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Effect of Pre and Early Post Emergence Herbicides on the Growth and Yield of Rainfed Greengram

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Abstract: ***A field experiment was conducted at Agricultural Research Station, Kovilpatti during kharif 2017 to find out the suitable weed management practices for rainfed greengram. In this study, application of Oxyfluorfen @ 0.10 kg a.i. ha^{-1} or Pendimethalin @ 0.75 kg a.i. ha^{-1} as pre emergence + application of Imazethapyr @ 50 g a.i. ha^{-1} as early post emergence on 20 DAS recorded lowest weed density and dry weight at 15, 30 and 45 DAS and resulted in lower weed dry weight, higher weed control efficiency, higher plant height, grain and haulm yield. Unweeded control treatment produced least grain yield due to its maximum crop weed competition.***

Keywords: Greengram, Rainfed, Weed dry weight, Weed control efficiency, Plant height and yield

Introduction:

The pulses constitute an important group of crops and have been the main stay in Indian Agriculture, as they improve physical condition of soil and provide nutritious food and fodder. India has a distinction of being world's largest producers of pulses. However, India needs to make immediate strides in pulse production programme taking into account the extreme relevance of pulses in our diet. Increasing yield of pulse crops should be the top priority to fill up the existing gap in the requirement and availability of pulses. Among the grain legumes, greengram ranks third after chickpea and pigeon pea among the pulses in respect of production, and it can be grown throughout the year. Due to its short duration in nature and deep rooted, it can be grown under rainfed condition.

Dryland occupy extensive lands in all continents of the world. About 56 % of the total cultivated area in India falls under rainfed agriculture. The importance of the rainfed agriculture can be gauged from the fact that it contributes to 40 % of the country's food production; accounts for much of the national area under 85% area under

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coarse cereals, 83% under pulses, 70% under oilseeds and 65% under cotton and holds 60 % under the total livestock populations (B. Venkateswarlu and Prasad, 2012).

However weed infestation is one of the major constraints in greengram cultivation. The loss of yield due to weeds is quite high, ranges from 40-68% (Diwash Tamang *et al.*, 2015). In view of severe infestation of annual and perennial weeds in rainfed green gram, the potential yield is generally not realized. The available pre and early postemergence herbicides *viz.*, pendimethalin, oxyfluorfen, quizalofop-ethyl, imazethapyr and Chlorimuron - p - ethyl are able to check the emergence and growth of annual grasses, sedges and broadleaved weeds in rainfed greengram.

Materials and Methods:

The experiment was conducted at Agricultural Research Station, Kovilpatti during *kharif* 2017 to find out a viable and effective means of weed management in greengram under rainfed condition. The experiment was laid out in a randomized block design with three replications. It consisted of twelve treatments *viz.*,T_1- PE Pendimethalin @ 0.75 kg a.i. ha^{-1} + HW on 30 DAS, T_2 - PE Oxyfluorfen @ 0.10 kg a.i. ha^{-1} + HW on 30 DAS, T_3 - PE Pendimethalin @ 0.75 kg a.i. ha^{-1} + EPOE Quizalofop ethyl @ 50 g a.i. ha^{-1} on 20 DAS, T_4 - PE Pendimethalin @ 0.75 kg a.i. ha^{-1} + EPOE Imazethapyr @ 50 g a.i. ha^{-1} on 20 DAS, T_5 - PE Pendimethalin @ 0.75 kg a.i. ha^{-1} + EPOE Chlorimuron - p - ethyl @ 4 g a.i. ha^{-1}on 20 DAS, T_6 - PE Oxyfluorfen @ 0.10 kg a.i. ha^{-1} + EPOE Quizalofop ethyl @ 50 g a.i. ha^{-1} on 20 DAS, T_7 - PE Oxyfluorfen @ 0.10 kg a.i. ha^{-1} + EPOE Imazethapyr @ 50 g a.i. ha^{-1} on 20 DAS, T_8 - PE Oxyfluorfen @ 0.10 kg a.i. ha^{-1} + EPOE Chlorimuron - p - ethyl @ 4 g a.i. ha^{-1} on 20 DAS, T_9 - EPOE Quizalofop ethyl @ 50 g a.i. ha^{-1} + Imazethapyr @ 50 g a.i. ha^{-1} on 20 DAS, T_{10} - HW twice on 15 and 30 DAS, T_{11} - Weed free check and T_{12} - Unweeded control. Greengram Co (Gg) 8 was used as a test variety.

Results and Discussion:

Weed flora

Weeds by integrity of their high flexibility and faster growing nature predominate the crop habitat and remit the yield. The common weed flora of the experimental field consisted of sedges and broadleaved weeds. The major sedge weed was *Cyperus rotundus*. Among the broad-leaved weeds *Amaranthus viridis, Boerhavia diffusa,*

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Commelina benghalensis, *Convolvulus arvensis*, *Corchorus fascicularis*, *Corchorus olitorius*, *Desmodium triflorum*, *Digera arvensis*, *Euphorbia hirta*, *Euphorbia microphylla*, *Phyllanthus niruri*, *Phyllanthus maderaspatensis*, *Trianthema portulacastrum*, *Tribulus terrestris* were the pre dominant species. Such a wide spectrum of weeds in greengram and pulse cropping system was reported by (Punia *et al.*, 2004), (Kaur *et al.*, 2009). None of the grassy weed was noticed in the experimental field.

Total weed dry weight

Adoption of various weed management practices significantly influenced the total weed dry weight at all the stages of observation (Table 1).

At 15 DAS, apart from weed free check application of Oxyfluorfen @ 0.10 kg a.i. ha^{-1} as pre emergence + application of Imazethapyr @ 50 g a.i. ha^{-1} as early post emergence on 20 DAS significantly lowered the total weed dry weight to 9.56 g m^{-2}. This was on par with the application of Oxyfluorfen @ 0.10 kg a.i. ha^{-1} as pre emergence + application of Quizalofop ethyl @ 50 g a.i. ha^{-1} as early post emergence on 20 DAS (10.08 g m^{-2}) and application of Oxyfluorfen @ 0.10 kg a.i. ha^{-1} as pre emergence + application of Chlorimuron - p - ethyl @ 4 g a.i. ha^{-1} as early post emergence on 20 DAS (10.30 g m^{-2}). While highest total weed dry weight of 21.23 g m^{-2} was recorded by unweeded control treatment.

At 30 DAS Weed free check registered zero total weed dry weight. Application of Oxyfluorfen @ 0.10 kg a.i. ha^{-1} as pre emergence + application of Imazethapyr @ 50 g a.i. ha^{-1} as early post emergence on 20 DAS (11.86 g m^{-2}) and application of Pendimethalin @ 0.75 kg a.i. ha^{-1} as pre emergence + application of Imazethapyr @ 50 g a.i. ha^{-1} as as early post emergence on 20 DAS (13.83 g m^{-2}) were the next best treatments. These two were on par with each other. Unweeded control registered the highest total weed dry weight of 64.03 g m^{-2}.

At 45 DAS, weed free check registered zero total weed dry weight and was significantly higher than all other treatments. This was followed by the application of Oxyfluorfen @ 0.10 kg a.i. ha^{-1} as pre emergence + application of Imazethapyr @ 50 g a.i. ha^{-1} as early post emergence on 20 DAS with a total weed dry weight of 6.48 g m^{-2}. Next to these treatments, application of Pendimethalin @ 0.75 kg a.i. ha^{-1} as pre emergence + application of

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Imazethapyr @ 50 g a.i. ha^{-1} as early post emergence on 20 DAS (7.51 g m^{-2}). These two treatments were comparable with each other. Unweeded control treatment recorded highest total weed dry weight of 116.69 g m^{-2}.

This might be due to the broad spectrum efficiency of pre-emergence and early post emergence herbicide application and hence, reduced the weed density and weed dry weight considerably as evinced from the data. The death of susceptible species of broadleaved weeds by imazethapyr application was due to the inhibition of acctolactate synthase (ALS) enzyme which is essential for leucine, valine and isoleucine synthesis in weeds (Chhodavadia *et al.*, 2014) (Komal *et al*., 2015) in greengram.

Weed control efficiency

Weed control efficiency shows the magnitude of effective reduction of weed density by weed control treatments over weedy check. It was significantly influenced by all the weed control treatments (Table 1). Among the weed management practices, application of Oxyfluorfen @ 0.10 kg a.i. ha^{-1} as pre emergence + application of Imazethapyr @ 50 g a.i. ha^{-1} as early post emergence on 20 DAS registered more reduction of weed density and resulted in higher WCE (94.45 per cent) and it was comparable with the application of Pendimethalin @ 0.75 kg a.i. ha^{-1} as pre emergence + application of Imazethapyr @ 50 g a.i. ha^{-1} as early post emergence on 20 DAS (93.57 per cent). It was mainly due to the better control of weed up to critical stage by the above treatment combination resulting in lower weed densities which reduced the weed biomass and ultimately registered higher WCE.

The contiuance of earlier effect made the pre-emergence herbicides performed evenly with early post-emergence herbicides at later stages of the crop growth accounted with very low weed biomass might be the reason for higher WCE in the above combination of weed control practices. Similar finding was also reported by (P. Singh *et al.*, 2006); (Ali *et al.*, 2011); (Kachhadiya *et al*., 2009) in various situations with different pulse crops.

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Plant height

The plant height was measured at15 DAS, 30 DAS, and at harvest stage. Plant height was increased with the advancement of crop growth from 15 DAS and it reached maximum at harvest stage. Adoption of different weed management practices significantly influenced the plant height at all growth stages (Table 2).

At 15 DAS, significantly maximum plant height of 16.7 cm was recorded with weed free check. It was on par with the application of Oxyfluorfen @ 0.10 kg a.i. ha^{-1} as pre emergence + application of Imazethapyr @ 50g a.i. ha^{-1} as early post emergence on 20 DAS (16.5 cm), application of Pendimethalin @ 0.75 kg a.i. ha^{-1} as pre emergence + application of Imazethapyr @ 50 g a.i. ha^{-1} as early post emergence on 20 DAS (16.3 cm) and application of Oxyfluorfen @ 0.10 kg a.i. ha^{-1} as pre emergence + handweeding on 30 DAS (16.0 cm).

At 30 DAS, highest plant height of 33.8 cm was recorded with weed free check. This comparable with the application of Oxyfluorfen @ 0.10 kg a.i. ha^{-1} as pre emergence + application of Imazethapyr @ 50 g a.i. ha^{-1} as early post emergence on 20 DAS (32.2 cm) and application of Pendimethalin @ 0.75 kg a.i. ha^{-1} as pre emergence + application of Imazethapyr @ 50g a.i. ha^{-1} as early post emergence on 20 DAS (31.8 cm).

Similar trend was noticed at harvest stage also, weed free check significantly produced taller plants (53.9 cm). It was on par with the application of Oxyfluorfen @ 0.10 kg a.i. ha^{-1} as pre emergence + application of Imazethapyr @ 50g a.i. ha^{-1} as early post emergence on 20 DAS (52.6 cm) and application of Pendimethalin @ 0.75 kg a.i. ha^{-1} as pre emergence + Imazethapyr @ 50 g a.i. ha^{-1} as early post emergence on 20 DAS (51.2 cm).

This might be due to the better weed control by the above treatments at different growth stages of the crop. This effective suppression of the weeds provided competition free condition and hence, the plant can utilize all the available resources *viz.*, light, moisture, space and more nutrients at all stages which results in increased plant height. This is in line with the findings of several earlier workers *viz.*, Shaikh *et al.* (2010), Chhodavadia *et al.* (2014). Unweeded control showed significant reduction in plant height at all growth stages of the crop due to the high competition by weeds and suppression of growth due to lesser availability of growth contributing factors to plants thus reduced the plant height to a greater extent.

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Grain and haulm yield

Adoption of different weed management practices significantly influenced the grain and haulm yields of rainfed greengram (Table 2).

Among the different treatment combinations tried, weed free check significantly recorded highest grain and haulm yield. This treatment was comparable with application of Oxyfluorfen @ 0.10 kg a.i. ha^{-1} as pre emergence + application of Imazethapyr @ 50 g a.i. ha^{-1} as early post emergence on 20 DAS and application of Pendimethalin @ 0.75 kg a.i. ha^{-1} as pre emergence + application of Imazethapyr @ 50 g a.i. ha^{-1} as early post emergence on 20 DAS. This might be due to reduced weeds and lesser competition at the critical stages of crop which in turn favoured the crop to utilize the factors for growth and production and enhanced the well balanced source sink capacities which responsible for higher grain and haulm yield of rainfed greengram compared to all the other treatments. This was in accordance with the earlier findings of Kachhadiya *et al*. (2009), Komal *et al*. (2015).

Unweeded control showed the real picture of the aggressive nature of weeds on the growth of rainfed greengram. The lowest grain and haulm yield were recorded in unweeded control. This was due to increased crop weed competition for different resources *viz*., light, moisture, space and nutrients. Yield losses of similar magnitude due to the weed competition have been reported by Adpawar *et al*. (2011).

Conclusion:

From the above results, it could be concluded that application of Oxyfluorfen @ 0.10 kg a.i. ha^{-1} as pre emergence + application of Imazethapyr @ 50 g a.i. ha^{-1} as early post emergence on 20 DAS or application of Pendimethalin @ 0.75 kg a.i. ha^{-1} as pre emergence + Imazethapyr @ 50 g a.i. ha^{-1} as early post emergence on 20 DAS was found to be the suitable and economical weed management practice for achieving higher productivity and profitability of rainfed greengram.

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Table 1: Effect of different weed management practices on total dry weight of weeds (g m^{-2}) and weed control efficiency (%) in rainfed greengram

	Treatments	Total weed dry weight (g m^{-2}) at 15 DAS	Total weed dry weight (g m^{-2}) at 30 DAS	Total weed dry weight (g m^{-2}) at 45 DAS	Weed control efficiency (%) at 45 DAS
T_1	PE Pendimethalin @ 0.75 kg a.i. ha^{-1} + HW on 30 DAS	11.79 (3.43)	29.56 (5.44)	12.71 (3.57)	89.10
T_2	PE Oxyfluorfen @ 0.10 kg a.i. ha^{-1} + HW on 30 DAS	10.58 (3.33)	26.01 (5.10)	11.39 (3.37)	90.24
T_3	PE Pendimethalin @ 0.75 kg a.i. ha^{-1} + EPOE Quizalofop ethyl @ 50 g a.i. ha^{-1} on 20 DAS	11.66 (3.41)	19.80 (4.45)	20.13 (4.49)	82.75
T_4	PE Pendimethalin @ 0.75 kg a.i. ha^{-1} + EPOE Imazethapyr @ 50 g a.i. ha^{-1} on 20 DAS	11.43 (3.38)	13.83 (3.72)	7.51 (2.83)	93.57
T_5	PE Pendimethalin @ 0.75 kg a.i. ha^{-1} + EPOE Chlorimuron- p- ethyl @ 4 g a.i. ha^{-1}on 20 DAS	11.36 (3.37)	23.57 (4.86)	23.54 (4.85)	79.82
T_6	PE Oxyfluorfen @ 0.10 kg a.i. ha^{-1} + EPOE Quizalofop ethyl @ 50 g a.i. ha^{-1} on 20 DAS	10.08 (3.17)	19.78 (4.45)	18.13 (4.26)	84.46
T_7	PE Oxyfluorfen @ 0.10 kg a.i. ha^{-1} + EPOE Imazethapyr @ 50 g a.i. ha^{-1} on 20 DAS	9.56 (3.17)	11.86 (3.44)	6.48 (2.64)	94.45
T_8	PE Oxyfluorfen @ 0.10 kg a.i. ha^{-1} + EPOE Chlorimuron - p - ethyl @ 4g a.i. ha^{-1} on 20 DAS	10.30 (3.21)	22.15 (4.71)	21.24 (4.61)	81.80
T_9	EPOE Quizalofop ethyl @ 50 g a.i. ha^{-1} + Imazethapyr @ 50 g a.i. ha^{-1} on 20 DAS	20.78 (4.56)	16.73 (4.09)	16.26 (4.03)	86.06
T_{10}	HW twice on 15 and 30 DAS	20.70 (4.55)	22.43 (4.74)	15.50 (3.94)	86.71
T_{11}	Weed free check	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	100.00
T_{12}	Unweeded control	21.23 (4.61)	64.03 (8.00)	116.69 (10.80)	-
	SEd	0.08	0.18	0.17	-
	CD(P=0.05)	0.16	0.35	0.33	-

- Figure in parenthesis are $\sqrt{X + 0.5}$ transformed values.

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Table 2: Effect of different weed management practices on the plant height, grain and haulm yield of rainfed greengram

	Treatments	Plant height (cm)			Grain yield (kg ha^{-1})	Haulm Yield (kg ha^{-1})
		15 DAS	30 DAS	At harvest		
T_1	PE Pendimethalin @ 0.75 kg a.i. ha^{-1} + HW on 30 DAS	15.0	20.3	46.3	532	2215
T_2	PE Oxyfluorfen @ 0.10 kg a.i. ha^{-1} + HW on 30 DAS	16.0	21.7	47.9	561	2247
T_3	PE Pendimethalin @ 0.75 kg a.i. ha^{-1} + EPOE Quizalofop ethyl @ 50 g a.i. ha^{-1} on 20 DAS	14.0	29.0	35.0	403	1903
T_4	PE Pendimethalin @ 0.75 kg a.i. ha^{-1} + EPOE Imazethapyr @ 50 g a.i. ha^{-1} on 20 DAS	16.3	31.8	51.2	605	2398
T_5	PE Pendimethalin @ 0.75 kg a.i. ha^{-1} + EPOE Chlorimuron- p–ethyl @ 4 g a.i. ha^{-1} on 20 DAS	13.1	26.7	31.0	354	1650
T_6	PE Oxyfluorfen @ 0.10 kg a.i. ha^{-1} + EPOE Quizalofop ethyl @ 50 g a.i. ha^{-1} on 20 DAS	14.5	29.5	36.7	415	1965
T_7	PE Oxyfluorfen @ 0.10 kg a.i. ha^{-1} + EPOE Imazethapyr @ 50g a.i. ha^{-1} on 20 DAS	16.5	32.2	52.6	636	2453
T_8	PE Oxyfluorfen @ 0.10 kg a.i. ha^{-1} + EPOE Chlorimuron - p - ethyl @ 4g a.i. ha^{-1} on 20 DAS	13.5	27.5	34.2	370	1819
T_9	EPOE Quizalofop ethyl @ 50 g a.i. ha^{-1} + Imazethapyr @ 50g a.i. ha^{-1} on 20 DAS	11.8	24.9	39.8	462	2021
T_{10}	HW twice on 15 and 30 DAS	12.2	24.3	42.1	498	2069
T_{11}	Weed free check	16.7	33.8	53.9	654	2475
T_{12}	Unweeded control	11.0	16.0	26.3	273	1328
	SEd	0.48	0.65	1.26	24	71
	CD(P=0.05)	0.95	1.57	2.74	49	147