 0.1% surfactant (40.00 q/ha) and pendimethalin PRE 500 g/ha + 2,4-D POE 500 g/ha (38.78 q/ha). GMR, NMR and B:C ratio showed similar trend. Hence, where labour is a problem, herbicide application proves an effective option in wheat crop.

## P-50 Control of broadleaf weeds in barley (*Hordeum vulgare* l.) with new herbicides

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A field experiment was conducted during *rabi* 2007-08 and 2008-09 at Punjab Agricultural University Ludhiana. Two new herbicides *viz*. carfentrazone-ethyl and metsulfuron were evaluated for their tolerance in barley crop and control of broadleaf weeds. Three barley varieties (VJM 201, PL 419 and PL 426 during 2007-08 and VJM 401, PL 426 and DWRUB 52 during 2008-09) in main plots and, carfentrazone-ethyl 0.015, 0.020, 0.025 kg/ha and metsulfuron 0.004 kg and 0.005 kg/ha, 2, 4-D 0.5 kg/ha (standard), 2 hand hoeing and unweeded control in sub plots were tested with three replications. VJM 201 and DWRUB 52 are two-rowed while PL 419 and PL 426 are six-rowed varieties. Carfentrazone and metsulufron were applied at 30 days and 2, 4-D at 40 days after sowing. Barley varieties exhibited statistically similar weed dry matter and barley grain yield during both the years. Among weed control treatments, carfentrazone and metsulfuron at the doses tested provided effective control of all the broadleaf weeds and reduced the weed dry matter significantly as compared to unweeded control. Both the herbicides were safe to the barley crop at the doses tested. Grain yield under these herbicides was at par with 2,4-D and 2 hand weeding but significantly higher than unweeded control during 2007-08 while the grain yield differences were not significant during 2008-09. It was concluded that metsulfuron 0.004 kg/ha and carfentrazone ethyl 0.015 kg/ha could safely be used for effective control of broadleaf weeds in barley.

## P-51 Evaluation of herbicides in summer irrigated cotton

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An experiment was conducted at Cotton Research Station, Srivilliputtur during 2004-05 to evaluate the herbicides in summer irrigated cotton. The experiment was laid out in RBD replicated thrice. The treatments included hand weeding twice (20 and 45 DAS), fluchloralin 1.0 kg/ha, trifloxysulfuron 5, 7.5 and 10 g/ha, galaxy 2 and 2.5 lit/ha. The test variety was SVPR 2. The weed flora consisted of *Cynodon dactylon, Cyperus rotundus, Trianthema portulacastrum, Euphorbia hirta* and *Cleome viscosa*. The results of the experiment revealed that at 30 DAS, hand weeding twice, galaxy 2 2.5 lit/ha controlled grass, sedge and *Trianthema portulacastrum* density. At 30 DAS, the weed DMP and at 60 DAS the weed density and weed DMP of grass, sedge and *Trianthema portulacastrum* were lower in hand weeding twice, galaxy 2 & 2.5 lit/ha, trifloxysulfuron 7.5, 10 g/ha. The yield attributes like boll number, boll weight and seed cotton yield were comparable in hand weeding twice (1215 kg), trifloxysulfuron 7.5 g/ha (1185 kg), galaxy 2 lit/ha (1185 kg) and galaxy 2.5 lit/ha (1163 kg). From these results it can be concluded that hand weeding twice on 20 and 45 DAS, trifloxysulfuron 7.5 g/ha and galaxy 2 & 2.5 lit/ha were found to be comparable and effective in controlling the weed growth of grass, sedge and *Trianthema portulacastrum* and improving the yield attributes and increasing the seed cotton yield in irrigated summer cotton.

## P-52 Performance of new pre and post emergent herbicide molecules against weeds in soybean (*Glycine max* L.)

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To evaluate the effect of new herbicide molecules, diclosulam 84 WDG as pre-emergence (PE) and haloxyfop 10 EC as post emergence (POE) application against weeds in soybean (cv.JS335), a field experiment was carried out in medium black soil (organic carbon-0.43%, available N-420 kg, $P_2O_5$-45.8 kg, $K_2O$-312 kg /ha and soil pH 7.8) during *kharif* 2008 at Agricultural Research Station, University of Agricultural Sciences, Dharwad, (Karnataka, India). The experiment was replicated thrice in completely randomized block design with treatments, Diclosulam at 18, 22, 26 g/ha, haloxyfop 75 and 100 g/ha, checks (quizalofop ethyl 15 EC 50 g/ha as POE, pendimethalin 30 EC 1 kg/ha as PE) and two hand weeding at 20 and 40 DAS. The crop was sown on 27$^{th}$ July 2008 with recommended agronomic practices (FYM 5t, 40:80:25 kg NPK per hectare). Soybean crop experienced well distributed rainfall from July to September (29 rainy days). Soybean seed yield was significantly increased with diclosulam at 22 g/ha (1880 kg/ha) and at 18 g/ha (1768 kg/ha) compared to quizalofop ethyl at 50 g/ha (1299 kg/ha). However, it was at par with haloxyfop at 75 g/ha (1758 kg/ha) and at100 g/ha (1684 kg/ha) and pendimethalin 1 kg/ha (1656 kg/ha) and two hand weeding at 20 and 40 DAS (1630 kg/ha). Weed control efficiency, harvest index and soybean growth and yield parameters followed the similar trend. Diclosulam 22 g/ha and haloxyfop 75 g/ha proved effective in minimizing the weeds and increasing the soybean seed yields.

## P-53 Studies on weed flora of okra and its management in the lateritic zone of West Bengal

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A survey of weed flora in okra growing areas of the lateritic zone of West Bengal conducted in summer 2007 revealed that 27 weed species under 13 families infested the crop. *Poaceae* was largest family with 4 species followed by *Asteraceae* with 4 species; *Cyperaceae, Amaranthaceae* and *Euphorbiaceae* with 3 species each; *Apiaceae* with 2 species and rest with one species each. Altogether 12 species had 'C' class frequency and their individual IVI ranged from 4.48 to 8.25. Another 12 species had 'D' class frequency and their IVI ranged from 8.05 to 20.26. Two species had 'E' class frequency and their IVI were as much as 33.33. Only one species had 'B' class frequency and IVI 3.03. *Cyperus rotundus* was recorded as the most dominant with IVI 42.01 followed by *Croton bonplandianum* with IVI 33.33 and *Trianthema portulacastrum* with IVI 20.26. Most of the farmers use mechanical method (hand weeding) to control weeds. Subsequently a field investigation was conducted in a Randomized Block Design with 8 treatments replicated thrice during summer 2008 at Bhedia, Burdwan to find out a suitable management practice of dominant weed flora of okra. The application of pendemethalin and fluchloralin alone and integrated with one hoeing controlled all categories of weeds effectively. Pendimethalin 0.75 kg/ha integrated with one hoeing at 40 DAS recorded maximum yield of 9435 kg/ha followed by fluchloralin 0.75 kg/ha + hoeing (9417 kg/ha) and three hoeing operations (9415 kg/ha). In unweeded control 79.4 % loss in yield was recorded as compared to that of 0.75 kg pendimethalin + one hoeing.

## P-54 Influence of crop geometry, intercropping and topping on weed dynamics and productivity of baby corn

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Field experiments were conducted during the *kharif,* 2006 and 2007 at Tamil Nadu Agricultural University, Coimbatore to study the effect of crop geometry and topping on weed dynamics and productivity of baby corn based intercropping systems. The main plot treatments comprised of two factors *viz.,* crop geometry (60 x 20 cm and 75 x 16 cm) and intercropping systems (baby corn alone, baby corn + fenugreek (greens), baby corn + fodder cowpea). Four topping practices (detasseling alone, topping beyond 9$^{th}$ internode, topping beyond 10$^{th}$ internode and topping beyond 11$^{th}$ internode) were assigned to sub plots. The results revealed that the crop geometry levels did not alter the weed population but altered the weed total dry matter production (TDMP) and weed smothering efficiency (WSE). Baby corn raised at 75 x 16 cm crop geometry registered lower TDMP of weeds and higher WSE as compared to 60 x 20 cm during both the years. Intercropping systems exerted significant influence on weed population and TDMP over two years of study. At 25 DAS, higher WSE was noticed with baby corn + fenugreek than baby corn intercropped with fodder cowpea. However, baby corn + fodder cowpea had the maximum WSE at 45 DAS. Topping practices did not influence the weed density, TDMP and WSE because the treatments were imposed only after 45 DAS. Baby corn raised at 75 x 16 cm produced higher yield over 60 x 20 cm spacing. Intercropping systems did not have positive influence on yield of baby corn. Higher green cob yield was obtained with topping beyond 10$^{th}$ internode.

## P-55 Evaluation of herbicides for Bt cotton

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Field experiment was conducted during winter irrigated season at TNAU, Coimbatore. The test hybrid was Bt Bunny. The experiment was conducted in RBD with three replication, ten different treatment combination were tried. Among the different treatment maximum plant height was recorded in galaxy at the rate of 2.5 lit/ha. Boll number and boll weight were higher weed free check and it was on pare with hand weed twice and trifloxysulfuron 5 g/ha. Weed free check recorded significantly higher seed cotton yield of 1419 kg/ha. It was followed by hand weeding twice (1215 kg/ha) which was on par with trifloxysulfuron 7.5 g/ha. Among the weed management practices, the grass weed DMP was lower in galaxy 2.5 l/ha and it was on par with trifloxysulfuron 10 g/ha, galaxy 2 lit./ha, trifloxysulfuron 7.5 g/ha and hand weed twice. Sedge weed DMP was lower in galaxy 2.5 lit/ha and it was on par with fluchloralin 1.0 kg/ha, galaxy 2.0 lit/ha, trifloxysulfuron 10.0 g/ha followed by trifloxysulfuron 7.5 g/ha and hand weed twice. *Trianthema* weed DMP was lower in galaxy 2.5 lit/ha and it was on par with Trifloxysulfuron 10.0 g/ha, galaxy 2.0 lit./ha and trifloxysulfuron 7.5 g/ha. Hand weed twice was less effective on *Trianthema* weed DMP compared to other weed management practices.

## P-56 Efficacy of herbicides on weeds and productivity of wheat

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A field experiment was conducted during *rabi* seasons 2006-07 and 2007-08 to study the efficacy of herbicides on weeds and yield of wheat at Research Farm College of Agriculture, Gwalior. The soil of experimental field was sandy clay loam in texture, low in organic carbon and available nitrogen, medium in available phosphorous and potassium with neutral in reaction (pH 7.6). The ten treatments comprising of isoproturon 1000 and 2000 g/ha, clodinofop 60 and 120 g/ha, fenoxaprop 120 and 240 g/ha, sulfosulfuron 25 and 50 g/ha among weed free and weedy check, were tried in a randomized block design with four applications. All the herbicides were applied in saturated soil moisture as per protocol of application time *i.e.* 25 DAS. Wheat variety MP 4010 was sown at 22.5 cm row spacing, using seed rate of 125 kg/ha on 2$^{nd}$ fortnight of November during both years. *Chenopodium album*, *Spergula arvensis*, *Anagallis arvensis, melilotus indica* were the broad leaf weeds and *Phalaris minor*, *Cynodon dactylon* and *Cyperus rotudus* the narrow leaf weeds among the major weed species in the experimental site. All the weed control measures lead to significant reduction in weed density and dry weight of weed as compared to weedy check except fenoxaprop. There was significant decrease in weed population and weed dry matter accumulation with the application of sulfosulfuron and isoproturon as compared to weedy check and were statistically at par with weed free treatment, resulting in higher grain yield and weed control efficiency. Maximum weed control efficiency (93.1 %) and grain yield (5094 kg/ha) were recorded with sulfosulfuron followed by isoproturon and Clodinofop. Thus post emergence application of sulfosulfuron 25 g/ha, isoproturon 1000 g/ha and clodinofop 60 g/ha were proved more effective for controlling broad and narrow leaf weeds with increased grain yield of wheat crop.

## P-57 Studies on the effect of herbicides on kharif rice weed management in the lateritic belt of west bengal

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A field experiment on transplanted IR36 rice was conducted during *kharif* 2007 and 2008 at the Agricultural Farm, Institute of Agriculture, Visva-Bharati, Sriniketan, with three replications of 14 treatments under RBD on clay-loam, slightly acidic (pH 6.0) soil having medium organic C (0.73%) and medium to low fertility. The field was supplied with 80:60:60 kg/ha N: $P_2O_5$: $K_2O$. Rice crop was transplanted on July 29, 2007 and July 24, 2008 and harvested at 91 and 90 DAT. Herbicides like PSE (pyrazosulfuron ethyl) 20 g, butachlor 1250 g and anilofos 400 ml/ha were applied at 4 DAT. Almix ( metsulfuron methyl 10 % + xhlorimuron ethyl 10 %) at 4 g and GOD H002 at 15, 20, 30, 40, 60 and 80 g/ha were applied at 15 DAT and the macerated green leaves of herbal materials like *Annona squamosa* and *Vitex negundo* at 200 kg/ha were applied at 6 DAT. The field was infested with sedge (12.31 % and 41.28 % by *Cyperus iria, C. difformis* and *Fimbristylis miliacea*), broad leaf (76.75 % and 40.33 % by *Hydrolea zeylanica, Ludwigia parviflora, Marsilea quadrifolia, Sphenoclea zeylanica, Monochorea vaginalis* and *Sagittaria sagitifolia*) and grass (10.94 % and 18.40 % by *Echinochloa colona* and *E. crus-galli*) weeds belonging to 11 species under eight families, having the highest population of 141.66/$m^2$ of broadleaves during 2007 and 80.74/$m^2$ of sedges at 20 DAT during 2008 and the highest biomass of 4.54 g/m and 116.43 g/m at 40 DAT during both the years respectively. The predominant species was *Hydrolea zeylanica* during both the years. Infestation of weeds reduced grain yield of rice by 20.73 % (0.79 t/ha) in 2007 and 32.53 % (1.22 t/ha) in 2008, respectively. All the treatments were effective with variable results in weed management. Weed management saved 17.17 and 24.55 % grain yields in the first and the second year respectively. GOD H002 at 20 and 30 g/ha applied at 15 DAT were the better treatments in effectively controlling weeds and producing higher rice grain yield.

## P-58 Effect of dose and time of orthosulfamuron application on weeds and yield of transplanted rice

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Weeds are the major biotic constraints responsible for low productivity of rice. Reduction in grain yield due to unchecked weed infestation in transplanted rice varies between 29 to 63 per cent. Butachlor, pretilachlor and anilofos are most commonly used herbicides for weed control in transplanted rice. However, continuous and indiscriminate use of these herbicides for a long time may result in the build up of problematic weeds and also development of herbicide resistance in weeds. Hence, it is imperative to evaluate other herbicide molecules, for effective control of weeds and to ensure better crop yield. A field experiment was conducted during *kharif* season of 2005 to find out the optimum dose and time of orthosulfamuron application in transplanted rice. Orthosulfamuron at 75, 120 and 150 g/ha applied at 6 days after transplanting gave excellent control of grass weeds density. The *Cyperus difformis* density was lower in orthosulfamuron at 150 g/ha applied at 6 days after transplanting. Broad leaved weeds density was lower in all the doses of orthosulfamuron applied at 3 days after transplanting and higher doses of 120 and 150 g/ha application at 6 days after transplanting was on par with butachlor 1.25 kg/ha applied at 3 days after transplanting. Higher grain yield of 5736 kg/ha was recorded in butachlor, which was comparable with orthosulfamuron at 75, 120 and150 g/ha applied at 3 days after transplanting and 120 and 150 g/ha applied at 6 days after transplanting.

## P-59 Bioefficacy of imazethapyr and chlorimuron-ethyl in clusterbean and their residual effect on succeeding rabi crops

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The bioefficacy and phytotoxicity of imazethapyr and chlorimuron in cluster bean and their residual carryover on succeeding *rabi* crops was studied at CCS HAU Hisar during *kharif* 2006-07 and 2007-08.The experimental field was dominated with *Digera arvensis*, *Trianthema portulacastrum*, *Physallis minima*, *Corchorus olitorius*, *Solanum nigrum, Tribulus terrestris* and *Cyperus rotundus*. Post emergence application of chlorimuron at 6 & 8 g/ha although provided excellent (90-92 %) control of weeds but caused 20-30 % injury to cluster bean resulting in severe yield reductions. PPI, PRE. and PoE (21-28 DAS) application of imazethapyr provided season long control (85-95%) of weeds in cluster bean. Post emergence application of imazethapyr at 80 and 100 g/ha although caused mild injury to cluster bean in terms of yellowing of leaves and stunted crop growth but it diminished with in 3 weeks and had no yield penalty. Maximum seed yield (1424 kg/ha) of cluster bean was obtained with pre-emergence use of imazethapyr at 100 g/ha which was similar to weed free check but during 2007, PRE usage of imazethapyr at 80 g/ha gave maximum seed yield (1720 kg/ha) which was similar to its application at 80 & 100 g/ha as pre-emergence, PPI or post emergence at 21 DAS. Chlorimuron and imazethapyr irrespective of dose and time of application did not cause any injury to wheat, barely and chickpea planted as succeeding crop after harvest of cluster bean but both these herbicides caused severe injury to mustard.

## P-60 Bioefficacy of pinoxaden (Axial 5 EC) against grassy weeds in wheat and its residual effect on succeeding crops

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To study the bioefficacy and phytotoxicity of new herbicide pinoxaden against isoproturon resistant population of *P. minor* in wheat and its residual effect on succeeding rice and sorghum crops, field experiments were conducted at Chaudhary Charan Singh Haryana Agricultural University, Hisar during winter season of 2006-07 and 2007-08 and at Barhi (Ambala) and Chanarthal (Kurukshetra) during *rabi* 2007-08 and 2008-09, respectively. Little seed canary grass (*Phalaris minor* Retz.), the dominant grassy weed was very effectively controlled by post emergence (35 DAS) application of pinoxaden at 45-50 g/ha. At Hisar, pinoxaden at 45 g/ha provided 98.7 & 100 % control of *P.minor* during 2005-06 and 2006-07, respectively which was at par with clodinafop at 60 g/ha, sulfosulfuron and more than fenoxaprop. Grain yield of wheat with use of pinoxaden at 45 g/ha was 4450 and 4650 kg/ha during first and second year of experimentation, which was significantly higher than its lower doses of 35 and 40 g/ha but statistically at par with its higher dose of 50 g/ha and already recommended herbicides clodinafop-propargyl and sulfosulfuron. Post emergence use of pinoxaden at 50 g/ha was able to control clodinafop resistant population of *P.minor* at farmers fields in Barhi (Ambala) and Chanarthal ( Kurukshetra). Results of 13 and 20 on farm trials conducted during 2007-08 and 2008-09, respectively in various districts of state reveal that pinoxaden at 50 g/ha gave 10.6 and 9.6% higher grain yield over recommended clodinafop at 60 g/ha. No carry over effect of this herbicide at any of doses tested was observed on succeeding sorghum and rice crops grown in succession after wheat.

**P-61**

# Effect of chemical weed management on the morpho-physiological parameters of soybean

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A Field experiment was carried out in Central Research Station, OUAT, Bhubaneswar during spring season of 2007-08 to assess and to compare the effect of pre-emergence herbicides like pendimethalin (400 g/ha) and oxyfluorfen (15 g/ha ) and panteru (40 g/ha), their tank mix application (9 + 40, 18 + 80) with that of hand weeding on growth and development of soybean cv. JS 355 (*Glycine max* (L.) Merill) and its associated weeds. The experiment was laid out in a randomized block design with three replications. The study revealed that seedling emergence was more in pendimethalin than oxyfluorfen. The dominant weeds were *Dactyloctenium aegyptium, Digitaria ciliaris, Echinochloa colona, Cynodon dactilon, Phyllanthus niruri* and *Cyperus rotundus*. Both pre and post-emergence herbicides proved better in reducing the weed density with the quizalofop-P-ethyl, oxyfluorfen and pendimethalin having edge over other herbicide combinations. Nodule number, dry weight leg-haemoglobin content in nodules and chlorophyll content in leaves were drastically higher in quizalofop-p-ethyl followed by oxyfluorfen and kloben + pantera (18+80 + Surf), the lowest more often being registered in weedy check plot. Dry matter of root, shoot, shoot to root ratio, RGR, CGR, LAI and dry matter at harvest and the harvest index were significantly higher in quizolofop-p-ethyl treatment, although there was little inconsistency observed in the few parameters cited above at different sampling stages. The yield and its attributes varied significantly amongst various treatment combinations and substantial values were obtained in quizalofop-p-ethyl followed by oxyfluorfen in respect of these parameters. The reduction in seed yield due to various weeding treatment was to the tune of 30.6% to 60.4 % compare to control. But the nitrogen and crude protein content in seed were higher in weeding check. From the present investigation it was concluded that quizalofop-p-ethyl surpassed the new molecules of post emergence herbicides alone and their combinations as well in respect of yield and physiological parameters. Further oxyfluorfen were superior to pendimethalin in respect of same parameters.

## P-62 Climber weed (*Ipomoea* spp.) management in sugarcane

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Major climber weeds namely, *Ipomoea pes-tigridis* and *I. sepiaria* along with other climbers like *Coccinia* sp causes lodging, yield loss and hindrance in harvesting sugarcane. To evaluate the best method of management of these weeds, experiments were conducted in weed infested ratoon harvested farmer's field during 2003-06 with rice followed by mid and special season sugarcane. The influence of weed management practices in rice on the succeeding sugarcane was studied along with the effect of pre and post emergence herbicides in sugarcane on the late emerging problematic climbers. The treatments in rice *viz*., the pre emergence application of chlorimuron ethyl + metsulfuron methyl (1:1) + hand weeding on 40 DAT, butachlor + hand weeding on 40 DAT and HW twice on 20 and 40 DAT and in sugarcane *viz*., pre-emergence atrazine and pre- emergence metribuzin were applied alone at 1.0 kg/ha along with combinations of post- emergence 2, 4 –D and post-emergence directed spray of glyphosate. Treatments were replicated thrice in split plot design. Results revealed that weed management practices in rice had no significant influence in reducing the weeds in subsequent sugarcane crop as all the three treatments were comparable with each other. In sugarcane the broad leaved weeds along with climbers were effectively controlled at 90, 150 and 210 DAP and up to harvest by pre emergence metribuzin + post emergence 2, 4-D while the least effective was with pre emergence atrazine 1.0 kg/ha (farmer's practice) in both the seasons. Better performance here was due to blanket spray of 2, 4-D which gave complete control of climbers and broad leaved weeds that germinated along with the cane base. Pre emergence application of atrazine along with the post emergence spray of 2, 4-D was also equally effective.

## P-63 Weed management and intercropping practices for cassava

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Field experiments were conducted at Agricultural College & Research Institute, TNAU, Madurai during *kharif* 2003-2005 to evaluate the weed management and intercropping practices for cassava. The experiment was laid out in split plot design replicated thrice. The test variety was CO 4. Main plot treatments included intercropping of groundnut, vegetable cowpea, blackgram, groundnut followed by blackgram, vegetable cowpea followed by blackgram. Sub plot treatments consisted of weed management practices such as pendimethalin + HW on 4$^{th}$ week, alachlor + HW on 4$^{th}$ week, fluchloralin + HW on 4$^{th}$ week, HW twice on 4$^{th}$ & 15$^{th}$ weeks, HW thrice on 4$^{th}$, 12$^{th}$ & 20$^{th}$ weeks and HW four times on 4$^{th}$, 8$^{th}$, 12$^{th}$ & 20$^{th}$ weeks. The weed flora consisted of *Cynodon dactylon, Cyperus rotundus, Euphorbia hirta, Trianthema portulacastrum* and *Achyranthes aspera*. The results showed that among intercrops, vegetable cowpea effectively suppressed all categories of weeds. Similarly, among pre emergence herbicides fluchloralin effectively checked the weeds. The treatment combination of cassava intercropped with vegetable cowpea and pre emergence application of fluchloralin 0.75 kg/ha + one HW on 4$^{th}$ week after planting effectively controlled the weed growth of grass, sedge and BLW and improved the growth parameters like plant height, No. of branches per plant, No. of leaves per plant, dry matter production; enhanced the yield attributes like tuber length, tuber circumference, No. of tubers per plant, tuber weight and increased the tuber yield of cassava. This treatment combination also registered higher economic returns.

## P-64 Perennial weed (*Cyperus rotundus*) management in sugarcane

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In recent past, chemical control of weeds by using the herbicide, atrazine at 1.75 kg/ha has been recommended and cane farmers started adopting this practice on wider scale. Atrazine, as pre-emergence spray controls most of the broad leaved as well as grass weeds that germinated from seeds, but it has no effect on the perennial weeds (sedges and grasses). So, metribuzin, was tried in sugarcane for pre-emergence control of weeds. The influence of weed management practices in rice *viz*., the pre emergence chlorimuron ethyl + metsulfuron methyl (1:1) + hand weeding 40 DAT, butachlor + hand weeding 40 DAT and HW twice on 20 and 40 DAT on the succeeding sugarcane along with study of pre and post emergence herbicides on sugarcane weeds the experiment was formulated and conducted in farmer' field during mid and special season of 2003-06. Among the pre-emergence herbicides, metribuzin was relatively better in controlling weeds compared to atrazine. When the crop growth advanced from 60 to 90 DAP the spraying of glyphosate as post emergence directed spray (PtEDS) and 2, 4-D as post emergence blanket spray around 60 DAP, superseded the remaining treatments with no post-emergence herbicide application by reducing weed density. The same effect was pronounced by these post emergence herbicides up to the end of crop growth. The pre emergence application of metribuzin along with the post emergence directed spray application of glyphosate was effective in controlling the weeds like sedges, grasses and total weeds in sugarcane crop. The pre emergence application of atrazine along with the post emergence directed spray of glyphosate is also equally effective. Higher net return and B:C ratio were obtained with the PE chlorimuron ethyl + metsulfuron methyl (1:1) + HW on 40 DAT in rice followed by PE metribuzin + PtEDS glyphosate and PE atrazine + PtEDS glyphosate in sugarcane, during both the crop seasons.

## P-65 Bio efficacy evaluation of imazomox + imazethapyr in weed management in Soybean

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Field experiments were conducted during summer and *kharif* seasons, 2000 to evolve a suitable herbicide and its dose for soybean under irrigated conditions on a sandy clay loam soil at Agricultural College and Research Institute, Madurai. The treatments consisted of herbicides imazomox (Raptor), imazethapyr (Pursuit) and imazomox + imazethapyr (Odyssey) and were applied as early post and tested in randomized block design with three replications. Results revealed that the application of imazomox + imazethapyr (Odyssey) 1.0 l/ha (FP) followed by imazomox + imazethapyr (Odyssey) 0.8 l/ha (FP) gave excellent control of broad leaved weeds, grasses with better weed control efficiency, lower weed index, reduced dry matter production and reduced nutrient removal by weeds. These treatments increased the plant height, number of branches per plant, leaf area index, crop dry matter production, crop nutrient uptake, number of pods per plant, number of seeds per pods, test weight, grain and haulm yield of soybean. They also recorded the highest gross return, net return per rupee invested and net returns. These above best treatments were followed by imazomox 40 g/ha. Thus, imazomox + imazethapyr (Odyssey) 1.0 or 0.8 l/ha (FP) is an effective herbicide in control of weeds in soybean.

## P-66 Influence of herbicide imazethapyr + pendimethalin in irrigated soybean

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Field experiments were conducted during summer and *kharif* seasons, 2000 to evolve a suitable herbicide and its dose for soybean under irrigated conditions on a sandy clay loam soil at Agricultural College and Research Institute, Madurai. The treatments consisted of herbicides imazethapyr (Pursuit), pendimethalin (Stomp) and imazethapyr + pendimethalin (Pursuit plus) where imazethapyr (Pursuit) was applied as early post and also a Pre Plant Incorporation (PPI) and others as PPI alone in randomised block design with three replications. The results of the experiment revealed that imazethapyr + pendimethalin 3.0 l/ha followed by Pursuit plus 2.5 l/ha recorded the best control of all weed flora namely grasses and broad leaved weeds along with higher weed control efficiency, lower weed index, reduced dry matter production and reduced nutrient removal by weeds. These also increased the plant growth character such as plant height, number of branches per plant, leaf area index, crop dry matter production, crop nutrient uptake and yield attributing characters like number of pods per plant, seeds per pod, test weight, grain yield and haulm yield. The above treatments were followed by imazethapyr 100 g/ha as early post and imazethapyr 100 g/ha as pre-plant incorporation and was significantly better than pendimethalin (Stomp)1.0 kg/ha as pre-plant incorporation and these were comparable with each other. The economic analysis also revealed that the above discussed best treatments recorded significantly higher gross return, net return and net return per rupee invested. Hence it can be concluded that imazethapyr + pendimethalin 3.0 or 4.0 l/ha is the effective herbicide in controlling weed species of soybean crop followed by imazethapyr 100 g/ha as early post or pre-plant incorporation.

## P-67 Effect of combination herbicide imazaquin + pendimethalin on weeds and soybean

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Field experiments were conducted during summer and *kharif* seasons, 2000 to evolve a suitable herbicide and its dose for soybean under irrigated conditions on a sandy clay loam soil at Agricultural College and Research Institute, Madurai. The treatments consisted of herbicides imazaquin (Scepter), pendimethalin (Stomp) and imazaquin + pendimethalin (Squadron) and all were applied as pre-plant incorporation and tested in randomized block design with three replications. Results revealed that application of imazaquin + pendimethalin (Squadron) 4.0 l/ha (FP) (FP) followed by imazaquin + pendimethalin (Squadron) 3 l/ha (FP) gave excellent control of broad leaved weeds, grasses with better weed control efficiency, lower weed index, reduced dry matter production and reduced nutrient removal by weeds. The growth characters like plant height, number of branches per plant, leaf area index, crop dry matter production, crop nutrient uptake and yield attributing like number of pods per plant, seeds per pod, test weight, grain yield and haulm yield were increased with the above treatments and were followed by imazaquin (Scepter) 150 g/ha which was significantly better than pendimethalin (Stomp) 1.0 l/ha (FP). The above best treatments also recorded the highest gross return, net return and net return per rupee invested. Thus, imazaquin + pendimethalin (Squadron) 4.0 or 3.0 l/ha (FP) effective in control of weeds in soybean followed by imazaquin + pendimethalin (Scepter) 150 g/ha.

## P-68 Evaluation of weed management practices in system of rice intensification

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Field experiment was conducted at Agricultural College and Research Institute, Madurai during *rabi* 2008 to evaluate the different weed management practices under system of rice intensification. The experiment was laid out in RBD with treatments *viz*., hand weeding (HW) twice on 25 & 45 DAT ($T_1$); pretilachlor 0.45 kg/ha on 3 DAT + HW on 45 DAT($T_2$); pretilachlor 0.45 kg/ha on 3 DAT + mechanical weeding (MW) on 45 DAT($T_3$); pretilachlor 0.45 kg/ha on 3 DAT + MW on 25 & 45 DAT($T_4$); MW thrice on 10, 25 & 45 DAT($T_5$); MW four times on 10, 20, 30 and 40 DAT($T_6$); almix 20 g/ha on 3 DAT + MW on 25 DAT($T_7$); almix 20 g/ha on 3 DAT + MW on 25 & 45 DAT($T_8$); almix 20 g/ha on 15DAT + MW on 25 DAT( $T_9$); unweeded check($T_{10}$). The total weed population at 40 DAT was found lowest (18.7/$m^2$) in pre-emergence application of pretilachor 0.45 kg/ha+ two rotary weeding on 25 and 45 DAT($T_4$). This was followed by pre-emergence application of almix 20 g/ha on 3 DAT *fb* two rotary weeding on 25 and 45 DAT ($T_4$). The weed dry matter production at 40 DAT was minimum (30.0 kg/ha) in pre-emergence application of pretilachlor 0.45 kg/ha on 3 DAT *fb* two rotary weeding on 25 and 45 DAT ($T_4$) which was on par with the pre-emergence application of Almix 20 g/ha on 3 DAT *fb* two rotary weeding on 25 and 45 DAT ($T_8$). Application of pretilachlor 0.45 kg/ha on 3DAT + MW twice on 25 & 45 DAT recorded excellent control on the broad spectrum of weeds *viz*., grasses , sedges and broad leaved weeds followed by Almix 20 g/ha on 3 DAT + MW on 25 & 45 DAT. The weed control efficiency and weed control index were also higher in the above said treatments. The higher grain (9061 kg/ha) was recorded in the application of pretilachlor 0.45 kg/ha on 3 DAT+ MW twice on 25 & 45 DAT ($T_4$) which was comparable with the Almix 20 g/ha on 3DAT+ MW twice on 25 &45 DAT ($T_8$).

## P-69 Management of *Orobanche* in tobacco

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A field experiment was carried out during 2005-2006, 2006-07 and 2007-08 on young alluvial calcareous sandy loam soil at Crop Research Centre of Rajendra Agricultural University, Bihar, Pusa with an objective to find out the effective weed management practices for *Orobanche* in tobacco and carry over effect of soil solarization along with different herbicides on economic feasibility. The results revealed that *Orobance* infestation under non solarized condition showed earlier emergence in tobacco than the solarized condition and herbicidal treatments delayed the infestation duration, whereas, in solarized condition under non-chemical situation, slight delay in *Orobance* emergence was observed. Further herbicidal treatments under solarized condition also shifted the weed emergence upto five days later in comparison to non-solarized condition. The tobacco growth indices *viz.* plant height, leaf length, leaf width, leaf area index and nicotine content in tobacco leaves showed higher values in herbicidal treated plots than non-herbicidal treated plots. Solarized treated plots showed higher value of crop growth and nicotine content in leaves than the non-solarized condition. The pH value increased slightly in non-solarized plots than the solarized plots which impticate the better release of phosphorus and potash under solarized condition.

## P-70 Studies to evaluate the effectiveness of new herbicides for transplanted rice ecosystem

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Herbicide application is a common practice to control weeds in rice cultivation under rainfed and irrigated conditions. A field trial was conducted to evaluate the effectiveness of new herbicides for transplanted rice, during *kharif* 2005-06 under randomized block design (RBD), replicated thrice in wetland soils in Coimbatore centre at Department of Rice, Tamil Nadu Agricultural University under AICRIP (All India Co-ordinated Rice Improvement Project) programme. Every year new molecules of herbicides from Directorate of Rice Research, Hyderabad are being evaluated at Coimbatore centre for irrigated transplanted lowland rice ecosystem Rice, under AICRIP programme at Coimbatore. During *kharif* 2005-06 chemical herbicides *viz*., butachlor (Machete) as standard check were compared with pretilachlor (0.500 kg/ha and 0.750 kg/ha) at 3-5 DAT, bensulfuron methyl (0.05 kg/ha and 0.06 kg/ha) at 20-25 DAT, triasulfuron (0.006 kg/ha) at 5-7 DAT and 12-15 DAT and combination of triasulfuron + pretilachlor at 5-7 DAT at lower and higher dose were compared, with two hand weeding, unweeded control and weed free condition under irrigated transplanted rice ecosystem in CO-47 rice variety. The results were statistically significant. Among the different combination of treatments, the best combination was found to be triasulfuron + pretilachlor at 20 WSG + 50 EC 0.009 + 0. 005 kg/ha applied at 5-7 DAT recording higher grain yield of 5475 kg/ha with B.C. ratio of 1.79. The details of the experiment and the results obtained has been discussed in this paper.

## P-71 Evaluation of herbicides in summer irrigated cotton

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Bio efficacy of trifloxysulfuron and Galaxy (clomozone 15% + pendimethalin 30% combination product) was evaluated in irrigated cotton (SVPR 2). The treatment were unweeded check ($T_1$), weed free ($T_2$), hand weeding twice ($T_3$), fluchloralin 1.0kg/ha ($T_4$), trifloxysulfuron 5.0g/ha ($T_5$), trifloxysulfuron 7.5g/ha ($T_6$), trifloxysulfuron 10.0g/ha ($T_7$), Galaxy 2.0 litres/ha ($T_8$) and Galaxy 2.0 litres/ha ($T_9$). The predominant weeds were *Echinochloa colona* and *Dactyloctenium aegyptium* in grasses, *Cyperus rotundus* in sedges and *Trianthema portulacastrum* in broad leaved weeds. The results revealed that application of Trifloxysulfuron at 10.0 g/ha as early post emergence herbicide (20 DAS) in summer irrigated cotton resulted in phytotoxicity. However, trifloxysulfuron at 7.5 g/ha was safe to cotton and also effective in controlling weeds. Performance of Galaxy as pre-emergence herbicide at 2.0 and 2.5 l/ha was effective against weeds without phytotoxicity symptoms. Among the weed control methods, weed free check registered lower weed population and weed dry matter and was on a par with pre-emergence application of galaxy 2.5 litre/ha. Weed free check recorded taller plants (61.1 cm), monopodia/plant (1.07), sympodia/plant (11.2), bolls/plant (10.1), boll weight (3.35 g) and kapas yield (1419 kg/ha) which was comparable with hand weeding, trifloxysulfuron 7.5 g/ha and galaxy 2.0 litre/ha. B:C ratio was highest with hand weeding and was followed by galaxy 2.0 l/ha. Either pre-emergence application of galaxy 2.0 l/ha or early post emergence application of trifloxysulfuron 7.5 g/ha can be recommended for effective controlling of weeds in summer irrigated cotton.

## P-72 Evaluation of bioefficacy of oryzalin in combination with glyphosate for weed control in grapes.

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A field experiment was conducted to evaluate the different doses of new herbicide oryzalin (XL 40 SC) in combination with glyphosate for weed control in grapes at Grape research station, Rajendranagar, Hyderabad during *kharif* 2007. The experiment was laid out in Randomized Block design with four replications. The different treatments include oryzalinat 2.5, 5.0, 7.5 and 10.0 l/ha alone and oryzalin at 5 l/ha + glyphosate at 2.5 and 5.0 l/ha and oryzalin at 7.5 l/ha + glyphosate at 2.5 and 5.0 l/ha; glyphosate at 2.5 and 5.0 l/ha along with unweeded control. The dominant weed flora of the experimental filed was *Portulaca oleraceae, Trianthema portulacastrum, Legasca mollis, Corchorus* spp., *Commelina benghalensis* and *Parthenium hysterophorus*. The results indicated that lowest weed dry matter and higher weed control efficiency was recorded with oryzalin at 7.5 l/ha in combination with glyphosate at 5.0 l/ha which was significantly superior to rest of the treatments except oryzalin at 5.0 l/ha in combination with glyphosate at 5.0 l/ha . The results also indicated that oryzalin alone at any level of application did not show any influence in reducing the weed biomass, but in combination with glyphosate resulted in drastic reduction in weed dry matter. Glyphosate alone resulted in lower weed dry matter indicating that it could control weeds effectively on compared to oryzalin alone. The grape yield recorded revealed that significantly higher grape yield was recorded with oryzalin 7.5 l/ha + glyphosate 5.0 l/ha which was significantly superior to oryzalin alone at all the doses and unweeded control while it was on par with the yield obtained from oryzalin + glyphosate (5.0 +5.0 l/ha) oryzalin + glyphosate (7.5 + 2.5 l/ha) and glyphosate alone at 2.5 l/ha and 5 l/ha.

## P-73 Direct effect of herbicides on gram and residual effect on succeeding urd crop

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A field experiment was conducted during *rabi* 2007-08 at Student's Instructional Farm of this university. Four herbicides viz pendimethalin, alachlor, isoproturon and metribuzine with recommended ( x) and double of recommended (2x) ware compared with control in randomized block design with three replications. The experimental field was neutral in pH, normal in salt concentration, low in organic carbon, medium in available phosphorus and available potash. Gram crop was sown on 16.11.2007 and herbicides were sprayed on 17.11.2007 as pre-emergence treatments. Number of plants/$m^2$ and plants height at 30 DAS, Plant height dry weight/plant and yield were recorded at harvest stage. Results revealed that application of pendimethalin (2kg/ha) and alachlor (1.5 kg and 3 kg/ha) decreased the gram yield significantly. Metrubuzin persisted upto crop harvest at both the levels. There was no residual effect of any herbicides on succeeding urd crop in respect of plant height and no. of plants at 30 DAS and grain yield.

# P-74 Effect of levels and time of application of herbicides on growth, yield and weed control efficiency under direct drilled rainfed rice ecosystem

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The experiment was conducted at Instructional Farm of Indira Gandhi Agricultural University, Raipur (Chhattisgarh), during *kharif* 2005 to find out the effect of herbicides on the growth and yield of rice, nutrient uptake by rice and weeds, economics and studies on weed dynamics. The twelve weed management treatments were undertaken which comprised of pre-planting incorporation at different levels of thiobencarb 0.937 kg/ha, 1.250 kg/ha, 1.562 kg/ha, and butachlor at 1.562 kg/ha, pretilachlor at 0.450 kg/ha and all three levels of thiobencarb 3 DAS as pre-em. while thiobencarb at 0.937 kg/ha, at 1.250 kg/ha, at 1.562 kg/ha at 6 DAS and unweeded control were laid out in randomized block design with three replications. Rice cultivar "Poornima" was grown as test crop. Rice was sown in rows at 20 cm apart with a seed rate of 80 kg/ha on 4th July, 2005 by tractor drawn seed cum fertilizer drill and harvested on 12th October, 2005. The crop was fertilized with 60:40:20 kg N, P and K/ha respectively.

Results revealed that application of Pretilachlor at0.450 kg/hasignificantly icreased the plant population, dry matter of rice, effective tillers, , panicle weight, test weight, grain and straw yield. It also reduced the weed density and weed dry weight ,significantly. However, application of Thiobancarb at 1.562 kg/ha at 3 DASalso resulted in at par growth and yield attributes. The weed control efficiency was also higher under application of Pretilachlor at 0.450 kg/ha.

Unweeded plot of the experiment was infested dominantly with *Echinochloa colonum*, *Eleunsine indica*, *Ischaemum regosum*, *Cyperus irria*, *Cyperus difformis*, *Fimninstylis miliacea*, *Phyllanthus niruri*, *Eclipta alba etc.M*minimum weed density and dry weight of weeds were recorded under application of pretilachlor at 0.450 kg/ha followed by thiobencarb at 1.562 kg/ha respectively. dry. Weed control efficiency was maximum under application of pretilachlor at 0.450 kg/ha (79%) followed by butachlor at 1.562 kg/ha (76%) applied as pre-emergence.. Application of thiobencarb at 1.562 kg/ha as pre. em. effectively controlled the grassy weeds, whereas broad leaf weeds and sedge were effectively controlled by pretilachlor. applied at 0.450 kg/ha and butachlor at 1.562 kg/ha as pre-emergence. The nutrient uptake by weeds was registered minimum when thiobencarb at 1.562 kg/ha was applied at 6 DAS over rest of the treatment combinations. Maximum net return (Rs. 14,996) and. additional net return Re invested on weed control (Rs. 12.93) was obtained under application of butachlor at 1.562 kg/ha as pre emergence.

## P-75 Azimsulfuron 50 df – a new herbicide formulation for weed control in transplanted rice

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Rice is the staple food of more than 60 per cent of the world's population. With the advent of capital intensive technology, farmers have achieved a breakthrough in increasing the yield of transplanted rice. But weeds were the major threats, which are competing with rice for resources and thus reducing the yield levels. Since hand weeding and other weed control methods are difficult, chemicals are the obvious alternative, indispensable and cost efficient weed control practices. For this many pre-emergent herbicides were released and used by farmers. But, very few post emergent weedicides are available to know the effect of post emergent weedicide (Azimsulfuron) on crop safety and weed control, the experiments were laid out at Agricultural Research Station, Kathalagere. The investigation involves five herbicides *viz.,* Azimsulfuron 50 DF at three doses (27.5, 30.0 and 35.0 g/ha), Pyrazosulfuron 10 WP 25 kg/ha, 2,4-DEE 2.0 kg/ha, Butachlor 50 EC 1.0 kg/ha and Butachlor 50 EC 0.9 kg/ha + Almix at 2.0 g/ha. The Cv. IR- 64 was used for investigation. The major weeds observed in the experimental plots were *Echinochloa glabrascence* among the grasses. *Cyperus sps., Scripus rayali* and *Fimbristylis miliaceae* among sedges. *Ludwizia parviflora, Lindernia vernicaefolia* and *Glinus oppositifolia* among the broad leaved weeds. Application of azimsulfuron at 30.0 kg/ha + 0.2% surfactant followed by one hand weeding at 40 DAT recorded significantly higher grain yield (6834 and 6683 kg/ha in summer 2008 and *kharif* 2008, respectively) and straw yield (7008 and 7030 kg/ha in summer 2008 and *kharif* 2008, respectively), than other weed control treatments. The weedy check recorded significantly lower grain yield (2771 and 2882 kg/ha in summer 2914 and *kharif* 3095, respectively) and straw yield (7008 and 7030 kg/ha in summer 2008 and *kharif* 2008, respectively).

## P-76 Direct effect of herbicides on pea and residual effect on succeeding paddy crop

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A field experiment was conducted during *rabi* 2007-08 at Student's Instructional Farm of this university. Four herbicides *viz* pendimethalin, alachlor, metribuzine and isoproturon in recommended dose were compared with control in randomized block design with three replications. The experimental field was neutral in pH, normal in salt concentration, low in organic carbon, medium in available phosphorus and available potash. Pea cv KPMR-522 was sown on 6 Nov. 2007 and herbicides were sprayed on 7 Nov. 2007 under recommended package of practices. Number of plants/$m^2$ , plant height and yield were recorded at 15 DAS and harvest stage. Succeeding crop paddy was transplanted and growth character were observed at 40 DAP stage. Results revealed that application of Alachlor (1.5 kg/ha), metribuzin (0.175 kg/ha) and isoproturon (1.5 kg/ha) reduced the number of plants per square metre and plant height at 15 days after application. Metribuzin reduced the grain yield of pea than other treatments. There was not any residual adverse effect of all herbicides on succeeding paddy crop.

**P-77**

# Management of *cuscuta* on niger

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An experiment was conducted at Research Farm of Project Coordinating Unit (Sesame & Niger), JNKVV, Jabalpur during *qutumn* Season of 2008 to find out a suitable method for controlling the *cuscuta* on niger crop. The soil of the experimental field was clay loam in texture, neutral in reaction (pH-7.2) and analyzing in low organic carbon (0.39%), available N (220 kg/ha) and available P (7.85 kg/ha) and high in available K (345 kg/ha) contents. Ten treatments consisted of different weed control measures *viz* Control {imweeded/ *Cuscuta* infested field}, Weeding at 20 DAS, Weeding at 20 and 40 DAS, Sieving by separation of *Cuscuta* seed by 1 mm sieve, Seed treatment with 10% brine solution (Nacl), Intercropping of niger with sunflower (4:2), Pre-emergence application pendimethalian, Pre-emergence application of pendimethalian + sieving, Preemergence application of pendimethalin + 10% brine solution seed treatment and Sieving + (10% brine solution) seed treatment (Nacl) were tested in randomized block design by replicating thrice. Seeds of JNC-1 variety were sown on October 16, 2008 in 30 cm rows by drilling 5 kg seeds/ha at about 3 cm depth. Just after sowing the seeds were well covered in the soil and a light irrigation was given for germination of seed. The crop was fertilized at 40:30:20- N:P:K (kg/ha) through Urea, Single super phosphate and Muriate of Potash. Entire quantity of P & K and half of the N was given as basal and remaining quantity of half N was top-dressed at 30 DAS. The harvesting was done on January 24, 2009. The data on seed yield and weed control efficiency was worked out. The economic analysis of the treatments was also made on the basis of seed yield.

The results revealed that sieving + 10 % brine solution seed treatment gave the highest seed yield (518 kg/ha) followed by 497 kg/ha in pre-emergence application of pendimethalin + 10% brine solution seed treatment and 488 kg/ha in seed treatment with 10% brine solution which were at par with no statistical differences *interse*. The maximum NMR and B:C ratio of Rs 5529/ha and 2.46 was recorded with sieving + 10% brine solution seed treatment followed by Rs 5019 /ha and 2.33 obtained in seed treatment with 10% brine solution. The minimum NMR of Rs 3143/ha was recorded in control treatment. Where as the minimum B:C ratio of 1.84 was recorded with pre-emergence application of pendimethalin. The maximum weed control efficiency of. 55 per cent was with weeding at 20&40 DAS which was followed by 54 per cent in sieving + 10% brine solution seed treatment (Nacl)) and 51 per cent in pre-emergence application of pendimethalin + 10% brine solution seed treatment with the minimum of 29 per cent in weeding at 20 DAS.

# P-78 Weed management in newly planted mango and citrus orchard

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Diversification of agriculture is considered as an important strategy for agricultural development in India and importance of horticulture crops as a means of diversification and creation of employment opportunities in rural areas has also been recognized, that leads to agro-industries' development and value addition. In India, horticulture accounts for 8.5% of the gross cropped area and occupying the frontier position in fruits and vegetables production. The diverse situation in different agro-ecological zones of the country encourages the growth of broad-spectrum weeds especially nurseries which face a serious weed threat with annuals (mono and dicot weeds). The critical weed competition generally occurs between 3 to 5 years, causing 34-72 per cent loss due to unchecked weeds to citrus. Competition from weeds is damaging to citrus trees when they are young because its initial slow growth and increases their susceptibility to insect and disease damage. Weeds must be managed intelligently in order to achieve the highest productivity from orchard crops. In addition to direct effect, weeds around tree trunks may also create a favorable environment for pathogens that infect the trunk and roots as well as provide shelter for field mice. Type of weeds determines the strategy for better weed control. During the years of establishment of trees, cover crops may be utilized for weed control purpose. The season long efficacy of numerous, economical soil applied herbicides and post emergence herbicides makes herbicides as the most widely utilized weed management tools in orchard. Instead of allowing weeds to disturb the orchard ecosystem, efforts should be made to tackle weeds of various natures intelligently in mango and citrus orchard by using suitable weed management practices for getting maximum outcome of the vacated space. Present study on integrated weed management in mango and citrus orchard has been designed to find out the suitable weed control practice to encourage the growth of mango and citrus orchard. The experimental fields of mango and citrus orchards were mainly infested with *Dinebra* sp, *Malachra capitata*, *Medicago hispida*, *Chenopodium album, Paspaladium sp., Alternanthera sessilis* and *Physalis minima* in *rabi* season. While in *kharif* season, the dominant weeds were *Echinochloa colona, Cyperus rotundus, Physalis minima, Cynodon dactylon, Dinebra* sp. *etc*. Results reveal that adoption of cropping system like cowpea-pea-cowpea and greengram-pea-greengram as intercropping combined with herbicide application significantly reduced the weed population and weed dry matter in mango and citrus orchards. Intercropping with a cropping system of cowpea-pea cowpea gave highest per cant increase in plant height, while mechanical weeding twice in each season gave higher per cant increase in girth of citrus plant. So for the growth of mango is concerned, highest per cent increase in height of mango plant was recorded with metribuzin 0.5 kg/ha. While, highest increase in girth of plant was registered with glyphosate application at 2.0 kg/ha in each season. Intercropping of pea with and without pendimethalin 1.25 kg/ha as well as application of metribuzin 0.5 kg/ha alone were found to be superior over other herbicidal treatments including weedy check during *rabi* season. Data revealed that the bonus yield of cowpea and green gram ranged between 3-8 q/ha/year and 10-12 q/ha/year, respectively in these orchards has been obtained. While in case of pea, it ranged around 15-20 q/ha/year through out the cropping system. It is very clear from the results that growing intercrops like cowpea and greengram during *kharif* and summer seasons and pea during *rabi* season with and without herbicide application could be utilized as a integrated weed management (IWM) package for effective weed control, reducing of soil weed seed bank and to get additional income during non-fruiting period of orchard crops.

**P-79**

# Effects of different herbicides on growth and yield of late sown wheat and associated weeds

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The field experiment was conducted to study the effect of different herbicides on growth and yield of late sown wheat and associated weeds during *rabi* season of 2007-2008 at Agronomy Farm of Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad (U.P.). There were fifteen treatments *viz.* Fenaxoprop 90 g/ha,2,4-D sodium salt 500 g/ha, Metsulfuron-methyl (MSM) 4 g/ha, Clodinafop 60 g/ha, Isoproturon 1000 g/ha, Sulfosulfuron 25 g/ha, Metribuzin 200 g/ha, Fenaxoprop + 2, 4 D 90+500 g/ha, Fenaxoprop + MSM 90+4 g/ha Clodinafop + MSM 60+4 g/ha, Clodinafop + 2,4-D 60+500 g/ha, Isoproturon + 2,4-D 1000+500 g/ha, Isoproturon + MSM 1000+4g /ha weed free and weedy control. The treatments were arranged in Randomized block design with three replications. The soil of the experimental field was silt loam in texture, low in organic carbon & nitrogen and medium in available phosphorus and potash having pH 7.9 and E.C. 0.93 dsm. The wheat variety UP 2425 was sown by tractor drawn seed drill on 20$^{th}$ December, 2007. 120 kg N/ha, 60 kg $P_2O_5$ /ha and 40 kg $K_2O$/ha, were applied through urea, Diammonium phosphate and murate of Potash as per recommendation. Post emergence application of Isoproturon + MSM (1000+4 g/ha) significantly reduced the number and dry weight of weeds as compared to other treatments but remained at par with weed free and Isoproturon + 2,4-D (1000+500 g /ha),. All the growth and yield contributing characters *viz.* plant height, dry matter accumulation, tillers $m^{-2}$ , length of spike, grains spike$^{-1}$ and 1000 grain weight as well as grain and straw yield were significantly higher with weed free and the values were at par with post emergence application of Isoproturon + MSM (1000 + 4 g/ha) and isoproturon + 2,4- D (1000 + 500 g/ha). Nitrogen and protein content in grain was not affected significantly by different weed management practices. The highest net return of Rs 33600/ha and benefit cost ratio was recorded with post emergence application of isoproturon + MSM (1000 + 4 g /ha) closely followed by post emergence application of Isoproturon + 2,4 D (1000+500 g /ha) of Rs 33,023 /ha. Thus, it is concluded that post emergence application of Isoproturon (1000 g /ha) tank mixed either with MSM (4 g/ha) or with 2,4-D (500 g/ha) applied at 45 DAS was found most effective in weed control and economically feasible for higher production of late sown wheat.

## P-80 Influence of irrigation schedules based on IW:CPE ratios and herbicidal weed control in isabgul (Plantago ovata Forsk)

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Blonde psyllium is an important medicinal crop of Gujarat. Due to low cost of production and higher return from the crop. Gujarat commands near monopoly in the production and export of isabgul seed and seed husk to the world market. It is cultivated in India about 1.3 lakh ha with production 77000 MT seed. (Desai and Devra, 2008). Earning about 130 crores rupees from the isabgul seed and 150 crores rupees from husk were exported valued together Rs.280 crores.

With the introduction of high yielding varieties coupled with increased use of fertilizers and irrigation on weed problem have increased manifolds. Application of irrigation in proper amount and in proper time will go a long way in arresting the problem created by weeds. The predominant method of weed control by mechanical hoeing and manual weeding is found to be laborious and time consuming not only this nut in peak period of crop growth. Labour is not easily available. Under these situations the chemical control of weeds is found to be effective and economical. Establishing proper herbicidal weed control and irrigation scheduling can enhance the productivity of isabgul. The experiment was laid out in split plot design with allocation of irrigation schedule in main plots and herbicidal weed control in sub-plots. The treatments were replicated fourth. Isoproturon and oxadiargyl were applied at 0.5 kg /ha as pre-emergence and post-emergence respectively, in 500 liter /ha of water. Isabgul variety GI-2 was sown by broadcasting the seeds on November 15, 2006-07., at 4.0 kg seed /ha and fertilized with 30+15 kg NP /ha. Application of isoproturon was most effective for the control of all weeds, which resulted in 99.32%.weed control efficiency and 49.00 % higher mean seed yield over unweeded control. The higher WUE (3.606 kg /ha $mm^{-1}$) was observed under 0.4 IW:CPE ratio and higher net return (Rs /ha 28904) were obtained under the treatment combination (0.4 IW:CPE ratio and application of isoproturon at 0.5 kg /ha as pre-emergence). The interaction effect of irrigation schedule and herbicidal weed control practices was found non-significant in some case

## P-81 Efficacy of herbicides to control the weeds in wheat

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A field experiment was conducted at Crop Research Centre of Rajendra Agricultural University, Bihar, Pusa during 2007-08 and 2008-09, to find out the effective and economic weed control practices for wheat crop. The maximum reduction of weed indices was recorded in hand weeding followed by Sulfosulfuron 75% + Met Sulfuron 25%, 30 g/ha. The lowest weed count and weed dry weight were recorded under hand weeding (30 DAS) which was closely followed by Sulfosulfuron 75% + Met Sulfuron 25% 30 g/ha treatment. The highest weed control efficiency was recorded under the treatment of hand weeding followed by Sulfosoufuron 75% + Metsulfuron 25% 30 g/ha, Sulfosulfuron 75% + Met sulfuron 25% 20 g/ha and Clodinafop 90 g/ha. The highest grain and straw yields were recorded by hand weeding which was found to be at par with sulfosulfuron 75% + Metsulfuron 25%, 20 g/ha and Clodinafop 60 g/ha.

## P-82 Bio-efficacy and phytotoxicity of fenoxoprop-p-ethyl on *rabi* transplanted paddy

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Field experiment was conducted during *rabi* 2007-2008 at C Block Farm, Kalyani, Nadia, West Bengal, to study the Bio-efficacy and phytotoxicity of UPH 707 on potato. The soil of the experimental field was sandy loam with pH 6.89, Organic Carbone – 0.597 %, total Nitrogen – 0.0569%, available 'P' and 'K' 27.73 kg/ha and 98.26 kg/ha. The experiment was conducted in Randomized Block design with seven treatments *viz.* $T_1$ – UPH 707 at 400g a.i. /ha, $T_2$ - UPH 707 at 500g a.i. /ha, $T_3$ - UPH 707 at 600g a.i. /ha, $T_4$ – Paraquat dichloride 24% SL at 500g a.i. /ha, $T_5$ – Metribuzin70% WP at 525 g a.i. /ha, $T_6$ - Untreated control, $T_7$ - Hand Weeding were replicated thrice. The tubers were planted after treating with Mancozeb at 3 g $kg^{-1}$ and the crop was fertilized 150:100:100 as N:$P_2O_5$:$K_2O$ as Urea, SSP and MOP. Hand weedings were done 15 and 30DAT and herbicide was applied at 2-3 leaf stages of weed. Among all the treatments Hand weeding recorded minimum weed biomass and density followed by $T_3$ - UPH 707 at 600g a.i. /ha. Treatment $T_2$ - UPH 707 at 500g a.i. /ha and $T_5$ – Metribuzin70% WP at 525 g a.i. /ha which were at par among themselves and closely followed by treatment $T_4$ – Paraquat dichloride 24% SL at 500g a.i. /ha. Slightly higher values of biomass on 30DAA were mainly due to the top dressing of nitrogenous fertilizer. However the lowest dose of UPH 707 at 400g a.i. /ha did not find to be effective far controlling weed flora in potato crop through recorded higher effectiveness than the weedy check. Maximum tuber yield of potato (34.10 t/ha) was obtained from hand weeding plot which was at par with the highest dose of herbicide *i.e.* UPH-707 at 600 g / ha (33.67 t/ha). UPH-707 at 500 g a.i. /ha, Metribuzin70% WP at 525 g a.i. /ha and Paraquat dichloride 24% SL at 500g a.i. /ha gave tuber yield 32.70 t/ha, 31.20 t/ha and 29.33 t/ha respectively. The lowest tuber yields obtained from unweeded control plot *i.e.* 22.60 t/ha. The herbicide UPH-707 did not cause phytotoxicity and safe to potato crop at all the doses of application up to 1000 g a.i. /ha or 4000 ml/ha.

## P-83 Integrated weed management in maize (*Zea mays* L.)

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A field experiment was carried out during *kharif* seasons of 2006 and 2007 on young alluvial calcareous saline sandy loam soil at Crop Research Centre of Rajendra Agricultural University, Bihar to study the integrated weed management in maize. The results revealed that the lowest weed indices were recorded under the treatment of Pendimethaline 1.0 kg/ha PE + Intercropping of cowpea followed by the treatment mechanical weeding (twice) and Atrazine 0.5 kg/ha PE *fb* one Mechanical weeding at 30 DAS. The highest weed control efficiency was found in the treatment Pendimethaline 1.0 kg/ha PE + Intercropping of cowpea followed by Mechanical weeding (Twice). Specific leaf weight and nitrate reductase activity were also recorded highest in the treatment Pendimethaline 1.0 kg/ha PE + Intercropping of cowpea which is followed by Mechanical Weeding (Twice). Weedy check recorded the highest weed indices and the lowest maize grain yield. The highest maize equivalent yield was recorded in the treatment of Pendimethaline 1.0 kg/ha PE + Intercropping of cowpea.

# P-84 Bio-efficacy and phytotoxicity of fenoxaprop-p-ethyl on *kharif* transplanted paddy

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Field experiment was conducted during *kharif* 2007 at Gangetic alluvium (Entisol) of 'C' block farm, Kalyani, Nadia, West Bengal, to study the Bio-efficacy and phytotoxicity of Fenoxaprop-p-ethyle on *kharif* transplanted paddy. The soil of the experimental soil has medium fertility status with low water holding capacity and sandy loam in texture having pH 6.85, Organic Carbone – 0.597 %, total Nitrogen – 0.0587%, available 'P' and 'K' 25.30 kg/ha and 130.50 kg/ha. The experiment was conducted in Randomized Block design with seven treatments *viz.* $T_1$ - Fenoxaprop-p-ethyl 6.9% EC at 47.44 g a.i. /ha), $T_2$ - Fenoxaprop-p-ethyl 6.9% EC at 51.75 g a.i. /ha, $T_3$ - Fenoxaprop-p-ethyl 6.9% EC at 56.06 g a.i. /ha, $T_4$ - Fenoxaprop-p-ethyl 6.9% EC at 60.38 g a.i. /ha, $T_5$ - Cyhalofop-p-butyl 10 ECat62.5 g a.i. /ha, $T_6$ - Hand Weeding (20 and 40 DAT), $T_7$ - (Untreated control) were replicated thrice. The seeds were sown after treating with Mancozeb at 3 g $kg^{-1}$. The crop was fertilized 60:30:30 as $N:P_2O_5:K_2O$ as Urea, SSP and MOP. Whole 'P' and 'K' and ¼ th nitrogen was applied as basal and the rest nitrogen applied in 2 splits at active tillering stage (50 %) and at flowering stage (25%). The result revealed that all the doses of Fenoxaprop-p-ethyl 6.9% EC and Cyhalofop-p-butyl recorded lower grassy weed population and biomass than the unweeded control. A gradual lower grassy weed density and dry weight were obtained by increasing the doses of Fenoxaprop-p-ethyl 6.9% EC from 47.44 to 60.38 g a.i. /ha. The higher two doses of Fenoxaprop-p-ethyl 6.9% EC at 56.06 and 60.38 g a.i. /ha recorded lower populations of all the grassy weeds. Grain yield revealed that hand weeding twice at 20 and 40 DAT recorded highest grain yield of paddy (4.51t /ha) followed by the higher three doses 60.38 g a.i. / ha(4.49 t /ha), 56.06 g a.i. /ha(4.38 t /ha)51.75 g a.i. /ha(4.12 t /ha) of Fenoxaprop-p-ethyl 6.9% EC. Cyhalofop-p-butyl because of its inability to control the grassy weeds other than the *Echinochloa species* recorded 4.14 t /ha but all these five treatments recorded significantly higher grain yield of transplanted paddy over the unweeded control (3.58 t /ha). The straw yield also shows similar variation. No phytotoxicity was observed on transplanted paddy plants from Fenoxaprop-p-ethyl 6.9% EC applied up to the dose of 60.38 g a.i. /ha. Slight stunting growth was seen at double dose at 7DAA but recovered within 15 days time.

## P-85 Bio - efficacy evaluation of early POE tank-mix application of kloben 25% wp + pantera 4% ec on weed control in soybean and its residual effect on succeeding crops

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Soybean is highly susceptible to weed infestation encountering a yield reduction of 59-86%. Field experiments were conducted on Bio - efficacy evaluation of POE tank-mix application of kloben 25% WP + pantera 4% EC on weed control in soybean during summer and *kharif*, 2008 at Tamil Nadu Agricultural University, Coimbatore. Phytotoxicity symptoms like chlorotic, stunted growth with rosette formation were occurred in weeds and spreading of *Trianthema* was completely arrested. But complete drying of weeds was not observed in any of these treatments. There was slight chlorosis occurrence observed on 3 DAHS in soybean and the intensity of chlorosis was higher with post emergence tank mix application of kloben 18 g/ha + pantera 80 g/ha with or with out surfactant. However crop recovered completely with in 10 DAHS. Kloben and pantera have no control on grasses and BLW respectively. Whereas, tank mix early POE application has broad spectrum of weed control. Early POE tank mix application of kloben 9 g/ha + pantera 40 g/ha with or with out surfactant has recorded higher grain yield and was on par with application of kloben 18 g/ha + pantera 80 g/ha with or with out surfactant with lesser total weed density, dry weight and higher weed control efficiency during both the years of study. There was no carry over toxicity of these tested herbicides in the succeeding pearl millet, sunflower and cowpea. Yield of these succeeding crops were not significantly influenced by preceding POE application of kloben + pantera in soybean.

## P-86 Pre-emergence control of purple nutsedge using growth promoting substances in combination with herbicides

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Weeds are perceived as unwanted intruders into agro ecosystems. Among the perennial weeds, *Cyperus* species is considered as one of the most harmful weeds of cultivation and its spread is so great. All the commercial herbicides available in the market aimed to control or kill the growing above ground part of the weed plants. None of the herbicides are inhibiting activity of viable underground plant parts like rhizome or tubers which act as a source for new plants in the next season. An investigation was carried out at department of Agronomy and Department of Seed Science and Technology, Tamil Nadu Agricultural University during 2007-2008 to evaluate the pre-emergence control of purple nutsedge using growth promoting substances in combination with herbicides. Application of growth promoting substances along with different herbicides as tank mix and followed by application, significantly influenced the viability of the tubers and survival of the sprouted tubers. Among the herbicides, application of metolachlor 2 kg/ha as tank mix with cytokinin (0.01%) reduced one hundred per cent viability of the tubers. Application of cytokinin at 0.01 per cent induced the buds to sprout and glyphosate (3.0 kg/ha) application on the third day after sprouting killed the sprouted buds (92%) significantly compared to metalachlor and almix under laboratory condition tested in paper media.

**P-87**

# Response of late sown varieties of wheat (*Triticum aestivum* L. emend Fiori and Paol) to 2,4-D

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A field experiment entitled "Response of late sown varieties of wheat (*Triticum aestivum* L. emend Fiori and Paol) to 2, 4-D" was conducted at Agronomy Research Farm of Narendra Deva University of Agriculture & Technology, Kumarganj, Faizabad (U.P.)during Rabi season of 2007-08 with an objective to find out the effect of 2, 4-D applied at various crop growth stages on different wheat varieties and their performance under late sown condition of eastern U.P. Field trial was laid out in a split plot design with three replications, keeping four time of 2, 4-D application *viz*., $S_1$ (application of 2, 4-D at 25$^{th}$ day of sowing), $S_2$-(application of 2, 4-D at 35$^{th}$ day of sowing), $S_3$-(application of 2, 4-D at 45$^{th}$ day of sowing) and $S_4$ (weed free) in main plots and six wheat varieties, *viz*., $V_1$ (PBW-373), $V_2$ (NW-2036), $V_3$ (HUW-234), $V_4$ (K-7903), $V_5$ (Raj-3077) and $V_6$ (Raj-3765) in sub-plots. The experimental field was kept free from weeds after 35$^{th}$ day of sowing in weed free treatment. The 2, 4-D amine salt was applied as per treatment with the help of manually operated knapsack sprayer fitted with flat fan nozzle using 800 litres of water/ha. The density of BLW as well as total weed density and dry weight were recorded significantly less with the application of 2,4-D at 25$^{th}$ day stage as compared to rest of the stages of 2, 4-D application. All the growth and yield contributing characters *viz*. Plant height, dry matter accumulation, leaf area index, length of spike, grains spike$^{-1}$ and test weight as well as grain and straw yield were significantly higher as compared to control (weed free) and the values were at par with application of 2, 4-D at 35$^{th}$ day stage. Number of shoots ($m^{-1}$) was not affected due to different time of 2, 4-D application. Spike deformities were recorded when 2, 4-D applied at 25$^{th}$ day stage. Wheat variety HUW-234 being at par with NW-2036 recorded significantly higher growth and yield contributing characters as well as grain and straw yield as compared to other varieties. Highest spike deformities were recorded in variety PBW-373. 2, 4-D applied at 35$^{th}$ day after sowing was found safer for toxicity and effective for weed control. Among the wheat varieties, HUW 234 or NW 2036 found superior over rest of the varieties.

# P-88 Weed control studies in wheat (*Triticum aestivum* L.) under late sown condition

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The field experiment was conducted to study the effect of weed control methods on wheat (*Triticum aestivum* L.) under late sown condition during *rabi* season of 2007-2008 at Agronomy Farm of Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad (U.P.). There were twelve treatments *viz.* Isoproturon alone 1.0 kg /ha, Isoproturon 1.0 kg /ha + metsulfuron methyl 4 g /ha, Isoproturon 1.0 kg /ha + 2,4-D 0.5 kg /ha, Isoproturon 1.0 kg /ha + MSM 4 g /ha + urea (2 %), Isoproturon 1.0 kg /ha + 2,4-D 0.5 kg /ha + urea (2 %), Isoproturon 1.0 kg /ha + MSM 4 g /ha + urea (2 %) + $ZnSO_4$ (0.5 %), Isoproturon 1.0 kg /ha + 2,4-D 0.5 kg /ha + urea (2 %) + $ZnSO_4$ (0.5 %), Isoproturon 1.0 kg /ha + $ZnSO_4$ (0.5 %), Isoproturon 1.0 kg /ha + urea (2 %), Isoproturon 1.0 kg /ha + urea (2 %) + $ZnSO_4$ (0.5 %), weedy check and weed free. The treatments were arranged in Randomized block design with three replications. The soil of the experimental field was silt loam in texture, low in organic carbon & nitrogen and medium in available phosphorus and potash having pH 8.0 and EC 0.93 $dsm^{-1}$. The wheat variety UP 2425 was sown on 20th December, 2007. Nitrogen 120 kg N /ha, Phosphorus 60 kg $P_2O_5$ /ha and Potassium 40 kg $K_2O$ /ha, were applied through urea, single super phosphate and muriate of potash as per recommendation.

Post emergence application of Isoproturon 1.0 kg + 2,4-D 0.5 kg /ha being at par with weed free and isoproturon 1.0 kg + MSM 4 g /ha significantly reduced the number and dry weight of weeds as compared to other treatments. The post emergence application of Isoproturon 1.0 kg /ha + 2,4-D , 0.5 kg /ha + urea (2 %) + $ZnSO_4$ (0.5 %) significantly increased all the growth and yield contribuging characters *viz.* Plant height, dry matter accumulation, shoots $m^{-1}$, length of spike, grains $spike^{-1}$, test weight. Grain and straw yield obtained with weed free and post emergence application of Isoproturon 1.0 kg /ha + MSM 4 g + urea (2 %) + $ZnSO_4$ (0.5 %) /ha being at par significantly superior over rest of the treatment.

Nitrogen and protein content in grain was not affected significantly. The highest net return of Rs.31940 /ha and benefit cost ratio (1:1.72) was recorded with post emergence application of Isoproturon 1.0 kg /ha + 2,4-D 0.5 kg + urea (2%) + $ZnSO_4$ (0.5 %) /ha closely followed by weed free and post emgergence application of Isoproturon 1.0 kg /ha + MSM 4 g /ha + urea (2 %) + $ZnSO_4$ (0.5 %) /ha of Rs. 29880 /ha.

Thus, it is concluded that for effective weed control and higher return post emergence application of Isoproturon 1.0 kg tank mixed either with 2,4-D 0.5 kg /ha or with MSM 4g /ha and urea (2%) + $ZnSO_4$ (0.5%) /ha applied at 35 days after sowing may be adopted in late sown wheat.

# P-89 Effect of time of establishment and weed control methods on direct seeded rice in Chhattisgarh

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More than 70 per cent of rice grown in Chhattisgarh is under direct seeding which is prone to heavy densities of weeds as compared to transplanted or puddled rice cultivation, especially in the initial stage of crop causing substantial yield losses. Paucity and timely unavailability of labourers, their ever hiking wages and rainfed ecosystem are the other serious concerns responsible for the lower rice production as compared to national average. Keeping above in view, an experiment was conducted in the wet season of 2008 in inceptisol at farm of Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh. There were two treatments of time of establishment of rice in main plot and six treatments of weed management practices were allotted in sub plots, respectively. The experiment was conducted in split plot design with three replications. The prominent weed flora of the experimental field was of *Echinochloa colona, Ischaemum rugosum* among grasses and *Alternathera triandra, Cynotis axillaries, Croton banplandianum* among broad leaves. Weed population *i.e.* total number of weeds /$m^2$ at 30, 60 and at harvest was slightly higher under pre-monsoon sowing of rice than post-monsoon sowing. Within the weed control measures, at 30 DAS, lowest population of weeds was recorded under pre-emergence application of butachlor 1.5 kg/ha *fb* one hand weeding. This was followed by two hand weedings at 20 and 40 DAS. Weed population recorded at 60 DAS and at harvest revealed that lowest weed count was registered under two hand weeding and it was followed by pre-emergence application of butachlor 1.5 kg/ha *fb* one hand weeding. Significantly higher grain yield by 14.42 per cent was observed under post-monsoon sowing time of rice establishment than pre-monsoon sowing. Among various weed control measures, significantly higher grain yield was obtained under two hand weeding which was statistically at par with butachlor 1.5 kg/ha *fb* one hand weeding. The percent yield increase under these two treatments over control was to the tune of 77.45 and 77.14, respectively.

## P-90 Integrated weed management in blackgram for higher productivity

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Blackgram (*Vigna mungo* L. Hepper) is one of the major *kharif* pulse crops in Bidar district which lies in North Eastern transition zone (zone -1) of Karnataka. It is cultivated in this zone in an area of 65,000 hectares which accounts for 65 per cent of the area in the state. It is usually grown as an inter crop with pigeonpea and as a sole crop in black soils where double cropping is practiced. The productivity of the crop is low in the zone. Among different constraints, weeds pose a major threat. Being a short duration crop, blackgram is very much sensitive to delayed weeding which is a common feature in this zone due incessant rains and scarcity of labour during the period of critical weed- crop competition. Therefore, an experiment was conducted at Agricultural Research Station, Bidar (UAS Dharwad Campus) during monsoon season of 2000 and 2001 to know the efficacy of pre-emergence herbicides either alone or in combination with inter-cultivation (IC) and hand weeding (HW). The results of pooled analysis indicated that alachlor (1.5 kg/ha) or fluchloralin (1 kg /ha) with one IC gave significantly higher grain yield of 11.63 and 11.53 q / ha, respectively over farmers' practice (10.20 q/ha). Higher yields in these treatments were attributed to lower dry weight of weeds and higher wed control efficiency (WCE). The dry weight of weeds was 123 kg/ha and 137 kg/ha, respectively in these treatments at 25$^{th}$ day after sowing (DAS) *i.e.* before taking up IC, as against 1123 kg/ ha in farmers' practice; and it was 55 kg/ha and 60 kg/ha, respectively at 30$^{th}$ DAS *i.e.* after IC, but before HW, as against 515 kg in farmers' practice. The net returns and net gain in returns were higher with these two treatments compared to farmers' practice. The yield levels obtained with the herbicides when used alone (without IC and HW) were similar to that with farmers' practice, thus signifying the timely weed control though herbicides during the period of critical weed-crop competition which plays a great role in increasing the productivity of blackgram in this zone.

## P-91 Efficacy of herbicides to control the weeds in Rajmash

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A field experiment was carried out at Crop Research Centre, Rajendra Agricultural University, Pusa, Bihar, Samastipur during rabi season of 2007-08 and 2008-09 to find out the suitable weed management practices for controlling the weeds associated with Rajmash. The highest reduction in weed count was recorded with hand weeding twice which was at par with Quizalafop 60 g/ha POE, Quizalafop 50 g/ha POE, Oxyflourfen 0.2 kg/ha PE, Oxyflorfen 0.1 kg/ha PE, Pendimethaline 1.0 kg/ha PE and Hoeing by Cycle Hoe at 35 & 55 DAS. However, the lowest weed dry weight was recorded with oxyfluorfen 0.2 kg/ha PE which was found to be at par with hand weeding twice, quizalafor 60 g/ha POE, Quizalafop 50 g/ha POE, Pendimethalin 1.0 kg/ha PE and Oxyfluorfen 0.1 kg/ha PE. The highest WCE was recorded with Oxyfluorfen 0.2 kg/ha PE which was followed by hand weeding twice, mechanical weeding (Hoeing by Cycle Hoe at 35 & 55 DAS), Quizalafop 60 g/ha POE and Quizalafop 50 g/ha POE. Hand weeding (twice) recorded the highest grain yield of Rajmash which was found to be at par with hoeing by cycle hoe at 35 & 55 DAS and closely followed by quizalafop 60 g/ha POE, quizalafop 50 g/ha POE, Oxyfluorfen 0.1 kg/ha PE and Oxyfluorfen 0.2 kg/ha PE.

## P-92 Integration of herbicides with cultural methods of Weed control in rainfed maize (*zea mays l.*)

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A field experiment was conducted during the rainy season of 2007 at Agricultural Research Station, Dharwad, Karnataka on a clay-loam soil to find out the efficacy of different herbicides applied alone and their integration with cultural methods in rainfed maize (*Zea mays* L.). Pre-emergence application of atrazine (1.0 kg/ha) and or pretilachlor (1.0 kg/ha) alone and in combination with one hand weeding (30 DAS) and of farmers' practice (two inter-cultivations and one hand weeding) were compared with weed-free and weedy check treatments. During the period of critical crop-weed competition, up to 30 DAS, the dry weight of weeds was less in herbicide applied plots (ranging from 47 to 55 kg/ha) compared to 475 kg/ha in farmers' practice. Weed control efficiency, WCE, was higher with herbicide treated plots ranging from 72 to 77% when compared to farmers' practice. The grain yields were significantly higher with pretilachlor + 1HW (3.28 t/ha), Atrazine + 1HW (3.21 t/ha) and were on a par with farmers' practice (3.34 t/ha).

## P-93 Integrated management of late emerging weeds in irrigated groundnut under red sandy loam soils

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Groundnut is one of the major edible oilseed crops extensively cultivated in the world. One of the major constraints in groundnut production is weed menace and the critical period up to 10 weeks after sowing. The uncontrolled late post emerged weeds compete with groundnut for nutrition and other inputs. Once peg formation has begun, manual or mechanical methods are not recommended because the pegs are damaged and reduce the crop yield. Herbicide is the only way to control weeds emerged during later stages of groundnut growth. Considering the impact of late emerging weeds, the experiment was conducted in randomized block design with four replications to identify suitable combination of chemical and cultural method of managing the late emerging weeds in groundnut. PE pendimenthalin 1.0 kg/ha 3 DAS + rotary weeder on 40 DAS, PE pendimenthalin 0.75 DAS + POE imazethapyr 50 g/ha on 20 DAS, PE pendimenthalin 0.75 DAS + HW and earthing up + layby application of pendimethalin 0.75 kg/ha on 40 DAS, Rotary weeder at 20 DAS + HW and earthing up at 40 DAS, imazethapyr 50 g/ha on 20 DAS were evaluated for weed control efficiency. Lower weed density and dry matter were recorded in PE pendimenthalin 1.0 kg/ha 3 DAS + rotary weeder on 40 DAS during 30 and 60 DAS. At 90 DAS, PE pendimenthalin 0.75 DAS + HW and earthing up + layby application of pendimethalin 0.75 kg/ha on 40 DAS recorded lower weed density and dry matter. This may be due to the effective control of second flush of the weeds. The yield and yield parameters also higher in PE pendimenthalin 0.75 DAS + HW and earthing up + layby application of pendimethalin 0.75 kg/ha on 40 DAS when compared to the other treatments.

## P-94 Impact analysis on integrated weed management in the cultivation of onion in Tamil Nadu

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Agriculture in India is the main source of occupation and everything for billions of people. The productivity of crops has a significant role in enhancing the income level of the farmer at micro level and national income at macro level. The productivity of crops is much dependent on various attributes starting from the variety, climate and other management practices including human resource management. It is estimated that nearly 30 per cent of the crop is lost due to weed menace in the agricultural fields. There is a need to study the benefits of weed management practices in terms of labour use and profits obtained in the cultivation of crops. The present study aims at analyzing the benefits in the cultivation of Onion, a major vegetable crop. The objective of the study is to estimate and compare the labour use and yields of farms using herbicides and other wise. The study was conducted in the western zone of Tamil Nadu during 2008-2009 with 60 sample farms each using herbicides and other wise. The results reveal that nearly eight percent of the labour force was saved mainly on weeding in herbicide applied farms. The total cost of cultivation was lesser by Rs.1505 per ha in these farms. The productivity has also increased by nearly 52 quintals and profit by Rs.15000 in herbicide applied farms. This has clearly indicated that the herbicide application combined with other cultural practices would definitely go a long way in harnessing the income of the resource constrained farmers largely.

## P-95 Evaluation of different levels of Prometryn herbicide in cotton for its weed control efficiency under summer irrigated condition of Tamil Nadu

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Bio-efficacy of different levels of prometryn was evaluated in summer irrigated cotton with SVPR 2 during 2004 and 2005. The treatments tested were fluchloralin 1.0kg/ha ($T_1$), prometryn 0.75 kg/ha (prometrex) ($T_2$), prometryn 1.0 kg/ha ($T_3$), prometryn 1.5 kg/ha ($T_4$), prometryn 2.0 kg/ha ($T_5$), hand weeding twice ($T_6$) and unweeded check ($T_7$) in randomized block design with three replications. The predominant weeds in the experimental field included *Echinochloa colona, Dactyloctenium aegyptium*, *Cyanodon dactylon, Cyperus rotundus, Trianthema portulacastrum, Phyllanthus niruri* and Digiera *arvensis*. The results indicated that hand weeding twice registered significantly lesser weed density and weed dry matter production. Grasses dominated the unweeded check. Among the different levels of prometryn herbicide, application of Prometryn 2.0 kg/ha as pre-emergence herbicide resulted in lower weed population and weed dry weight than the lower levels of prometryn application and Fluchloralin 1.0 kg/ha. Higher growth parameters, yield attributes, kapas yield (2288 kg/ha) and B:C ratio (2.39) which was on par with pre-emergence application of Prometryn 1.5 kg/ha. In spite of the better weed control in prometryn at 2.0 kg/ha applied plot, kapas yield (1650 kg/ha) was found to be lesser due to plant stand reduction due to herbicide toxicity. Prometryn 0.75 kg/ha was not effective in controlling weeds in cotton crop. The yield reduction to a tune of 35 .2 percent was observed in unweeded check due to weed menace under summer irrigated condition. Hence, it can be concluded that pre-emergence application of prometryn 1.5 kg/ha was found effective in controlling weeds in cotton under summer irrigated condition of Tamil Nadu.

**P-96**

# Effect of chemical and non-chemical weed management practices in soybean

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Weed infestation in soybean cultivation is one of the major hurdles, which limits its production level. Under the present conditions of non-availability of labour for weeding and high cost involved therein, it has become extremely difficult to maintain crops free from weeds. Chemical method of weed control and particularly integration of such method with cultural practices have assumed greater importance. *kharif* soybean suffers severely due to competition stress of weeds with yield reduction to the tune of 20 to 77% depending on nature and density of weeds. The recent awareness is to minimize the use of herbicides (chemicals) through integrated approach and by adoption of eco-friendly approaches like cultural and biological methods of weed management. Hence an investigation was carried out to evaluate the efficacy of chemical and non-chemical weed management practices in terms of weed control and yield performance of soybean crop at Agronomy Farm, Dept. of Agronomy, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during 2006-07. Experiment was carried out in Randomize Block Design with three replication and twelve treatments having gross plot size with 5.0m x 4.5m and net 4.0m x 2.7m. Variety selected for this experiment was TAMS-38. Sowing of crop was done on 17$^{th}$ July, 2006 with spacing of 45cm x 5cm. Pre-emergence application of imazethapyr at 75 g/ha + 1 HW (30 DAS) with in situ weed biomass mulching recorded maximum weed control efficiency and recorded highest seed yield of soybean (22.70 q/ha). However, it was at par with treatment of 2H (20&40 DAS)+1HW(30 DAS) (22.11q/ha), imazethapyr as post emergence 75 g/ha 20 DAS + 1 HW(40 DAS) with in situ weed biomass mulching (20.60q/ha) and imazethapyr PRE 75 g/ha$^{1}$ + crop residue mulching 5.0 t/ha 30 DAS (19.21q/ha). GMR also showed similar trend. However, treatment of 1HW 20 DAS in paired row planting + smother intercrop was statistically equivalent to the aforesaid treatments in terms of GMR although, green gram as smother intercrop reduced seed yield of soybean by 31.14%.

## P-97 Comparative efficiency of organic and integrated weed management practices under rice based cropping system

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Organic farming is a sustainable system that avoids the use of synthetic fertilizers, herbicides, pesticides and raises the crop with the use organic cultivation practices. It is one among the broad spectrum of production methods that are supportive of the environment. Use of high analysis chemicals in imbalanced and indiscriminate manner has developed many problems like decline of soil organic matter, increase in salinity and sodicity, deterioration in the quality of crop produce, increase in hazardous pests and diseases and increase in soil pollutants. Field experiments were conducted at Tamil Nadu Agricultural University, Coimbatore during the year 2007-08 and 2008-09 to evaluate the performance of different weed management practices under rice based cropping system. The experiment was laid out in randomised block design with three replications. Rice crop improved White Ponni was raised during the *kharif* season. The different weed management practices adopted *viz.,* hand weeding on 20 and 40 DAT, cono weeding on 20 DAT and once in 10 days, cono weeding on 20 DAT + Hand weeding on 40 DAT, PE application of butachlor 1.25 kg/ha at 3 DAT + Hand weeding on 40 DAT. The result showed that, the lower weed density and weed drymatter was recorded in PE application of butachlor 1.25 kg/ha at 3 DAT + Hand weeding on 40 DAT and this was followed by cono weeding on 20 DAT + Hand weeding on 40 DAT. Post emergence application of butachlor 1.25 kg/ha 3 DAT + Hand weeding on 40 DAT recorded higher yield (5035 kg /ha) when compared with other treatments. Among the organic practices, cono weeding on 20 DAT + Hand weeding on 40 DAT recorded lesser weed dry matter and weed density with grain yield of 4700 kg/ha.

## P-98 Yield and yield attributes of direct seeded rice as influenced by weed management practices under different seeding methods

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Field experiment was conducted during *rabi* 2004-2005 at Tamil Nadu Agricultural University, Coimbatore. The experiment was laid out in split plot design with different seeding methods (drum seeding; drum seeding + green manure; broadcasting) in main plots and weed management practices (cyhalofop-butyl on 15 DAS + hand weeding on 45 DAS; pretilachlor + safener on 5 DAS + hand weeding on 45 DAS; hand weeding twice on 20 and 45 DAS; unweeded check) in sub plots. The treatments were replicated three times. The dual cropped Dhaincha was incorporated on 39 DAS by using "cono weeder". The pretilachlor + safener was applied at the rate of 0.45 kg/ha and cyhalofop-butyl was applied at the rate of 60 g/ha. Results of the study revealed that drum seeding + green manure method of seeding establishment proved better in terms of reducing total weed density (62.8/m) and total dry weight of weeds (77.2 g/$m^2$) resulting in higher panicles (349/$m^2$), filled grains/panicle (91.8) and grain yield (4286 kg/ha). Application of pre-emergence herbicide of pretilachlor + safener at the rate of 0.45 kg/ha on 5 DAS + hand weeding on 45 DAS registered significantly lower total weed density (28.3/$m^2$) and dry weight of weeds (37.8 g/$m^2$) compared to other treatments which led to significantly higher panicles (399/$m^{/2}$), filled grains/panicle (96.2) and grain yield (5155 kg/ha).

## P-99 Integrated weed management approaches and application in semi-dry rice ecosystem

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Rice is an unique crop amenable to cultivation under diverse situation of water availability. In semidry rice, absence of water increases the weed incidence and exposes rice to severe competition. The major challenge for farmers is effective weed management, as failure to eliminate weeds may result in low or no yield. The reduction due to competition is ranged from 42 to 65%. Therefore, the success of semi-dry rice system mainly depends on the management practices that can effectively check the growth and development of weeds. Research result revealed that conventional method of hand weeding twice registered lowest weed population at harvest. Timely weed control is crucial to increase rice productivity. Application of pre-emergence herbicide pendimethalin alone is effective in controlling weeds in direct seeded rice. Application of pre-emergence herbicide pendimethalin followed by post emergence application of 2,4,D shows higher weed control and recorded highest total grain/seed yield, net return and B:C ratio. The inter row weeds at 21 and 42 days after sowing were effectively controlled by the animal drawn implement. But within row weeds are to be removed by selective hand weeding. Green manure crops having bioherbicidal characteristics *i.e.,* weed smothering capability, *Sesbania* intercropping for 30 days are equally effective in controlling weeds by means of higher weed smothering efficiency. Integrated weed management by intercropping cowpea (fodder) + butachlor (1.0kg/ha) + mechanical weeding recorded weed control efficiency and yield of semidry rice. Effective and economical weed control methods include pre and post emergence herbicide along with one hand weeding was found effective in controlling weeds and producing higher paddy yield in semi-dry rice.

## P-100 Impact analysis on integrated weed management in the cultivation of onion in Tamil Nadu

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Agriculture in India is the main source of occupation and everything for billions of people. The productivity of crops has a significant role in enhancing the income level of the farmer at micro level and national income at macro level. The productivity of crops is much dependent on various attributes starting from the variety, climate and other management practices including human resource management. It is estimated that nearly 30 per cent of the crop is lost due to weed menace in the agricultural fields. There is a need to study the benefits of weed management practices in terms of labour use and profits obtained in the cultivation of crops. The present study aims at analyzing the benefits in the cultivation of Onion, a major vegetable crop. The objective of the study is to estimate and compare the labour use and yields of farms using herbicides and other wise. The study was conducted in the western zone of Tamil Nadu during 2008-2009 with 60 sample farms each using herbicides and other wise. The results reveal that nearly eight percent of the labour force was saved mainly on weeding in herbicide applied farms. The total cost of cultivation was lesser by Rs.1505 per ha in these farms. The productivity has also increased by nearly 52 quintals and profit by Rs.15000 in herbicide applied farms. This has clearly indicated that the herbicide application combined with other cultural practices would definitely go a long way in harnessing the income of the resource constrained farmers largely.

## P-101 Evaluation of different herbicides coupled with inter culture method for controlling of weeds in Pigeonpea

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An experiment was conducted at Post Graduate Institute Farm, Mahatma Phule Krishi Vidyapeeth, Rahuri. in randomized block design with three replication and nine treatment. Weed intensity and weed dry matter at harvest was significantly less in weed free treatment followed by fluchloralin PPl 1.0 kg/ha plus glyphosate at 45 DAS were in second order. Whereas, weed intensity and weed dry matter was maximum in weedy check treatment (206.57/$m^2$ and 12.22 q/ha, respectively). Decoct Weeds were found higher in proportion than monocot weed. The weed control efficiency and weed index were influenced by various treatments. It was higher (75.64%) weed control efficiency and lower (14.06%) weed index in pendimethalin PE 1.0 kg/ha plus glyphosate 1.0 kg/ha at 45 DAS as compared to other treatments except weed free treatment. Beneficial effect due to above treatments on growth characters resulted in enhanced yield. Maximum values of yield attributes were observed in weed free treatment followed by IWM treatments *viz.,* pendimethalin PE 1.0 kg/ha plus hand weeding at 45 DAS, two hand weeding at 20 and 45 DAS and Pendimethalin PE 1.0 kg/ha plus glyphosate 1.0 kg/ha at 45 DAS. The seed yield of pigeonpea (22.98 q/ha) was maximum in weed free treatment followed by IWM treatment *viz.,* pendimethalin 1.0 kg/ha plus hand weeding at 45DAS (22.30 q/ha). Among the herbicide treatment pendimethalin 1.0 kg/ha PE plus glyphosate 1.0 kg/ha POE at 45 DAS recorded the highest yield.

## P-102 Effect of power weeding and nutrient management practices on the productivity of hybrid maize

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Field experiment was conducted at Agricultural College and Research Institute, Madurai during *kharif* 2007 to study the impact of power weeding and nutrient management on the performance of hybrid maize. Weed management practices *viz.,* hand weeding twice (20 & 30 DAS), power weeding once (25 DAS), power weeding twice (20 & 30 DAS), atrazine at 0.5 kg/ha + hand weeding (25 DAS), atrazine 0.5 kg/ha + power weeding (25 DAS) and unweeded check were included as main plot treatment. Nutrient management practices like 100% RDF, 125% RDF and 150% RDF were assigned to sub plots. Weed management and nutrient management practices had significant effect on weeds. Pre emergence application of atrazine at 0.5 kg/ha followed by one power weeding at 25 DAS with 100% RDF ($M_5$ $S_1$) recorded the minimum total weed density of 72.6, 15.6 and 21.8/$m^2$, respectively. Pre emergence application of atrazine 0.5 kg/ha followed by one power weeding at 25 DAS coupled with 100% RDF ($M_5$ $S_1$) reduced DMP of total weed significantly with the value of 82.0, 16.6 and 44.6 g/$m^2$ at 20, 40 and 60 DAS, respectively. The combined effect of pre emergence application of atrazine 0.5 kg/ha followed by one power weeding at 25 DAS with 100% RDF registered minimum weed dry matter accumulation and nutrient depletion by weeds and registered higher grain yield of 6684 kg/ha and straw yield of 13792 kg/ha. Higher net return (33458 Rs/ha), benefit cost ratio (2.45) and labour productivity (5.39).

## P-103 Weed management in kodo millet (*Paspalum scrobiculatum*) through integrated approach under rainfed condition

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Kodo millet is traditional crop of bastar region under rainfed condition and grown with onset of monsoon. Weed flora germinate and compete with main crops because kodo kodo millet germinate 4-5 days later than other millets, this is one reason to incorporate the integrated approaches for controlling weeds in upland situation. Tillering capacity of kodo millet is drastically affected by increasing weed density during critical of crop weed competition periods. In such situation, weed flora lead to drastic reduction of yield potential of kodo millet which gradually become a serious problem for getting higher productivity. The field experiment was laid out in randomized block design with three replications during the *kharif* season of 2008 comprising 12 treatment combinations at S.G. College of Agriculture and Research Station, Jagdalpur. Variety *JK 155* was taken as test crop at 25 cm apart rows seeding. *Echinocloa colona*, *Digitaria sanguinalis, Brachiaris species,* and *Aegeratum conizoidus L., Celosia argentia, Tridex prcubens, Euphorbia genicnlata* were prominent monocot and dicot weeds in kodo millet. Summer ploughing is very effective against initial suppression of weed flora upto 50% and application of isoproturon 0.75 kg/ha as pre- emergence was also found effective against monocot and dicot weeds over weedy check. Application of isoproturon 0.5 kg/ha pre emergence +one intercultivation (20 DAS) resulted significantly higher grain yield.

## P-104 Integrated Weed management in finger millet (*Eleusine indica* L. Gaerth) under rainfed condition.

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Finger millet is livelihood support crop of Bastar region under rain fed cultivation. Weed infestation in upland crops is very common during critical period of 20-35 days after sowing. With occurring of every rain shower, weeds germinate fastly and effective measures need to manage the weed flora. Hardiness of finger millet comes later which may suppressed to weeds, but initial stage of crop plant affected more before establishment. Hence this provides favorable conditions for weed multiplication and a wide spectrum of heterogeneous weed flora, which gradually become a serious limitation for high productivity of finger millet. The field experiment was conducted during the *kharif* season 2007 at S.G. College of Agriculture and Research Station, Jagdalpur. Twelve treatments combinations were laid out in randomized block design with three replications. The test variety *Ratnagiri* was sown on 30 cm apart in rows during June with onset of rain. The major weeds observed in finger millet were *Echinocloa colona*, *Digitaria sanguinalis, Brachiaris species, Cynodon dectylon* and *Aegeratum conizoidus L., Amaranthus virdis, Celosia argentia, Tridex prcubens Commelina benghalensis, Euphorbia geniculata*. Application of isoproturon 0.5 kg/ha as pre-emergence or combination is very effective against monocot and dicot weeds over weedy check. Application of isoproturon 0.5 kg/ha pre emergence + one hand weeding (20 DAS) was resulted significant higher grain yield.

## P-105 Evaluation of New Molecules of Herbicides in Soybean

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Among the various constraints in soybean cultivation, the weeds are considered the most important in reducing yield and quality of soybean. The losses may vary with the intensity, density and type of weed flora present under different agro-climatic conditions. The reduction in yield may vary from 60- 80 per cent, were observed when crop was left with grass cover and these losses were dependent on weed species, their intensity and time of infestation. Therefore, to harvest a good yield, weed control during the crop growth is essential. Weeds compete with soybean for moisture, light, nutrients and space and also hamper operation of equipment, harbor crop pests such as insects and diseases, and contaminate harvested grain with foreign matter and weed seeds. Therefore, a trial was conducted to evaluate new molecules diclosulam and Quizalofop-p-ethyl to control weed flora in soybean field. Herbicides *viz.* Diclosulam 84 WDG of different levels *viz.* 14, 22 and 30 g/ha, respectively, as pre emergence, Pendimethalin 30EC 1.0 kg/ha as pre emergence, Quizalofop-p-ethyl 5 EC 50 g/ha as post emergence, Imazethapyr 10% SL at 75 g a.i./ ha as post emergence, hand weeding at 20 and 45 days after sowing, weed free and weedy were the some treatments taken in the experiment. There was no significant effect of treatment on seeds/pod and seed index. Among the test herbicides, Diclosulam 84 WDG 22 g/ha as PE produced maximum yield and was *at par* with two hand weeding at 30 and 60 days after sowing and significantly superior over Pendimethalin and Imazethapyr. Plant height was maximum with Pendimethalin 30EC 1.0 kg/ha, branches/plant and pods/plant with Diclosulam 84 WDG 30 g/ha and straw yield and harvest index were maximum with two hand weeding at 30 and 60 days after sowing, respectively. The monocot, dicot and total weed density at 30 and 60 days after sowing as well as total weed dry matter at both the stages were zero in Diclosulam 84 WDG 22 and 30 g a.i. /ha as pre emergence and two hand weeding at 30 and 60 days after sowing. The weed control efficiency (WCE) of test herbicides, Diclosulam 84 WDG 22 and 30 g/ha as pre emergence was 100 per cent at 30 and 60 days after sowing while of Quizalofop-p-ethyl 5 EC 50 g/ha as post emergence, it was 16 and 64 per cent at days after sowing, respectively.

## P-106 Growth and nutrient uptake of transplanted *rabi* rice, weeds as influenced by different weed management practices

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A field experiment was conducted at the College Farm, college of Agriculture, Rajendranagar, Hyderabad during *rabi* 2005. The soil of the experimental site was sandy clay loam in texture with a medium content of organic carbon, nitrogen and phosphorus, high in available potassium status and slightly alkaline in reaction (pH 8.1). The experiment was laid out in a randomized block design replicated thrice with 12 weed control treatments. The results indicate that hand weeding at 20 and 40 DAT recorded highest plant height , dry matter production, tillers/$m^2$, nutrient uptake by crop and lowest nutrient uptake by weeds through out the crop growth period. Among the herbicidal treatments during active tillering stage (around 25 DAT) the pre-emergence application of anilophos 0.4 kg/ha and oxadiargyl 70 g/ha was effective in recording higher growth parameters, while at later stages (maximum tillering to harvest) anilophos 0.3 kg/ha + one HW at 25 DAT and oxadiargyl 50 g/ha + one HW at 25 DAT were the best treatments. The highest grain and straw yield was registered by hand weeding at 20 and 40 DAT followed by anilophos 0.3 kg/ha + one HW at 25 DAT and oxadiargyl 50 g/ha + one HW at 25 DAT.

## P-107 Integrated weed management in *kharif* groundnut (*Arachis hypogaea* L.) under Saurashtra region

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Groundnut (*Arachis hypogaea* L.) is an important oilseed crop of tropical and sub tropical regions of the worlds. It is regarded as "King of Oilseed crops" on the accounts of its diversified uses. In Saurashtra region of Gujarat mainly groundnut grown during *kharif* season. Slow initial growth and wide row spacing; crop is heavily infected by weeds. Various weed control methods are adopted for weed control, but newly available pre and post emergence herbicide efficacy is not tested in this region and therefore present experiment was planned and executed. On the bases of pooled results highest pod & haulm yields of groundnut, lowest dry weeds weight, highest weed control efficiency, maximum gross and net realization over three years were recorded when weed were control by carried out four hand weddings at 15, 30, 45 and 60 days after sowing, followed by pre emergence application of pendimethalin 1.0 kg/ha + 1 HW & 1 IC at 30 DAS. Where, pre emergence herbicide spray could not performed, post emergence application of quizalofop-ethyl 40 g/ha at 25 DAS + 1 HW & 1 IC at 45 DAS found best herbicides for effective and economical integrated weed management for *kharif* groundnut.

## P-108 Integrated weed management Practices in wheat

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The field experiment was carried out during the *rabi* seasons of 2004-2005 and 2005-2006. Thirty six treatments comprised of three methods of sowing (broadcast, line sowing and cross sowing), three levels of seed rate (100, 125 and 150 kg/ha) and four weed management practices (weedy check, weed free, isoproturon at 1.0 kg/ha alone and in combination with 2, 4-D Na salt at 0.50 kg/ha post emergence) were laid out in split plot design.Herbicide mixture *i.e.* isoproturon at 1.0 kg + 2, 4-D Na salt at 0.5 kg/ha (tank mix) applied as post emergence proved its superiority over the use of isoproturon alone at 1.0 kg/ha and both were better than unwedded check by reducing the weed density, weed fresh and dry weight as well as nitrogen uptake by weeds. Various weed management practices did not show significant effect on initial plant population, functional leaves/plant and days taken to 50% heading and maturity. Significant increase in number of tillers/plant at 90$^{th}$ day and at harvest, plant height, leaf area index, fresh and dry weight of plant at 60$^{th}$, 90$^{th}$ and harvest stages were recorded with weed free and isoproturon at 1.0 kg/ha either alone or in combination with 2,4-D Na salt at 0.50 kg/ha than weedy check. weed free closely followed by isoproturon at 1.0 kg/ha + 2, 4-D Na salt at 0.50 kg/ha enhanced weight of grains/spike, number of spikelets/spike number of grains/spike and 1000 grain weight . Application of isoproturon at 1.0 kg/ha + 2, 4-D Na salt at 0.50 kg/ha which was at par with weed free provided higher grain, straw and biological yields. The increase in grain yield by weed free, isoproturon + 2, 4-D Na salt (1.0 + 0.50 kg/ha) and isoproturon alone at 1.0 kg/ha unwedded check was 48.16, 39.82 and 43.17 per cent in first year and 44.88, 35.47 and 42.92 per cent in second year, respectively.

## P-109 Effect of crop establishment methods and weed management practices on weed growth and productivity of aromatic rice (Basmati 370) in the Lateritic Belt of West Bengal

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A field study was undertaken on aromatic rice cv. Basmati 370 during rainy season (*kharif*) of 2008 at Sriniketan, West Bengal in a clay-loam soil, slightly acidic (pH 6.0) having medium organic C (0.73%) and medium to low fertility. Three crop establishment methods [Drum Seeding (DS), System of Rice Intensification (SRI) and Conventional Transplanting (CT)] were assigned in main plots and four weed management practices [Weed-free Check (WFC), Weedy Check (WC), Pyrazosulfuron ethyl (PSE) at 20 g/ha, Cono weeder (CW) twice at 15 and 30 DAS/DAT, Combination of Pyrazosulfuron ethyl (PSE) at 20 g/ha and Cono weeder twice (PSE + CW) and Almix (Metsulfuron methyl 10 % + Chlorimuron ethyl 10 %) at 4 g/ha] in sub-plots; replicated thrice. *Hydrolea zeylanica, Ludwigia parviflora, Sphenoclea zeylanica, Monochorea vaginalis, Sagittaria sagitifolia* and *Marsilea quadrifolia* among broadleaved (62.56 %); *Cynodon dactylon* and *Echinochloa colona* under grasses (21.45 %) and *Cyperus iria, C. difformis* and *Fimbristylis miliacea* among the sedges (15.98 %) were predominant. *Hydrolea zeylanica* was the most predominant species in SRI as well as Conventional Transplanting method while *Fimbristylis miliacea* was in Drum Seeding. SRI recorded significantly lower number as well as dry weight of total weeds at 40 DAS/DAT, the highest number of panicles (13.65/hill) and filled grains (96.92/panicle) producing the highest grain yield (3001 kg/ha), 18.84 and 28.65 % more than in CT and DS methods respectively. Pyrazosulfuron ethyl in combination with Cono Weeder recorded the lowest weed population and dry weight at 40 DAS/DAT, higher grain yield (2782 kg/ha), 25.13 % more over weedy check and was equivalent to Pyrazosulfuron ethyl alone and Almix.

## P-110 On-farm integrated management of broad spectrum weeds in irrigated groundnut under red sandy loam soils

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Groundnut is one of the most important oilseed crops grown for variety of purposes. Weed competition is maximum during the early stages of groundnut crop because of slow initial growth and less foliage cover. Weeds in groundnut crop not only compete with the crop for nutrients, water, and light, but also interfere with harvesting of the crop. The critical period of weed competition is to be 2-6 weeks after sowing. Cultural method or use of herbicide alone may not provide better weed free environment. For controlling fresh flush of weeds appearing relatively at later stages, use of herbicides plus hand weeding is found effective. Considering the importance, integrated weed management was conducted on farmers field at five locations during *rabi* season 2006-07.The treatments were ($T_1$) - pre-emergence pendimethalin 1.0 kg/ha + HW on 45 DAS , ($T_2$) - pre plant incorporation of fluchloralin 1.0 kg/ha + HW on 45 DAS , ($T_3$) - HW on 20 and 45 DAS, ($T_4$) - unweeded control. Results revealed that weed dry weight was lower with pre-emergence application of pendimethalin 1.0 kg/ha + HW on 45 DAS in all the five locations and the herbicide was more effective for broadleaved weeds than grasses and sedges. Groundnut pod yield, stover yield, economic returns were higher with pre-emergence application of pendimethalin 1.0 kg/ha + Hand Weeding on 45 DAS were comparable with other weed management methods.

## P-111 Saponin glycosides: a potential herbicidal phytochemicals in integrated weed management

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Increasing global concern about the indiscriminate use and hazards of deadly poisonous synthetic herbicides has prompted exploration of natural plant products in the management of weed pest of forests, agricultural fields as well as barren lands. Saponins are glycosidic secondary metabolites, present in more than one hundred plant families, possess tremendous biological activities and have commercial application especially in medicine/pharmacy. Neoil bearing forest seeds are the potential source of saponin glycosides. Saponins were isolated from three neoil bearing forest seeds *viz*.,*Maduca indica*, *Sapindus mukrossi* and *Jatropha curcas* and their herbicidal activities were assessed under laboratory conditions at different dilutions against *Ecinochloa colanum*, a notorious weed of Silvi- agri ( Babul- Paddy) agroforesty model. The effect of dilutions *viz*., 2.5, 5, 10% of saponin isolates on germination %, root and shoot length were recorded. The incorporation of 2.5 % concentration of saponin dilutions of different species drastically reduce germination (35-47%) as compared the control. No root formation was recorded in each treatment while 60.09-94.95% shoot length inhibition over control (3.27 cm) was recorded in different treatments. Screened species grow luxuriantly in tropical region and easily available source for the isolation of saponins which can be utilized as a lead molecule for the synthesis of safer, eco-friendly and more economical weed control agents.

## P-112 On-farm integrated management of predominant in irrigated maize under *vertisols* in western zones of Tamil Nadu

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Maize is the world's preeminent grain crop. It is widely used for animal feed and industrial raw material in the developed countries. Weed menace is high in maize because of the crop is heavily fertilized, wide spaced and slow initial growth. Losses caused by weeds are more during the early stages than in the later stages. Mechanical weeding is good for root aeration but continuous rains in *kharif* season poses a serious problem in which the soil becomes wet and any agricultural operation cannot be done. Under such conditions weed grow luxuriantly and they do permanent harm to the crop before they are controlled. Therefore integrated weed control measure is essential for taking care of weeds from initial stage of growth. Hence the on farm trial was conducted in five locations to identify suitable combination of chemical and cultural method of weed managing in irrigated maize. The treatments were ($T_1$) - PE atrazine 0.5 kg/ha on 3 DAS + HW on 40 DAS, ($T_2$) - PE alachlor 1.0 kg/ha on 3 DAS + HW on 40 DAS, ($T_3$) - HW on 20 and 40 DAS (farmers practice) and ($T_4$) - unweeded control. From that above treatments($T_1$)- PE atrazine 0.5 kg/ha on 3 DAS + HW on 40 DAS was found to be effective weed control combination in all locations and also lower weed dry weight on 40 DAS compared than other combination. In case of yield and economics the ($T_1$)-PE atrazine 0.5 kg/ha on 3 DAS + HW on 40 DAS gave higher yield and economic returns due to effective weeding and cost of weeding was less compared than other treatments in irrigated maize.

## P-113 Weed management in pigeonpea based intercropping systems in North- Eastern transition tract of Karnataka

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The region comprising Gulbarga and Bidar districts of Northern Karnataka is known as "Pulse bowl" of the state. Farmers usually cultivate pigeonpea as sole crop in Gulbarga district, while in Bidar district, pigeonpea based intercropping systems are popular and the crops like sorghum, blackgram, greengram, sesamum, *etc* are intercropped with pigeonpea. Bidar district lies in the North-Eastern transition zone of the state which receives frequent rains during monsoon. Hence, it is not possible to take up timely weeding operations because of untimely and incessant rains during critical crop-weed competition period which coincides with the period of weeding operations. As a result, the productivity of crops is reduced. Added to this, weed menace is severe when intercrops are cultivated with pigeonpea, which makes weeding operations more difficult. Therefore, experiments were conducted at Agricultural Research Station, Bidar, for two years (2001 and 2002) with the objective of working out suitable weed management strategies in pigeonpea based intercropping systems and such information is lacking in a system as a whole. The pooled analysis indicated that averaging across the pigeonpea based intercropping systems *viz.*, pigeonpea + blackgram, pigeonpea+greengram, pigeonpea+sorghum and pigeonpea+sesamum, the pre-emergence application of fluchloralin (1 kg/ha) along with two intercultivations (IC) gave significantly higher pigeonpea equivalent yields(1442 kg/ha), net returns(Rs 14704/ ha) and B:C ratio(2.02) and was on par with alachlor (1.5 kg/ha) with two IC (1426 kg/ha, Rs14546/ha and 1.99, respectively), and was significantly superior over pendimethalin (1 kg/ha) with two IC (1337 kg/ha, Rs 12751/ha and1.66, respectively) and over farmers' practice(1252 kg/ha, Rs 11676/ha and 1.57, respectively). The higher yields were attributed to lower dry weight of weeds and higher weed control efficiency in these treatments compared to farmers' practice. Studies indicated that herbicides have a great promise in increasing the productivity of pigeonpea based intercroping systems in North-Eastern transition zone of Karnataka.

## P-114 Integrated weed management in Asters

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A field experiment was conducted at College Farm, College of Agriculture, Rajendranagar, Hyderabad of Southern Telangana zone during *rabi*, 2008-09 to study the effect of integrated weed management practices on yield and economics of Asters. The experiment was laid out in randomized block design with three replications. The treatments include preemergence application of pendimethalin 1.0 kg/ha, alachlor 1.0 kg/ha, butachlor 1.0 kg/ha, pendimethalin 0.75 kg/ha *fb* hand weeding at 30 DAP, butachlor 0.75 kg/ha *fb* hand weeding at 30 DAP and alachlor 0.75 kg/ha *fb* H.W at hand weeding at 20 and 40 DAP and unweeded control. The results indicated that lowest weed dry matter and highest weed control efficiency (%) was recorded with hand weeding done at 20 and 40 DAP which was on par with pendimethalin 0.75 kg/ha *fb* H.W, Butachlor 0.75 kg/ha *fb* H.W and alachlor 0.75 kg/ha *fb* H.W and all these treatments were significantly superior to pendimethalin 1.0 kg/ha, butachlor (1.0 kg/ha) and Alachlor 1.0 kg/ha. The flower yield of asters in different treatments also indicated the same. Lowest flower yield was recorded with unweeded control due to heavy weed infestation. Pre-emergence application of pendimethalin at 0.75 kg/ha *fb* hand weeding at 30 days resulted in cost : Benefit ratio of 1:6.07 followed by either alachlor or butachlor 0.75 kg/ha *fb* hand weeding (1:5.85 and 1:5.81) and hand weeding twice (1:5:24).

## P-115 Non-chemical methods of weed management in maize-sunflower cropping system

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Weeds are the major deterrent to the development of a more sustainable agriculture system. Sustainable agriculture aims to incorporate the long term maintenance of natural resources and agricultural productivity with nominal adverse environmental impacts. It focuses on, optimal crop production with efficient management of internal resources while minimising the use of external inputs like fertilizer and chemicals. Maize-sunflower cropping system consisted of wide range of weed flora of the groups *viz*., grasses, sedges and broad leaved weeds. Majority of weed species differ widely due to soil type, season and cropping system. Both maize and sunflower should be free from weeds upto 60 days after sowing. Due to crop weed competition, yield loss ranging from 40 to 60 per cent in maize and 50 to 80 per cent in sunflower. Research on non-chemical weed management practices followed in maize-sunflower cropping system realize that non-chemical weed management practices offer not only good weed control but also higher net returns and benefit: cost ratio. In view of this, the paper briefly reviewed problems and prospects of non-chemical means of weed control with emphasis on the development of ecologically based weed management systems which supports agriculture over long run, improves environmental resources and creates a supply of healthy food supply.

## P-116 Weed management in direct seeded semi-dry with daincha dual cropping

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Rice, 'The stuff of life' is one of the most important food grains produced and consumed all over the world. Semidry rice cultivation holds special significance in the present day production systems with regard to saving in water consumption, time, labour, energy required for nursery and planting. Crop and weed seed germinate simultaneously in semidry rice and weed competition during critical period of crop growth is more severe. Loss in yield due to the absence of weed control measures in direct sown upland rice culture has been estimated to be upto 97 per cent. The present investigation was undertaken to study the influence of integrated weed management in direct seeded semidry rice. Field experiment was conducted at Agricultural Research Station, Bhavanisagar during 2004 and laid out in RBD with six treatments and four replication. The treatments are paired row sowing of rice, paired row sowing of rice + daincha and paired row sowing of rice under weeded and unweeded condition, normal sowing of rice with herbicide application (pendimethalin 1.0 kg/ha) + hand weeding and normal sowing of rice + two hand weeding. Paired row sowing of rice + daincha under weed free condition recorded lesser weed density and dry matter at all the stages of observation, since daincha intercropping suppressed the weed infestation due to faster canopy cover. WCE was higher in paired row sowing of rice + daincha under weed free condition, which was comparable with normal sowing of rice with herbicide application + hand weeding.

# P-117 Effect of stale seedbed technique of weed management on yield and economics of cotton-green gram cropping system

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Field experiments were conducted at TNAU, Coimbatore to study the pre (Stale Seed Bed - SSB) and post sowing weed management practices on yield and economics of cotton-green gram cropping system. Pre sowing weed control treatments *viz.*, stale seedbed by glyphosate at 2.0 kg/ha, SSB by cultivation and conventional seed bed were assigned to main plots and the post sowing weed management practices *viz.*, hand weeding twice at 20 & 45 DAS, pendimethalin 1.0 kg/ha followed by one hand weeding on 45 days after sowing, pendimethalin 0.5 kg/ha *fb* one hand weeding on 45 DAS and un weeded check were studied in sub plots. Weed control treatments were imposed to cotton crop only and after the harvest of cotton, green gram was raised as a succeeding crop to study the carry over effect of weed control treatments imposed to cotton in the cropping sequence. For green gram, one hand weeding was done uniformly at 25 DAS.

The highest seed cotton yield of 1521 kg/ha was registered in SSB by glyphosate when compared to SSB by cultivation (1357 kg/ha) and conventional seedbed preparation (1128 kg/ha). In green gram, the yield reduction in conventional seedbed over SSB by glyphosate was 11.1% and with SSB by cultivation was 4.4%.

In cotton – greengram cropping system, SSB by glyphosate 2.0 kg/ha recorded higher net return and B:C ratio (Rs. 26418/ha and 2.15, respectively) when compared to SSB by cultivation (Rs.22829/ha and 2.05, respectively) and conventional seedbed (Rs.17445/ha and 1.83, respectively).

SSB by glyphosate either with hand weeding (or) pendimethalin 1.0 kg/ha *fb* one HW on 45 DAS recorded maximum and similar B:C ratio of 2.34 followed by SSB by glyphosate + pendimethalin 0.5 kg/ha *fb* one HW on 45 DAS (2.30). SSB by glyphosate +pendimethalin 0.5 kg/ha *fb* one HW on 45 DAS registered comparatively higher B:C ratio of 2.30 than SSB by cultivation (2.05) and conventional seedbed preparation (1.83) with all the post sowing weed management treatment combinations. So there is possibility of reducing/half of the dose of recommended pendimethalin to cotton crop and one hand weeding to green gram by adopting pre sowing SSB technique.

## P-118 Effect of stale seedbed technique of weed management on weeds and yield of cotton

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Field experiments were conduced at TNAU, Coimbatore to study the pre and post sowing weed management practices on weed density and yield of cotton. Pre sowing weed control treatments *viz.*, stale seedbed (SSB) by glyphosate 2.0 kg/ha, SSB by cultivation and conventional seed bed were assigned to main plots and the post sowing weed management practices *viz.*, hand weeding twice at 20 & 45 DAS, pendimethalin 1.0 kg/ha followed by (*fb*) one hand weeding on 45 DAS, pendimethalin 0.5 kg/ha *fb* one hand weeding on 45 DAS and un weeded check were studied in sub plots. Over the growth stages of cotton (40 and 120 DAS observations were pooled) the lowest weed density and weed dry weight was recorded in SSB by glyphosate (86.3 $m^{-2}$ and 156.8 kg/ha, respectively) when compared to SSB by cultivation (106.4 $m^{-2}$ and 192.3 kg/ha, respectively) and conventional seed bed (141.8 $m^{-2}$ and 288.4 kg/ha, respectively). Among the post sowing weed control methods, lower weed density and dry weight was registered in hand weeding twice (58.2m and 92.1 kg/ha, respectively) and it was comparable with pendimethalin 1.0 kg/ha *fb* one HW on 45 DAS treatment (58.8/m and 103.9 kg/ha, respectively). With regard to relative density of weeds, the minimum relative density of sedge (11.5%), grass (17.7%) and maximum broad leaved weed density (70.9%) was recorded in SSB by glyphosate applied plot. SSB by glyphosate registered the highest seed cotton yield of 1521 kg/ha when compared to SSB by cultivation (1357 kg/ha) and conventional seed bed (1128 kg/ha). Post sowing weed management practices also caused substantial variation in seed cotton yield. HW twice at 20 and 45 DAS resulted in maximum seed cotton yield of 1639 kg/ha which was on par with pendimethalin 1.0 kg/ha *fb* one HW on 45 DAS (1614 kg/ha). Generally, pendimethalin 0.5 kg *fb* one HW on 45 DAS recoded 9.16% lower seed cotton yield when compared to pendimethalin 1.0 kg/ha *fb* HW. Interaction effect of pre sowing weed control through SSB by glyphosate with post sowing method of hand weeding twice recorded significantly higher seed cotton yield (1815 kg/ha) and was comparable with pendimethalin 1.0 kg/ha *fb* one HW on 45 DAS (1798 kg/ha). Pendimethalin 0.5 kg/ha *fb* one HW on 45 DAS with SSB glyphosate exhibited higher seed cotton yield (1701 kg/ha) than that of conventional seed bed + HW twice (1435 kg/ha).

## P-119 Role of Adjuvants to over come cuticular barrier and improving herbicide use efficiency

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Improving entry and translocation of herbicide to the targeted site leads to enhanced herbicide use efficiency (HUE), thus drastic reduction of dosage and pollution of foliar herbicide is possible. Physicochemical property of cuticle, herbicide and their interaction traps the polar herbicides in droplet on foliage or by different layers of cuticle which acts as 3 D ion trap. Thus herbicide molecule is non-available for the diffusion and partition between different layers of cuticle. The role of adjuvants to overcome cuticular barrier, increase free herbicide molecule for diffusion and enhance HUE were discussed.

## P-120 Studies on varietal variation of rice crop in grain yield due to weeds and their management practices

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Rice is cultivated under the area of 21 lakh hectare in all over Tamil Nadu and consider as a major staple food in India. Yield losses of rice crop due to weed density are estimated to be 15-40 % in transplanted rice. Weeds in rice farming are managed through either manual weeding or herbicide application to enhance rice growth without weed competition. Weed management trails were carried out in the Department of rice, Tamil Nadu Agricultural university and Coimbatore during the year of 2005 – 06. The treatment details as follows. $T_1$- Butachlor; $T_2$- Two hand weedings; $T_3$- Weed free, and T4- Unweeded check. In the variety CO-47, un-weeded check recorded grain yield of 3.14 t/ha. Butachlor application recorded 38.2 %, two hand weedings 43%, weed free recorded 28.7% higher grain yield compared to un-weeded check. In ADT-43, unweeded check recorded grain yield of 4.98 t/ha. Butachlor application recorded 10.4 %, two hand weedings 17.3%, weed free recorded 10.1% higher grain yield compared to un-weeded check. During the year of 2005, the *kharif* seasonal variation of CO-47 variety unweeded check recorded grain yield of 3.23 t/ha. Butachlor application recorded 22.0%, two hand weedings 35.9%, weed free recorded 25.7% higher grain yield when compared to unweeded check. In the same year during *rabi* season, with CO-47 variety unweeded check recorded grain yield of 3.05 t/ha. Butachlor application recorded 55.4%, two hand weedings 50.5%, weed free recorded 31.8% higher grain yield when compared to un-weeded check. Hence, weed density and their management practices significantly influence the grain yield of rice varieties.

## P-121 Parthenium (*parthenium hysterophorus*) management in mulberry

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Mulberry, the sole food plant of domesticated silkworm, Bombyx mori L. is affected by various annual and perennial weeds. Among them, the Parthenium hysterophorus is notorious one which is a prolific seed producer with seeds having long storage life and can quickly disperse through wind. It causes an estimated leaf yield loss of about 21 per cent in mulberry. Since an integrated practice is needed for its efficient management, the following methods are advocated in mulberry plantation. Hand pulling once the weed emerges from the soil, cutting the plants and composting to make the seeds lose their viability due to the higher temperature during composting, releasing Zygogramma bicolorata, a leaf eating beetle to feed on the leaves, spraying of common cooking salt solution @ 15-20 per cent concentration and application of 2,4-D @ 2-5 kg a.i/ ha along with wetting agent at active growth stage. Mulching with organic resources which is having smothering effect on weeds by restricting the photosynthesis. It also conserves moisture, lower surface temperature, fertilize the soil, protect from rainy season and improve the soil quality.

## P-122 Weed dynamics and yield of groundnut + castor intercropping system under rainfed conditions

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Field experiments were conducted at North West and Western zones of Tamil Nadu during *kharif* season to study the Seed hardening techniques and weed management for productivity enhancement in Groundnut + castor intercropping system under rainfed conditions. In Kharif 2003 and 2004 the effect of seed hardening in groundnut (0.5 per cent $CaCl_2$ and normal seed) and weed management practices (unweeded check, hoeing and weeding on 20 and 40 DAS, weeding with star type weeder on 20 DAS + hoeing and weeding on 40 DAS, pre-emergence application of pendimethalin at 1.0 kg/ha + hoeing and weeding on 40 DAS and pre-emergence application of metolachlor at 1.0 kg/ha + hoeing and weeding on 40 DAS) in groundnut + castor inter cropping system**.** In respect to groundnut, seed hardening with 0.5 per cent $CaCl_2$ treatment recorded the highest speed of emergence, field emergence, vigour index, plant height, LAI, CGR, RGR, DMP, number of matured pods, pod yield and haulm yield. Irrespective of the locations chlorophyll content, soluble protein, hundred kernel weight and oil content were however not influenced by $CaCl_2$ seed hardening. Among the weed management practices studied, pre-emergence application of metolachlor at 1.0 kg/ha + hoeing and weeding on 40 DAS recorded the highest weed control efficiency and lowest weed dry matter production at 20 DAS, while at 40 DAS hoeing and weeding on 20 and 40 DAS recorded the highest weed control efficiency. the overall experimental results it is concluded that groundnut seeds treated with 0.5 per cent $CaCl_2$ and pre-emergence application of metolachlor at 1.0 kg/ha followed by one hoeing and weeding on 40 DAS increased the yields of groundnut and castor crops during *kharif* season.

## P-123 Integrated weed management system for winter maize + potato intercropping system

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A field experiment was carried out at Crop Research Centre, Rajendra Agricultural University, Bihar, Pusa to find out the suitable, economical and integrated weed management practices for maize + potato intercropping system. The major weed flora observed in the experimental plots were *Cynodon dactylon, Polypogon monspliensis, Cyperus rotundus, Parthenium hysterophorus, Cannabis sativa, Anagallis arvensis* and *Melilotus alba*. The pooled data of three years, 2005-06, 2006-07 and 2007-08 of experimentation revealed that the maximum maize equivalent yield and the maximum net return were recorded in the treatment of two hand weeding (25 and 55 DAS) which were at par with the treatment metribuzin 0.5 kg/ha followed by one earthing up. The application of 0.5 kg/ha metribuzin followed by one earthing up was found to be the most effective and remunerative for controlling the weeds in the field of maize + potato intercropping system and for higher productivity and net return of the intercropping system. During the course of investigations it was observed that the application of Atrazine reduced the yield and size of potato tubers.

## P-124 Value added secondary metabolite from botanical agents to suppress parthenium

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Use of allelochemical releasing botanical agents to suppress parthenium is well known. From several botanical agents best available agents were *Lantana camara, Hyptis suaveolens* are most effective than recommended *Cassia uniflora*. Dry leaf methanol (20 % in water) or aqueous extract or leaf surface washings or decomposed plant material observed to be effectively suppress seed germination and growth of parthenium but no effect rather stimulatory effect on growth and development of sunflower and tomato seedlings under petri-dish condition. Colonization of these agents or continuous supply either by root exudation or by decomposing plant material is must to suppress parthenium under field condition. *Cassia* sps can be colonized being annual but other two agents being perennial in nature can not be used. However, mulching of fresh above plant parts (2.5 ton/ha) or decomposed for 30 days of *L. camara* or 20 days of *C. uniflora* or 10 days for *H. suaveolens* can be effectively used to suppress the growth of parthenium under field condition. Pelleting of effective organic extracts (methanol>chlororom>hexane) from dry leaf of any botanical agents has to be standardized. Two triterpenoids compounds, which are secondary metabolite from chloroform and from hexane fractions, were purified. Confirmation work using purified compound being carried out.

## P-125 Effect of herbicides on soil health and microbial population in chickpea under rice-chickpea cropping system

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A field trial was conducted in a randomized block design with three replication with an objective to study the effect of herbicides on soil health and microbial population in chickpea of the experimental field at Agronomy Research Farm of the University during kharif 2008. The soil of the experimental field was silt loam in texture and medium in fertility with a pH of 8.1, EC 0.22 $dsm^{-1}$, OC 0.32%.The treatment comprised of four weed control measures(weedy check, mechanical, weeding 2 HW,pendimethalin 1kg/ha, pendimethalin 1kg/ha+ 1HW).The rhizophoric soil samples were collected randomly from each plot at 0, 30 DAS and at harvest stage and were analysed for soil, pH, EC, OC, total bacterial and fungal population as influenced by various treatments.

Results revealed that during *rabi* season among various weed control measures highest microbial population were recorded under mechanical weeding (2 HW) and lowest in weedy check at all the stages. There were non significant variation observed due to various treatments in affecting soil health (pH, EC and OC) in the soil at various crop stages.

## P-126 Effect of 2,4-D application of late sown verities of wheat

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A field experiment was conducted during *rabi* season of 2007-08 at Agronomy Research Farm of N.D. University of Agriculture and Technology, Kumarganj, Faizabad-224229, Uttar Pradesh to findout the effect of 2, 4-D applied at various growth stages on different varieties of wheat and their performance under late sown condition of eastern Uttar Pradesh. Field experiment was conducted in split plot design taking stages of 2, 4-D application (25$^{th}$, 35$^{th}$ and 45$^{th}$ day of sowing and control) in main plot and wheat varieties (PBW 373, NW2036, HUW234, K7903, Raj 377 and Raj 3765) in sub-plot. Control plot was kept weed free after 35$^{th}$ day of sowing. 2, 4-D amine salt was applied as per treatement. *Phalaris minor, chenopodium album, Medicago denticulata, Melilotus indica* and *Rumex* sp. were the major weed species in weedy plot. 2, 4-D applied at 25$^{th}$ day of sowing caused significant reduction in the density and dry weight of broad leave weeds as compared to 2,4-D applied at 35 and 45$^{th}$ day of sowing. However, density and dry weight of narrow leave weeds did not influenced due to 2,4-D applciation. All the growth and yield contributing characters *viz*., plant height, dry matter accumulation, LAI, spike length, grains spike and test weight as well as grain and straw yield were recorded significantly higher with weed free being at par with 2, 4-D applied as 35$^{th}$ days stage as compared to rest of treatments. Spike deformities were recorded when the 2,4-D was applied at 25$^{th}$ day stage only and highest deformities recorded in variety PBW 373; while other varieties did not show any visible difference in plant phenotype. Among the wheat varieties, variety HUW-234 being at par with NW 2036 recorded significantly higher growth and yield attributes as well as grain and straw yield as compared to other varieties.

## P-127 Effect of time of sowing and weed control methods on direct seeded rice

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A field experiment was conducted during Kharif season of 2008-09 at Agronomy Research Farm of Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad (U.P.) to evaluate the efficacy of different herbicides *viz.*, pretilachlor 0.5 kg /ha (PE), butachlor 1.5 kg /ha (PE) + one hand weeding at 30 DAS, fenoxaprop 0.06 kg /ha (post emergence) and *sesbania* (broadcast) + 2,4-D 0.5 kg /ha at 30 DAS under two sowing times *viz.*, 25$^{th}$ June and 5$^{th}$ July and their effect on weeds, crop growth, yield and economics of rice. Weed free and weedy check were also included in the experiment. The field experiment was laidout in split plot design with three replications. Rice variety "NDR-97" was sown by broadcast method with recommended doses of fertilizers, 120 kg N, 60 kg $P_2O_5$ and 60 kg $K_2O$. *Echinochloa colona and E. crusgalli* among grasses, *Commelina benghalensis* among non-grasses and *Cyperus rotundus* among sedges were the predominant weeds in experimental field. Uncontrolled weeds in weedy check plots caused on an average reduction in grain yield 64.82 per cent over weed free plots. The lowest weed population and dry weight are recorded in 5$^{th}$ July, sown crop over 25$^{th}$ June, sown crop. Highest yield attributes and grain yield (24.45 q /ha) were recorded in 05$^{th}$ July, sown crop. Pre-emergence application of butachlor 1.5 kg /ha + one hand weeding at 30 DAS, produced highest grain yield (29.27 q /ha). Pretilachlor 0.5 kg /ha and fenoxaprop 0.06 kg /ha also gave effective control of weeds and higher grain yield. Butachlor 0.5 kg /ha + one hand weeding at 30 DAS found superior over all other weed control treatments, in reducing population and dry matter of weeds and it leads to highest grain yield which ultimately fetched higher net return.

## P-128 Impact of demonstration on weed management technology in maize

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Maize is one of the important food, green forage and industrial crops of the world. It has been considered a promising option for diversifying agriculture in upland area, and in India it is placed as the third most important food grain crop. The normal area for maize in India is 62 lakh hectares and 80% of it is cultivated under rainfed conditions. The present level of maize productivity in Madhya Pradesh is low as compared to the yield obtained at national and world level. The low productivity level of maize in Madhya Pradesh are primarily due to the reasons that hybrids varieties and other modern farm practices including improved weed management are not yet used extensively in the state. In recent years, severe weed menace in maize resulted in reduction in productivity, quality and income to farmers. Therefore, an attempt was made to address the weed management issue with its implications. Thirty five field demonstration on weed control technology were laid out during *kharif* of 2006 to 2008 in maize at purposively selected three villages (Kushner, Tagar and Barouda) of Panagar Block, Jabalpur, with a objective to show the performance and profitability of proven weed control technologies *viz.* atrazine at 1.0 kg/ha, atrazine at 1.0 kg/ha + 1 H.W. at 45 DAS and hoeing at 30 DAS on weed growth and productivity of maize at farmers fields. The weed management technology under demonstration were found effective in increasing grain yield of maize by 10-39% over farmers practice (manual weeding) depending upon the intensity and growth of weeds. Benefits over the treatment were varied from Rs. 4500 to 8000/- per hectare. During the period of field demonstration, it was observed that few resourceful farmers were aware of the role of improved weed management technology in enhancing the over all crop productivity. It was also noted that farmers practice, *i.e.* manual weeding, being adopted at inappropriate stages of crops, which has no relevance over the crop yield and economy. During survey, it was realized that despite the technological development in the field of weed science, the rational behind the conventional agricultural system is to derive the crop yield only through basic weed management strategy, *i.e.* manual weeding, owing to various social, economical and other constraints prevailing in the rural areas.

## P-129 Effects of intercrops on weed density in mulberry plantation

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The leaf yield of mulberry (*Morus alba* L.) is reduced by 20 to 25 per cent due to the weeds infestation. An investigation was carried out by intercropping the mulberry plantation with the aim of reducing the yield loss caused by weeds and increasing the leaf production. Among the various intercrops studied, the clusterbean recorded least density of 13 weeds/$m^2$ followed by cowpea (16 weeds/$m^2$) and green gram (23 weeds/$m^2$). These were found to be statistically superior over the control plot which recorded the density of 54 weeds/ m2. Intercropping with clusterbean enhanced the plant height, number of branches/ plant, number of leaves/ plant and leaf area index. It also effected an increase of 16 per cent in the leaf yield of mulberry with highest benefit cost ratio was 1.48.

## P-130 Potential of microbial bioherbicides in the biological management of weeds

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Microbial bioherbicides are potential plant pathogens that cause significance damage to the weeds by feeding on the plants. Biological control of weeds with plant pathogens is the deliberate use of host specific pathogens to reduce the population density of the weeds below its economic or ecological injury level. It is an effective, safe, and selective means of weed management. Once successfully established it is considered to be the best and safest long-term solution to the weed problem, which can be both environmentally and economically sustainable in the long run. During the last two decades biological control of weeds have received significant attention among the workers and policy planners mainly because of the following important considerations *viz.*, increased dependence on the herbicides due to decreased/ non-availability of cheap labour, increased awareness among the farmers and consumers for organic cultivation of edible crops, more income potential of organic produce, emergence of herbicide tolerant weeds and problems of contamination of land and water by the excessive use of herbicides. The main criteria for a successful bioherbicide are that they should be host specific, does not pollute the environment, should disseminate themselves easily and should have the capability to sustain even in the absence of the host. However since the plants always tend to defend themselves against their parasites by evolving new resistance mechanisms, the biocontrol agents should have multiple mechanisms for attacking the plants like secretion of enzymes, toxins etc. Rust fungi are the most preferred agent in the biological weed management programmes. They have huge damage potential on the hosts, wind disseminated and have high degree of host specialization. However despite intense research efforts on microbial bioherbicides, only a very few commercial products are available world over. The main limitations of biological weed control are the lack of effective native bioagents to imported weeds, vulne*rabi*lity of the imported bioagents in the new environment, technical difficulties in mass production, formulation and delivery systems. To overcome all these problems the following strategies like development of effective pathogens using molecular techniques, advancement in the formulations and delivery systems using nano technology, use of effective metabolites of potential microbes and stepping up of research in the field of bioherbicides have to be followed.

## P-131 Using Chlorophyll Fluorescence to study the effect of sulfosulfuron and surfactants on *Phalaris Minor*

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Chlorophyll fluorescence has been used widely to detect the effect of herbicides in crops and weeds as it is a simple, sensitive and non-destructive method. Among the chlorophyll fluorescence parameters, maximum quantum efficiency, $F_v/F_m$, can be used to study the effects of herbicides as well as to monitor the development of herbicide resistance in weeds. In the present study, an attempt was made to assess the effectivity of sulfosulfuron, a sulfonylurea herbicide, in controlling *Phalaris minor,* a notorious weed of wheat crop in the Indo-Gangatic plains. Sulfosulfuron is very effective in controlling the isoproturon resistant population of *P. minor*. Differences in $F_v/F_m$ values were observed among the control and treated plants within a week after treatment.

## P-132 Effect of herbicides on soil health and microbial in population in direct seeded rice under rice-chickpea cropping system

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The field experiment was conducted during kharif season of 2008-09 at Agronomy Research Farm, N.D.University of Agriculture and Technology, Kumarganj, Faizabad (U.P.) to study the effect of herbicides on soil health and microbial population in direct seeded rice. Soil at the test site was silt loam, with pH 8.14, EC 0.21 $dsm^{1}$,) OC 0.32%, available NPK 170.2, 18.2 and 252 kg /ha respectively. The experiment was laid out in a randomized block design with four weed management practices (weedy check, mechanical weeding (2), butachlor at 1.5 kg /ha and anilophos at 0.5 kg /ha + followed by one hand at 40 DAS each. The treatments were replicated three times. The herbicides were applied as pre-em at 3DAS. Recommended dose of NPK (120:60:60) was applied. There were non-significant variations observed due to various treatments in affecting soil health (pH, EC and OC) in the soil at various crop stages. Maximum bacteria (42.5(cfu/g) and fungi (23.4(cfu/g) were observed at 50 DAS in direct seeded rice soil under mechanical weeding followed by butachlor, anilophos and weedy check, respectively.

## P-133 System of rice intensification: answer for the tussle between weeds in rice cultivation and labour scarcity

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The teaming billions of population of the world consume rice as their staple food. But the grim scenario in rice production riddles due to the precarious condition of water and labour availability. Both these inputs are the highly needed in rice cultivation. Labour requirement during transplanting, weeding and harvesting consumes around 90 per cent of the total requirement. Of them, if labour scarcity during weeding operation is not tackled could reduce the yields upto 30 per cent and in worst cases 100 per cent. To tide over the situation, the outcome world over on SRI seems to be one of the options for reduced labour requirement. Field trials were conducted at Regional Research Station, Paiyur during 2005-08, to compare the labour requirement for weeding operation in rice under SRI and Conventional transplanting. Weed biomass in both the conditions were also observed. The results showed that for weeding, either the use of conoweeder or star weeder in SRI reduced the labour requirement to the tune of 40% (for three operations) than the conventional planting. The total weed biomass observed in conventional planting is almost double and the reason might be the wide gap between planting and weeding. This directly encouraged more nutrient removal by the weeds. Under SRI, weeder operation was done thrice, first at 15 DAT with 10 days interval and hence no biomass accumulation and less nutrient removal. Moreover, the perfect incorporation of weed biomass into the fields found to enrich the soil unlike conventional crop wherein in most conditions, the weeds will be thrown out. An additional advantage observed in SRI is that both men and women labourers can be engaged for operating the weeder and the practice is not so in conventional crop.

## P-134 Efficacy of bispyribac sodium 10% SC an early post emergence herbicide on rice

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Bispyribac Sodium 10% SC an early post emergence herbicide, was evaluated for its bio-efficacy on weed flora in transplanted irrigated rice in a field experiment during Kharif and Rabi seasons of 2005-06 at APRRI & RARS , Maruteru (26.380 N, 84. 440 E and 5 m above mean sea level). The soil was clay loam having pH 7.1, organic carbon 0.9%, available P2O5 38 kg/ha and K2O 344 kg/ha. This trial consists of 9 treatments of different doses of Bispyribac Sodium 10% SC test chemical and standard check (Pretilachlor), two hand weedings and un- weeded check and layed out in Randomised block design. Among different doses tried , application of Bispyribac Sodium 10% SC @ 30 g a i/ha at3-4 leaf stage of Echinocloa (14 DAT of rice ) performed superiorly by recording weed dry wt of 12.4 g/m2 against 49.5 g/m2 in control and 16.3 g/m2 against 51.3 g/m2 in control with weed control efficiency of 74.9% and 68.2% during kharif and rabi seasons respectively at 40 days after transplanting. Application of Bispyribac Sodium 10% SC @ 30 g a i/ha gave 5431 & 5979 kg/ha grain yield during kharif and rabi seasons respectively, which were comparable with two hand weedings and standard check Pretilachlor during both the seasons. There were no visible phytotoxicity symptoms were observed on rice as well as on fallow crop (Black gram var LBG 623) with this herbicide application.

## P-135 Effect of isoproturon in tank mixed combinations of 2,4-D, MSM and other nutrients on weed control of wheat

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An experiment was conducted during *rabi* 2007-08 at Agronomy Research Farm at N.D.University of Agriculture and Technology, Faizabad taking twelve weed control treatments with three replication wheat var. UP 2425 was sown on 15th December. The experiment was conducted in RBD design. Among the herbicides isoproturon is commonly used to control weeds. But now-a-days its effectivity has become in question. Considering this fact, tank mixed application of supplementary herbicides (2,4-D and MSM, urea and zinc were applied in combination to know the effect of controlling weed in wheat. Important weed flora recorded in the weedy plots were *viz. Phalaris minor, Chenopodium album*, *Melilotus alba, Convolvulus arvensis* and *Phyllanthus niruri*. Among sedges *Cyperus rotundus* was found. Among the different treatments isoproturon 1000g /ha alongwith tank mixed application of 2,4-D (500 g /ha) MSM (4 g /ha), urea (2%)and zinc (0.5) recorded weed density and weed dry matter as well as number of effective tillers ($m^{-2}$), number of grains per spike and grain yield at par, while isoproturon 1000 g /ha alone recorded significantly. Lower values of grain yield and yield attributes and higher values of density and dry weight of weeds. It might because of the fact that BLW could not be controlled and caused of more losses to yield. However, lowest grain yield (31 q /ha) was recorded with weedy and highest (46.2 q /ha) with weed free check in the experiment.

"National Symposium on Weed Threat to Environment, Biodiversity and Agriculture Productivity, August 2-3, 2009, Tamil Nadu Agricultural University, Coimbatore (Tamil Nadu)

## P-136 Critical period of crop-weed competition studies in zero-till cotton (*Gossypium hirsutum* L.) in the coastal deltaic region of Karaikal

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An investigation was carried out to study the crop-weed competition in zero-till cotton at Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal during summer 2007. The weeds associated with the crop were *Echinochloa colonum* Link., *Leptochloa chinensis* (L.) Nees, *Cyperus rotundus* (L.), *Trianthemma portulacastrum* (L.), *Rotala densiflora* Koehne, *Eclipta alba* and *Phyllanthus maderaspatensis*. Weed population increased between 20 and 60 DAS and decreased thereafter. Weed competition during the first 20 days after sowing resulted in an average yield loss of 12.5 per cent which increased with full season competition. The seed cotton yield increased from 2058 kg/ha to 2676 kg/ha as the initial weed free period was increased from 40 to 60 DAS. The critical period of crop-weed competition in rice-fallow cotton was found to be between 20 and 60 DAS. Maintaining the field weed free upto 80 DAS resulted in the highest seed cotton yield and maximum profit. However, maintaining the field weed free beyond 80 DAS resulted in significantly lower yield due to lower boll setting percentage.

## P-137 Comparison effect of tillage systems and weed control practices on soil microbiological properties of rice rhizosphere

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A field study was conducted in a rice – wheat cropping system , rotated for three consecutive years with different tillage systems vis-à-vis weed control practices and in the fourth year of study their effect was evaluated in terms of microbiological properties of rice rhizosphere soil. The results of the investigation revealed that different type of tillage operations exhibited their effects on physio-chemical properties, organic carbon status, enzymes' activity, basal respiration rate and microbial population of rhizosphere soil of rice. Soil reaction (pH) tend toward normality due to conventional-conventional tillage system, however, EC was least affected by different tillage systems. Maximum organic carbon was found in rhizosphere soil under conventional-conventional tillage system whereas minimum was observed under zero-zero tillage system. During the study it was found that soil enzymes activity and basal soil respiration was maximum under conventional-conventional tillage system whereas minimum under zero-zero tillage system. The acid phosphatase activity was found more than alkaline phosphatase activity. The microbial population study showed that conventional-conventional tillage system promoted the growth of fungal and bacterial population whereas zero-zero tillage system did not show any promotional activity of the concerned microbial population. Data of above microbial population were also supported by microbial biomass carbon status of soil. The results of weed management envisaged that the use of recommended herbicides application (Butachlor as pre emergence and Fenoxaprop ethyl + ethoxysulfuron as post emergence) significantly affected the physio-chemical properties, organic carbon status, enzymes' activity, basal soil respiration rate, microbial population and microbial carbon status of rhizosphere soil of rice except pH. The value of the above parameters was diluted with the advancement of crop growth and found minimum at harvest which was also reflected by the data related to enzymatic and basal soil respiration study.

# P-138 Conservation Technologies in Rice-Wheat System and Their Weed Management Features

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In India, rice-wheat cropping system is practiced in about 12 m ha in the Indo-Gangetic plains and contributes about 73% of the total food grain requirement of the country. In recent years, the major emphasis in the rice-wheat system has been an alternative resource-conservation technologies (RCTs) for both rice and wheat to reduce the cost of cultivation and energy consumption, to sustain productivity and to enhance the economic viability of farms and to improve rural livelihoods. Traditionally rice is transplanted at the end of the dry season (May/June) after the land has been flooded and puddle and wheat is sown in *rabi* season (Nov/Dec). Nearly 30% of the total water used in rice culture and its consumption occur mainly in puddling and transplanting. In conventional system (puddle transplanted) of rice need 4,000 L of water for producing 1kg of rice, whereas, wheat requires only 800 L of water to produce 1 kg of grain. Therefore, a key concern is that how the water requirement of rice culture with low monetary inputs to sustain the rice-wheat system. Constraints related to these traditional practices include the shortage of labour, increasing labour cost, the relative fertilizer, fuel and late sowing of wheat. Whereas, the adoption of DSR avoids puddling, retain soil structure and also to facilitate early wheat planting. However, weeds are the major problem which is not effectively managed in this system. Thus, in view of the above fact, a long term trial had been conducted on DSR and Zero tillage wheat at GBPUAT, Pantnagar to find out the impact of these technologies towards the weed management of the rice-wheat system. Five rice establishments in main plot and two weed management practices were compared in strip plot design. After harvesting of rice, wheat was sown by Pant zero-till ferti -seed drill without any tillage and conventional tillage. Average of 6 years data revealed that WSR recorded the highest grain yield followed by TPR and DSR in weed free situation. In zero tillage rice crops became completely failure due to weeds in weedy situation. However, one hand weeding/had significant impact on yield losses due to weeds which reduced the yield losses to the turn of 98% to 29.6 percent in zero tillage rice. Pedimethalin was applied at 1.0 kg/ha within three days after sowing in DSR, DSFR and ZTR for controlling the weeds in the field. Almost similar grain yield was recorded in DSR and stale seed bed technique. In wheat, higher grain yield was recorded in zero tillage (3.76 t/ha) as compared to conventional tillage (3.74 t/ha) in all the establishment methods of rice except in transplanting. Differences in grain yield were highest in DSR in these establishment methods of wheat due to weeds. The five years data revealed that among the rice establishment methods net return was highest (Rs. 13,350/ha) in DSR methods which may be due to its comparatively lowest production cost (Rs. 19787/ha).

## P-139 Effect of tillage system and weed control measures on soil microflora in wheat under rice-wheat cropping system

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Field experiment was conducted during *rabi* season of 2007-08 at Agronomy Research Farm N.D. University of Agriculture & Technology, Kumarganj, Faizabad (U.P.) to study the effect of tillage system and weed control measures on soil micro flora in wheat. Soil at the test site was silt loam, with pH 8.12, OC 0.33 %, available NPK 170.5, 17.5 and 252 kg /ha, respectively. The experiment was laid out a split plot plot design with three replications. The treatments comprised four tillage system (zero tillage $T_1$ and $T_2$ and conventional tillage $T_3$ and $T_4$) in main plots and three weed control measures (hand weeding $W_1$, herbicide sulfosulfuron $W_2$ and weedy check $W_3$) in sub plots. Results revealed that tillage system did not show significant impact on microbial population in soil. Minimum growth of different micro organism (Bacteria fungi and actinomycetes) were observed in zero tillage than conventional tillage at various growth stages (0, 30 DAS and at harvest stage). In case of weed control measures the significant impact were observed on microbial population (bacteria, fungi and actinomycetes) in soil at different intervals (0, 30 DAS and at harvest stage). Maximum microbial population were recorded in hand weeding and lowest in herbicide sulfosulfuron treated plots at 30 DAS and at harvest stage. Among various days of intervals (0,30 DAS and at harvest stage) at 30 DAS microbial growth tended to decrease but at harvest stage population were recorded more in comparison to 30 DAS. Herbicides sulfosulfuron 25 g /ha applied in wheat crop did not leave any harmful effect on soil microflora. Interaction effect between tillage system and weed control measures was found non significant at all the days of intervals with respect to soil microflora.

## P-140 Biology of weeds affected by varying tillage and sowing management under rice-wheat cropping system in Kymore Plateau and Satpura hillzone of Madhya Pradesh

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Field experiments were conducted in rice –wheat cropping system at Research Farm, JNKVV, Jablapur (M.P.). Weed dynamics including floristic composition of weeds, weed intensity and weed biomass were studied in irrigated rice and wheat grown in sequence each with 4 tillage and sowing methods grown rice –wheat system in strip plot design with 3 replications . In all, 29 weeds infested to rice crop and out of them 10 and 2 weed species were absent at 30 day and maturity stages, respectively. Total weed intensity was (116 weeds/$m^2$) at 30 day stage of rice, which was double (201 weeds / $m^2$) at maturity stage. Direct seeded rice had significantly higher weed intensity (143, and 226 weeds/$m^2$ at 30DAS and maturity stages, respectively) with the highest weed biomass 5.55 q/ha at maturity stage than all other 3 tillage and sowing methods. Wheat crops was infested with 17 weed species and out of them 2 and 2 weed species were absent at 30 DAS and maturity stages, respectively .The zero till wheat had significantly higher weed intensity (121 and 81 weeds /$m^2$ at 30 DAS and maturity stages, respectively) than other 3 tillage and sowing methods. The former had also significantly higher weed biomass than later. The weed intensity was higher (weeds 95 weeds/ $m^2$) at 30 DAS than that of at maturity (59 / $m^2$).

**P-141**

# Weed dynamic, growth and yield of rice as influenced by different rice-wheat crop establishment and tillage methods

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Rice is most important aquatic crop and plays a vital role in the global food and livelihood system. It is staple food for more than 70 % of the world population. Rice-wheat is a dominating cropping system of fertile and alluvial soil of north –west India, particularly Indo- Gangetic plains. Puddle-transplant rice is now facing serious constraints due to non availability of labour and rapidly escalating labour costs. The problem of weed competition with upland rice is of great economic importance in the country, because it causes 50-91% reduction in grain yield. The field experiment was conducted during *kharif* seasons of 2005-06 and 2006-07 at GBPUA&T,Pantnagar to find out the effect of different rice –wheat establishment methods on weed dynamic. The experiment was laid out in strip plot design with 3 replications. Treatments during the rainy season comprised 4 methods of crop establishment viz direct dry seeded rice, sprouted rice , hand transplanting rice and machine transplanting rice, and during *rabi* season 4 tillage methods viz, conventional wheat, bed planted wheat, Strip till drill wheat and zero till drill wheat. After the rice harvest each main plot was divided in to 4 sub plots for wheat spowing. Rice Cv. Narendra 359 was sown in all four system having 23 cm inter row spacing. While in wheat Cv. PBW-343 was sown. Direct seeded rice recorded significantly highest grain yield compaired to conventional puddling viz, hand transplanting and machine transplanting. At harvest lower weed density, fresh weight and dry weight was recorded under direct dry seeded rice.

## P-142 Tolerance of canola *gobhi sarson* cultivars to different herbicides

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A field experiment was conducted during *rabi* 2006-07 and 2007-08 at Punjab Agricultural University Ludhiana to test the tolerance of canola type *gobhi sarson* to different herbicides. Three canola cultivars (GSC 5, GSC 6 and Hyola PAC 401) in main plots and, six weed control treatments (fluchloralin 0.75 and 1.5 kg, trifluralin 0.75 and 1.5 kg/ha, two hand weeding and unweeded control) in sub plots were tested with three replications. Crop was sown on 7.11.2006 and 6.11.2007 and harvested on 9.4.2007 and 11.4.2008 respectively in 2006-07 and 2007-08. Major weed flora in the field was *Phalaris minor* among grasses and *Medicago denticulata, Coronopus didymus, Chenopodium album, Anagallis arvensis* and *Oenothera drumendii* among broadleaves. Both the herbicides were incorporated before planting. The canola cultivar did not show any differential effect on weed dry matter and recorded statistically similar seed yield. Among weed control treatments, fluchloralin and trifluralin at the doses tested recorded effective control of weeds and recorded canola seed yield at par to hand weeding. The study indicated that fluchloralin 0.75 kg and trifluralin 0.75 kg/ha could safely be used to control weeds in canola type *gobhi sarson.*

## P-143 Impact of tillage practices and weed control measures on yield of wheat in direct seeded rice-wheat cropping system

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Rice-wheat is one of the main cropping systems and occupies nearly 10.5 million hectares area in India. This cropping system is followed in irrigated eco- system of North and Central India. Weeds are the major problem in irrigated wheat. Many research workers have reported the predominance of *Phalaris minor, Avena fatua* among the monocots, and *Chenopodium album, Melilotus indica* among the dicot weeds in wheat. The weeds problem in wheat could be managed effectively and economically. However, cost of weed control in wheat could partially or completely be compensated by saving in the cost of tillage operations with zero till sowing of wheat. The weed control efficiency was almost similar and higher under conventional tilled wheat after conventional tillage in rice (88.54 %) and conventional tilled wheat after zero tillage in rice (88.43 %) against zero tilled wheat after conventional tillage in rice and zero tilled wheat after zero tillage in rice (85.35 % and 69.04%). Integrated weed management practice (Clodinafop 0.06 fb 2,4-D 0.5 kg/ha + 1HW at 40 DAS) gave higher weed control efficiency (89.64 %) than chemical control (76.03 %). Weed control efficiency was higher under the application of integrated weed management than chemical control under all the tillage packages. IWM practice (Clodinafop 0.06 fb 2,4-D 0.5 kg/ha + 1 HW at 40 DAS) adopted in wheat produced significantly higher grain yield than chemical control practice(Clodinafop 0.06 fb 2,4-D 0.5 kg/ha).

**P-144**

# Assessment of *Echinochloa* sp. resistance against early POE application of azimsulfuron in rice soils

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Satellite weed of rice, *Echinochloa* sp. reduces the quality of the produce and a heavy competitor due to biological similarity with rice. Two important species *Echninochloa colonum* and *E. crusgalli* are predominant rice ecosystems weeds of India. Repeated application of the same herbicide would develop resistance to a specific weed. Thus a pot culture experiment under controlled condition was conducted thrice to asses the susceptibility of *Echniochloa* sp. against early POE of azimsulfuron at three different concentrations 30, 35 and 40 g/ha. *Echinochloa* sp. seeds were collected from 10 different locations of paddy field, where azimsulfuron was applied for five seasons continuously. The seeds were treated with gibberlic acid and soaked overnight at10 ppm to enhance the germination under pot culture experiment. Azimsulfuron applied as early POE using mini hand operated sprayer at 3 to 4 leaf stage of *Echinochloa* sp. The phytotoxicity symptoms were observed at weekly intervals and were retained up to 60 DAHS with regular watering to study the regeneration. Slight drying and chlorotic symptom was observed on *Echinochloa* plants at 7 DAHS at all the doses. Reddening of stems and leaves, chlorosis and drying intensity was higher with increased dose (35 and 40 g/ha) of azimsulfuron than lower dose of 30 g/ha. Complete control was observed at 14 and 21 DAHS. The percentage of control and drying were higher with 35 and 40 g/ha at 14 and 21 DAHS. There were no resistance development and regeneration in *Echinochloa* seedlings against early POE application of azimsulfuron.

"National Symposium on Weed Threat to Environment, Biodiversity and Agriculture Productivity, August 2-3, 2009, Tamil Nadu Agricultural University, Coimbatore (Tamil Nadu)

## P-145 Resistance of *Phalaris minor* to Isoproturon in Uttarakhand

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Resistance of *Phalaris minor* to the herbicide Isoproturon is being constantly monitored in the tarai region of Uttarakhand for the last several years after reports of the same appeared from Punjab and Haryana. This weed still continues to be one of the most problematic weeds in the rice -wheat cropping system in this region. Therefore, seeds of this grass are collected from farmers' fields in the region and are grown in pot culture under close monitoring under the AICRP on Weed Control of this centre. Isoproturon is applied at three different doses viz. 0.5, 1.0 and 2.0 kg a.i./ha at the appropriate stage. Till recently, no resistance was observed in our pot culture experiments though resistance was reported in India as early as 1993. However, during the season 2007-08, *P minor* plants from at least nine locations out of a total of twenty locations in this region exhibited various degrees of resistance to isoproturon in our pot culture. Seeds collected from the Gadarpur, Sitarganj, Fatehpur (Haldwani) areas exhibited resistance to isoproturon even at double the recommended dose. The event is being closely monitored. If the trend continues, future investigations will include physiological and biochemical characterization of the resistant population and efforts will be to develop effective management strategies.

## P-146 Effect of elevated atmospheric $CO_2$ on competitive interactions between soybean and associated weeds (*Commelina benghalensis* and *Euphorbia geniculata*)

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An experiment was conducted to study the response of Soybean and associated weeds (*Commelina benghalensis* and *Euphorbia geniculata*). The experiments were conducted in Open Top Chambers (OTCs). In one chamber the $CO_2$ concentration was maintained at 360±20 ppm (Normal air $CO_2$ Concentration at the experimental site, DWSR Jabalpur.) and in the other chamber the $CO_2$ concentration was maintain at 550±30 ppm by injecting $CO_2$ gas (commercial grade) from the cylinders (45 Kg Capacity). The $CO_2$ concentration was monitored and controlled using l- T $CO_2$ monitor /controller (ADC make). Seeds of wheat and weeds were sown in pots and the pots were kept in Open top chambers maintained at two $CO_2$ levels *i.e.* one at ambient a (360±20 ppm) and other at elevated (550±30 ppm) $CO_2$. The observations were recorded at 15 days interval. The growth response of soybean to elevated $CO_2$ was significant. The association with weeds caused significant reduction in plant height; especially $CO_2$ promoted height increase was reduced by weed competition. The *C. benghalensis* caused more reduction than *Euphorbia geniculata* under elevated $CO_2$. The *C. benghalensis* was effective in reducing the growth and biomass production in soybean especially under elevated $CO_2$ due to its prolific vertical and lateral growth. Flowering and fruiting in Soybean and *E. geniculata* were delayed under elevated $CO_2$ (Plates.) Both the weed species significantly gained the biomass under elevated $CO_2$ when they were alone but the biomass increase was not remarkable when they were in association with the crop.

"National Symposium on Weed Threat to Environment, Biodiversity and Agriculture Productivity, August 2-3, 2009, Tamil Nadu Agricultural University, Coimbatore (Tamil Nadu)

## P-147 Persistence of imazethapyr residues in soybean crop and soil

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Imazethapyr belonging to imidazolines group is used as post emergence herbicide to control annual grasses and broad leaved weeds in soybean crop. It inhibits acetolactate synthatase (ALS), a key enzyme in the biosynthesis of the branched chain amino acids isoleucine, leucine and valine. At the recommended dose of herbicide application, generally the problem does not arise and it selectively kills the weeds. But when the dose is more than recommended rates due to indiscriminate use and improper calibration and method of application, there is possibility of residual hazards in soil and crop produced. Therefore an experiment was conducted to study the persistence of imazethapyr residues applied to soybean at double the recommended dose (200 g/ha) in soil, grain and straw of soybean. Soil (0-15 cm depth) from treated plots was collected at 15, 30, 45, 60 and 75 days after application of herbicide and after harvest of crop. The imazethapyr residues in soil, grains and straw were detected by HPLC method. The residue level of imazethapyr in soil decreased with time and at harvest the residues were below the detectable limit. However the residue level of 0.082 and 0.023 µg/g were detected in soybean grains and straw, respectively.

## P-148 Effect of some organic molecules on the rate of photolysis of chlorimuron-ethyl

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Chlorimuron-ethyl, ethyl 2-(4-chloro-6-methoxy pyrimidine-2-yl-carbamoyl sulfonyl) benzoate, is a post emergence herbicide for the control of important broad leaf weeds in soybean and maize. Though it is degraded in the agricultural environment primarily via pH and temperature dependent chemical hydrolysis, photolysis has also an important role to degrade this compound. In this present study, the sensitizing and stabilizing effect of some organic compounds on the photolysis of chlorimuron have been investigated. The organic compounds used in this study are humic acid, acetone, riboflavin, benzophenone, nicotine and rotenone. Effect of humic acid on the rate of photolysis of chlorimuron in distilled water at pH 7.0 under sunlight and UV-light in pyrex and quartz tube was studied. The calculated half-lives were 5.11 h in pyrex and 7.53 min in quartz under UV-light, and 5.78 day in quartz under sunlight. These results are not significantly deviated from the half-lives found in distilled water without any added organic compound. This indicates that humic acid has no effect on the photolysis of chlorimuron in water. In another experiment, it was observed that 98 % chlorimuron was recovered in the presence of rotenone after 5 h of irradiation in pyrex tube, whereas in presence of riboflavin and benzophenone the degradation was 40.43 and 33.96 %, respectively, as compared to 55.54 % degradation of chlorimuron without any sensitizer. In case of the photolysis of chlorimuron in presence of nicotine and acetone, the half-lives were12.32 and 4.58 d, respectively, as compared to that of chlorimuron having no sensitizers in the solution (5.99 d). Thus, it has been revealed from the experiment that riboflavin and benzophenone enhanced the rate of photolysis of chlorimuron whereas nicotine and rotenone significantly retard.

## P-149 Effect of different organic mulches on weed population and dry matter production in maize under rainfed condition in an alfisol

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Mulching is one of the promising technologies for dry land farming and is increasingly seen in the light of integrated soil management, an essential building stone for sustainable agriculture. Organic mulches are more popular in cropping systems, as they can suppress weeds, while at the same time reducing soil tillage for weed control under any tillage system implemented. A field experiment was conducted at Regional Research Station, Paiyur, Tamil Nadu with maize hybrid COHM-5 to study the effect of organic mulching on weed control under rainfed condition. The treatment structure comprised of nine treatments *viz.,* $T_1$- control, $T_2$- maize straw 5 t/ha, $T_3$- maize straw 10 t /ha, $T_4$- sugarcane trash 5 t/ha, $T_5$- sugarcane trash 10 t/ha, $T_6$- raw coir pith 5 t/ ha, $T_7$- raw coir pith 10 t/ha, $T_8$ - dried weeds 5 t/ha and $T_9$ - dried weeds 10 t/ha. Application of different organic mulches had significant effect on weed population and weed DMP in maize. Application of sugarcane trash at10 t/ha significantly reduced the total weed population (45.2, 58.0 and 53.6 per cent at knee - high, tasseling and harvest stages respectively). At all the stages sugarcane trash mulch at 10 t/ha recorded the least total weed population followed by raw coir pith at 10 t/ha, raw coir pith at 5 t/ha, dried weeds at 10 t/ha and dried weeds at 5 t/ha. Comparison of various mulches revealed that the superiority was in the order of sugarcane trash, coirpith, weed mulch and maize straw.

## P-150 Effect of organic mulching on weed control in groundnut under rainfed condition

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Field experiment was conducted in Regional Research Station, Paiyur to assess the effect of different organic mulches on weed population and dry matter production of groundnut. The treatments included maize straw at 5 and 10 t /ha, sugarcane trash at 5 and 10 t/ha, raw coir pith at 5 and 10 t/ha and dried weeds at 5 and 10 t/ha and unmulched control, which were replicated thrice in Randomized Block Design. The application of sugarcane trash mulch at 10 t/ha significantly reduced the total weed population at all the three stages (98.0, 97.2 and 109.2 number per $m^2$ at vegetative, peg initiation and harvest stages respectively). This was followed by maize straw at 10 t/ha sugarcane trash mulch at 5 t/ha, dried weeds at 10 t/ha and dried weeds at 5 t/ha treatments. At peg initiation and harvest stages sugarcane trash mulch accounted for lower weed dry matter production of 127.4 and 132.6 kg/ha respectively. Application of different organic mulches had significantly reduced the weed population and weed DMP in groundnut. Among the different treatments, sugarcane trash mulch at 10 t/ha ($T_5$) had reduced the weed population and weed DMP which was on par with dried weeds at 10 t/ha ($T_9$). The impact of sugarcane trash mulch was lower due to the more rapid decomposition, although surface application reduced the weeds to a greater extent than when incorporated.

## P-151 Soil microbial activity as influenced by long term application of herbicides.

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The effect of various chemical and mechanical weed control methods on soil microbial properties in terms of enzyme activity and microbial respiration was studied. In maize-chickpea cropping system the treatment that received mechanical weeding showed the highest phosphatase activity (82.98 µg pnp formed/g/soil/h). The lowest phosphatase activity was observed in the treatment with atrazine 0.75 kg/ha and 2,4-D 0.50 kg/ha (38.81 µg). The phosphatase activity was found to increase in the treatment receiving both atrazine 0.75 kg/ha and 2,4-D 0.50 kg/ha (43.22 µg) at 60 DAS. Similarly, increased dehydrogenase activity was noticed in the treatments receiving atrazine 0.75 kg/h (3.74 µg), this was followed by the treatment with only mechanical weeding (3.47µg). The lowest dehydrogenase activity (1.69µg) was seen in the treatment receiving combined spray of atrazine (0.75 kg/ha) and 2,4-D (0.50 kg/ha). In the groundnut-wheat cropping system it was observed that the phosphatase activity increased from 30 to 60 days after spraying (DAS) herbicide, in all the treatments as compared to 30 DAS. The highest phosphatase activity (119.05 µg) was noticed in the treatment receiving alachlor 1.5 kg/h. Similarly, the highest dehydrogenase activity (5.95 µg) was observed in weed free check, followed by application of butachlor 1.5 kg/h (5.37 µg) and the least activity was noticed in treatment with alachlor 1.5 kg/ha (2.74 µg ). The soil respiratory activity was drastically affected by spraying of pendimethalin 1.5 kg/ha on both 30 DAS (11.07 mg) and 60 DAS (59.11). However, the highest soil respiratory activity was observed in the treatments receiving/hand weeding on both 30 DAS (85.84 mg) and 60 DAS (92.11 mg). The nodule number (167.33) and nodule dry weight (0.47 g) was the highest in weed free check. Among the various herbicides sprayed, only application of butachlor 1.5 kg/ha at 60 DAS had no adverse effect on the nodule number (146.00) and nodule dry weight (0.29g). Application of pretilachlor 1.5 kg/ha drastically reduced both nodule number (68.00) and nodule dry weight (0.08 g). In the present study it was observed that the application of herbicides under field conditions, initially at (30 DAS), reduced the soil microbial activity. However, the activity improved gradually at 60 DAS. The mechanical method of weed control, such as hand weeding showed higher activity as compared to chemical methods.

## P-152 Heribicides residue studies in soil applied in transplanted rice under rice-wheat cropping system

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Field trials were conducted at Agronomy Research Farm as well as weed science laboratory of department of Agronomy, N.D.U.A. & T., Kumarganj, Faizabad during Kharif 2007 & 2008 in a randomized block design with four replications. Applications of Almix at 6g & 12 g /ha, pretilachlor at 0.5 kg and 1.0 kg/ha$^{-1}$, and oxadiargyl at 0.1 kg & 0.2 kg/ha$^{-1}$ at pre emergence applied in transplanted rice did not cause significant differences in germination, plant height and dry matter production of cucumber grown in sampled soil taken after the harvest of rice. Thus, almix at 6 g & 12 g /ha, pretilachlor at 0.5 kg & 1.0 kg /ha and oxadiargyl at 0.1 kg & 0.2 kg /ha applied in transplanted rice to control the weeds did not leave their harmful toxic level of residues in soil and rice-wheat cropping system.

## P-153 Effect of nitrogen and weed management on productivity of wheat

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A field experiment was conducted during winter season of 2004-05 to 2006-07 to evaluate the effect of weed management and nitrogen levels on weed growth and productivity of wheat. Increasing levels of nitrogen from 0 to 40, 40 to 80 and 80 to 120 kg/ha increased weed density by 34.0, 29.5 and 40.1 percent and weed dry matter by 33.5, 24.9 and 14.6 percent respectively. The weed control efficiency was higher at lower nitrogen levels as compared to their respective next higher levels. The N- uptake by weed and wheat was significantly higher at 120 kg/ha over 80 kg/ha. Significantly higher wheat grain yield (3339 kg/ha) was recorded at 120 kg/ha over 80 kg/ha. Among weed control measures, isoproturon + 2,4-D each 0.75 kg/ ha post emergence recorded lower weed density ( 25.3/$m^2$) and weed dry weight (17.2/m2)as compared to isoproturon or 2,4-D 1.0kg/ha compared to isoproturon or 2,4-D 1.0kg/ha applied individually remaining at par with weeding at 15, 30 and 45 DAS indicating higher weed control efficiency(85.3%) . The N uptake by weed was recorded minimum by isoproturon + 2,4-D 0.75 kg/ha each post emergence (11.5Kg/ha)and maximum by wheat (68.8kg/ha) being at par with weeding at 15,30 and 45 DAS . Maximum grain yield (2465 kg/ha) was recorded by isoproturon + 2,4-D 0.75kg/ha each post emergence being at par with weeding at 15,30 and 45 DAS.

## P-154 Weed management in organically grown sunflower

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Organic farming is gaining momentum in the recent past due to the farmers' movement, consumers' choice and promotion from the policy makers not only in India but also across the world. Growing awareness on health and environmental issues in agriculture has demanded production of organic foods, which are emerging as an attractive source of rural income generation. A field experiment was conducted at Tamil Nadu Agricultural University, Coimbatore during *rabi* 2006-07 to study the different weed management practices in organically grown sunflower. The experiment was laid out in randomised block design with three replications. The treatment consisted of hand weeding at 25 and 45 DAS, manually operated weeder at 25 and 45 DAS, manually operated weeder at 25 DAS + hand weeding at 45 DAS, two insitu green manuring at 45 DAS *viz*., cowpea and sunnhemp, intercropping with coriander, two mulches *viz*., crop residue (maize stalk) and weed residue at 5 t/ha, stale seedbed, eucalyptus oil spray at 0.4 per cent at 3 DAS, weed free and weedy check. The weed density and weed growth were lesser in the weed free treatment with the higher sunflower yield followed by hand weeding twice.

The data revealed that due to initial slow growth of sunflower wide range of weed flora infests the crop and the weeds could be effectively controlled by hand weeding twice. But, manually operated weeder at 25 DAS + hand weeding at 45 DAS turned to be economically viable. The treatment *in situ* green manuring with cowpea and mulching with crop residues as viable alternate weed control methods owing to the enhancement of the soil biological health improvement when system based approach in organic farming.

## P-155 Effect of organic weed management practices on black gram - sorghum - sesame cropping system

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Organic farming is both a philosophy and a system of agriculture. The objectives of environmental, social and economic sustainability lie at the heart of organic farming and are among the major factors determining the acceptability or otherwise of specific production practices. It is a production system which avoids the use of synthetic fertilizers, pesticides, herbicides and growth regulators and favours maximum use of organic materials on-farm and off-farm organic waste, bio-fertilizers and bio-herbicides, etc. A field experiment was conducted during 2005-06 and 2006-07 at garden land farms of Tamil Nadu Agricultural University, Coimbatore to study the effect of different organic weed management practices on Sorghum based cropping system (black gram – sorghum - sesame). The experiment was laid out in randomized block design with six treatmental combinations replicated thrice ($T_1$ - Stale seedbed + HW once, $T_2$ - Mulching + HW once, $T_3$ - Hand weeding twice, $T_4$ - Intercropping with smothering crops (Daincha) and incorporation + HW once, $T_5$ - Mechanical Weeder + HW once and $T_6$ – Control). Observations on total weed population, nutrient removal by weeds, nutrient uptake by crops, microbial population and yield were recorded in black gram, sorghum and sesame. The results showed that, Hand weeding twice recorded significantly lower weed population and it was followed by Mechanical Weeder + HW once. Higher microbial population (Bacteria, fungi and actinomycetes) was observed in Mulching + HW once whereas Hand weeding twice recorded the maximum nutrient uptake by crops and lower nutrient removal by weeds. Significantly higher yield (574.8, 1688 and 697.6 kg/ha in Black gram, Sorghum and Sesame cropping system) was obtained in hand weeding twice in all the three crops.

## P-156 Evaluation of a common single step procedure for estimation of residues of three pre emergence herbicides in soil

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A common analytical procedure for estimation of residues of butachlor, pretilachlor and oxyfluorfen in soil was attempted to make the analysis simpler and less expensive to suit advisory works. Multi residue method suggested by AINP PR (All India Net Work Programme on Pesticide Residues, 2006) was compared with the commonly used standard separate procedures with necessary standardization of gas chromatographic conditions. For the herbicides butachlor and pretilachlor , the single step method involving extraction and clean up of soil through the glass column with charcoal, florisil, anhydrous sodium sulphate and 10% acetone in hexanes was found to give 100% recovery with the GC conditions *viz*., column - BPX-5 capillary column., split ratio of 5: 1., temperature: injector- 250$^{o}$C, column – 220$^{o}$C, detector- 280$^{o}$C. For oxyfluorfen also, this method gave maximum recovery (49%) with the same column and detector. However, temperature conditions were different (injector- 220$^{o}$C, column – 210$^{o}$C, detector - 240$^{o}$C). Even the commonly used standard analytical procedure gave still lower recovery (38%) of oxyflourfen residues. As the herbicide has lower water solubility and is strongly bound to soil organic matter, extraction of oxyfluorfen residues is found to be difficult. The results showed that the common protocol developed here can be employed for routine testing of butachlor and pretilachlor residues in soil . It also indicated that there is a necessity for further standardization of procedure for estimation of oxyfluorfen residues.

## P-157 Weed management in sunflower - cotton - green manure cropping system under organic farming

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Organic agriculture is a unique production management system which promotes and enhances agro-ecosystem health and this is accomplished by using on-farm agronomic, biological and mechanical methods in exclusion of all synthetic off-farm input). Due to continuous cropping, ever increasing use of chemical like herbicides, pesticide, etc. without adequate organic recycling/ has deteriorated soil productivity and created environmental pollution. Considering its importance, the application of organic manure s, organic weed and pest management practices, etc. are popular as a part of organic farming. A field experiment was conducted during 2007-08 and 2008-09 at garden land farms of Tamil Nadu Agricultural University, Coimbatore to study the effect of different organic weed management practices on Cotton based cropping system (cotton – sunflower – green manure). The experiment was laid out in randomized block design with six treatmental combinations replicated thrice ($T_1$ - Stale seedbed + HW once, $T_2$ - Mulching + HW once, $T_3$ - Hand weeding twice, $T_4$ - Intercropping with smothering crops (Daincha) and incorporation + HW once, $T_5$ - Mechanical Weeder + HW once and $T_6$ – Control). Observations on total weed population, nutrient removal by weeds, nutrient uptake by crops, microbial population and yield were recorded in Cotton, Sunflower and Green manure. The result showed that hand weeding twice recorded significantly lower weed population and it was followed by Mechanical Weeder + HW once. Higher microbial population (Bacteria, fungi and actinomycetes) was observed in Mulching + HW once whereas Hand weeding twice recorded the maximum nutrient uptake by crops and lower nutrient removal by weeds. Significantly higher yield was obtained in hand weeding twice in all the three crops.

## P-158 Phytoremediation for removal of nitrate, phosphate and metals in waste water using *Arundo donax*

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The high nutrient loading in waste water from municipal source and runoff water from agricultural lands greatly increases the incidence of weeds in crops and eutrophication of water bodies respectively. It is in this background the waste water carrying in the DWSR drain was characterized for water quality and was treated in a sub-surface wetland model (4'x 2'x 1') using *Arundo donax* which is mainly developed for waste water treatment as a pre-requisite for field scale wetland studies. It was observed that the concentrations of iron, manganese, nickel, copper, nitrates, chlorides, phosphates in untreated waste water of drain were in the range of 1.52-2.0, 0.62-0.8, 0.22-0.34, 0.29-0.32, 50-56, 55-70 and 8-10 mg/L respectively. As compared with the permissible limit, the concentrations of manganese, nickel, copper and nitrates exceeded the prescribed standard limit of FAO. As far as the treatment of waste water in a wetland model is concerned, after treatment the reed plant except chlorides and alkalinity has reduced the concentrations of nitrate, phosphate, nickel and copper to the extent of 70, 42.8, 55.8 and 40.6 per cent respectively as compared to the untreated waste water before treatment.

## P-159 Long term application of herbicides on its fate and persistence behavior in the soil under rice-rice cropping system: effect of nitrogen sources

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Field experiments were conducted from *kharif* 2000 to *rabi* 2008 to study the influence of continuous application of herbicides on its fate and persistence behavior under transplanted rice-rice cropping systems. Treatments included hand weeding, combined application of butachlor plus 2, 4-DEE for both seasons and the rotational use of butachlor plus 2.4-DEE and pretilachlor plus 2,4-DEE for *kharif* and *rabi* seasons, respectively under two sources of nitrogen *viz.*, 100% N as inorganic and 75% organic plus 25% organic N sources during *kharif* seasons. The soil, straw and grain samples from 16$^{th}$ and 17$^{th}$ crops were analyzed for herbicides residue using GC-ECD. The results showed a progressive decline in butachlor content with advancement of crop growth. Applied butachlor degraded to 97.87 to 98.47% within 45 days of its application in both the seasons. The pattern of butachlor and 2,4-D degradation is similar and 50 % of the applied herbicide degraded from the soil with in 7 days of its application. Continuous application of either butachlor + 2,4-D or butachlor / pretilachlor + 2,4-D herbicide mixtures did not show build up of butachlor in the post harvest soil. Nearly 98.26% of applied pretilachlor got degraded within 45 days of its application and was below detectable level at harvest. Pretilachlor degradation rate was higher under 100 % inorganic N source treatment. Herbicide residues were below detectable level in rice grain and straw samples.

## P-160 Impact of municipal waste water irrigation on weed infestation in wheat and cauliflower

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The open drains carrying municipal and industrial waste water provides an irrigation source to farmers during dry season in peri-urban areas of India. The content of nutrients in waste water has been observed to enhance the weed infestation in crops indiscriminately irrigated with drain water on farmers field. Therefore, an investigation was carried out to judge the impact of waste water irrigation on weed density at various contaminated sites viz, Gohalpur, Panagar, Baldeobagh, Urdhana and Ukhari in Jabalpur and adjoining areas. The dominant weed flora found were *Avena ludoviciana* and *Vicia sativa* in both the crops whereas *Chenopodium album*, *Chicorium* intybus in wheat and *Parthenium hystrophorus* in Cauliflower. As compared to tube well water, total weed density and dry weight under drain water irrigation were 28 & 48 per cent higher in wheat and 26 and 53 per cent higher in cauliflower respectively. Among the drain water, Panagar drain water showed highest total weed dry weight (80.2 g/m$^2$) as compared to tube well water (26 g/m$^2$). The impact of drain water on wild oat (*Avena ludoviciana*) tested in lab studies found significant increase in the germination, shoot and root length of wild oat in petridishes treated with waste water as compared to the tube well water.

## P-161 Sorption of pyrazosulfuron-ethyl by soils of different agro-climatic zones of Southern Karnataka

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Sorption studies were conducted with pyrazosulfuron-ethyl using batch equilibration technique and HPLC analysis. Four different paddy growing soils of Kathalagere, Mandya, Mudigere and Mangalore soil of Southern transitional zone, Southern dry zone, Hilly zone and Coastal zones of Southern Karnataka were used in the study with a pH of 7.3, 6.9, 6.1 and 5.8 and organic matter (g/kg) of 12.9, 10.9, 6.4 and 10.4 respectively. The sorption isotherm (n) values were 0.104, 0.101, 0.085 and 0.165 for Kathalagere, Mandya, Mudigere and Mangalore soils, respectively. The sorption isotherm for pyrazosulfuron-ethyl was non-linear in all soils, as explained by the Freundlich equation ($n < 1.0$), indicating differential distribution of site energies for sorption. In general adsorption isotherms fitted well with Freundlich equation ($r^{-2} > 0.96$), and Freundlich constants 'K', 'Koc' and '$K_c$' values were in the range from 5.45 to 9.52, 1099.46 to 1436.12 and 32.24 to 49.07 in different soils and described in the order of Kathalagere > Mandya > Mudigere > Mangalore, which is also in the order of decreasing organic matter content in the soils. The coefficient of determination showed an improvement up to 96 per cent using quadratic functions, suggesting a better goodness of fit in preceding pyrazosulfuron-ethyl sorption compared to the linearised form of the Freundlich equation. The cumulative desorption of five days of pyrazosulfuron-ethyl in these soils were determined and it ranged from 22.3 to 41.1 mg/kg in Kathalagere soil, 25.6 to 49.4 mg/kg in Mandya soil, 37.1 to 51.9 mg/kg in Mudigere soil and 39.9 to 55.7 mg/kg in Mangalore soil. The desorption was also in decreasing order of Mangalore > Mudigere > Mandya > Kathalagere soils. The sorption of pyrazosulfuron-ethyl increased with increasing organic matter content and was significantly correlated with organic matter content of the soils where as clay content did not greatly affect the sorption as indicated by low regression coefficient.

## P-162 Persistence of glyphosate in water used to control *Echiornea crassipes* weed

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Glyphosate is a broad-spectrum, non-selective, systemic herbicide. It kills all plant types including grasses, perennials and woody plants. When a plant is sprayed with glyphosate, the herbicide is absorbed through the leaves and the soft tissue of the stem. Historically, glyphosate has not been included among herbicides that cause concern in water supplies, even though it sometimes has been detected in surface waters. Glyphosate samples were collected from water where glyphosate was applied to control *Echiornea crassipes* weeds. Tanks were sprayed at 100, 50 and 25 % area at 1.0 kg/ha dose. Glyphosate residues in water were analyzed at 0, 10, 20, 30, 60, 90, 150 and 200 days after herbicide application. Glyphosate residues in water reached a level of 0.75 to 2.08 mg/L within 5-6 hours after its application. Residues were reduced to 0.52 to 1.04 mg/L after10 days, and then dropped to levels of 0.03 mg/L within four months. It was found that residues were higher in those tanks where glyphosate was sprayed in 100 % area and has no-weed treatment.

## P-163 Field studies on persistence of pyrazosulfuron-ethyl in soil, ground water and residues in transplanted rice

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Field experiment was conducted at Zonal Agricultural Research Sattion, Kathalagere, during *kharif* 2008. Persistence and residues of pyrazosulfuron-ethyl in soil and ground water in transplanted rice ecosystem were estimated using HPLC technique. Pyrazosulfuron-ethyl was applied at 25 g/ha and 50 g/ha with and without addition of recommended farm yard manure in transplanted rice. The study revealed that the residue of pyrazosulfuron-ethyl in soils ranged from 0.0103 and 0.0199 mg/kg, respectively with FYM at recommended and double the recommended dose on 2$^{nd}$ day of application. And with out FYM the residues were 0.0116 and 0.0229 mg/kg, respectively. The residues were detected up to 35 days only. The half-life of pyrazosulfuron-ethyl ranged from 16.6 to 21 days. The results revealed that the residues of pyrazosulfuron-ethyl were below the detectable level in the post harvest soil, paddy grain and straw. No residues of pyrazosulfuron-ethyl were detected in ground water up to two weeks after the application of pyrazosulfuron ethyl. After two weeks the residues were detected in ground water collected from both the piezometers which were applied with recommended and double the recommended dose of pyrazosulfuron-ethyl. The residues ranged from 0.0071 to 0.0042 mg kg$^{-1}$ between 21 and 28$^{th}$ day, respectively, after which the residues were below the detectable level both at recommended and double the recommended level of application . A maximum of 0.0154 mg/kg on 21st day and minimum of 0.0023 mg/kg of pyrazosulfuron ethyl residues on 35$^{th}$ day were detected in the underground water.

## P-164 Direct effect of herbicides on pea and residual effect on succeeding paddy crop

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A field experiment was conducted during *rabi* 2007-08 at Student's Instructional Farm of this university. Four herbicides *viz* pendimethalin, alachlor, metribuzine and isoproturon in recommended dose were compared with control in randomized block design with three replications. The experimental field was neutral in pH, normal in salt concentration, low in organic carbon, medium in available phosphorus and available potash. Pea cv KPMR-522 was sown on 6 Nov. 2007 and herbicides were sprayed on 7 Nov. 2007 under recommended package of practices. Number of plants/m$^2$ , plant height and yield were recorded at 15 DAS and harvest stage. Succeeding crop paddy was transplanted and growth character were observed at 40 DAP stage. Results revealed that application of Alachlor (1.5 kg/ha), metribuzin (0.175 kg/ha) and isoproturon (1.5 kg/ha) reduced the number of plants per square metre and plant height at 15 days after application. Metribuzin reduced the grain yield of pea than other treatments. There was not any residual adverse effect of all herbicides on succeeding paddy crop.

## P-165 Persistence of butachlor under different soil moisture conditions

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Under field condition, sometimes soil remain continuously moist for a sufficiently long period of time, while at times it passes trough alternate spell of drying and subsequent rewetting due to irrigation or rainfall. An experiment was conducted under laboratory condition study the persistence of butachlor in soil under such varying soil moisture conditions and its implication on the growth of the different flashes of *Echinocloa colona* and *Ischimum rogusum*. The field soil was taken in a series of pots, the soil was moistened and then butachlor was applied at 1.5 kg/ha. One set of pots was routinely watered to maintain soil moisture at field capacity (FC) level. The soil of the other set of pots was allowed to dry and then re-watered, again allowed to dry and so on. The butachlor residue content in the soil was measured after different period of time. The seeds of *E. colona* and *I. rogusum* were sown after different time interval of butachlor treatment to simulate the different flashes of their germination. The weed seeds were also sown in the untreated soil as a measure of control. The butachlor residue in the soil decreased very rapidly with time under FC moisture condition, and the residue level decreased by more than 80% by14$^{th}$ day. No residue was detected in the soil after 35 days of its application. Under alternate wetting-drying situation, the rate of butachlor degradation in soil was relatively slow, and the butachlor residue was detected in soil till the end of experimental period of six weeks. As the time span between the butachlor application and the germination of *E colona* increased, the impact of butachlor residue on its growth decreased. This decrease in impact was much faster in the soil that was under FC moisture level than in the soil subjected to alternate wet-dry spell. The relative shoot length of *E colona* that germinated after 14 days of butachlor application was 86% when the soil was under FC moisture level, where as it was 59% in the soil which passed through two dry spell during the same period of time. Although the butachlor residue was detected up 35 days in the soil under FC condition, the amount of residue was not sufficient enough to restrict the growth of *E colona*. Whereas, the butachlor resudue remaining in soil after 42 days of alternate wetting-drying treatment significantly reduced the shoot length of *E colona*. Similar observation was also recorded in respect to the *I. rogusum.* Overall, the result showed that the persistence of butachlor is very short to take care of the weeds that could grow after 3 weeks of its application under normal crop growing condition with FC moisture. On the other hand, it will persist for longer time in the soil that passes through frequent dry spell following its application. The implication of the given findings is that utmost care should be taken to select the subsequent crop, if the existing crop fails due to severe drought spell in the butachlor treated field. Otherwise there is hardly any possibility of carry over problem as it showed sufficiently short persistence period.

## P-166 Herbicide residue status in ground water samples in different districts of Punjab.

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The increasing use of herbicides in agriculture, has led to a concern of their contamination in ground water and surface water. Ground water samples were collected from the tubewells in the districts of Kapurthala, Amritsar, Ferozepur, Moga, Hoshiarpur, Jalandhar, Ropar, Ludhiana, Patiala and Gurdaspur of Punjab state where farmers had applied isoproturon, 2,4-D, sulfosulfuron, anilophos and butachlor in rice-wheat cropping system at recommended doses for last so many years. It was observed that tubewell water showed no detectable residue of isoproturon, 2, 4-D, butachlor and sulfosulfuron and were below detectable limits. This showed that these herbicides had not moved into the water table in the above said districts of Punjab.

## P-167 Uptake of heavy metals by weedy plants of medicinal value grown in metal contaminated sites of Jabalpur

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The uses of weedy plants having medicinal value have been increasing constantly in ayurvedic pharmaceutical industries. These weeds grow with least care and have ability to absorb non-essential toxic metals from contaminated sites. An investigation was therefore made to study the status of heavy metals (nickel, copper, lead and zinc) in weedy plants grown in drains carrying waste water and along the roads in Jabalpur and adjoining areas. Out of twenty weed species of medicinal value, eleven from drains and nine from the road sites were studied for the heavy metal uptake in their shoot part. It was observed that among weedy plants grown in drains, *Amaranthus viridis, Ageratum conyzoides, Polygonum persicaria, Commelina communis, Alternanthera sessilis, Solanum nigrum and Ipomea aquatica* absorbed copper in their shoot part which was higher than the prescribed standard limit. The concentrations of nickel and zinc found exceeding the permissible limit in shoot part of all eleven species viz, *Polygonum persicaria, Commelina communis, Alternanthera sessilis, Amaranthus viridis, Ipomoea aquatica, Heliotropicum indicum, Ageratum conyzoides, Blumia lacera, Solanum nigrum, Convolvulus arvensis and Cyperus iria.* As far as weedy plants along road is concerned, *Calotropis procera, Hyptis suaveolens, Chicorium intybus, Lantena camera, Datura stramonium* accumulated the lead far above the prescribed standard limit. Conversely, the copper content was found within prescribed limit in *Heliotropicum indicum, Cyperus iria, Convolvulus arvensis, Blumia lacera* at drains and no lead was detected in *Alternanthera sessilis, Abutilon indicum, Xanthium strumarium, Anagalis arvensis* at road sites respectively. Keeping in view the bio-magnification of metals in food chain, these observations may be exploited while selecting the weedy plants as a source of raw material for the preparation of the ayurvedic/ herbal products.

## P-168 Effect of chemical and non chemical weed management practices on weed spectrum, yield of tomato and its residual effect on succeeding crops

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A field study was conducted in the eastern block of TNAU, Coimbatore during *kharif* season, 1999 to study the effect of chemical, non- chemical and allelopathic plant products on the weed spectrum and yield potential of tomato. The pot culture bioassay study was also made to assess the herbicide residue in the soil as well as in the tomato fruits. The results revealed that black polythene mulching enhanced the growth and yield of tomato (27.59 t/ha), which was followed by the pre- emergence application of pendimethalin 1.0 kg/ha and metribuzin 0.50 kg/ ha.The results of bioassay studies after the harvest of tomato crop revealed that there was no reduction in germination and growth characters of succeeding test crops. Seeds extracted from the harvested tomato fruits tested for germination and the results indicated no reduction in germination and seedling growth of tomato.

## P-169 Role of soil microorganisms for weed management

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Traditional methods of weed management have not considered the microbial or other biological factors that influence plant growth; however, incorporating this knowledge may expand weed management possibilities to develop weed-suppressive soils. Alternative weed management strategies are needed to expand the capability of weed control as weed pressures continue to limit optimum yield. Biotic factors can influence the distribution, abundance, and competitive abilities of plant species. It has been shown that soil microorganisms are capable of suppressing weeds in the field, and seed decay phenomena are most likely microbial. It is imperative that an understanding of soil microorganisms and their ecology be developed, so that they may be used to benefit agriculture, especially weed management. Rhizobacteria that colonize the surfaces of plant roots, produce, and release phytotoxic metabolites, similar to allelochemicals, that detrimentally affect growth of plants. Practical application of this group of bacteria to agriculture could contribute to biological weed management systems that have less impact on the environment than conventional systems by reducing inputs of herbicides. Rhizobacteria have been investigated for potential as inundative-type biological control agents on several weeds. Unlike conventional herbicides, this group of bacteria generally do not attack specific biochemical sites within the plant, they offer a means to control weeds without causing direct selective pressure on the weed population; therefore, development of resistance is not a major consideration. Additionally, the use of rhizobacteria appears to be environmentally benign relative to herbicides. These characteristics make rhizobacteria an attractive approach for managing crop weeds in a sustainable manner, even within the boundaries of conventional agriculture systems. However, recent evidence suggests that indigenous rhizobacteria might be exploited under certain crop and soil management practices that are inherently part of sustainable agricultural systems.

## P-170 Persistence of tribenuron residues in wheat

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Tribenuron-methyl (methyl 2-[[[[*N*-(4-methoxy-6-methyl-1,3, 5-triazin-2-yl) methylamino] carbonyl]amino]sulfonyl]benzoate) is a sulfonylurea herbicide used for the control of broad-leaved weeds in cereals. It is rapidly absorbed by the foliage and roots and translocated throughout the plant. Susceptible plants cease growth almost immediately after post-emergence treatment and are killed within 7 – 21 days. Herbicides when applied post-emergence may leave residues in crop produce and soil, depending on the chemical structure, doses and their interaction with the soil properties. Since herbicides are necessary to manage weeds, their residues in crop produce at harvest are of great concern. Thus residues of triabenuron were determined in grains and straw and soil where triabenuron was applied at 18.75 to 45 g/ha as postemergence in wheat crop by using HPLC coupled with PDA detector. After 30 days residue level of tribenuron in soil was found 0.096 to 0.174 µg/g. At harvest residues in wheat grains was found 0.001, 0.0026, 0.0030, 0.0038 µg/g at 18.75, 22.50, 36.50, 45 g/ha doses of tribenuron, respectively. However in the straw, residues were found below 0.001 µg/g at 18.75 dose, and 0.0030, 0.0038, 0.0050 µg/g residues were detected at 22.50, 36.50, 45 g/ha doses, respectively.

## P-171 Persistence and bioaccumulation of ethoxysulfuron in paddy

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Rice is the main food crop after wheat and an exportable commodity in India. Although herbicides provide effective weed control, yet the herbicides pose serious health and environment threats. Thus persistence of ethoxysulfuron (60 %WG) was evaluated in rice crop. Ethoxysulfuron [3-(4,6-dimethoxyoyrimidin-2-yl)-1-(2-ethoxyphenoxysulfonyl) urea] belongs to sulfonylurea group having a toxicity class of III and used as a selective herbicide. It acts by reducing the levels of three branched-chain aliphatic amino acids. Ethoxysulfuron was sprayed at 15, 17.5, 18.75 and 20 g/ha doses as pre-emergence. Soil and crop samples were collected at harvest and analyzed to see persistence of ethoxysulfuron in soil and crop produce by HPLC. Residues were found below <0.001 µg/g in soil, grains and straw at harvest at 15 to 20 g/ha doses, respectively. This showed fast dissipation of ethoxysulfuron in soil and plants and thus not pose environmental risk at discussed application rates.

## P-172 Studies on residual effect of herbicides applied in *rabi* maize on succeeding rice crop under rice - *rabi* maize cropping system

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A field trail was conducted during Kharif 2008 with an objective to study the harmful toxic level of residues of herbicides applied in *rabi* maize on succeeding rice crop in a randomized block design with four replications at Agronomy Research Farm as well as in weed science laboratory of department of Agronomy, N.D.U.A. & T. , Kumarganj, Faizabad. Application of atrazine at 1.5 kg and 3.0 kg/ha$^{-1}$, pendimethalin at 1.0 kg & 2.0 kg /ha, isoproturon at 1.0 kg and 2.0 kg/ha$^{-1}$ at pre emergence applied in *rabi* maize to control the weeds did not show their harmful toxic level of residual effects on weed density, weed dry weight and rice yield significantly.

## P-173 Chlorimuron-ethyl persistence in soil and its residue analysis in soybean crop at harvest

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Study was undertaken for the persistence of chlorimuron-ethyl in soil (clay loam) of Tarai region of Uttarakhand. Chlorimuron ethyl was applied on soil of soybean crop at two different doses *i.e.* 6 and 12 g ai /ha under field condition. Soil of 0 – 15 cm depth was taken and chlorimuron-ethyl residues were analysed by RP-HPLC at 235nm using mobile phase acetonitrile: water: formic acid (60: 40: 0.1% v/v). Chlorimuron-ethyl persisted in soil for more than 30 days at lower dose while at higher application dose it persisted for more than 45 days after which it was below detectable. Dissipation of chlorimuron-ethyl followed first order kinetics. At harvest chlorimuron-ethyl residues were below detectable limit in soil, soybean pods and soybean plant/straw. The limit of detection was 0.05µg/g of soil.

# P-174 Weeds of Potato fields and their degree of preponderance in high altitude of Nilgiris

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The severity of weed problem is generally high in higher hills of Nilgiris due to the prevalence of humid temperate climate during the crop growing season. This makes the cultivation difficult, more expensive and lowers the crop yields. Potato is most widely grown in these hills. An area of 4,000 to 4,500 hectares is under potato cultivation in the Nilgiris. One of the major reasons for their low yields is failure to control weeds at the correct time. Therefore one of the most important concerns in the crop production is to reduce competitive effects of weeds on the crops in order to minimize yield losses. Weed management thus assumes utmost importance in the cultivation of potato crops. For planning an integrated weed management programme for the area and to conserve moisture and nutrient for the potato, it is necessary to know the weed species occurring in the region, their population densities and growth. It was, therefore inevitable to conduct a survey of weed flora and weed population of the potato fields of this region. The survey of the weed flora conducted at high altitude (2300-2500 MSL) revealed the presence of 24 weed species belonging to 8 families. *Polygonum alatum, Spergula arvensis, Oxalis sp., Polycarpon loeflingiac, Poa annua* were the most prevalent weeds in potato fields with relative abundance values of 25.7, 23.1, 32.1, 14.1 and 23.1 respectively. Dicot weeds infestation was more (82%) compared to monocot weeds. *Poa annua* was the most dominant weed species (93.5%) among the monocot weeds. The highest dry matter accumulation was recorded in *Polygonum alatum*(47.3 kg $ha^{-1}$) followed by *Poa annua*(19.88 kg $ha^{-1}$). The weed population was very high (1943 $m^{-2}$) in main season (Kharif)compared to that in the Autumn season (325 $m^{-2}$). It was found that the rotation of potato-cabbage and potato-carrot were mo9re effective in controlling the weed growth as comp[ared to other crop rotations. The monoculture of potato enhanced the weed population.

## P-175 Effect of rice establishment techniques, weed and nutrient management on rice grain yield under sodic soil condition

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A Field experiment was conducted during Aug – Jan 2008 at Anbil Dharmalingam Agricultural College and Research Institute, Trichy farm with alkali soil of pH 8.4, EC 0.14 ds/m and ESP 16.1. The experiment was laid out in split plot design with three replications. Rice variety TRY 1 was tested with the following treatments *viz.*, rice establishment techniques and weed management ($M_1$- Conventional Planting + No rotary weeding , $M_2$-Conventional planting + Rotary weeding, $M_3$- SRI planting + No rotary weeding, $M_4$-SRI planting + rotary weeding) and nutrient management ($S_1$- Control, $S_2$- 150:50:50 kg/ha NPK, $S_3$-$S_2$ + FYM (12.5 t/ha), $S_4$- S3 + Azophosmet + PPFM) In no rotary weeding treatment conventional method of weeding (Butachlor 1.25 kg/ha + Hand weeding 35 DAT) was practiced. The results revealed significant difference in yield attributes and grain yield by the treatment studied. Higher No of panicles hill$^{-1}$, filled grain panicle$^{-1}$ and panicle length was recorded by $M_4S_4$ – SRI + rotary weeding + 150: 50: 50 kg/ha NPK + FYM + Azophosmet + PPFM and higher No of panicles meter$^{-2}$ was recorded by $M_2S_4$ - Conventional planting + rotary weeding + 150: 50: 50 kg/ha NPK + FYM + Azophosmet + PPFM. Regarding grain yield, SRI planting + rotary weeding + 150: 50: 50 kg/ha NPK + FYM (12.5 t/ha) + Azophosmet (Seed treatment 200 g/ha and Soil application 2 kg/ha) + PPFM (Foliar spray @ 1 ppm at PI and Heading) recorded significantly higher grain yield (6608 Kg/ ha) and was comparable with conventional planting + rotary weeding +150: 50: 50 kg/ha NPK + FYM (12.5 t/ha) + Azophosmet (Seed treatment 200 g/ha and Soil application 2 kg/ha) + PPFM (Foliar spray @ 1ppm at PI and Heading) (6075 Kg/ha).

## P-176 Evaluation on the efficacy of Azimsulfuron 50 DF against direct seeded rice weeds as post emergent application

**S.Sakthivel, R.Balasubramanian and S. Sanbagavalli**

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An experiment was conducted at Agricultural College & Research Institute, Madurai during *kharif* 2007 to study the efficacy of Azimsulfuron 50 DF against direct seeded rice weeds as post emergent application. The experiment was laid out in RBD replicated thrice. The test variety was ADT 45. The treatments consisted of Azimsulfuron 50 DF @ 27.5, 30.0, 35.0, and 40.0 g a.i./ha with 0.2% surfactant: butachlor 50 EC @ 1.25 kg a.i./ha; hand weeding twice (standard checks) and unweeded check. Post emergent herbicide was applied to rice on 20 DAS (2-3 leaf stage of weed). For phyto-toxicity observations, Azimsulfuron 50 DF applied at the rate of 70 and 80 g a.i./ha plots were also maintained. The weed flora consisted of *Echinochloa colonum, Cyperus difformis, Cyperus iria Spheranthus indicus, Sphenoclea zeylonica* and *Ammania baccifera*. The species wise weed count was observed at pre-treatment, 15, 30 and 45 days after application. The result on phytotoxicity rating taken on 7 and 10 days after application of herbicide showed that there was slight yellowing of rice crop at initial stage at higher dose of Azimsulfuron 50 DF application (40 g a.i./ha and above). But the yellowing recovered by 10 days after application. Hand weeding twice effectively controlled all categories of weeds by reducing the density and DMP. Azimsulfuron 50 DF @ 35.0 g/ha + 0.2% surfactant was found to be safe to rice variety ADT 45 and was found to be effective against sedges, grasses and broadleaf weeds when applied at 20 DAS for direct seeded rice. This treatment also registered higher grain yield which was on par with standard checks.

## P-177 Evaluation on the efficacy of Azimsulfuron 50 DF against direct seeded rice weeds as post emergent application

**S.Sakthivel, R.Balasubramanian and S. Sanbagavalli**
*Department of Agronomy, Agricultural College & Research Institute, TNAU, Madurai, (TN)*

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## P-178 Weed dynamics and yield of groundnut + castor intercropping system under rainfed conditions

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Field experiments were conducted at North West and Western zones of Tamil Nadu during *Kharif* season to study the Seed hardening techniques and weed management for productivity enhancement in Groundnut + castor intercropping system under rainfed conditions. In Kharif 2003 and 2004 the effect of seed hardening in groundnut (0.5 per cent $CaCl_2$ and normal seed) and weed management practices (unweeded check, hoeing and weeding on 20 and 40 DAS, weeding with star type weeder on 20 DAS + hoeing and weeding on 40 DAS, pre-emergence application of pendimethalin @ 1.0 kg a.i. ha + hoeing and weeding on 40 DAS and pre-emergence application of metolachlor @ 1.0 kg a.i. ha + hoeing and weeding on 40 DAS) in groundnut + castor inter cropping system. In respect to groundnut, seed hardening with 0.5 per cent $CaCl_2$ treatment recorded the highest speed of emergence, field emergence, vigour index, plant height, LAI, CGR, RGR, DMP, number of matured pods, pod yield and haulm yield. Irrespective of the locations chlorophyll content, soluble protein, hundred kernel weight and oil content were however not influenced by $CaCl_2$ seed hardening. Among the weed management practices studied, pre-emergence application of metolachlor @ 1.0 kg *a.i.* ha + hoeing and weeding on 40 DAS recorded the highest weed control efficiency and lowest weed dry matter production at 20 DAS, while at 40 DAS hoeing and weeding on 20 and 40 DAS recorded the highest weed control efficiency. the overall experimental results it is concluded that groundnut seeds treated with 0.5 per cent $CaCl_2$ and pre-emergence application of metolachlor @ 1.0 kg *a.i.* ha followed by one hoeing and weeding on 40 DAS increased the yields of groundnut and castor crops during *Kharif* season.

## P-179 Influence of Paddy—Maize sequence on weed density and weed population

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A field experiment was conducted on clay loam soils of Agricultural Research Station,Kathalagere (Karnataka) during 2006-07 under irrigated conditions to study the major weed flora (weed density/population) in the rice—maize cropping system. The results revealed that the density of broad leaved weeds was highest (3.03 to 7.99/ 0.25 $m^2$ ) at 35 days after planting in paddy (*kharif*).It was followed by sedges (0.69 to 2.06/ 0.25 $m^2$).Least weed density was noticed incase of grasses (0 to 0.54/ 0.25 $m^2$).Whereas, total weed density ranged from 4.03 to 10.05/0.25 $m^2$. But, much higher weed density was observed in maize (*summer*) than the paddy (*kharif*).Broad leaved weeds recorded the highest weed density i.e., 8.51 to 26.78/0.25 $m^2$ @ 35 days after sowing and sedges ranged from 0.35 to 7.62 per 0.25 $m^2$. Least was recorded incase of grasses (2.37 to 6.69/ 0.25 $m^2$).Total weed density was also more during summer than kharif .It ranged from 18.82 to 41.10 per 0.25 $m^2$.

## P-180 Effect of integrated weed management in direct sown finger millet under upland conditions

**S. Manoharan**
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A field experiment was conducted during the rainy seasons of 2001, 2002 and 2003 at TNAU, Coimbatore to evaluate the efficiency of Isoproturon herbicide alone and in combination with other cultural practices on finger millet under upland conditions. The study revealed that the recommended management practice of one inter-cultivation and two hand weedings gave significantly higher grain yield (3109 kg/ha) compared to all other treatments which was followed by application of isoproturon @ 0.5kg a.i/ha as pre-emergence combined with one inter-cultivation and one hand weeding (2900 kg/ha) and both the treatments increased the grain yield by 271.5 and 246.9 per cent respectively over the unweeded check.

## P-181 Weed flora as influenced by organics and inorganics in maize

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A field experiment was conducted on clay loam soils of Agricultural Research Station, Kathalagere (Karnataka) during *kharif* season of 2007 under irrigated conditions to study the major weed flora (weed density/population) as influenced by the different organics and inorganics in maize. Among the different nutrient treatments tried, maximum number of sedges (0.5/0.25 $m^2$) were recorded in T3 i.e application of organics(each 1/3 of FYM + vermicompost + neem cake-equivalent to recommended N with intercropping of green gram and also in T-7 i.e, 100 % of recommended NPK + 10 kg ZnSO4/ha).But, the highest number of grasses (4.5/0.25 $m^2$) were recorded in T2 (each 1/3 of FYM+ vermicompost + neem cake- equivalent to recommended N).Number of broad leaved weeds were found maximum(2.5/0.25 $m^2$) in T1 (50% RDF + 50% N as FYM +10 kg ZnSO4/ha) and also in T-5 (50% N through FYM+rock phosphate for required P supply) + PSB bio-fertilizer).The total weed density was found maximum (5.5/0.25 $m^2$) in T1(50% RDF + 50% N as FYM +10 kg ZnSO4/ha) and T 2 (each 1/3 of FYM+vermicompost+neem cake-equivalent to recommended N).

## P-182 Studies on varietal variation of rice crop in grain yield due to weeds and their management practices

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Rice is cultivated under the area of 21 lakh hectare in all over Tamil Nadu and consider as a major staple food in India. Yield losses of rice crop due to weed density are estimated to be 15-40 % in transplanted rice. Weeds in rice farming are managed through either manual weeding or herbicide application to enhance rice growth without weed competition. Weed management trails were carried out in the Department of rice, Tamil Nadu Agricultural university and Coimbatore during the year of 2005 – 06. The treatment details as follows. $T_1$- Butachlor; $T_2$- Two hand weedings; $T_3$- Weed free, and T4- Unweeded check. In the variety CO-47, un-weeded check recorded grain yield of 3.14 t $ha^{-1}$. Butachlor application recorded 38.2 %, two hand weedings 43%, weed free recorded 28.7% higher grain yield compared to un-weeded check. In ADT-43, unweeded check recorded grain yield of 4.98 t $ha^{-1}$. Butachlor application recorded 10.4 %, two hand weedings 17.3%, weed free recorded 10.1% higher grain yield compared to un-weeded check. During the year of 2005, the *kharif* seasonal variation of CO-47 variety unweeded check recorded grain yield of 3.23 t $ha^{-1}$. Butachlor application recorded 22.0%, two hand weedings 35.9%, weed free recorded 25.7% higher grain yield when compared to unweeded check. In the same year during *rabi* season, with CO-47 variety unweeded check recorded grain yield of 3.05 t $ha^{-1}$. Butachlor application recorded 55.4%, two hand weedings 50.5%, weed free recorded 31.8% higher grain yield when compared to un-weeded check. Hence, weed density and their management practices significantly influence the grain yield of rice varieties.

## P-183 Effect of time of sowing and weed control methods in direct seeded rice

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Weed are the major threat in direct seeded rice. Successful direct seeding requires efficient weed management early in the life of crop to replace the suppressive effect of water in transplanted rice. A long term trial was initiated at Crop Research Center of G.B. Pant University of Agriculture & Technology Pantnagar during *kharif* 2008 to find out the effect of two date of sowing (before and after of mansoon) and different weed control methods on grain yield and weed emergence in rice. The experiment was conducted in split plot design by taking two dates of sowing as main plot and six weed control methods as sub plot treatments. Rice crop was sown on June, 19 and July 8, 2008, respectively according to the treatments. Weed flora of experimental field consisted of *Celosia argentia* (27 & 34%), *Eleusine indica* (22 & 23%), *Cleome viscose* (4 & 21%), *Echinochloa* spp. (16 & 14%), *Cyperus* spp. (11 & 8%) in before and after monsoon sown crops, respectively. Other weeds like *Panicum* spp (17%) and *Alhagi camelorum* (3%) were recorded in the weedy plots of before monsoon sown crop. Time of sowing did not influence total weed density, weed dry weight accumulation and grain yield of rice. However, the interaction effect of time of sowing and methods of weed control influenced the dry matter accumulation of weeds and yield of rice significantly. Post-emergence spray of fenoxaprop at 60 g $ha^{-1}$ and broadcasting sesbania + 2, 4-D spray at 0.5 kg $ha^{-1}$ reduced weed dry weight significantly in after monsoon sown rice as compared to before monsoon sown crop. All the weed control methods produced significantly higher yield of rice as compared to weedy check. Keeping field weed-free in before monsoon sown crop produced significantly higher grain yield as compared to after monsoon sown crop.

## P-184 Bio-efficacy evaluation of Paraquat Dichloride 24% SL against weeds in potato crop

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A field trial was conducted during winter season of 2008-09 to evaluate the bio- efficacy of paraquat dichloride 24% SL against weeds in potato crop at Crop Research Centre of G.B. Pant University of Agriculture & Technology, Pantnagar, U.S. Nagar, Uttarakhand. The experiment with 8 treatments (Table-1) and 3 replications was layed out in randomized block design. *Kufri Badshah* variety of potato was planted on 3 December, 2008 at 60 cm spaced ridges with plant to plant spacing of 25 cm. Both the formulations of paraquat either new or existing were sprayed as post-emergence at 21 days after planting and metribuzin was applied as pre-emergence spray at next day of planting by using 600 liters of water per hectare with Knap Sac sprayer. Experimental crop was raised by using recommended package of practices other than weed control. The experimental field was mainly infested with *Phalaris minor* (54.7%), *Cyperus rotundus* (41.6%), *Chenopodium album*,(8.9%), *Parthenium hysterophorus* (3.2%) and *Coronopus didymus* (1.2%) in weedy plots at 75 days after planting. Paraquat dichloride 1000 g $ha^{-1}$ being on par with metribuzin 350 g $ha^{-1}$ at 45 DAP and metribuzin being on par with paraquat 1000 and 600 $gha^{-1}$ recorded the lowest weed density, respectively at 75 days stage. Remaining doses of paraquat including existing and new molecules did not show any significant variation in weed density as noted at both the stages. Metribuzin 350 $gha^{-1}$ being on par with all the doses of existing or new molecules of paraquat produced lowest dry matter of weeds at 45 DAP, however it was lowest with new molecule of paraquat 1000g and was at par with 600 $gha^{-1}$ of its new molecule at 75 days after planting. New molecule of paraquat dichloride 1000 $gha^{-1}$ recorded highest weed control efficiency at 45 and 75 DAP. Either new or existing molecule of paraquat 500 g $ha^{-1}$ was the second best treatment with respect to weed control efficiency at 45 days stage. New molecule of paraquat 600 g $ha^{-1}$ and existing and new molecules at 500 g $ha^{-1}$ were also proved effective in controlling weeds at 75 days after planting. Significant variation with respect to yield and yield attributes like number, weight and diameter of tubers per plant was recorded due to various treatments. Number of tubers per plant ranged in between 3.9 to 7.0, diameter of tubers in between 2.30 to 3.04cm and tuber weight in between 0.53 to 1.06 g per plant. Uncontrolled growth of weeds on an average recorded 13.3 per cent reduction in tuber yield when compared with weed-free treatment. Existing molecule of paraquat 500 $gha^{-1}$ being on par with its new molecule at 1000g $ha^{-1}$ and metribuzin 350 g $ha^{-1}$ recorded highest tuber yield per hectare among various herbicides. Existing or new molecule of paraquat showed an initial yellowing and burning of potato leaves within 24 hours of their spray in the field. However, the plants were fully recovered within 5-10 days after their application without any adverse effect on the newer growth of crop plants and thus, there was no any phytotoxicity or killing was noted with these herbicides.

## P-185 Effect of chemical weed control methods on productivity of rainfed finger millet

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A field experiment was conducted at Tamilnadu Agricultural University ,Coimbatore during the rainy seasons of 2005, 2006 and 2007 to study the efficacy of herbicides viz., isoproturon @ 0.5 kg a.i/ha and oxyflurofen @ 0.050 and 0.075 l a.i/ha as pre-emergence spray combined with inter-cultivation and manual weeding. The study revealed that application of oxyflurofen @ 0.050 l a.i/ha along with two inter-cultivation and one hand weeding were essential for maintaining higher grain yields (2682 kg/ha) which resulted in higher net returns and benefit : cost ratio.

**P-186**

# Influence of weed management practices on yield of rice fallow sesame (*Sesamum indicum*) in Cauvery new delta region

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In Cauvery new delta zone, rice-rice black gram/sesame is the cropping sequence. Weed infestation is the one of the major constraints in rice fallow sea same production. Sesame is slow growing crop during its initial period, hence weeds compete for moisture, light and nutrients and there by reduces the crop growth and yield. Keeping this in view, an experiment was conducted at Agricultural Research Station, Pattukkotti during October 2005 and September 2007 to study the influence of weed management practices in rice fallow sesame. The experiment was laid out in randomized block design with three replications. The treatment comprises for four herbicides *viz*., butachlor (1 kg/ha ), pendimethalin (0.75 kg/ha) fluchloralin (1.0 kg/ha) and alachlor granules (3 g) applied in two methods as spray and sand mix, followed by one hand weeding on 30 DAS, were compared with manual weeding once /twice and unweeded check. Trianthema *portulacastrum*, *Eclipta alba Pyllanthus niruri* are the broad leaved weeds while *Cynodon dactylon* and *Echnocloa* are grasses *and Cyprus rotundus, Cyprus difformis* sedges were the major weed flora in the experimental field. Among the weed management methods application of alachlor granules as sand mix followed by one hand weeding favorly influenced the yield attributes *viz*., number of branches per plant, number of capsules per plant, number of seeds per capsules and 1000 seed weight significantly. Lower weed population and wed dry weight matter production, higher weed control efficiency (72.4%). The higher seed yield (979 kg/ha) and stalk yield (2359 kg/ha) of sesame were registered in the application of alachlor as sand mix followed by one hand weeding on 30 DAS. This treatment was closely followed by hand weeding twice treatment. The highest weed population and dry matter production and lower seed yield (618 kg/ha) and stalk yield (1087 kg/ha) were recorded in the unweeded check treatment.

## P-187 Weed management in mango and cashewnut orchards in costal region of Maharashtra (Konkan)

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In *Konkan* region despite control of perennials in interplant spaces, seasonal grasses mainly *Themeda quadrivolus* grow naturally to the height 0.75 to 1.5 m on large scale with underneath growth of many other grasses like *Oplismenus burmanii*, *Oplismenus compositus* etc. In orchards situated on plain areas in *Konkan,* incidence of *Coix lacryma jobi* and *Ischacmum rugosum* and such other weeds is common. Growth of these grasses during monsoon season is beneficial as fodder for milch and draft cattles besides the fact that such growth of grasses in interplant spaces of orchards acts as effective live mulch to avoid direct impact of intense rains besides soil binding action through their fibrous roots. Studies were conducted at Agricultural Research Station, *Mulde* Agricultural Research Station, *Phondaghat* and at Agricultural College Farm, Dapoli for control of grass weeds in orchards revealed that grassy vegetation needs to be harvested immediately during post monsoon period from October to December as it proves hindrance to plant protection measures, harvesting and picking fallen cashew nuts. So also dried grass makes orchards vulnerable for fire hazards. Every year hundreds of acres of orchards are damaged this way particularly in *Konkan* region.

## P-188 Invasive weeds under different cropping systems of costal Maharashtra

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Weed survey was conducted under National Invasive Weed surveillance Programme (NIWSP) at Dapoli centre during *Kharif* season of the year 2008. Weed survey had been conducted in different zones and in different systems i.e. in non-cropped area and cropped area. Data of non-cropped area of Sindhudurg and Ratnagiri district reveled that the important value index (IVI) are maximum in *Digitaria ciliaris* i.e. 49.87% and 35.20% and *Cynodon dactylon* 27.28% and 11.96% in both the locations, where as *Chromolaena odorata*, *Dactyloctenium aegyptium* and *Mimosa pudica* recorded 18.99%, 12.27%, and 11.93% IVI in Sindhudurg and *Cyprus iria* 11.47% IVI in Ratnagiri district respectively. As regards to IVI of Sindhudurg district in rice cropped area *Digitaria ciliaris* is 16.53%, *Cyperus rotendus* is 14.15%, where as in Ratnagiri district *cyperus iria* shows 21.51% and *Digitaria ciliaris* is 15.44%. Different weed species observed in orchard revealed that *Digitaria ciliaris, Mimosa pudica, Chromolaena odorata* are common weeds shows 65.57% and 68.17%, 18.32% and 29.27%, 14.06% and 12.87% IVI in above mentioned species respectively in both the location of the centre. More over *Lantana camera*, *Celoria argentea* and *Cyperus* species are the invasive species recorded in both the locations in the orchards. Orchards should be regularly watched for alien invasive weeds like *Chromolaena odorata*, *Mimosa pudica*, *Lantena camera* and their introduction should be prevented by uprooting them in seedling stage itself. This way many farmers have been able to keep their mango, cashewnut and such other orchards free from alien invasive weeds.

## P-189 Invasive weeds under different cropping systems of south Maharashtra

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The weed was survey conducted during *Kharif* season 2009 in south Maharashtra (Viz. Satara, Sangali and Kolhapur districts) under the project of National Invasive Weed Surveillance Programme at Dapoli Centre in different cropping systems. Based on important value index (IVI) data reveled that in non-cropped area of Satara district, *Digitaria ciliaris* (31.86%) was most dominant weed followed by *Parthenium hysterophorus* (26.83%). Where as in Sangli and Kolhapur district, *Cynodon dactylon* was most problematic weed under non-cropped area followed by *Digitaria ciliaris*, *Mimosa pudica*, *Chromolaena odorata* and *Parthenium hysterophorus* respectively. Under cropped area of Satara district, *Cyperus iria* (55.42%) in rice and *Ageratum conizoides* (31.55%) in sugarcane were most dominant weed species followed by *Celosia argentea* and *Parthenium hysterophorus* respectively. However, *Celosia argentea* was densely populated weed under, sorghum, groundnut and cotton crops. Where as, *Cynodon dactylon* was most problematic weed species observed in sugarcane, groundnut, maize and *Kharif* vegetable of Sangli and Kolhapur district. Based on surveillance data it seems that the non-cropped and cropped area of south Maharashtra were damaged by *Digitaria ciliari, Cynodon dactylon, Parthenium hysterophorus, Mimosa pudica*, *Chromolaena odorata*, *Ageratum conyzoides* and *Celosia argentea* respectively.

## P-190 Invasive weeds under different cropping systems of north Maharashtra

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The weed survey was conducted during *Kharif* season 2008 of north Maharashtra (viz. Nashik, Jalgaon, Nandurbar and Dhule district) under the project of National Invasive Weed Surveillance Programme at Dapoli Centre in different cropping systems. Based on important value index, data revealed that under non-cropped area of Nashik district, *Parthenium hysterophorus* (27.53%) was dominant weed species followed by *Alternenthera sessilis* (21.02%), *Celosia argentea* (18.95%) and *Lantana camera* (18.94%). However, *Cynodon dactylon* was most problematic weed observed in Dhule, Jalgaon and Nandurbar districts under non-cropped area followed by *Parthenium hysterophorus* and *Celosia argentea*. Where as, *Cynodon dactylon* was most dominant weed in *Kharif* vegetable and sorghum crops followed by *Parthenium hysterophorus* in cropping pattern of Nashik district. However, in orchard crops, it seems that IVI was maximum in *Parthenium hysterophorus* (32.89%) which followed by *Celosia argentea* (29.42%) and *Ageratum conyzoides* (24.84%). In Dhule district, *Cynodon dactylon* was most problematic weed species in maize, soybean and cotton crops followed by *Parthenium hysterophorus*. However, *Celosia argentea* (48.66%) indicates maximum IVI in groundnut followed by *Cynodon dactylon* (43.73%). Cropping pattern of Jalgaon district reveled that, *Cynodon dactylon* was dominant weed in sorghum and cotton crops, however, *Celosia argentea* was problematic weed under sugarcane and *Kharif* vegetable. Where as, *Cynodon dactylon* was most dominant weed species in sorghum, cotton and soybean followed by *Parthenium hysterophorus* under Nandurbar district. From the above data it is revealed that *Parthenium hysterophorus*, *Cynodon dactylon* and *Celosia argentea* are the most problemic weed species in north Maharashtra.

# P-191 Influence of FYM, brown manuring and levels of nitrogen on weed count and weed dry matter of direct seeded and transplanted rice

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Transplanting is the most common method of crop establishment in lowland rice. However, this method is not a profitable due to high labour wages and the problem of availability of labour during peak period of operation. The alternative to transplanting could be direct seeding because it does not require heavy amount of labour and crop matures early (8-12 days) than transplanted rice allowing timely planting of wheat crop. But heavy weed infestation causing poor establishment, growth and development of rice crop is major problem with direct seeding in rainy season. Keeping in view the above facts, a field experiment was conducted on direct seeded and transplanted rice during *kharif* 2008 to study the effect of organic manures, brown manuring and graded doses of fertilizers on total weed count and weed dry matter accumulation. The field experiment comprised 20 treatment combination viz; five main plot treatments (Direct seeded rice with FYM @ 10 tonnes/ha, Direct seeded rice without FYM, Direct seeded rice with Brown manuring, Transplanted rice with FYM @ 10 tonnes/ha and Transplanted rice without FYM) and 4 nitrogen levels as sub plot treatments (90, 120 and 150 kg N $ha^{-1}$ and LCC treatment). The experiment was laid out in split plot design with four replications. PR 115 variety of rice was sown on 4 June, 2008 by using 50 kg $ha^{-1}$ seed rate. Transplanting was done with 28 days old seedlings on 2 July, 2008. Brown manuring in direct seeded rice significantly decreased the total weed count and weed dry matter accumulation as compared to other main plot treatments. The reduction in total weed count and weed dry matter accumulation in brown manuring ranged between 28-43 per cent and 25-42 per cent respectively as compared to other main plot treatments. However, all the main plot treatments recorded statistically similar grain yield. Regarding nitrogen levels, non-significant differences were observed of total weed count and weed dry matter accumulation of direct seeded and transplanted rice. However, an increasing trend in total weed count and weed dry matter production with an increase of nitrogen levels was observed. The maximum weed count and weed dry matter accumulation was recorded in highest level of N i.e. 150 kg N $ha^{-1}$. However maximum grain yield was obtained in 120 kg N $ha^{-1}$ which was significantly superior to 90 kg N $ha^{-1}$, but statistically at par with 150 kg N $ha^{-1}$ and LCC treatment.

## P-192 Evaluation of herbicides for Bt cotton

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Field experiment was conducted during winter irrigated season at TNAU, Coimbatore. The test hybrid was Bt Bunny. The experiment was conducted in RBD with three replication, ten different treatment combination were tried. Among the different treatment maximum plant height was recorded in galaxy at the rate of 2.5 lit / ha. Boll number and boll weight were higher weed free check and it was on pare with hand weed twice and Trifloxysulfuron @ 5 g/ha. Weed free check recorded significantly higher seed cotton yield of 1419 kg/ha. It was followed by hand weeding twice (1215 kg/ha) which was on par with Trifloxysulfuron @ 7.5 g/ ha. Among the weed management practices, the grass weed DMP was lower in galaxy 2.5 lit / ha and it was on par with Trifloxysulfuron 10 g/ ha, galaxy 2 lit / ha, Trifloxysulfuron 7.5 g/ha and hand weed twice. Sedge weed DMP was lower in galaxy 2.5 lit/ ha and it was on par with fluchloralin 1.0 kg/ha, galaxy 2.0 lit / ha, Trifloxysulfuron 10.0 g/ha followed by Trifloxysulfuron 7.5 g/ha and hand weed twice. Trianthema weed DMP was lower in galaxy 2.5 lit/ha and it was on par with Trifloxysulfuron 10.0 g/ha, galaxy 2.0 lit / ha and Trifloxysulfuron 7.5 g/ha. Hand weed twice was less effective on trianthema weed DMP compared to other weed management practices.

## P-193 Effect of weed management pactices on Yield and economics of sunflower

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Higher yields and quality of oil in sunflower can be realized only when all the management practices such as weed, nutrient and irrigation management *etc*., are adopted in appropriate time. Keeping this in view, field experiments were conducted at Agricultural Research station Pattukkottai, to study the effect of organic and inorganic weed management practices on yield and economics of sunflower during October 2005 and September 2007. The experiments were laid out in randomized block design with three replications. The soil is sandy loan in texture with normal $p^H$ with low in available N, medium p and high in available N, medium P and high in available K status. The treatments consisted of eight weed control treatments comprising two inorganic sprays, two organic sprays, two mulches and one each of intercropping and unwedded control. The results revealed that among the weed management methods pre-emergence application of alachlor 2 kg/ha + one hand weeding on 30 DAS recorded significantly higher recorded significantly higher head diameter (15.1cm), percentage of filled grain(91.7.), 100 grain weight(6.41g), seed yield (2360kg/ ha) and stalk yield (3757 kg/ha). This treatment also recorded significantly lower weed population at 15 DAS (19.46) and 30 DAS (125.7) and higher weed control efficiency at 15 DAS (78%) , 30 DAS (67.2%), gross income (Rs.34533 $ha^{-1}$), net income(Rs.23,440 $ha^{-1}$) and cost benefit ratio(1:3.09). Hence, for sunflower pre-emergence application of alachlor 2 kg/ha+ one hand weeding on 30 DAS is effective.

## P-194 Performance of different Weed Control Measures in Soybean (*Glycine Max* (L.) Merrill)

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A field experiment was conducted during kharif season of 2008-09 on medium black soil under All India Co-ordinated Research Project on Weed Control at Directorate of Weed Science Research Centre, M.A.U., and Parbhani. In all eight treatments comprised of Imazethapyr @ 0.100 kg/ha as early POE, Quizolfop ethyl @ 40 g/ha as early POE, Chlorimuron ethyl @ 9 g/ha as early POE, Pedimethalin @ 0.75 kg/ha as PE, Tank mix of Quizolfop ethyl @ 20 g/ha + Chlorimuron ethyl @ 4.5 g/ha as early POE, two hand weddings and hoeing at 3 &6 WAS, wee free and weedy check were allocated in randomized block design with three replications. The soybean is was son on 1.7.2008 at 45 x 5 cm spacing. Major weed flora in the experimental field indicated that 43% grass weeds and 57 % broad-leaved weeds were associated with soybean crop. The dominant weed species in broad-leaved weeds were *Merremia emerginata, Corchorus acutangulus, Acalypha indica, Phyllanthus medraspentasis, Digera arvensis, Parthenium hysterophorus* & *Euphorbia geniculata* while in grassy weeds *Cynodon dactylon, Brachiaria eruciformis & Cyperus rotundus* were found dominant.

## P-195 Integrated weed management of jute and mesta

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Manual weeding in jute consumes about 40% of the total cost of cultivation and fibre yield reduction is around 70 per cent if remains unweeded. Butachlor @ 3 kg a.i./ ha when applied (with irrigation) 10 days ahead of jute sowing effectively controlled wide range of weed in jute field (*Trianthema portulcastrum* in particular) including *Cyperus difformis* and produced 42 quintal fibre/ha. Butachlor and Pretilachlor (0.83 to 1 kg ai/ha) have been found to be promising as preemergence herbicide for jute crop. From experiments over the years it has come out that Quizalofop ethyl 5% EC (grass killer) @ 45 to 60 g a.i./ha followed by one manual weeding or one wheel hoeing is economic for weed control in jute (JRO-524) and mesta (HC-583) and yielded 38 and 35 q fibre/ha. This herbicide was also effectve on sunnhemp and ramie crop and left no phyto toxicity on fibre crops. At 15 to 20 DAE, application of Glyphosate @ 0.82 to 0.3 kg ai/ha successfully controlled composite weed flora in jute and mesta crop (line sown 30 to 45 cm) when applied through guarded hooded nozzles. Rainfall even after 1 to 1.5 hours did not affect the jute crop growth Composite weed control through herbicide brush (weedicide applicator) assembled at CRIJAF, with herbicides like Glyphosate and Paraquat in combinations and at different doses produced jute fibre yield (46.5 q/ha cv. JRO-204) equivalent to conventional manual weeding twice (45.8 q/ha). For mechanical weed control in jute field at early stage (4 & 15 DAE) six rows nail weeder developed at CRIJAF was found effective in controlling composite weed flora and yielded 45.68 quintal fibre/ ha. Expenditure on manual weeding can be remitted by generating early revenue growing moong ( K-851, RMG-62) and moth bean (RMO-40) yielding 4 to 5 quintal pulse grain/ha, maize (40,00 green cobs/ha with 9 tonnes green fodder) and summer radish ( >50 q/ha) etc. as strip crops. Jute productivity in strip crop with pulses (4:4) ranged from is 20-22 q/ha. This strip crops will also mitigate the chronic problem of distress sale of jute fibre, generating early cash (within 60 DAS) and help the farmers to earn better profit from stored jute fibres when the fibre price goes high in the market.

## P-196 Studies on weed management in Rainfed Maize

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A field experiment comprising six treatments was conducted at the experimental farm of Directorate of Weed Science Research Centre, M.A.U., Parbhani in a randomized block design with four replications. The maize hybrid was sown on 30.6.2008 at 60 x 30 cm spacing. Atrazine was applied as pre-emergence immediately after sowing in four ways i.e. T- PE- Atrazine @ 1.5 kg/ha, T2 – Atrazine @ 0.75 kg/ha, T3 PE- Atrazine @ 0.75 kg/ha followed by one hand weeding at 6 WAS and T4 – PE- Atrazine @ 0.75 kg/ha and with these herbicidal treatments were compared with two mechanical weedings at 3 & 6 WAS and weedy check to study their effect on weeds and grain yield of maize. During the experimentation period the 46 % grassy and 54 % broad-leaved weeds were associated with Maize crop. Among grassy weeds, dominant weed species were *Cynodon dactylon, Cyperus rotundus, Brachiaria eruciformis, Dinebra retraflexa* and *Eragrotis minor*. The dominant broad-leaved weeds were *Euphorbia geniculata, Parthenium hysterophorus, convolvulus arvensis, Euphorbia hirta, Digera arvensis, Acalypha indica & Abutilon indicum.* The significantly lowest number as well as dry matter of weeds and higher weed control efficiency and lower weed index was recorded in PEA trainee @ 0.75 kg/ha followed by one hand weeding and it is was closely followed by mechanical weddings and PE-Atrazine @ 1.5 kg/ha and significantly superior over rest of the treatments. As regards maize grain yield, significantly higher grain yield was observed in PE- Atrazine @ 0.75 kg/ha followed by one hand weeding which behaved statistically similes with the mechanical weedings and PE- Atrazine @ 1.5 kg/ha and significantly superior over rest of the treatments.

## P-197 Effect of tillage and herbicides on weed dynamics and grain yield of wheat

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Results revealed that the highest grain and straw yield was observed in Minimum-Minimum tillage system, which was found at par with CT-CT and found significantly superior over rest of the tillage systems. The lowest dry matter of grassy weeds was found in Minimum tillage system, which was found significantly superior, i.e. lowest than rest of the treatments. The lowest dry matter of broad-leaved weeds was observed in CT-CT tillage system, which was found at, par with Minimum-Minimum tillage system and significantly lowest than rest of the treatments. As regards weed control efficiency of grassy weeds, it was found highest (43.97 % )in Minimum – Minimum tillage system. Whereas in case of broad leaved weeds, it was maximum in CT-CT tillage system (62.78 %).The reduction in yield of 27.80 % was observed in Zero-Zero tillage system as compared to Minimum –Minimum tillage system for wheat crop. As regards weed control treatments hand weedings resulted in highest grain yield which was found at par with herbicide (PE- Pedimethalin @ 1.0 kg/ha ) application and significantly superior over the unweeded control. The minimum dry matter of grassy weeds was observed in 2 HW for grassy as well as broad leaved weeds which was found at par with herbicide (PE- Pedimethalin @ 1.0 kg/ha ) application for both the type of weeds and found significantly superior over the unweeded control. The reduction in yield of wheat crop was recorded to 30.55 % in unwedded control over hand weeding. The highest weed control efficiency for grassy as well as broad leaved weeds was recorded in 2 HW treatment (30.55 % & 47.91 % respectively ) followed by PE- Pedimethalin @ 1.0 kg/ha. (26.56 % & 38.41 % respectively).

# P-198 Influence of pre - emergence herbicide on germination and seedling vigour of teak

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Teak (*Tectona grandis* Linn.f) is the most extensively planted tree species in India and its planting has been on an increase in the recent years. Teak wood is famous around the world over for its strength, durability, dimensional stability, working qualities, and the fact that it does not cause corrosion when in contact with metal. Teak is mostly propagated through seeds. Stumps are obtained from 6 to 12 months old nursery grown seedling. Containerized nursery grown with sprouted stumps is normally used for field planting. For quality seedling production in the nursery, weed management should be taken care of. Weeds must not be allowed to grow in nursery beds, because they compete with seedlings for water, nutrients, light and space. Weed invasion in nursery is exacerbated by the common practices of leaving gaps of bare ground and growing single that do not utilize all of the site resources. Weeds can also have an allelopathic effect on nursery seedlings. i.e., they can harm seedlings through the production of chemical compounds that escape into the environment. Other negative impacts of weeds are their potential for harboring insects or disease causing organisms. Furthermore, weedy nurseries may have an adverse psychological impact on workers and customers, thus potenicially reducing the productivity and profits. A national survey of forest nursery practices conducted in 1974 at United States showed that weed control constituted a major production cost. Of 99 nurseries surveyed, more than half of them reported that the cost of weed control accounted for 10% or more of their costs; one third reported about 25%; and the remaining one third reported more than 50%. Nurserymen generally prepare nursery media using red earth, sand and farmyard manure in different ratios. These mixtures have chances for mixing up of weed seeds and other reproductive structures like rhizomes, tubers, roots, corms, bulbs and bulblets. The weed growth cause large interference in the nursery on germination and seedling growth. Application of herbicides is considered to be the effective reducer of weed population in forest nurseries and there by lowering the cost of weeding. Therefore, the present study has been taken up to evaluate the effect and compatibility of pre-emergence herbicide on germination , seedling growth and weed control in teak nursery. The pre conditioned teak drupes (fruit with seed) were placed for germination in nursery bed (10 m length and 1.0 m width) mixed with red earth + sand + Farm Yard Manure at 2:1:1 ratio. The experiment included sixteen treatments , Three days after sowing, the pre emergence herbicides viz. Atrazine (50%wp-0.05%,0.1%,0.15%,0.20%,0.25%), Fluchloralin (45% EC-0.05%,0.1%,0.15%,0.20%,0.25%) and Pendimethaline (30 % EC-0.05%,0.1%,0.15%,0.20%,0.25%)) were applied as liquid spray at different concentrations compared with control (Water spray) on the nursery beds using knapsack sprayer with fan type nozzle. 3000 ml of spray solution was required for each nursery bed. The experiment was laid out in Randomized Block Design with three replications. Five kilogram of teak drupes were sown in each bed. On 25 day after application of herbicides, observations were made on weed population (monocot, dicot and sedges) and twenty eight days after sowing (ISTA, 1993) the observations were made on germination percentage of teak in each treatment. Six months after application of herbicides, the observations were made on root length(cm) ,shoot length (cm), number of leaves and number of secondary roots per seedling and dry matter production (g-5) of teak seedlings. The important weed species observed in teak nursery were *Boerheavia diffusa, Phyllanthus niruri, Digera arvensis and Cyperus rotundus*. The results revealed that application of Fluchloralin at 0.05-0.1 percent was found to be very effective in controlling the weeds without impairing the germination of teak drupes. In-depth investigation is needed for different herbicide compatibility in teak nursery along with economic analysis of manual and chemical weed control.

**P-199**

# Weed Management in field crops

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Field experiments were conducted during 2001-2007, under AICRP weed control at Gwalior centre (Madhya Pradesh). To know the suitable and economically viable weed management practices for major crops of Madhya Pradesh. Experiments on different major cereals, pulses and oilseeds crops were studied and compiled. Based on mean data in rice crop the result revealed that weed free treatment gave highest grain yield of 4978 kg/ha, followed by 2,4-D EE + fenoxaprop PoE 500 +75 g/ha (4687 kg/ha) as compared to lowest in weedy check (2719 kg/ha), In wheat crop it was found that combination of 2,4-D + IPU @ 0.5 +1.25 kg/ha POE recorded maximum seed yield of 5186 kg/ha followed by metsulfuron + IPU @ 4.0 g + 1.25 kg/ha with seed yield of 4974 kg/ha as compared to minimum of weedy check (3705 kg/ha). In trial rate and time of application of isoproturon in wheat IPU @ 1.00 kg/ha as pre-emergence recorded highest grain yield of 4816 kg/ha followed by IPU 0.75 kg/ha (4744 kg/ha). In trial of broad leaves weed control, trisulfuron @ 20 g/ha recorded highest seed yield (5036 kg/ha) as compare to lowest of weedy check (2968 kg/ha). In black gram crop highest seed yield and net income of 755 kg/ha and Rs.3825/ha was recorded in weed free treatment respectively followed by alachlor 2.0 kg/ha PE which gave 598 kg/ha yield and net return of Rs.3440./ha respectively. In pigeon pea, trial pigeon pea + soybean intercropping (1:1 row) with metolachlor 1.0 kg/ha gave highest Pigeon pea yield equivalent and net return of 1894 kg/ha and Rs. 20985/ha, respectively In pea crop weed free treatment (2 H.W at 30 & 60 DAS) recorded highest yield of 2253 kg/ha followed by Isoproturon 0.75 kg/ha PE + 1 H.W. 1916 kg/ha. In chick pea weed free treatment having highest seed yield of 1485 kg/ha followed by oxyfluorfen 0.23 kg/ha as PE (1323 kg/ha). In soybean imazethapyr 100 g/ha (POE) having highest net income (Rs. 8969/ha) and BCR (2.03) followed by weed free treatments net return of (Rs. 8024./ha) and BCR of (1.77) respectively. In another experiment of soybean clomazone 0.75 kg/ha (PE) gave highest net returns of Rs. 3838/ha (1224 kg/ha seed yield) followed by metolachlor 1.25 kg/ha (PE) with net return of Rs. 3000/ha (1156 kg/ha yield) and weed free (Rs. 2880/ha and 1317 kg/ha). In mustard weed free treatment produced highest seed yield of 2284 kg/ha followed by oxyflurofen @ 0.120 kg/ha (PE) which yielded 2005 kg/ha. In mustard another trial Pendimethalin 1.0 kg/ha PE having highest seed yield 1884 kg/ha, net return of (Rs. 25070/ha) and BCR of (4.60) respectively was found economical.

## P-200 Weed flora of cultivated fields of Middle Gujarat

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A survey of weed flora of *Kharif* and *Rabi* crops in middle Gujarat was conducted during 2008 in Anand, Kheda, Panchmahal & Ahmedabad districts of middle Gujarat. Altogether 1470 numbers of spots of Anand district in cropped area were surveyed covering 49 villages. Similarly in the Kheda district, 1480 numbers of spots were covered in two routes. In Panchmahal district 1440 spots in cropped area were surveyed covering 48 villages. Weed survey carried out in *Kharif* revealed that a total of 35 species were found to infest *Kharif* crop fields in Middle Gujarat, out of which seven were grassy, twenty five broad leaf weeds and three sedges. In Anand district, *Cyperus iria* and *Cyperus esculentus* were the most dominant weeds with a relative density of 9.2 and 7.2 no/$m^2$, respectively in *kharif* crops. In Kheda district, *Euphorbia geniculata* and *Eragrostis major* were the most dominant weeds. *Convolvulus arvensis* and Setaria *tomentosa* were the dominant weeds in Panchmahal district, *Cyprus iria* and *Cyperus rotundus* were the most dominant weeds with a relative density of 6.24 and 5.29 no/$m^2$, respectively in *kharif* crops in Ahmedabad district. Weed survey carried out in *Rabi* field crops revealed that a total of 25 species were found to infest *Rabi* crop fields in Middle Gujarat, out of which seven were grassy, sixteen broad leaf weeds and two sedges. In Anand district, *Chenopodium album* and *Commelina forskalaei* were the most dominant weeds with a relative density of 9.2 and 7.2 no/$m^2$, respectively found in *kharif* crops. In Kheda district, *Chenopodium album* and *Amaranthus spinosus* were the most dominant weeds. *Chloris barbata* and Trianthema *monogyna* were the dominant weeds in Panchmahal district, In Ahmedabad district, *Chenopodium album* and *Cyperus rotundus* were the most dominant weeds with a relative density of 6.24 and 5.29 no/$m^2$ , respectively. *Phalaris minor* was dominating weed in the wheat fields of Samadara village in Ahmedabad district. *Phalaris minor* was found in the fields of wheat in 66 villages in Gujarat.

## P-201 Utilisation of chromolaena odorata as a source of nutrients in finger millet – groundnut system

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Field experiment was conducted at Main Research Station, Hebbal, University of Agricultural Sciences, Bangalore, consisting of eleven treatments on fixed site for two seasons during *Kharif* 2003 with finger millet and *rabi* 2004 with groundnut. The treatments comprised various combinations of *Chromolaena's* compost with recommended dose of fertilizer (RDF), RDF+ farm yard manure (FYM), RDF alone and unfertilized control. Application of *Chromolaena odorata* (90%) + Cow dung slurry (10%) + Microbial slurry + Rock phosphate @ 7.5 t $ha^{-1}$ + RDF and RDF+ FYM @ 7.5 t $ha^{-1}$ showed significantly higher grain yield (5367 kg $ha^{-1}$ and 5289 kg $ha^{-1}$respectively) in finger millet and pod yield (2896 kg $ha^{-1}$ and 2682 kg $ha^{-1}$ respectively) in groundnut than RDF alone and unfertilized control. But it was found to be on par with other treatments. The next best treatment was *Chromolaena odorata* (50%) + Leaf litter (50%) + Vermiculture @ 7.5 t $ha^{-1}$+ RDF (4880 kg $ha^{-1}$ in finger millet and 2041 kg $ha^{-1}$ in groundnut). The pattern of variation in straw yield among various treatments was similar to that of grain yield. Unfertilized control resulted in lower straw yield (2889 kg$ha^{-1}$ in finger millet) and haulm yield (1764 kg$ha^{-1}$ in groundnut) than various combinations of *Chromolaena's* compost with RDF and RDF alone. Compared to RDF+ FYM, the straw yield was higher in *Chromolaena odorata* (90%) + Cow dung slurry (10%) + Microbial slurry + Rock phosphate @ 7.5 t. $ha^{-1}$ + RDF.

## P-202 Weed management through non-chemical practices in Okra

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A field experiment was conducted during *Kharif s*easons of 2007 and 2008 at DWSR Anand Centre, Anand to find out most efficient and economical non-chemical weed management practices in okra. The soil of the experimental field was sandy loam having pH 8.20 with 0.026 % nitrogen, 63 kg $P_2O_5$/ha and 380 kg $K_2O$/ha. The experiment was laid out in randomized block design with four replications. The predominant weeds of okra crop were Dactyloctenium *aegyptium*, *Eragrostis major*, *Phyllanthus niruri*, *Commelina benghalensis*, *Cyperus rotundus*, *Molugo nudicuulis*, *Oldenlandia umbellata* and *Digera arvensis.* Weed dry biomass recorded at harvest was significantly influenced by weed management practices. Significantly the lowest weed biomass was recorded in the treatment of inter culturing and hand weeding done at 20 & 40 DAS. Mechanical weeding was second and statically at par with mulch of black polyethylene and mulch of green and dry leaves during both the years and in pooled analysis. Plant height was significantly the higher recorded in mulch of green and dry leaves treatment which was at par with mulch of wheat straw, mulch of black polyethylene and twice inter culturing and hand weeding treatment. Green fruit yield of okra was significantly the highest recorded in weed free treatment. Black polyethylene mulch was second and significantly at par with mechanical weeding and mulch of green and dry leaves. Maximum reduction in yield was 63.5 % recorded in weedy treatment. Inter culturing with hand weeding at 20 & 40 DAS gave the highest additional profit over control followed by only IC at 20 & 40 DAS and mulch of green and dry leaves. The study indicated that in non chemical weed management practices, inter culturing and hand weeding done at 20 & 40 DAS is effective to control weeds efficiently.

## P-203 Bio - efficacy of herbicides for management of *Chromolaena odorata* under waste land situation

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A field trial was conducted at Gandhi Krishi Vigyan Kendra, University of Agricultural Sciences, Bangalore, during August 2003 on existing plants of *Chromolaena.* The experiment consisted of 18 herbicidal treatments involving glyphosate 41 SL 0.4, 0.8, 1.2 and 1.6 kg ai $ha^{-1}$, paraquat 24 SL 0.4, 0.6, 0.8 and 1.0 kg ai $ha^{-1}$, chlorimuron ethyl 10WP + metsulfuron methyl 10 WP (Almix 20WP) 2.0, 3.0, 4.0 and 5.0 g $ha^{-1}$, 2,4-D Na Salt 80 WP 1.0, 1.5, 2.0 and 2.5 kg ai $ha^{-1}$. These herbicidal treatments were compared with manually cutting and unsprayed control. The design of experiment was Random Block Design with 3 replications. Major weed flora observed along with *Chromolaena odorata* in most of the treatments was *Mimosa pudica, Ageratum conyzoides, Convolvulus arvensis* and *Themeda grass.* Application of paraquat at 0.4 to 1.0 kg ai $ha^{-1}$ caused 100% mortality of *Chromolaena* by 30$^{th}$ day after spraying and there was no re - sprouting of *Chromolaena* up to 90$^{th}$ day after spray. Spraying of glyphosate at 0.4 to 1.6 kg ai $ha^{-1}$ caused slow mortality initially, being 5 to 9% on 10$^{th}$ day after spraying (DASp), 31 to 39% on 20$^{th}$ DASp and 100% mortality by 40 DASp. Spraying of Chlorimuron ethyl 10WP + metsulfuron methyl 10WP (Almix 20WP) 2.0 to 5.0 g $ha^{-1}$ did not cause any mortality up to 20$^{th}$ day after spraying, subsequently percent drying increased gradually. By 60$^{th}$ day after spraying, 100% *Chromolaena's* plant drying was observed due to Almix usage. 2,4-D Na Salt sprayed *Chromolaena* did not show mortality up to 50$^{th}$ day after spraying and by 90$^{th}$ day onwards, a slight mortality of 7 to 9% was observed. In manual cutting, there were no re growth up to 90$^{th}$ DASp and was very expensive than the use of herbicides.

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