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Effect of Sequential Application of Pre and Post-emergence Herbicides on Nutrients Uptake by Crop and Weeds in *kharif* greengram

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ABSTRACT: *A field experiment was conducted during kharif season of 2013 to study the effect of sequential application of pre and post-emergence herbicides on nutrients uptake by both crop and weeds in kharif greengram. Results indicated that sequential treatments were found to be superior over individual applications in reducing the nutrient uptake by weeds and further enhancing the nutrient uptake by crop. Among the sequential treatments, pre emergence application of pendimethalin 1.0 liter ha*$^{-1}$ *followed by imazethapyr 75 g ha*$^{-1}$ *at 20 days after sowing (DAS) significantly reduced weed growth, nutrient uptake by weeds and recorded the higher nutrient uptake by crop. And a consequence gave significantly higher seed yield (1110 kg ha*$^{-1}$*) and it was on par with other sequential treatments* viz., *pendimethalin fb post-emergence application of fenoxyprop-p-ethyl, pre-emergence application of alachlor fb post-emergence application of either imazethapyr, tank mix application of alachlor + pendimethalin as pre-emergence fb 1 HW and 1 IC and farmers' practice.*

Keywords: *Greengram, NPK uptake, Pre and post-emergence herbicides, Sequential application.*

INTRODUCTION

In India, greengram is the third most widely cultivated pulse crop after bengalgram and pigeonpea. India alone accounts for 65 per cent of the world acreage and 54 per cent of the world production. In India it is grown in an area of 3.55 m ha with a total production of 1.82 m t and average productivity of 500 kg ha^{-1}. In Karnataka, it is widely grown in *kharif* season and it covers an area of 2.84 lakh ha with a production of 0.69 lakh t and productivity of only 258 kg ha^{-1} [1]. The crop has very high yielding capacity but its productivity in India and Karnataka is comparatively low when compared with world. Among many factors responsible for low productivity in greengram, the problem of weed infestation is considered to be prime importance. The greengram grown in *kharif* season is severely infested by various grassy, sedges and broad leaved weeds due to continuous rains in the monsoon. Several research results reported that full season association of weeds with crop resulted in 30-50 per cent reduction in yield [8, 7]. This reduction in the crop yield was mainly attributed to substantial uptake of plant nutrients by the weeds. Therefore, removal of weeds at appropriate time using a suitable method is essential to reduce the competition for nutrients and to obtain high yields of greengram. In greengram, weeds could be controlled by hand weedings [3]. However, hand weeding is laborious, time consuming, costly and tedious. Moreover, many times labour is not available at the critical period of weed removal. Furthermore, weather conditions (rains) do not permit timely hand weeding due to wet field conditions. Delayed removal of weeds is not as effective in controlling weeds and obtaining higher yields as the timely removal of weeds. Under these conditions, use of herbicides offers an alternative for possible effective control of weeds. Keeping above information in view, the present investigation was undertaken to study the effect of sequential application of pre and post-emergence herbicides on losses of nutrients caused by weeds in *kharif* greengram grown under rainfed condition.

MATERIAL AND METHODS

The experiment was conducted during *kharif* season of 2013, at Main Agricultural Research Station, University of Agricultural Sciences, Dharwad, Karnataka state. The soil of experimental site was clay loams comprising maximum clay content (70.1%)

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with bulk density and particle density of 1.15 g cc^{-1} and 2.65 g cc^{-1}, respectively. The soil pH was 6.5 (neutral in reaction). It was low in available nitrogen and available phosphorus and high in available potassium. Fifteen treatments *viz.,* oxyfluorfen 0.10 kg ha^{-1} (PRE) fb 1 HW and 1 IC at 30 DAS (T_1) or fb imazethapyr 75 g ha^{-1} (POST) at 25 DAS (T_2) or fb fenoxyprop-p-ethyl 75 g ha^{-1} (POST) at 25 DAS (T_3); alachlor 1.5 liter ha^{-1} (PRE) fb 1 HW and 1 IC at 30 DAS (T_4) or fb imazethapyr 75 g ha^{-1} (POST) at 25 DAS (T_5) or fb fenoxyprop-p-ethyl 75 g ha^{-1} (POST) at 25 DAS (T_6); pendimethalin 1.0 liter ha^{-1} (PRE) fb 1 HW and 1 IC at 30 DAS (T_7) or fb imazethapyr 75 g ha^{-1} (POST) at 25 DAS (T_8) or fb fenoxyprop-p-ethyl 75 g ha^{-1} (POST) at 25 DAS (T_9); tank mix application of alachlor 1.0 liter ha^{-1} + pendimethalin 0.5 liter ha^{-1} (PRE) fb 1 HW and 1 IC at 30 DAS (T_{10}) and post-emergence alone application of imazethapyr 75 g ha^{-1} at 20 DAS (T_{11}) or fenoxyprop-p-ethyl 75 g ha^{-1} at 20 DAS (T_{12}). These weed control treatments were compared with farmers' practice (1 HW and 1 IC at 20-25 and 1 IC at 40 DAS- T_{13}), weedy (T_{14}) and weed free check (T_{15}). These fifteen treatments were laid out in complete randomized block design with three replications. Herbicides were sprayed with a knap sack sprayer fitted with a flat fan nozzle using 500 liters of water per hectare. Pre-emergence herbicides were applied either one day after sowing, whereas post-emergence herbicides were sprayed 25 days after sowing.

The greengram variety DGGV-2 was sown in June 2013with a spacing of 30 cm X 10 cm using a seed rate of 15 kg ha^{-1}. Total weed density and weed dry weight were recorded at various stages with the help of a quadrate and then converted to m^{-2} and the data on weed parameters were subjected to square root transformation (x + 0.5) before statistical analysis. The composite plant and weed dry matter samples taken at various growth stages was oven dried and ground into fine powder using Willey mill and used for estimating nitrogen, phosphorous and potassium uptake by the crop and weeds.

RESULTS AND DISCUSSION

Effects on weeds

The experimental field was dominated by natural infestation of broad leaved weeds like *Digitataria muricata*, *Amaranthus viridis*, *Commelina benghalensis*, *Cyanotis cucullata*, *Phyllanthus fraternus* and *Argemone mexicana;* grasses like *Brachiaria eruciformis*, *Cynodon dactylon, Digitaria sanguinalis* and *Dinebra retroflexa* and lonely sedge *Cyperus rotundus.*

All the weed control treatments significantly reduced the total weed dry weight over unweeded check at all stages of observation (Table 1). Contrary to the weedy check, in the standard weed free check complete control of weeds at all the stages was maintained. Among the herbicide treatments, sequential application of pendimethalin as pre-emergence fb imazethapyr as post-emergence recorded significantly lower total dry weight of weeds (1.50, 3.57 and 3.77 g m^{-2}, respectively) at 30, 60 DAS and harvest compared to weedy check (23.53, 37.89 and 39.83 g m^{-2}). But, it was on par with either sequential or pre-emergence application of herbicide fb 1 HW or 1 IC treatments and farmers' practice *viz.,* T_5, T_9, T_7, T_4, T_{10} and T_{13}. This was mainly due to effective control of weeds by pre-emergence application of herbicides like pendimethalin or alachlor up to 20-25 DAS (early stage). While, later emerging weeds were effectively taken care by either post-emergence application of imazethapyr or fenoxyprop-p-ethyl or mechanical weed control *i.e,.* 1 HW and IC at 30 DAS. These treatments were recorded statistically on par in control of weeds as that of farmers' practice. The similar results were also reported by earlier worker [6]. They reported that sand mix application of pendimethalin 1.0 kg ha^{-1} fb imazethapyr 50 g ha^{-1} at 20 DAS significantly reduced weed growth in greengram and it was on par with sequential application of alachlor 1.5 liter ha^{-1} fb imazethapyr 50 g ha^{-1} and also with two hand weedings at 15 and 30 DAS.

Effect on nutrient uptake by weeds

Among the treatments, weedy check recorded significantly higher uptake of nitrogen (2.11, 7.88 and 24.69 kg ha^{-1}), phosphorus (1.43, 5.34 and 16.73 kg ha^{-1}) and potassium (1.75, 6.53 and 20.51 kg ha^{-1}) by the weeds compared to weed control treatments (Table 1) as weeds were not controlled by any means which facilitates the weeds to utilize nutrient to the maximum extent. Among the weed control treatments, T_{15}, T_8, T_9, T_7, T_5, T_4, T_{10} and T_{13} found lower uptake of nutrients by the weeds at all the stages of observations. This reduction in the nutrient uptake in above treatments was mainly due to effective control of weeds throughout the growing season. A similar observation was also reported by Kaur [5] and Chhodavadia [2].

Effect on nutrient uptake by crop

The uptake of N, P and K by the greengram crop decreased with increase in weed population and

Table 1

Effect of sequential application of pre and post-emergence herbicides on weed dry weight and nutrient uptake by weeds at different growth stages of greengram

Treatment	*Total dry weight of weeds (g m^{-2})*			*Nutrient uptake by weeds at 30 DAS (kg ha^{-1})*			*Nutrient uptake by weeds at 60 DAS(kg ha^{-1})*			*Nutrient uptake by weeds at harvest (kg ha^{-1})*		
	30 DAS	*60 DAS*	*At harvest*	*N*	*P*	*K*	*N*	*P*	*K*	*N*	*P*	*K*
T_1	1.98(3.42)d	2.37(5.17)e-g	2.53(5.92)de	0.58cd	0.39c-e	0.49cd	2.01d	1.36d	1.68d	5.85cd	3.96cd	4.89cd
T_2	1.67(2.30)f-h	2.40(5.24)ef	2.51(5.80)de	0.35de	0.24d-f	0.29e-g	1.27f-h	0.87e-g	1.04e-g	3.80f-h	2.61fg	3.13f-h
T_3	1.79(2.70)d-f	2.90(7.97)d	2.99(8.52)cd	0.47de	0.32d-f	0.39d-g	1.73d-f	1.17de	1.42de	5.28de	3.58de	4.35de
T_4	1.94(3.28)de	2.31(4.87)e-h	2.48(5.64)de	0.58cd	0.40cd	0.48c-e	1.88de	1.28d	1.55d	5.19d-f	3.52d-f	4.27de
T_5	1.52(1.81)gh	2.18(4.26)f-h	2.32(4.86)e	0.42de	0.28d-f	0.34d-g	1.20f-h	0.82f-h	0.99fg	3.01g-i	2.04g-i	2.45f-i
T_6	1.70(2.41)e-g	2.56(6.09)e	2.60(6.63)de	0.51de	0.36c-f	0.42d-g	1.57d-f	1.09d-f	1.29d-f	4.11e-g	2.87e-g	3.38e-g
T_7	1.73(2.49)d-g	2.15(4.19)f-h	2.35(5.07)e	0.53de	0.36c-f	0.43d-f	1.60d-f	1.08d-f	1.31d-f	4.17e-g	2.83e-g	3.43ef
T_8	1.41(1.50)h	2.02(3.57)f-h	2.06(3.77)e	0.27e	0.19e	0.23g	0.77h	0.53h	0.64g	1.90i	1.30i	1.58i
T_9	1.64(2.19)f-h	2.35(5.03)e-g	2.43(5.41)de	0.48de	0.32d-f	0.39d-g	1.37e-g	0.93ef	1.13ef	3.41gh	2.31gh	2.81f-h
T_{10}	1.48(1.71)gh	1.99(3.48)gh	2.11(3.96)e	0.28e	0.20ef	0.23g	0.88gh	0.60gh	0.72g	2.35hi	1.59hi	2.26g-i
T_{11}	2.23(4.57)c	3.32(10.49)c	3.41(11.20)c	0.80c	0.54c	0.65c	2.54c	1.72c	2.09c	6.94c	4.70c	5.71c
T_{12}	2.60(6.27)b	3.78(13.86)b	3.97(15.34)b	1.04b	0.71b	0.85b	3.40b	2.32b	2.81b	9.51b	6.50b	7.85b
T_{13}	1.68(2.38)e-g	1.96(3.36)h	2.28(4.84)e	0.41de	0.22d-f	0.25fg	0.84gh	0.55h	0.70g	2.94g-i	1.51hi	2.13hi
T_{14}	4.90(23.53)a	6.19(37.89)a	6.35(39.83)a	2.11a	1.43a	1.75a	7.88a	5.34a	6.53a	24.69a	16.73a	20.51a
T_{15}	0.71(0.00)i	0.71(0.00)i	0.71(0.00)f	0.00f	0.00g	0.00h	0.00i	0.00i	0.00h	0.00j	0.00j	0.00j
S.Em.±	0.09	0.11	0.17	0.09	0.05	0.06	0.17	0.11	0.13	0.46	0.30	0.35
CD (P=0.05)	0.25	0.33	0.50	0.25	0.15	0.16	0.50	0.31	0.37	1.32	0.87	1.01

Figures indicating ($\sqrt{x+0.5}$) transformed values, Figures in parenthesis are indicating original values Means followed by same letters do not differ significantly

T_1- Oxyfluorfen 0.10 kg ha^{-1} (PRE) fb 1 HW and 1 IC, T_2- Oxyfluorfen 0.10 kg ha^{-1} (PRE) fb Imazethapyr 75 g ha^{-1}(POST), T_3- Oxyfluorfen 0.10 kg ha^{-1} (PRE) fb Fenoxyprop-p-ethyl 75 g ha^{-1}(POST), T_4- Alachlor 1.5 l ha^{-1} (PRE) fb 1 HW and 1 IC, T_5- Alachlor 1.5 l ha^{-1} (PRE) fb Imazethapyr 75 g ha^{-1}(POST), T_6- Alachlor 1.5 l ha^{-1} (PRE) fb Fenoxyprop-p-ethyl 75 g ha^{-1}(POST), T_7- Pendimethalin 1.0 l ha^{-1} (PRE) fb 1 HW and 1 IC, T_8- Pendimethalin 1.0 l ha^{-1} (PRE) fb Imazethapyr 75 g ha^{-1}(POST), T_9- Pendimethalin 1.0 l ha^{-1} (PRE) fb Fenoxyprop-p-ethyl 75 g ha^{-1}(POST), T_{10}- Alachlor 1.0 l ha^{-1} (PRE) + Pendimethalin 0.5 l ha^{-1} (PRE) 1 HW and 1 IC, T_{11}- Imazethapyr 75 g ha^{-1}(POST), T_{12}- Fenoxyprop-p-ethyl 75 g ha^{-1}(POST), T_{13}- Farmer 's practice(1 HW and 2 IC), T_{14}- Weedy check, T_{15}- Weed free increased with decreased in weed competition. Among the treatments weedy check recorded significantly lower uptake of nitrogen (9.1, 28.1 and 64.9 kg ha^{-1}), phosphorus (2.5, 7.8 and 18.3 kg ha^{-1}) and potassium (7.3, 26.7 and 63.4 kg ha^{-1}) compared to weed control treatments. Among the weed control treatments, T_{15}, T_8, T_9, T_7, T_5, T_4, T_{10} and T_{13} found significantly superior in uptake of nutrients by the crop at all the stages of growth (Table 2). A similar observations were also reported by Younesabadi [10] recorded significantly higher amount of NPK uptake by soybean. This increased uptake nutrients especially nitrogen by the crop resulted in increased nitrogen concentration in the seeds and finally resulted in significantly higher crude protein content (Table 3) in the seeds in above said treatments. Chhodavadia [2] also reported significantly higher crude protein content in seeds under weed control treatments due to higher uptake of nitrogen.

Effect on crop

All the herbicide treatments produced significantly higher seed yield (714-1110 kg ha^{-1}) compared to weedy check (500 kg ha^{-1}). Unweeded check registered 57.4 per cent reduction in seed yield compared to weed free check owing to sever competition offered by uncontrolled weeds for nutrients, soil moisture, space and light. Among the weed control treatments, significantly higher seed yield (1175 kg ha^{-1}) was obtained with season long weed free check (T_{15}) as compared to weedy check and treatments consisted of only post-emergence herbicides (T_{11} and T_{12}) (Table 2). However, it was on par with all herbicide treatments involving sequential and pre-emergence herbicides application fb cultural practices *viz.,* pendimethalin fb post-emergence application of either imazethapyr (T_8-1110 kg ha^{-1}) or fenoxyprop-p-ethyl (T_9-1060 kg ha^{-1}) or 1 HW and 1 IC (T_7-1103 kg ha^{-1}), pre-emergence application of alachlor fb post-emergence application of either imazethapyr (T_5- 1026 kg ha^{-1}) or 1 HW and 1 IC (T_4-1012 kg ha^{-1}), tank mix application of alachlor + pendimethalin as pre-emergence fb 1 HW and 1 IC (T_{10}- 1019 kg ha^{-1}) and farmers' practice (T_{13}-1084 kg ha^{-1}). The extent of yield increase in T_{15}, T_8, T_9, T_7, T_5, T_4, T_{10} and T_{13} was to the tune of 135, 122, 112, 121, 106, 102, 104 and 117 per cent, respectively over weedy check. The superior performance of these treatments was mainly due to higher uptake of nutrients by the crop as a result of effective control of weeds since from the sowing to maximum vegetative stage which created conditions similar to weed free environment due to sequential

Table 2
Nutrient uptake (kg ha^{-1}) by crop at 30, 60 DAS and harvest as influenced by sequential application of pre and post-emergence herbicides.

Treatment	*30 DAS*			*60 DAS*			*At harvest*		
	N	*P*	*K*	*N*	*P*	*K*	*N*	*P*	*K*
T_1	13.3g	3.4hi	10.5g	38.6de	9.8d-f	35.7ef	87.0d	22.4c	80.5d
T_2	12.6g	3.2h-j	9.8gh	37.8de	9.6ef	34.8ef	87.1d	22.3c	80.3d
T_3	12.1gh	3.1ij	9.3gh	37.1e	9.4ef	33.7f	85.5d	21.9c	78.8d
T_4	19.1de	4.8ef	14.6d-f	52.7bc	13.2bc	46.8bc	110.9a-c	28.1a	101.2ab
T_5	21.4b-d	5.4c-e	17.5b-d	53.9bc	13.7a-c	50.3ab	110.5a-c	27.8a	101.2ab
T_6	20.2c-e	5.1de	16.0b-e	53.1bc	13.3bc	48.3bc	111.6a-c	27.9a	100.5ab
T_7	20.6cd	5.2de	16.0b-e	53.6bc	13.5a-c	48.0bc	113.0ab	28.2a	99.4ab
T_8	24.4ab	6.2ab	18.7ab	59.1ab	14.5ab	52.3ab	117.5ab	28.7a	103.0ab
T_9	22.7bc	5.7b-d	18.0bc	56.4ab	14.1ab	51.1ab	113.2ab	28.3a	101.8ab
T_{10}	19.4c-e	4.9ef	15.3c-e	52.1bc	13.2bc	47.2bc	111.6a-c	28.0a	99.8ab
T_{11}	16.9ef	4.3fg	13.5ef	46.2cd	11.8cd	42.6cd	100.7b-d	25.5a-c	91.6b-d
T_{12}	15.3fg	3.9gh	12.1fg	42.7de	10.9de	39.5de	94.7cd	24.0bc	86.4cd
T_{13}	24.4ab	6.0a-c	18.6ab	57.0ab	14.4ab	50.8ab	110.1a-c	27.0ab	96.9a-c
T_{14}	9.1h	2.5j	7.3h	28.1f	7.8f	26.7g	64.9e	18.3d	63.4e
T_{15}	27.2a	6.6a	21.0a	63.7a	15.6a	55.6a	121.6a	29.3a	105.5a
S.Em.±	1.1	0.2	0.9	2.7	0.7	1.8	5.3	1.2	3.9
CD (P=0.05)	3.1	0.7	2.7	7.8	1.9	5.3	15.4	3.4	11.3

Means followed by same letters do not differ significantly

T_1- Oxyfluorfen 0.10 kg ha^{-1} (PRE) fb 1 HW and 1 IC, T_2- Oxyfluorfen 0.10 kg ha^{-1} (PRE) fb Imazethapyr 75 g ha^{-1}(POST), T_3- Oxyfluorfen 0.10 kg ha^{-1} (PRE) fb Fenoxyprop-p-ethyl 75 g ha^{-1}(POST), T_4- Alachlor 1.5 l ha^{-1} (PRE) fb 1 HW and 1 IC, T_5- Alachlor 1.5 l ha^{-1} (PRE) fb Imazethapyr 75 g ha^{-1}(POST), T_6- Alachlor 1.5 l ha^{-1} (PRE) fb Fenoxyprop-p-ethyl 75 g ha^{-1}(POST), T_7- Pendimethalin 1.0 l ha^{-1} (PRE) fb 1 HW and 1 IC, T_8- Pendimethalin 1.0 l ha^{-1} (PRE) fb Imazethapyr 75 g ha^{-1}(POST), T_9- Pendimethalin 1.0 l ha^{-1} (PRE) fb Fenoxyprop-p-ethyl 75 g ha^{-1}(POST), T_{10}- Alachlor 1.0 l ha^{-1} (PRE) + Pendimethalin 0.5 l ha^{-1} (PRE) 1 HW and 1 IC, T_{11}- Imazethapyr 75 g ha^{-1}(POST), T_{12}- Fenoxyprop-p-ethyl 75 g ha^{-1}(POST), T_{13}- Farmer 's practice(1 HW and 2 IC), T_{14}- Weedy check, T_{15}- Weed free

Table 3

Growth, yield components and yield of greengram as influenced by sequential application of pre and post-emergence herbicides.

Treatment	*Crop dry matter production ($g\ plant^{-1}$)*			*No. of effective nodules per plant*		*No. of pods per plant*	*No. of seeds per pod*	*100-seed weight*	*Seed yield ($kg\ ha^{-1}$)*	*Crude protein content in seed (%)*
	30 DAS	*60 DAS*	*At harvest*	*30 DAS*	*60 DAS*					
T_1	2.00d	15.03cd	14.14cd	14.78f	44.72d	26.19b-e	5.43b	5.09ab	897c-e	21.62b
T_2	1.93d	14.82cd	13.87d	14.23f	44.14d	25.70c-e	5.27b	5.37ab	874d-f	21.68b
T_3	1.79d	14.30d	13.84d	15.59f	44.17d	25.50c-e	5.40b	5.11ab	849d-f	21.70b
T_4	2.78c	16.28a-d	15.31a-d	21.93c-e	59.65b	28.72a-c	6.90a	6.01a	1012a-d	21.93ab
T_5	2.95bc	16.70a-c	15.58a-d	21.69de	58.85b	29.51a-c	6.83a	6.19a	1028a-d	22.03ab
T_6	2.70c	16.13b-d	15.03b-d	22.81b-e	59.00b	28.14a-d	6.67a	6.19a	988b-d	22.20ab
T_7	3.10a-c	17.49ab	16.57a-c	23.94a-d	59.77b	30.66a-c	7.07a	6.18a	1103ab	22.30ab
T_8	3.62ab	18.09ab	16.84ab	24.89ab	59.18b	31.24ab	7.23a	6.33a	1110ab	22.83ab
T_9	3.17a-c	17.16a-c	16.10a-d	24.33a-c	59.00b	30.02a-c	6.97a	6.07a	1060a-c	22.20ab
T_{10}	2.86c	17.16a-c	15.41a-d	21.67de	58.41b	29.26a-c	5.33b	6.30a	1019a-d	22.14ab
T_{11}	1.93d	11.57e	11.57e	23.49a-d	59.67b	23.42de	6.90a	4.60b	794ef	21.99ab
T_{12}	1.59d	10.33e	10.33e	22.26c-e	58.27b	22.36e	6.73a	4.43b	714f	21.91ab
T_{13}	3.33a-c	17.43ab	16.42a-c	25.33a	63.22a	31.20ab	5.77b	5.33ab	1084ab	22.72ab
T_{14}	0.66e	6.94f	6.94f	20.89e	54.95c	21.34e	2.20c	3.23c	500g	19.71c
T_{15}	3.75a	18.65a	17.79a	25.92a	64.29a	32.78a	7.43a	6.37a	1175a	23.07a
S.Em.±	0.23	0.72	0.75	1.65	2.98	1.61	0.30	0.40	55	0.37
CD (P=0.05)	0.65	2.08	2.17	4.79	8.65	4.66	0.87	1.15	160	1.08

Means followed by same letters do not differ significantly

T_1- Oxyfluorfen 0.10 kg ha^{-1} (PRE) fb 1 HW and 1 IC, T_2- Oxyfluorfen 0.10 kg ha^{-1} (PRE) fb Imazethapyr 75 g ha^{-1}(POST), T_3- Oxyfluorfen 0.10 kg ha^{-1} (PRE) fb Fenoxyprop-p-ethyl 75 g ha^{-1}(POST), T_4- Alachlor 1.5 l ha^{-1} (PRE) fb 1 HW and 1 IC, T_5- Alachlor 1.5 l ha^{-1} (PRE) fb Imazethapyr 75 g ha^{-1}(POST), T_6- Alachlor 1.5 l ha^{-1} (PRE) fb Fenoxyprop-p-ethyl 75 g ha^{-1}(POST), T_7- Pendimethalin 1.0 l ha^{-1} (PRE) fb 1 HW and 1 IC, T_8- Pendimethalin 1.0 l ha^{-1} (PRE) fb Imazethapyr 75 g ha^{-1}(POST), T_9- Pendimethalin 1.0 l ha^{-1} (PRE) fb Fenoxyprop-p-ethyl 75 g ha^{-1}(POST), T_{10}- Alachlor 1.0 l ha^{-1} (PRE) + Pendimethalin 0.5 l ha^{-1} (PRE) 1 HW and 1 IC, T_{11}- Imazethapyr 75 g ha^{-1}(POST), T_{12}- Fenoxyprop-p-ethyl 75 g ha^{-1}(POST), T_{13}- Farmer 's practice(1 HW and 2 IC), T_{14}- Weedy check, T_{15}- Weed free application of herbicides and pre-mergence application of herbicides fb cultural practices which resulted in significantly increased yield attributing parameters *viz*., number of pods per plant, number of seeds per pod, 100- seed weight. These increased yield parameters were mainly due to increased crop growth in terms of total dry matter production at all the growth stages of crop (Table 3). The results are akin to those reported by Vijayalaxmi [9] Dwivedi [4] and Younesabadi [10]. Even though herbicide treatments reduce the number of nodules per plant significantly as compared to cultural practices but at later stages they were recovered and recorded on par nodules as that of cultural treatments. This is also one of the main reasons for increased nutrient uptake and yield in above treatments.

CONCLUSION

From the results it can be concluded that, sequential application of pendimethalin 1.0 liter ha^{-1} as pre-emergence fb imazethapyr 75 g ha^{-1} as post emergence at 25 DAS was found effective in reducing weed dry weight and thereby reduce the nutrients mining by the weeds and increase the nutrient uptake by the crop resulted in significantly higher seed yield. Hence, it can be used as substitute to farmers practice in greengram grown in transition tract under rainfed areas. Hoverer, pendimethalin 1.0 liter ha^{-1} as pre-emergence fb fenoxyprop-p-ethyl 75 g ha^{-1} as post-emergence, pendimethalin 1.0 liter ha^{-1} fb 1 HW and 1 IC can also be used as an alternative practice.

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