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Management of *Trianthema portulacastrum* through herbicides in greengram

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ABSTRACT

Field experiments were conducted to select suitable pre- and post-emergence herbicides for the control of *Trianthema portulacastrum* in greengram. Treatments were consisted of pre-emergence (PE) herbicides, *viz*. pendimethalin (1.0 kg/ha), oxyfluorfen (100 and 200 g/ha) with one hand weeding at 30 days after sowing (DAS), post-emergence (PoE) imazethapyr 50 g/ha at 15 DAS, combinations of PE and PoE herbicides and hand weeding (HW) twice at 15 and 30 DAS and control. Significantly lesser weed density (137/m^2) and dry weight (30.4 g/m^2) and higher weed control efficiency (89.6%) were recorded with application of pendimethalin 1.0 kg/ha at 3 DAS + imazethapyr 50 g/ha at 30 DAS than other treatments at 45 DAS. Significantly higher dry matter production (1.34 t/ha), more number of pods per plant (38.4) and seeds per pod (9.8) were recorded with application of pendimethalin1.0 kg/ha + imazethapyr 50 g/ha 30 DAS than other treatments. Application of pendimethalin 1.0 kg/ha on 3 DAS followed by imazethapyr 50 g/ha on 30 DAS recorded significantly higher mean grain yield of 461 kg/ha, mean net returns (₹ 14443/ha) and benefit cost ratio (2.09) over other treatments. Thus, it could be concluded that application of PE herbicide pendimethalin 1.0 kg/ha on 3 DAS followed by PoE herbicide imazethapyr 50g/ha on 30 DAS controlled the *Trianthema portulacastrum* effectively and produced higher productivity and profitability of greengram in irrigated condition.

Horse purslane (*Trianthema portulacastrum L.*) belongs to the Aizoaceae family and is a much branched, fast growing, prostrate, succulent annual herb with ovate green leaves. It is widely distributed in India, Pakistan, Sri Lanka, West Asia, Africa, and tropical America (Saeed *et al.* 2010). Its infestation is very common in various crops, such as maize, pigeon pea, black gram, green gram, sesame, onion, cotton, soybean, and sugarcane especially during the rainy season. Its prostrate growth and profuse branching capacity help it to quickly cover the soil surface and form a green carpet (Senthil *et al.* 2009).

It is a very problematic weed in summer irrigated crops (pulses and sesame) in Cauvery delta zone, Tamil Nadu and a complete crop failure has been observed because of this weed. Hand weeding and hoeing are common practices of controlling this weed in Tamil Nadu, but this method is quite expensive and time consuming. Hand weeding becomes ineffective as new weed seeds germinate after every hoeing and affect the crop. Under these circumstances, it is essential to find out suitable PE and PoE herbicides for its effective control. Application of PoE herbicides imazethapyr + quizalofop-ethyl each at 75 g/ha registered higher weed control efficiency, grain yield, net returns and benefit cost ratio in summer irrigated black gram (Ramesh and Rathika 2016). Keeping this in view, field experiments were conducted to study the effect of PE and PoE herbicides on control of *Trianthema* under irrigated greengram.

Field experiments were conducted at Department of Agronomy, Anbil Dharmalingam Agricultural College and Research Institute, Tiruchirappalli during *Summer* and *Kharif*, 2016. The experimental soil was alkaline pH, low in available nitrogen, high in available phosphorus and medium in available potassium. The experiment was laid out in a randomized block design with three replications. Treatments were consisted of PE herbicides, *viz*.

pendimethalin (1.0 kg/ha), oxyfluorfen (100 and 200 g/ha) at 3 DAS along with one hand weeding at 30 DAS, pendimethalin (1.0 kg/ha) + imazethapyr 50 g/ha at 30 DAS, oxyfluorfen 100 g/ha + imazethapyr 50 g/ha at 30 DAS, oxyfluorfen 200 g/ha + imazethapyr 50 g/ha at 30 DAS, imazethapyr 50 g/ha at 15 DAS, hand weeding twice at 15 and 30 DAS and control. Greengram variety '*VBN 2*' was used for this study. Recommended seed rate (25 kg/ha) was used for sowing at 30 x 10 cm spacing. Recommended dose of fertilizer at 25: 50: 25 kg/ha NPK was applied as basal. Spraying of herbicides was done using knapsack sprayer fitted with flat fan nozzle by using a spray volume of 500 L/ha. Observations on weeds density and dry weight, growth and yield attributing characters and grain yield of greengram were recorded. Weed count was recorded by using 0.25 m^2 quadrate at four places in each plot and expressed as no./m^2. Square root transformation ($\sqrt{x+0.5}$) was used to analyze the data on weeds. Weed control efficiency was worked out on 45 DAS and expressed as the percentage. Economics of weed management was worked out by using the current market price of inputs and greengram grain. All the recorded data were analyzed statistically as per the method suggested by Gomez and Gomez (1984).

Effect on weeds

Weed species like *Trianthema portulacastrum (*71%) in broad-leaved weeds, *Echinochloa colona* (21%) in grasses and *Cyperus rotundus* (8%) in sedges were the predominant weed species found in the experimental field. Weed density and dry weight recorded at 45 DAS revealed that significantly lesser mean weed density of 137/m^2 recorded with pendimethalin at 1.0 kg/ha + imazethapyr 50 g/ha on 30 DAS, which was comparable with pendimethalin 1.0 kg/ha + HW 30 DAS (173.5/m^2) **(Table 1)**. Significantly lesser weed dry weight of 30.4 g/m^2 was registered with pendimethalin 1.0 kg/ha + HW 30 DAS than other treatments. However, it was comparable with HW twice on 15 and 30 DAS (36.4 g/m^2) and pendimethalin at 1.0 kg/ha + imazethapyr 50 g/ha on 30 DAS (41.7 g/m^2). Considerable reduction in germination of *Trianthema* under application of pendimethalin 1.0 kg/ha was the reason behind lesser weed density and dry weight.

Higher mean weed control efficiency of 89.6% was registered under application of pendimethalin 1.0 kg/ha + HW 30 DAS **(Table 1)**. This was closely followed by hand weeding twice at 15 and 30 DAS (87.6%). Application of pendimethalin1.0 kg/ha + imazethapyr 50 g/ha on 15 DAS recorded higher weed control efficiency of 85.8% than other combination of herbicides. Application of PE and PoE herbicides controlled the weeds effectively resulted in lesser weed dry weight and higher WCE. Minimum weed dry weight and higher weed control efficiency were recorded with application of pendimethalin 0.5 kg + imazethapyr 50 g/ha in cluster bean (Sangwan *et al.* 2016). The lowest WCE of 62.3% was obtained with application of imazethapyr 50 g/ha on 15 DAS. Imazethapyr did not control the grownup *Trianthema* completely and there was stunting and yellowing of leaves for two weeks and recovered after that. This was the reason behind lesser WCE. Compared to pendimethalin 1.0 kg/ha, oxyfluorfen 200 g/ha as PE herbicide showed lesser effect in controlling of *Trianthema* during both the seasons.

Table 1. Effect of herbicidal treatments on total weed density, dry weight, weed control efficiency at 45 DAS, growth parameters of greengram (pooled data of two seasons)

Treatment	Total weed density (no./m^2)	Weed dry weight (g/m^2)	WCE (%)	Plant height (cm)	DMP (t/ha)
Pendimethalin 1.0 kg/ha + HW 30 DAS	173.5 (13.2)	30.4(5.6)	89.6	35.8	1.27
Oxyfluorfen 100 g/ha + HW 30 DAS	344.0 (18.6)	48(7.0)	83.7	34.1	0.96
Oxyfluorfen at 200 g/ha + HW 30 DAS	363.5 (19.1)	49.9(7.1)	83.2	32.6	1.07
Imazethapyr 50 g/ha 15 DAS	643.5 (25.4)	111.2(10.6)	62.3	31.3	1.10
Pendimethalin 1.0 kg/ha + imazethapyr 50 g/ha 30 DAS	137.0 (11.7)	41.7(6.5)	85.8	33.9	1.34
Oxyfluorfen 100 g/ha + imazethapyr 50 g/ha 30 DAS	276.0 (16.6)	100.3(10.0)	65.9	32.7	1.09
Oxyfluorfen 200 g/ha + imazethapyr 50 g/ha 30 DAS	247.0 (15.7)	84.3(9.2)	71.3	32.0	1.17
Control	772.5 (27.8)	293.1(17.1)	-	27.4	0.40
HW twice on 15 and 30 DAS	352.5 (18.8)	36.4(6.1)	87.6	37.7	1.28
LSD(p=0.05)	1.8	1.1	-	2.6	0.07

Figures in parentheses are square root ($\sqrt{x+0.5}$) transformed values

Effect on crop growth characters

Growth characters of greengram has significantly influenced by weed management treatments. Hand weeding twice at 15 and 30 DAS produced significantly taller plants (37.7 cm) than other herbicidal treatments. However, this was comparable with pre-emergence application of pendimethalin at 1.0 kg/ha followed by one hand weeding at 30 DAS (35.8 cm). Plant height of greengram under different combination of herbicides showed comparable with each other.

Generally, treatments which received imazethapyr produced significantly shorter plants than hand weeding treatments. Control plot produced significantly shorter plants than other treatments mainly due to higher weed competition. Significantly higher DMP of 1.34 t/ha was recorded with pendimethalin1.0 kg/ha + imazethapyr 50 g/ha 30 DAS than control as well as oxyfluorfen treatments. This was comparable with hand weeding twice at 15 and 30 DAS (1.28 t/ha) and pendimethalin at 1.0 kg/a + hand weeding at 30 DAS (1.27 t/ha). This is mainly because of reduced weed competition during early stages of crop growth with the simultaneous increase in the uptake of nutrients by the crop which favoured taller plants, increased assimilation surface which enhanced the crop DMP (Patel *et al*., 2011). The control plot recorded significantly lower DMP than other treatments.

Effect on yield attributes and yield

With reference to yield attributes, significantly higher number of pods per plant (38.4) and seeds per pod (9.8) were recorded with application of pendimethalin1.0 kg/ha + imazethapyr 50 g/ha 30 DAS than other treatments **(Table 2)**. Pre-emergence application of pendimethalin at 1.0 kg/ha + hand weeding at 30 DAS and hand weeding twice at 15 and 30 DAS produced comparable with each other in terms of number of pods per plant and seeds per pod. Better control of weds under these treatments would have favoured increased source sink relationship which resulted in more yield attributing characters (Kaur *et al.* 2016, Muthuram *et al.* 2018). Minimum number of pods per plant was recorded under un-weeded control plot.

Grain yield of greengram was significantly varied with weed management practices. Application of pendimethalin 1.0 kg/ha on 3 DAS + imazethapyr 50 g/ha on 15 DAS recorded significantly higher mean grain yield of 461 kg/ha over other treatments **(Table 2)**. Pre-emergence application of pendimethalin at 1.0 kg/ha + one hand weeding at 30 DAS registered mean grain yield of 417 kg/ha. However, this was at par with hand weeding twice at 15 and 30 DAS. Post-emergence application of imazethapyr 50 g/ha on 15 DAS produced higher grain yield of 338 kg/ha over oxyfluorfen 100 g/ha + HW 30 DAS and control. This might be due to reduced weeds under pre- and post-emergence herbicides applied plots resulted in competition free environment at the critical stages of crop favoured the crop to utilize the factors for crop growth and production and enhanced the well balanced source sink capacities which attributed to the production of more DMP, number of pods/plant and number of seeds/pod compared to all other treatments and responsible for higher yield of irrigated green gram. In addition to that a uniform and good stand of the crop due to application of pre and post-emergence herbicides. These were in accordance with the earlier findings of Patel *et al*. (2011) and Chhodavadia (2014). In general, lesser grain yield was recorded in these field experiments mainly due to *sodic* nature of field soil as well as use of saline water for irrigation.

Table 2. Effect of herbicidal treatments on yield attributes, grain yield and economics of greengram (pooled data of two seasons)

Treatment	No. of pods /plant	No. of seeds/pod	Grain yield (kg/ha)	Net returns (x10^3 ₹/ha)	Benefit: Cost ratio
Pendimethalin 1.0 kg/ha + HW 30 DAS	33.1	9.6	417	11.50	1.85
Oxyfluorfen 100 g/ha + HW 30 DAS	26.2	9.4	296	5.00	1.39
Oxyfluorfen at 200 g/ha + HW 30 DAS	29.5	9.4	345	7.10	1.52
Imazethapyr 50 g/ha 15 DAS	29.6	9.0	338	9.25	1.84
Pendimethalin 1.0 kg/ha + imazethapyr 50 g/ha 30 DAS	38.4	9.8	461	14.44	2.09
Oxyfluorfen 100 g/ha + imazethapyr 50 g/ha 30 DAS	28.8	9.2	333	7.52	1.60
Oxyfluorfen 200 g/ha + imazethapyr 50 g/ha 30 DAS	33.1	9.4	373	9.08	1.68
Control	17.0	8.7	115	-2.60	0.73
HW twice on 15 and 30 DAS	32.3	9.3	389	5.26	1.29
LSD (p=0.05)	2.6	0.5	41		

Effect on economics

Economics of *Trianthema* weed management techniques in greengram revealed that pre-emergence application of pendimethalin 1.0 kg/ha + post-emergence application of imazethapyr 50 g/ha 30 DAS gave higher mean net returns (₹ 14443/ha) and benefit cost ratio (2.09) than other treatments **(Table 2)**. Pendimethalin 1.0 kg/ha + HW 30 DAS registered net returns of ₹ 11503/ha and BCR of 1.85. Better weed control by the herbicides resulted in increased grain yield and reduced cost of weeding were reason behind higher net profit. Similar magnitude of higher profit due to PE and PoE herbicides has been reported by Komal *et al.* (2015) and Kalhapure *et al.* (2013). This was followed by application of imazethapyr at 50 g/ha on 15 DAS, which gave ₹ 9250/ha. Manual weeding twice at 15 and 30 DAS gave lesser net returns of ₹ 5260/ha mainly because of higher cost of manual weeding. Control plot gave negative net returns in both the seasons because of higher weed competition led to lesser grain yield.

Thus, it was concluded that application of PE herbicide pendimethalin 1.0 kg/ha on 3 DAS followed by PoE herbicide imazethapyr 50 g/ha on 30 DAS controlled the *Trianthema portulacastrum* effectively and produced higher productivity and profitability of greengram in irrigated condition.

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