



RESEARCH NOTE

Efficacy of herbicides and their combinations in managing mixed weed flora effectively and economically in *Rabi* greengram

G. Janakiram Naidu, D. Subramanyam^{1*}, S. Bharathi and B. Sreekanth

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ABSTRACT

A field experiment was conducted at Regional Agricultural Research Station, Lam, Acharya N.G. Ranga Agricultural University, Guntur Andhra Pradesh India during *Rabi* 2023-24, to evaluate the efficacy of herbicides and their combinations and identify the suitable effective and economical pre-and post-emergence herbicides options in *Rabi* greengram, to manage mixed weed flora including certain weeds such as *Chrozophora rotleri*, *Cardiospermum helicacabum* and *Phyllanthus maderaspatensis*. which are not controlled by recommended herbicides. Significantly lower weed density and biomass with higher weed control efficiency (WCE), greengram yield components, seed yield and benefit-cost ratio were obtained with post-emergence (PoE) application of fomesafen + fluazifop-p-butyl 222 g/ha and sodium-acifluorfen + clodinafop-propargyl 185 g/ha PoE. These treatments were effective in controlling mixed weed flora including broad-leaved weeds that were not controlled by imazethapyr.

Keywords: Diclosulam, Greengram, Fomesafen + fluazifop-p-butyl, Herbicide mixtures, Sodium-acifluorfen + clodinafop-propargyl, Weed management

Greengram (*Vigna radiate* L.) plays an important role not only in human diet, but also in improving the soil fertility through biological nitrogen fixation with *Rhizobium* (Das *et al.* 2024). The lowest productivity of greengram is mainly due to non-adoption of good crop husbandry practices by the farming community.

The *Rabi* greengram is subjected to heavy infestation of weeds and their competition due to its short duration and relatively slow initial growth. Weed infestation is the one of major constraints in greengram cultivation and the extent of yield loss due to heavy weed infestation in *rabi* greengram is about 10 to 45% (Rao and Chauhan 2015).

Initial weed free situation is essential for greengram as the critical period of crop-weed competition is up to 20-30 DAS (Singh and Singh 2020). Due to shortage of human labour and high wages, manual weeding is not a feasible and economical practice. In spite of the pre-and-post emergence herbicides are available for control of weeds in greengram (Maji *et al.* 2025), there is large variation in weed flora associated in *Kharif* and *Rabi* greengram due to rainfall pattern or irrigation

schedule adopted. The pre-emergence application (PE) of pendimethalin and imazethapyr at recommended doses and pendimethalin + imazethapyr 1.0 kg/ha (Kumar *et al.* 2019) failed to control certain broad-leaved weed species like *Phyllanthus maderaspatensis*, *Cardiospermum helicacabum* and *Chrozophora rotleri*, which are dominant in *Rabi* greengram on vertisols. This might be due to change in cropping rotations like dry direct-seeded rice preceding to greengram and adoption of zero till pulse cultivation in black soils of Coastal Andhra Pradesh.

In the recent years, new generation low dose and high efficiency pre-emergence herbicides like pyroxasulfone and diclosulam or ready-mix herbicides are available to control the weeds in greengram with better selectivity and broad-spectrum weed control as well as low mammalian toxicity. However, their performance varied due to type of soil and weed flora associated with greengram. Hence, there is a need to evaluate new generation pre-emergence and post-emergence herbicide mixtures, alternative to pendimethalin and imazethapyr for broad-spectrum weed control in greengram on vertisols of Krishna Zone of Andhra Pradesh. Thus, a study was conducted to evaluate the efficacy of pre-and post-emergence herbicides and their combinations to identify the suitable effective and economical option to manage weeds in *Rabi* greengram.

ANGRAU, Integrated Weed Management Unit, Regional Agricultural Research Station, Guntur, Andhra Pradesh, India

¹ S.V. Agricultural College, Tirupati-517502, Acharya N G Ranga Agricultural University, Andhra Pradesh, India

* Corresponding author email: subbuagro37@gmail.com

The field experiment was conducted at Regional Agricultural Research Station, Lam campus of Acharya N.G. Ranga Agricultural University, Lam, Guntur, Andhra Pradesh, India during *Rabi*, 2023-24. The experimental site is situated at 16.36° N latitude and 80.43° E longitude at an altitude of 33 m above the mean sea level in the Krishna Zone of Andhra Pradesh. A total of 187.2 mm of rainfall was received during crop growth period in two rainy days. The soil was black clay loam in texture, neutral in reaction, low in organic carbon and available nitrogen, medium in available phosphorous and available potassium. The experiment was laid out in a randomized block design with twelve treatments, replicated thrice. The tested treatments include: pre-emergence application (PE) of pyroxasulfone 125 g/ha; diclosulam 20 g/ha PE; metolachlor 1200 g/ha PE; pendimethalin 1000 g/ha PE; post-emergence application (PoE) of imazethapyr 50 g/ha + clethodim 125 g/ha (TM); imazethapyr 50 g/ha + haloxyfop-r-butyl 125 g/ha (RM) PoE; fomesafen + fluazifop-p-butyl (RM) 222 g/ha PoE; imazethapyr + imazamox (RM) 75 g/ha PoE; sodium-acifluorfen + clodinafop-propargyl (RM) 185 g/ha PoE applied at 20 DAS; pendimethalin 1000 g/ha PE followed by (*fb*) imazethapyr 50 g/ha PoE at 20 DAS, hand weeding twice at 20 and 40 days after seeding (DAS) and unweeded check. The gross plots size was 4.8 m × 4.0 m and the crop was sown at spacing of 30 cm × 10 cm. The greengram variety 'LGG-607' was used. The required quantities of pre-and post-emergence herbicides were applied at one and 20 DAS, respectively using spray fluid 500 l/ha with the help of knapsack sprayer fitted with flat fan nozzle. The data on weed density, weed biomass, greengram yield components and seed yield were recorded as per the standard methods. The greengram phytotoxicity was assessed using a scale of 1 to 10 where 0 indicates no crop injury and 10 indicate complete crop destruction.

The diversified weed flora associated with *Rabi* greengram in clay soils were *Echinochloa colona*, *Leptochloa chinensis* and *Dinebra retroflexa* among the grasses, *Chrozophora rotleri*, *Phyllanthus maderaspatensis*, *Cardiospermum helicacabum*, *Trianthema portulacastrum*, *Euphorbia geniculata*, *Commelina benghalensis*, *Digera arvensis*, *Cleome viscosa*, *Amaranthus viridis*, *Portulaca oleracea* and *Phyllanthus niruri* among the broad-leaved weeds; and *Cyperus rotundus* and *Cyperus iria* among the sedges. All the weed management treatments significantly influenced weed density and weed biomass. Among the weed management treatments tested, significantly lower density and biomass of grasses, sedges, broad-leaved weeds and total weeds as well as higher weed control efficiency were obtained with hand weeding twice at 20 and 40 DAS,

which were at par with fomesafen + fluazifop-p-butyl 222 g/ha PoE and sodium-acifluorfen + clodinafop-propargyl 185 g/ha PoE applied at 20 DAS (**Table 1**). This might be due to better control of all categories of weeds including *Chrozophora rotleri*, *Phyllanthus maderaspatensis* and *Cardiospermum helicacabum* because of dual mode of action of herbicide mixtures (Tej Pratap *et al.* 2024). Imazethapyr 50 g/ha + clethodim 125 g/ha PoE was the next best treatment which was at par with imazethapyr 50 g/ha + haloxyfop-R-butyl 125 g/ha PoE. The tested herbicide mixtures registered significantly lesser weed density and biomass than pre-emergence herbicides.

The higher weed control efficiency (WCE) was observed with fomesafen + fluazifop-p-butyl 222 g/ha PoE followed by sodium-acifluorfen + clodinafop-propargyl 185 g/ha PoE and pendimethalin 1000 g/ha PE *fb* imazethapyr 1000+50 g/ha PoE. The weed control efficiency with hand weeding twice was lower than above herbicide treatments. Pre-emergence herbicides registered lower weed control efficiency than all PoE herbicides.

Different pre-and post-emergence herbicides significantly influenced the greengram yield components and seed yield (**Table 2**). The highest values of greengram yield components, seed yield, haulm yield and harvest index were recorded with hand weeding twice at 20 and 40 DAS which was comparable with fomesafen + fluazifop-p-butyl 222 g/ha PoE and sodium-acifluorfen + clodinafop-propargyl 185 g/ha PoE. This might be due to broad-spectrum of weed control during critical period of crop growth which enhanced the better translocation of photosynthates from source to pods and then to seeds. The seed yield of greengram was increased by 63.08, 60.35, 58.72% with hand weeding twice at 20 and 40 DAS, fomesafen + fluazifop-p-butyl 222 g/ha PoE and sodium-acifluorfen + clodinafop-propargyl 185g/ha PoE, respectively compared to unweeded check. These results are in agreement with results of Maji *et al.* (2025). All the PoE herbicides out yielded higher yield components and yield compared to PE herbicides applied in greengram. The lowest values of yield components and seed yield of greengram were obtained with unweeded check, which was significantly lesser than rest of the weed management practices. All the post-emergence herbicides did not show any phytotoxicity on greengram. Among all the PE herbicides, diclosulam 20 g/ha and pyroxasulfone 125 g/ha usage resulted in phytotoxicity rating of '2' (discoloration and stunting) '1' (slight injury) in 0-10 scale in greengram. However, greengram crop plants were recovered from phytotoxicity within 15 days after their application.

Table 1. Weed density, weed biomass and weed control efficiency (WCE) as influenced by pre-and post-emergence herbicides in *Rabi* greengram

Treatment	Weed density (no./m ²) at harvest				Weed biomass (g/m ²) at harvest				WCE (%)
	Grasses	Sedges	BLWs	Total	Grasses	Sedges	BLWs	Total	
Pyroxasulfone 125 g/ha PE	6.0(35.3)	3.4(11.0)	5.6(30.7)	8.8(77.0)	3.7(13.1)	2.9(8.0)	4.9(24.0)	6.7(45.1)	45.20
Diclosulam 20 g/ha PE	6.6(43.0)	1.0(0.7)	5.8(33.3)	10.0(104.3)	4.0(15.9)	1.0(0.4)	5.2(26.3)	6.6(42.7)	48.18
Metolachlor 1200 g/ha PE	7.3(55.7)	4.1(16.3)	7.5(55.5)	11.2(127.7)	4.6(20.6)	3.5(11.9)	6.3(38.7)	8.5(71.2)	13.57
Pendimethalin 1000 g/ha PE	6.7(45.3)	3.6(12.7)	6.8(46.0)	10.2(104.0)	3.7(13.4)	3.1(9.2)	6.1(36.3)	7.7(59.0)	28.40
Imazethapyr 50 g/ha + clethodim 125 g/ha (TM) PoE	4.1(16.3)	2.7(6.7)	4.1(16.0)	6.3(39.0)	2.5(6.0)	2.3(4.8)	3.6(12.4)	4.9(23.2)	71.81
Imazethapyr 50 g/ha + haloxyfop-R-methyl 105 g/ha (TM) PoE	4.7(21.7)	2.8(7.7)	4.3(18.0)	6.9(47.0)	2.9(8.0)	2.4(5.4)	3.8(14.2)	5.3(27.7)	66.40
Fomesafen + fluazifop-p-butyl 222 g/ha (RM) PoE	3.3(10.3)	2.1(4.0)	3.4(11.0)	5.1(26.0)	2.1(3.8)	1.8(2.9)	3.0(8.7)	4.0(15.4)	81.30
Imazethapyr + imazamox 75 g/ha (RM) PoE	5.5(30.3)	3.1(9.0)	4.8(22.7)	7.9(61.7)	3.4(11.0)	2.6(6.6)	4.3(17.8)	6.0(35.5)	56.86
Sodium-acifluorfen + clodinafop-propargyl 185 g/ha (RM) PoE	3.5(12.0)	1.9(3.0)	3.5(11.7)	5.2(26.7)	2.2(4.4)	1.6(2.2)	3.1(9.2)	4.0(15.5)	80.82
Pendimethalin 1000 g/ha PE <i>fb</i> imazethapyr 50 g/ha PoE	3.9(15.0)	2.2(4.3)	3.7(13.0)	5.7(32.3)	2.4(5.5)	1.2(0.9)	3.3(10.3)	4.1(16.8)	79.65
Hand weeding twice at 20 and 40 DAS	3.2(10.0)	1.2(1.0)	2.9(8.0)	4.4(19.0)	2.0(3.7)	1.1(0.7)	4.5(20.3)	5.0(24.7)	70.00
Unweeded check	8.4(69.7)	4.0(15.3)	7.1(50.7)	11.6(134.0)	5.1(25.7)	3.6(12.6)	6.7(43.9)	9.1(82.3)	-
LSD (p=0.05)	1.21	0.45	0.59	1.63	0.56	0.38	0.39	0.50	

Data given in parenthesis are original values and subjected to square root transformation. WCE: weed control efficiency; TM: tank-mix; RM: ready-mix; BLWs=Broad-leaved weeds; PE=pre-emergence application; PoE=post-emergence application *fb*=followed by; DAS=days after sowing

Table 2. Greengram yield components and yield as influenced by pre-and post-emergence herbicides

Treatment	No of pods/plant	No of seeds/plant	Pod length (cm)	No of seeds/plant	100 seed weight (g)	Seed yield (kg/ha)	Haulm yield (kg/ha)	Harvest index (%)	Weed index (%)	Benefit-cost ratio
Pyroxasulfone 125 g/ha PE	7.76	9.01	7.01	69.91	3.83	764	1222	38.47	33.80	1.95
Diclosulam 20 g/ha PE	8.11	9.12	7.14	73.80	3.98	785	1256	38.46	31.98	2.15
Metolachlor 1200 g/ha PE	7.62	8.64	6.62	65.83	3.61	712	995	38.47	38.30	1.67
Pendimethalin 1000 g/ha PE	7.67	8.87	6.85	67.85	3.74	710	1136	38.46	38.47	1.95
Imazethapyr 50 g/ha + clethodim 125 g/ha (TM) PoE	9.44	9.33	7.86	88.07	4.18	885	1368	39.28	23.31	2.26
Imazethapyr 50 g/ha + haloxyfop-R-methyl 105 g/ha (TM) PoE	8.77	9.28	7.54	81.38	4.1	810	1296	38.46	29.81	2.07
Fomesafen + fluazifop-p-butyl 222 g/ha (RM) PoE	11.10	9.86	8.23	109.4	4.84	1074	1675	39.07	6.93	2.90
Imazethapyr + imazamox 75 g/ha (RM) PoE	8.40	9.14	7.25	81.06	4.01	801	1282	38.45	30.59	2.12
Sodium-acifluorfen + clodinafop-propargyl 185 g/ha (RM) PoE	10.14	9.65	8.14	97.85	4.46	1032	1651	38.46	10.57	2.81
Pendimethalin 1000 g/ha PE <i>fb</i> imazethapyr 50 g/ha PoE	9.63	9.4	8.05	90.52	4.22	954	1526	38.47	17.33	2.51
Hand weeding twice at 20 and 40 DAS	11.93	10.46	8.54	124.7	4.92	1154	1710	40.29	-	2.29
Unweeded check	5.15	7.14	5.02	36.77	3.17	426	805	34.64	63.08	1.25
LSD (p=0.05)	1.72	1.61	0.98	11.23	0.98	143	284	0.46	-	0.53

TM: tank-mix RM; ready-mix; PE = pre-emergence application; PoE = post-emergence application *fb* = followed by; DAS= days after sowing

The percent reduction in seed yield due to weed infestation was higher with unweeded check. Among the weed management treatments tested, the highest benefit-cost ratio was observed with fomesafen + fluazifop-p-butyl 222 g/ha PoE which was statistically at par with sodium-acifluorfen + clodinafop-propargyl 185 g/ha PoE due to increased economic yield and low cost associated with these treatments. Benefit-cost ratio obtained with hand weeding twice at 20 and 40 DAS was lesser than above two best weed management practices due to increased cost of weeding.

It was concluded that in *Rabi* greengram on clay soils, fomesafen + fluazifop-p-butyl 222 g/ha PoE and sodium-acifluorfen + clodinafop-propargyl 118 g/ha PoE applied at 20 DAS effectively and economically managed broad-spectrum of weeds and recorded higher greengram seed yield and benefit-cost ratio.

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