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Weed management through early post-emergence herbicides to improve productivity and nutrient uptake in greengram

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ABSTRACT

A field experiment was conducted at College of Agriculture, PJTSAU, Rajendranagar, Hyderabad (Telangana) during rainy season 2015-16 on sandy loam soil to study the weed growth, yield and nutrient uptake in greengram under different early post-emergence herbicide treatments. Lower density and dry matter of weeds was recorded with hand weeding at 20 and 40 DAS followed by haloxyfop-p-methyl 135 g/ha + imazethapyr 75 g/ha at 12-15 DAS as early post-emergence, which remained at par with quizalofop-ethyl 50 g/ha + imazethapyr 75 g/ha at 12-15 DAS. Hand weeding twice at 20 and 40 DAS showed the highest uptake of N, P and K, which was comparable with haloxyfop-p-methyl 135 g/ha + imazethapyr 75 g/ha at 12-15 DAS and quizalofop-ethyl 50 g/ha + imazethapyr 75 g/ha at 12-15 DAS. Significantly higher seed yield was observed with hand weeding at 20 and 40 DAS (1.09 t/ha) which remained at par with haloxyfop-p-methyl 135 g/ha + imazethapyr 75 g/ha at 12-15 DAS (1.03 t/ha) and quizalofop-ethyl 50 g/ha + imazethapyr 75 g/ha at 12-15 DAS (1.01 t/ha).

Greengram is the third important pulse crop of India in terms of area (3.55 million ha) and production (1.82 million tonnes). It serves as vital source of vegetable protein (19.1-28.3%) and vitamins (Singh *et al*. 2015). Being a short-statured crop, it faces heavy weed competition right from the early crop growth stages. In greengram, hand weeding is effective in controlling the weeds but cost, unavailability of labour and continuous rainfall in rainy season does not permit it to operate timely. Therefore, chemical weed control forms an excellent alternative and provide weed-free environment up to 30–35 days after sowing (Dungarwal *et al*. 2003). Pendimethalin is the most commonly used pre-emergence herbicide in greengram which control weeds during early growth stage, but it does not control newly germinated weeds. Hence, this warrants the use of early post-emergence herbicides for good weed control and thereby increasing the crop yield. Keeping these facts in view, the present investigation was carried out to study weed growth, yield and nutrient uptake in greengram through various early post-emergence herbicide combinations.

The present experiment was carried out during rainy season 2015-16 at research farm of College of Agriculture, PJTSAU, Rajendranagar, Hyderabad (Telangana) with eleven early post-emergence weed management treatments in a randomized block design and replicated thrice **(Table 1)**. The plant and weed samples collected for dry matter production were utilized for chemical analysis. The dried samples were grounded in willey mill. The powdered material collected was used for chemical analysis of N, P and K content as suggested by Subbiah and Asija (1956) for N, Olsen *et al*. (1954) for P and Jackson (1973) for K. Total N, P and K uptake was calculated for each treatment separately by multiplying per cent content in the tissue with their respective dry matter values and expressed as kg/ha.

Weed flora

The field was infested with complex weed flora comprising grasses, sedges and broad-leaved weeds. The predominant weeds observed in the experimental field during crop growth period were: *Cynodon dactylon, Dactyloctenium aegyptium, Digitaria sanguinalis, Dinebra retroflexa, Echinochloa crus-galli, Panicum repens* and *Rottboellia exaltata* among the grasses. *Cyperus rotundus* was the dominant sedge. *Amaranthus viridis, Celosia*

argentia, Commelina benghalensis, Digera arvensis, Euphorbia hirta, Parthenium hysterophorus, Trianthema portulacastrum, Tribulus terrestris and *Trichodesma indicum* were the major broad-leaved weeds.

Weed density, dry matter, yield and nutrient uptake

Significantly lower density 5.44 no./m^2 and dry matter 1.97 g/m^2 of weeds were recorded with pendimethalin 1.0 kg/ha as pre-emergence, which was on a par with pendimethalin at 1.0 kg/ha as pre-emergence + imazethapyr at 75 g/ha as post-emergence (5.45 no./m^2 and 1.97 g/m^2) whereas significantly higher weed density 8.16 no./m^2 and dry matter 2.76 g/m^2 were recorded with unweeded control. The varying weed control treatments showed significant effect on weed density and dry matter at 30 DAS (**Table 1**). Significantly lowest weed density 3.31 no./m^2 and dry matter 3.20 g/m^2 of weeds were recorded with hand weeding at 20 and 40 DAS which was at par with haloxyfop-p-methyl 135 g/ha + imazethapyr 75 g/ha at 12-15 DAS for weed density 3.44 no./m^2 and dry matter 3.33 g/m^2 and quizalofop-ethyl 50 g/ha + imazethapyr 75 g/ha at 12-15 DAS (3.55 no./m^2 and 3.49 g/m^2, respectively) and were significantly superior over rest of the treatments. Significantly higher weed density 10.38 no./m^2 and dry matter 10.41 g/m^2 were recorded in unweeded control compared to other treatments at 30 DAS. From the findings, it can be stated that the combination of early post-emergence herbicides showed effective weed control same as hand weeding at early stages. At 45 DAS, significantly lower weed density 1.84 no./m^2 and dry matter 1.48 g/m^2 of weeds were recorded in hand weeding at 20 and 40 days after sowing followed by haloxyfop-p-methyl 135 g/ha + imazethapyr 75 g/ha at 12-15 DAS (4.56 no./m^2 and 5.55 g/m^2), which remained at par with quizalofop-ethyl 50 g/ha + imazethapyr 75 g/ha at 12-15 DAS (4.58 no./m^2 and 5.59 g/m^2 for weed density and dry matter, respectively) than other treatments. Significantly higher density and dry matter of weeds were recorded with unweeded control (9.46 no./m^2 and 11.52 g/m^2 for weed density and dry matter, respectively). Similar trend was observed at harvest stage also (**Table 1**). This clearly indicated that the excellent performance of two hand weedings at 20 and 40 DAS was due to better control of weeds. Herbicides showed significant reduction in weed growth thereby facilitated vigourous crop growth, increased photosynthesis and biomass accumulation and ultimately helped to smother weeds resulted in higher WCE (Naidu *et al.* 2012).

Hand weeding at 20 and 40 DAS showed significantly higher uptake of nitrogen, phosphorus and potassium (79.19, 7.58 and 63.90 kg/ha, respectively) which was at par with haloxyfop-p-methyl 135 g/ha + imazethapyr 10% SL 75 g/ha (76.98, 7.37 and 62.12 kg/ha, respectively) and quizalofop-ethyl 50 g/ha + imazethapyr 75 g/ha (75.65, 7.24 and 61.05 kg/ha, respectively) (**Table 2**). The higher uptake of N, P and K in these treatments were due to vigorous growth with adequate supply of these nutrients resulting in higher biological yield coupled with their effective transfer to the ultimate sink *i.e.* grains (Kaur *et al.* 2009). Significantly lower removal of nitrogen, phosphorus and potassium by weeds was observed with hand weeding at 20 and 40 DAS (0.64, 0.26 and 0.60 kg/ha, respectively) followed by haloxyfop-p-methyl 135 g/ha + imazethapyr 75 g/ha (8.96, 1.29 and 6.33 kg/ha, respectively) and quizalofop-ethyl 50 g/ha + imazethapyr 75 g/ha (9.12, 1.31 and 6.45, respectively) whereas significantly the highest

Table 1. Effect of weed management practices on weed density and dry matter of weeds

Treatment	Weed density (no./m^2)				Weed dry matter (g/m^2)			
	15 DAS	30 DAS	45 DAS	At harvest	15 DAS	30 DAS	45 DAS	At harvest
Pendimethalin (1000 g/ha) at 2-3 DAS	5.4(28.6)	6.6(43.5)	7.4(54.1)	8.1(64.4)	1.97(2.9)	6.7(44.3)	9.3(85.3)	10.1(102)
Pendimethalin *fb* imazethapyr (1000 *fb* 75 g/ha) at 2-3 *fb* 12-15 DAS	5.4(28.7)	4.6(20.4)	5.3(27.3)	6.3(38.5)	1.97(2.9)	4.6(20.5)	6.6(42.4)	7.8(61.0)
Imazethapyr (75 g/ha) at 12-15 DAS	8.1(65.3)	6.5(41.8)	6.2(37.2)	7.1(49.0)	2.76(6.7)	6.6(43.2)	7.7(57.8)	8.9(77.8)
Chlorimuron-ethyl (9 g/ha) at 12-15 DAS	8.0(62.8)	8.8(77.9)	7.5(54.7)	8.1(65.0)	2.75(6.7)	8.4(70.6)	9.3(86.5)	10.2(103)
Quizalofop-ethyl + imazethapyr (50+75 g/ha) at 12-15 DAS	7.9(61.2)	3.5(11.7)	4.6(20.2)	5.5(29.5)	2.75(6.7)	3.5(11.4)	5.6(30.6)	6.9(46.5)
Imazethapyr + imazamox (70 g/ha) at 12-15	8.0(62.5)	4.7(21.1)	5.4(27.9)	6.3(38.7)	2.76(6.7)	4.6(21.0)	6.6(42.9)	7.7(61.4)
Propaquizafop + imazethapyr (50 + 75 g/ha) at 12-15 DAS	7.8(60.8)	4.5(19.8)	5.3(27.0)	6.2(38.2)	2.75(6.6)	4.5(20.0)	6.5(41.8)	7.8(60.5)
Haloxyfop-p-methyl + imazethapyr (135+75 g/ha) at 12-15 DAS	8.1(65.5)	3.4(11.0)	4.6(19.8)	5.5(29.0)	2.75(6.7)	3.3(10.4)	5.5(30.2)	6.8(45.7)
Cycloxydim + imazethapyr (80 + 75 g/ha) at 12-15 DAS	8.0(62.8)	6.6(42.6)	6.2(37.8)	7.1(49.5)	2.75(6.7)	6.7(43.7)	7.7(58.5)	8.9(78.7)
Hand weeding at 20 and 40 DAS	8.1(65.0)	3.3(10.1)	1.8(2.4)	2.3(4.4)	2.76(6.6)	3.2(9.6)	1.5(1.2)	2.0(3.2)
Unweeded control	8.2(66.0)	10.0(107)	9.5(88.6)	9.9(96.7)	2.76(6.7)	10.4(108)	11.5(132)	12.5(156)
LSD (p=0.05)	0.70	0.52	0.55	0.60	0.27	0.59	0.52	0.57

Original values are given in parentheses which were transformed to $\sqrt{x+0.5}$

Table 2. Effect of weed management practices on WCE, seed yield and nutrient uptake by crop and weeds

Treatment	WCE (%)	Seed yield (t/ha)	Nutrient uptake (kg/ha)					
			Crop			Weeds		
			N	P	K	N	P	K
Pendimethalin (1000 g/ha) at 2-3 DAS	34.47	0.43	37.16	2.67	24.08	0.16	0.11	0.15
Pendimethalin *fb* imazethapyr (1000 *fb* 75 g/ha) at 2-3 *fb* 12-15 DAS	60.89	0.91	66.73	6.23	52.13	0.16	0.11	0.15
Imazethapyr (75 g/ha) at 12-15 DAS	50.12	0.74	57.88	4.49	43.41	0.37	0.19	0.32
Chlorimuron-ethyl (9 g/ha) at 12-15 DAS	33.75	0.22	28.99	2.20	17.36	0.37	0.19	0.33
Quizalofop-ethyl + imazethapyr (50+75 g/ha) at 12-15 DAS	70.15	1.01	75.65	7.24	61.05	0.37	0.19	0.32
Imazethapyr + imazamox (70 g/ha) at 12-15	60.62	0.90	64.92	6.06	50.72	0.37	0.16	0.33
Propaquizafop + imazethapyr (50 + 75 g/ha) at 12-15 DAS	61.18	0.92	67.33	6.28	52.61	0.37	0.19	0.33
Haloxyfop-p-methyl + imazethapyr (135+75 g/ha) at 12-15 DAS	70.69	1.03	76.98	7.37	62.12	0.37	0.19	0.32
Cycloxydim + imazethapyr (80 + 75 g/ha) at 12-15 DAS	49.51	0.74	57.88	4.49	43.41	0.36	0.16	0.33
Hand weeding at 20 and 40 DAS	97.92	1.09	79.19	7.58	63.90	0.36	0.16	0.33
Unweeded control	0.00	0.42	36.46	2.62	23.44	0.37	0.16	0.33
LSD (p=0.05)		0.08	6.55	0.58	5.22	0.12	0.03	0.03

removal of nitrogen, phosphorus and potassium by weeds was recorded with unweeded control (31.87, 4.40 and 26.52 kg/ha, respectively) at harvest. Because in hand weeding treatment one manual weeding was done at 40 DAS that contributed very less weed population and reduced the nutrient removal by weeds. This could be attributed to higher weed control efficiency of haloxyfop-p-methyl 135 g/ha + imazethapyr 75 g/ha and quizalofop-ethyl 50 g/ha + imazethapyr 75 g/ha resulting in more favourable environment for growth and development of crop apparently due to the lesser weed competition up to harvest. Similar results were reported by Chhodavadia *et al*. (2013).

Significantly higher seed yield was observed with hand weeding at 20 and 40 DAS (1.09 t/ha) which remained at par with haloxyfop-p-methyl 135 g/ha + imazethapyr 75 g/ha at 12-15 DAS (1.03 t/ha) and quizalofop-ethyl 50 g/ha + imazethapyr 75 g/ha at 12-15 DAS (1.01 t/ha) (**Table 2**). The combination of early post-emergence herbicides resulted in superior control of weeds over other treatments leading to higher seed yield. Significantly the lowest seed yield (0.22 t/ha) was obtained with the application of chlorimuron-ethyl 9 g/ha at 12-15 DAS since it showed high phyto- toxicity and plant did not recover even at later stages also which in turn led to poor weed control during entire crop growth period. Thus, it can be summarized that combinations of haloxyfop-p-methyl 135 g/ha + imazethapyr 75 g/ha and quizalofop-ethyl 50 g/ha + imazethapyr 75 g/ha at 12-15 DAS as early post-emergence can be recommended for Southern Zone of Telangana in greengram.

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