



## RESEARCH ARTICLE

# Effect of sole and ready-mix herbicides on weeds and productivity of summer greengram in Odisha

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### ABSTRACT

A field study was conducted to assess the effect of different sole and ready-mix herbicides on weeds and productivity of summer greengram in Odisha, during summer season of 2020 and 2021 at Agricultural Research Station, Chatabar, Faculty of Agricultural Sciences, IAS, SOADU, Bhubaneswar. Eight treatments *viz.* pre-emergence application (PE) of pendimethalin 0.75 kg/ha at 1 day after sowing (DAS), post-emergence application (PoE) of imazethapyr 75 g/ha at 20 DAS, pendimethalin + imazethapyr 0.75 kg/ha PE at 1 DAS, quizalofop-ethyl 50 g/ha PoE at 20 DAS, fenoxaprop-p-ethyl 50 g/ha PoE at 20 DAS, sodium-acifluorfen 16.5% + clodinafop-propargyl 8% 245 g/ha PoE at 20 DAS, hand weeding twice at 15 and 30 DAS and weedy check, were replicated thrice in the randomized block design. Hand weeding twice at 15 and 30 DAS registered significantly lowest density and biomass of all categories of weeds as well as total weeds and it was closely followed by pendimethalin + imazethapyr (ready-mix) 0.75 kg/ha PE. Pendimethalin PE and imazethapyr PoE recorded at par value of density and biomass of grasses, broad-leaved and total weeds. Hand weeding twice at 15 and 30 DAS registered the highest seed yield (1076 kg/ha) of greengram along with higher yield attributing characters like number of pods/plant (29.23), seeds/pod (7.90) and number of branches/plant (8.88) and it was closely followed by pendimethalin + imazethapyr (ready-mix) 0.75 kg/ha PoE. Highest net return (₹ 39,809/ha) and return per rupee invested (2.12) was registered with pendimethalin + imazethapyr (ready-mix) 0.75 kg/ha PE.

**Keywords:** Greengram, Herbicides, Pendimethalin + imazethapyr (ready-mix), Weed management

### INTRODUCTION

Greengram [*Vigna radiata* (L.) Wilczek] is ranked third among the pulse crops cultivated in India. In eastern India, after the harvest of winter season crops fields remain fallow for 70–80 days during summer. As a measure to increase productivity and not to keep the land fallow during that time, inclusion of short-duration crops like greengram (60–70 days) in the summer season is gaining momentum. Weed competition is found to be a major constraint in achieving high yield. The yield loss in greengram due to weed competition ranged from 46 to 85% (Ali *et al.* 2013; Mirjha *et al.* 2012; Algotar *et al.* 2015) depending upon weed species, their densities and crop-weed competition period. Thus, it is essential to control the weed population in initial stage. About 70–80% of crop growth generally occurs during initial 20–40 days. The pre-emergence herbicide application (PE) suppresses the weed emergence, hence provides favourable environment

to the crop during initial crop growth period with weed free condition. The weeds emerged later during critical growth period also require indispensable attention and can be controlled either by the use of post-emergence application (PoE) of herbicides or hand weeding or inter culture operations. Thus, weed management during all the growth stages ensures achievement of higher greengram yield. It is well known that weed management with manual hand weeding is most efficient and safe but it needs high physical energy and involves higher cost for its timely implementation in large area. Hence, chemical weed management is getting popularity amongst farmers. Pre- and post-emergence herbicides and some ready-mix formulations are available in the market to manage the emergence and growth of annual grasses and broad-leaved weeds and also to reduce the crop-weed competition. With this background, the present experiment was conducted to study the effect of sole and ready-mixed herbicides on weed dynamics and productivity of greengram.

### MATERIALS AND METHODS

A field study was carried out during summer seasons of 2020 and 2021 at Agricultural Research

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station, Binjhagiri, Chatabar, Faculty of Agricultural Sciences, IAS, SOADU, Bhubaneswar. The geographical location of research farm comes under the East and South Eastern Coastal Plain Agro climatic Zone of Odisha. It is situated between 20°26' N latitude and 85°67' E longitude at an altitude of 45 meters above mean sea-level. South-west monsoon period is the grant rainfall period of this zone. The soil of the experimental field was sandy loam in texture with acidic in reaction (pH 5.80), low in organic C (0.41%). Eight treatments *viz.* pendimethalin 0.75 kg/ha PE at 1 day after seeding (DAS), post-emergence application (PoE) of imazethapyr 75 g/ha at 20 DAS, pendimethalin + imazethapyr 0.75 kg/ha PE at 1 DAS, quizalofop ethyl 50 g/ha PoE at 20 DAS, fenoxaprop-ethyl 50 g/ha PoE at 20 DAS, sodium-acifluorfen Na 16.5% + clodinafop-propargyl 8% 245 g/ha PoE at 20 DAS, hand weeding twice at 15 and 30 DAS and weedy check, were replicated thrice in the randomized block design. Line to line spacing of 30 cm for greengram was maintained manually. Seed rate taken into account was 25 kg/ha for greengram. The greengram variety IPM-02-14 was used in this experiment. Recommended dose of nutrients N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O at 20:40:20 kg/ha were applied. Full dose of nitrogen, phosphorus and potash was applied as basal. Hand operated knapsack sprayer fitted with a flat fan type nozzle was used for spraying the herbicides with a spray volume of 500 liters/ha. All other recommended agronomic practices were followed and plant protection measures were adopted as per need. Weed count was recorded at 45 DAS by placing 50 x 50 cm quadrat in the marked sampling area of 1.0 m<sup>2</sup> of each plot and after drying them in hot air oven at 70°C, weed dry weight (biomass) was recorded. The data were subjected to a square root transformation to normalize their distribution. Yield attributes and seed yield of greengram was recorded at harvest and the data were statistically analyzed at 5% level of significance.

## RESULTS AND DISCUSSION

### Effect on weeds

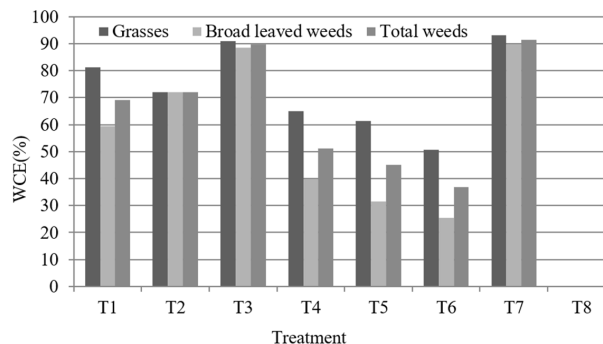
The dominance of weeds varied across different weed control treatments. The weedy check plots consisted of nine weed species. *Poa annua*, *Digitaria sanguinalis* and *Echinochloa colona* among the grasses and *Cleome viscosa* and *Melochia corchorifolia* among the broad-leaved weeds were observed dominating throughout the crop growing period. Similar weed flora in greengram was also reported by Aliveni *et al.* (2016), Kavadi *et al.* (2016), Jinger *et al.* (2016) and Kundu *et al.* (2011).

The weed density and biomass at 45 DAS were highest under weedy check with dominance of grasses (53.82%), followed by broad-leaved weeds (46.18%). Among the different weed control treatments, hand weeding twice at 15 and 30 DAS was found to be significantly superior over others in reducing the density and biomass of grasses, broad-leaved and total weeds at 45 DAS and it was at par with pendimethalin + imazethapyr at 0.75 kg/ha PE (**Table 1**). The pendimethalin + imazethapyr (ready-mix) at 0.75 kg/ha PE, resulted in 91.04, 88.52 and 89.66% reduction of grasses, broad-leaved and total weed biomass as compared to weedy check. Imazethapyr at 75 g/ha PoE and pendimethalin 0.75 kg/ha PE recorded at par value of density and biomass of grasses, broad-leaved and total weeds at 45 DAS.

Pendimethalin + imazethapyr (ready-mix) at 0.75 kg/ha PE caused significant reduction of density and biomass of grasses, broad-leaved and total weeds in all the crop growth stages due to better weed control by two constituent herbicides. Singh *et al.* (2017) also reported similar observations. Hand weeding twice at 15 and 30 DAS recorded lowest density and biomass of grasses, broad-leaved and total weeds at all the crop growth stages over other treatments as also reported by Sultan and Baigh (2013) and Chhodavadia *et al.* (2014). Hand weeding twice at 15 and 30 DAS and pendimethalin + imazethapyr at 0.75 kg/ha PE were at par with each other in all the crop growth stages conforming the findings of Singh *et al.* (2017). Among the other treatments, pendimethalin and imazethapyr controlled the complex weed flora at all the crop growth stages. Chaudhari *et al.* (2016) reported that pendimethalin 1.0 kg/ha PE recorded lowest weed density of monocot, dicot and sedge at 25, 50 DAS and at harvest of crop.

At the initial stage of crop growth, quizalofop-ethyl PoE and fenoxaprop-p-ethyl PoE registered lower density of grassy weeds, indicating the ability of these herbicides to control grassy weeds up to substantial period of time. But these herbicides were ineffective to control the broad-leaved weeds (**Table 1**) as reported earlier by Mundra and Maliwal (2012).

Amongst different weed control treatments, hand weeding twice at 15 and 30 DAS registered the highest WCE at 45 DAS against grasses (93.13%), broad-leaved (89.83%) and total weeds (91.32%) and was closely followed by pendimethalin + imazethapyr 0.75 kg/ha PE (**Figure 1**). Among the other herbicidal treatments, imazethapyr controlled the complex weed flora, registering higher WCE of



T<sub>1</sub>: Pre-emergence application (PE) of pendimethalin 0.75 kg/ha at 1 day after sowing (DAS), T<sub>2</sub>: post-emergence application (PoE) of imazethapyr 75 g/ha at 20 DAS, T<sub>3</sub>: pendimethalin + imazethapyr 0.75 kg/ha PE at 1 DAS, T<sub>4</sub>: quizalofop-ethyl 50 g/ha PoE at 20 DAS, T<sub>5</sub>: fenoxaprop-p-ethyl 50 g/ha PoE at 20 DAS, T<sub>6</sub>: Sodium-acifluorfen 16.5% + clodinafop-propargyl 8% 245 g/ha PoE at 20 DAS, T<sub>7</sub>: hand weeding twice at 15 and 30 DAS and T<sub>8</sub>: weedy check

**Figure 1. Weed control efficiency (%) of different weed control treatments at 45 DAS in greengram**

total weeds (72.06%) followed by pendimethalin (69.23%), quizalofop-ethyl (51.15%), fenoxaprop-p-ethyl (45.06%) and acifluorfen Na 16.5% + clodinafop-propargyl 8% treatment (36.78%) at 45 DAS.

### Effect on greengram

Hand weeding twice at 15 and 30 DAS registered higher number of pods/plant and seeds/pod than other treatments and it was at par with pendimethalin + imazethapyr 0.75 kg/ha PE. Among the other herbicidal treatments imazethapyr 75 g/ha recorded higher number of pods/plant and seeds/pod over others and it was closely followed by pendimethalin 0.75 kg/ha PE (Table 2). The crop under weedy check treatment faced severe weed competition for nutrient, light, water and space throughout the crop growth resulting in the lowest

value of plant height, leaf area index and dry matter accumulation and ultimately recorded the lowest number of seeds/plant as also observed by Tagour *et al.* (2010). The pod length and test weight did not vary significantly among different weed control practices.

The highest seed yield was recorded with hand weeding twice during both the years and it was at par with pendimethalin + imazethapyr 0.75 kg/ha PE. Pendimethalin + imazethapyr PE recorded 13.26 and 18.97% higher seed yield than sole application of pendimethalin 0.75 kg/ha PE and imazethapyr 75 g/ha PoE (Table 2). When weeds were not controlled, yield was 450 kg/ha, whereas it was increased by 881 to 1048 kg/ha when weeds were controlled with different herbicide-based treatments (Table 2). Higher seed yield with hand weeding twice at 15 and 30 DAS and different herbicidal treatments was due to effective control of dominant weeds as evident from the lower weed density and biomass. The competition between greengram and weeds for nutrient, water, light and space was less under the above treatments, which facilitated greater utilization of sun light, higher synthesis of photosynthates and better partitioning towards seed formation and ultimately leading to higher seed yield. Gupta *et al.* (2019) reported that the combination of imazethapyr + imazamox (ready-mix) 80 g/ha PoE recorded highest seed yield (993 kg/ha), and was at par with hand weeding twice at 20 and 40 DAS and pendimethalin + imazethapyr 750 g/ha and 1000 g/ha PE. Weedy check recorded 58.17 and 57.07% lower seed yield of greengram as compared to hand weeding twice at 15 and 30 DAS and pendimethalin + imazethapyr 0.75 kg/ha PE, respectively. Yield reduction in greengram due to weed competition was 58.17%.

**Table 1. Grasses, broad-leaved and total weed density and biomass at 45 DAS as influenced by different weed control practices in greengram (pooled mean)**

Treatment	Weed density (no./m <sup>2</sup> )			Weed biomass (g/m <sup>2</sup> )		
	Grasses	Broad-leaved	Total	Grasses	Broad-leaved	Total
Pendimethalin 0.75 kg/ha PE at 1 DAS	3.75(13.7)	4.22(17.3)	5.40(31.0)	2.59(6.4)	4.15(16.8)	4.85(23.2)
Imazethapyr 75 g/ha PoE at 20 DAS	3.91(15.0)	3.66(13.0)	5.35(28.0)	3.14(9.5)	3.45(11.5)	4.62(21.1)
Pendimethalin + imazethapyr PE 0.75 kg/ha at 1 DAS	2.55(6.3)	2.73(7.0)	3.95(13.3)	1.88(3.0)	2.27(4.7)	2.87(7.8)
Quizalofop-ethyl 50 g/ha PoE at 20 DAS	4.49(19.7)	4.98(24.3)	6.84(44.0)	3.52(11.9)	5.03(24.9)	6.10(36.8)
Fenoxaprop-p-ethyl 50 g/ha PoE at 20 DAS	4.74(22.0)	5.19(26.7)	6.96(48.7)	3.68(13.1)	5.35(28.3)	6.47(41.4)
Acifluorfen Na 16.5% + clodinafop-propargyl 8% 245 g/ha PoE at 20 DAS	5.27(27.3)	5.49(29.7)	7.56(57.0)	4.16(16.8)	5.59(30.8)	6.94(47.6)
Hand weeding twice at 15 and 30 DAS	2.47(5.7)	2.64(6.7)	3.24(12.3)	1.67(2.3)	2.16(4.2)	2.64(6.5)
Weedy check	7.21(51.7)	6.67(44.3)	9.68(96.0)	5.87(34.7)	6.46(41.3)	8.71(75.4)
LSD (p=0.05)	0.69	0.79	0.75	0.64	0.65	0.63

Figures in parentheses are the original values. The data was transformed to SQRT ( $\sqrt{x+0.5}$ ) before analysis; PE = pre-emergence application, PoE = post-emergence application

**Table 2. Yield attributes, yield and economics of greengram as influenced by different weed control practices (pooled mean)**

Treatment	Pod length (cm)	No. of pods/plant	No. of seeds/pod	Test weight (g)	Yield (kg/ha)	Weed index (%)	Net returns (x10 <sup>3</sup> ₹/ha)	Returns per rupee invested
Pendimethalin 0.75 kg/ha PE at 1 DAS	6.10	25.92	6.25	36.25	881	18.12	28.46	1.81
Imazethapyr 75 g/ha PoE at 20 DAS	6.25	26.20	6.34	37.67	926	13.94	31.58	1.90
Pendimethalin + imazethapyr 0.75 kg/ha PE at 1 DAS	6.35	28.80	7.53	38.17	1048	2.60	39.81	2.12
Quizalofop ethyl 50 g/ha PoE at 20 DAS	6.02	23.57	5.07	37.73	761	29.27	18.54	1.51
Fenoxaprop-p-ethyl 50 g/ha PoE at 20 DAS	6.04	23.45	4.85	38.45	742	31.04	18.22	1.52
Acifluorfen Na 16.5% + clodinafop propargyl 8% 245 g/ha PoE at 20 DAS	5.68	23.12	4.79	35.12	712	33.83	15.08	1.42
Hand weeding twice at 15 and 30 DAS	6.50	29.23	7.90	38.23	1076	0.00	33.02	1.74
Weedy check	5.40	18.20	2.87	33.53	450	58.18	-0.94	0.97
LSD (p=0.05)	NS	2.49	0.85	NS	118	-	-	-

PE = pre-emergence application, PoE = post-emergence application

Weed index (%) was calculated on the basis of seed yield and all the weed control practices recorded lower WI over that of weedy check (Table 2). The lowest value of WI was recorded under pendimethalin + imazethapyr 0.75 kg/ha PE (2.60%), followed by imazethapyr 75 g/ha PoE (13.94%) and pendimethalin 0.75 kg/ha PE (18.12%). The highest weed index was recorded under weedy check (58.18%). Among the weed control practices, pendimethalin + imazethapyr (ready-mix) 0.75 kg/ha registered higher net returns (₹ 39809/ha) and returns/rupee invested (2.12) over other treatments (Table 2) as reported by Tamang *et al.* (2015). The lowest value of returns per rupee invested was recorded under weedy check.

It can be concluded that pendimethalin + imazethapyr (ready-mix) at 0.75 kg/ha PE may be advocated for effective weed control, higher productivity and profitability in summer greengram.

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