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RESEARCH NOTE

Weed management in blackgram with pre- and post-emergence herbicides

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ABSTRACT

A field experiment was conducted during *Kharif* (rainy season) 2019 to study the weed management efficacy of pre-emergence application (PE) of diclosulam, pendimethalin + imazethapyr and pendimethalin at 20, 1000 and 1000 g/ha, respectively and post-emergence application (PoE) of propaquizafop + imazethapyr, sodium acifluorfen + clodinafop propargyl and imazethapyr at 127, 180 and 75 g/ha, respectively and compared with hand weeding (HW) twice and unweeded check. The diclosulam 20 g/ha PE followed by (*fb*) HW resulted in reduced weed density and biomass and recorded higher weed control efficiency at 30 and 60 days after seeding (DAS). The next best treatment in suppressing weed growth was pendimethalin + imazethapyr 1000 g/ha PE *fb* HW. Among the post-emergence herbicides, propaquizafop + imazethapyr 127 g/ha was superior in reducing weed density and biomass. Diclosulam 20 g/ha PE and imazethapyr 75 g/ha PoE showed phytotoxicity rating of '2' and '1', respectively. Initially, blackgram population was reduced by 15.83% due to diclosulam phytotoxicity. Pendimethalin + imazethapyr 1000 g/ha PE *fb* HW resulted in higher plant height, dry matter production, yield components and seed yield of blackgram and it was comparable with HW twice and diclosulam 20 g/ha PE *fb* HW. The highest benefit-cost ratio was obtained with pendimethalin + imazethapyr 1000 g/ha PE.

Keywords: Blackgram, Crop productivity, Diclosulam, Economics, Pendimethalin + imazethapyr, Weed management

Blackgram (*Vigna mungo* L.) is a major pulse crop grown in Andhra Pradesh during *Kharif* (rainy) and *Rabi* (winter) seasons. It is valued for high protein in its seeds. Abiotic and biotic factors including severe competition offered by weeds are the major bottlenecks in obtaining higher seed yield of blackgram. Blackgram is usually associated with heavy weed infestation of mixed weed flora during rainy season because of continuous and high rainfall recorded during crop growth period. Further, weed problem is aggravated due to blackgram varieties slow initial growth, compact and early maturing habit. The most sensitive period for competition offered by weeds in blackgram was 15 to 45 DAS (Rana *et al.* 2008). Weed infestation in blackgram reduce the seed yield up to an extent of 45-60% (Upasani *et al.* 2017). The traditional methods of weed control like hand weeding and intercultivation are expensive due to increased cost of labour and tedious. Further, continuous rains during initial stages hinder the intercultivation or hand weeding. Pre-emergence application (PE) of pendimethalin 1000 g/ha has been recommended to control weeds in blackgram, but it is not effective to control purple nutsedge and some of the broad-leaved weeds (BLWs) like *Tricodesma indicum* and *Commelina benghalensis* (Naveen *et al.* 2019). Thus, there is a need to have an alternate herbicide for pendimethalin to obtain broad-spectrum weed control in blackgram. Diclosulam at 22 and 26 g/ha PE was found effective against grassy and broad-leaved weeds in soybean on sandy loam soils (Singh *et al.* 2009). Post-emergence application (PoE) of imazethapyr 75 g/ha was found effective in controlling late emerging weeds, but is limited by the choice of succeeding crops (Singh *et al*. 2018). In recent years, pre-mix post-emergence herbicides like propaquizafop + imazethapyr are available for control of weeds in pulses. Thus, this study was undertaken to identify the suitable pre-and post-emergence herbicide mixtures for broad-spectrum weed control and higher seed yield of *Kharif* blackgram.

A field experiment was conducted at S. V. Agricultural College, Tirupati campus of Acharya N. G. Ranga Agricultural University, Andhra Pradesh during *Kharif*, 2019. The soil of the experimental field was sandy loam with soil pH of 7.46 and EC of 0.68 dS/m. The experimental soil was low, medium and

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high in available nitrogen, phosphorous and potassium, respectively. The experiment was laid out in a randomized block design comprising of ten weed management treatments and replicated thrice. The treatments consisted of diclosulam 20 g/ha PE, pendimethalin + imazethapyr (ready-mix) 1000 g/ha PE and pendimethalin 1000 g/ha PE either alone or followed by (*fb*) hand weeding (HW) at 30 days after seeding (DAS). Other treatments include: propaquizafop + imazethapyr (ready-mix) 127 g/ha PoE, sodium acifluorfen + clodinafop propargyl (ready-mix) 180 g/ha PoE and imazethapyr 75 g/ha PoE; HW twice and unweeded check **(Table 1)**. Pre- and post-emergence herbicides were applied at 1 and 15 DAS, respectively with the help of knapsack sprayer fitted with flat fan nozzle at spray volume of 500 L/ha. The blackgram variety "*TBG-104*" was sown at 30 x 10 cm spacing. A uniform dose of 20 kg N/ha in the form of urea and 50 kg P/ha through single super phosphate was supplied. The entire dose of nitrogen and phosphorous was applied at the time of sowing. The data on weeds were at 30 and 60 DAS and subjected to square root transformation. Weed control efficiency was worked out and expressed as per cent reduction in total weed biomass. The data on black gram growth and yield attributes were recorded at crop maturity by adopting standard procedure. Phytotoxicity rating on blackgram due to pre-and post-emergence herbicides was assessed at 10 and 5 days after herbicide application, respectively as per the scale suggested by Singh and Rao (1976). Benefit-cost ratio was worked out by using current market price of inputs and economic yield of blackgram. All the data recorded on weeds and crop were analysed statistically as per the method suggested by Gomez and Gomez (1984).

Effect on weeds: The major weed flora associated with winter blackgram in the experiment field were *Digitaria sanguinalis*, *Cyperus rotundus*, *Euphorbia thymifolia*, *Boerhavia erecta*, *Borreria hispida*, *Cynodon dactylon*, *Commelina benghalensis* and *Cleome viscosa.* All the weed management practices significantly influenced the total weed density and biomass at 30 and 60 DAS. Diclosulam 20 g/ha PE *fb* HW at 30 DAS proved to be the most effective weed management treatment in suppressing weed density and biomass as well as higher weed control efficiency (WCE) and weed index (WI) compared to rest of the weed management practices **(Table 1)**. Pendimethalin + imazethapyr 1000 g/ha PE *fb* HW at 30 DAS was the next best weed management treatment in suppressing total weed density and biomass and reordering next higher WCE and WI. Diclosulam inhibit acetolactate synthase enzyme, a key enzyme responsible for biosynthesis of branched chain amino acids and lead to reduce the protein synthesis in susceptible weed species (Nainwal *et al.* 2013). Pendimethalin + imazethapyr 1000 g/ha (pre-mix) proved to be effective against mixed weed flora in black gram However, it was inferior than diclosulam 20 g/ha. All the pre-emergence herbicides were found effective in controlling weeds than post-emergence herbicides. Post-emergence application of imazethapyr 75 g/ha resulted in higher weed density and biomass and minimum WCE, among the herbicidal treatments.

Effect on crop: Pre-emergence application of diclosulam 20 g/ha and post-emergence application of imazethapyr 75 g/ha resulted in phytotoxicity rating of '2' and '1' in 0-10 scale, respectively on blackgram at 10 and 5 days after herbicide application. The crop was recovered from its

Table 1. Weed density and biomass, weed control efficiency (WCE) and weed index as influenced by different weed management treatments in Black gram at 30 and 60 days after seeding (DAS)

Treatment	Total weed density* (no./m)		Total weed biomass (g/m)		Weed control efficiency (%)		Weed index
	30 DAS	60 DAS	30 DAS	60 DAS	30 DAS	60 DAS	
Diclosulam 20 g/ha 1 DAS	16.8(4.21)	48.7(7.04)	4.45(2.32)	22.2(4.80)	83.90	65.24	20.4
Pendimethalin + imazethapyr 1000 g/ha 1 DAS	23.1(4.90)	52.0(7.27)	6.94(2.84)	29.5(5.51)	72.72	53.83	10.3
Diclosulam *fb* HW 20 g/ha1 *fb**30 DAS	16.8(4.21)	33.8(5.89)	3.79(2.18)	15.3(4.02)	86.29	75.99	08.3
Pendimethalin + imazethapyr *fb* HW 1000 g/ha 1 *fb* 30 DAS	23.0(4.90)	38.0(6.23)	6.78(2.78)	17.2(4.25)	75.47	73.00	-
Propaquizafop + imazethapyr 127 g/ha 15 DAS	28.1(5.38)	58.7(7.71)	11.08(3.47)	31.3(5.67)	59.91	50.95	22.4
Sodium-acifluorfen + clodinafop-propargyl 180 g/ha 15 DAS	44.1(6.70)	81.7(9.08)	16.85(4.21)	44.9(6.77)	39.04	29.57	26.4
Pendimethalin 1000 g/ha 1 DAS	38.0(6.24)	83.3(9.17)	14.06(3.87)	44.1(6.70)	49.13	30.90	21.1
Imazethapyr 75 g/ha 15 DAS	52.5(7.31)	105.6(10.32)	17.33(4.35)	53.8(7.39)	39.47	15.72	27.0
HW twice 15 *fb* 30 DAS	17.7(4.32)	42.0(6.55)	3.69(2.16)	17.3(4.26)	86.65	72.90	01.0
Unweeded check (control)	61.2(7.88)	119.7(10.97)	27.64(5.34)	63.8(8.04)	-	-	58.4
LSD (p=0.05)	0.09	0.15	0.16	0.07			-

* The figures in parentheses are transformed values; *fb*: followed by; HW: hand weeding

Table 2. Growth and yield components and yield of blackgram as influenced by different weed management practices

Treatment	Phytotoxicity rating	Initial plant population (no/m^2)	Plant height (cm)	Dry matter production (kg/ha)	No. of pods/ plant	No. of seeds/ pod	Test weight (g)	Seed yield (t/ha)	Haulm yield (t/ha)	B:C ratio
Diclosulam 20 g/ha 1 DAS	2	27.59	15.49	1758	16.3	5.1	38.8	0.63	1.01	1.78
Pendimethalin + imazethapyr 1000 g/ha 1 DAS	0	32.40	18.16	1943	17.2	5.3	41.1	0.72	1.14	1.88
Diclosulam *fb* HW 20 g/ha1 *fb**30 DAS	2	28.02	16.70	2097	16.7	5.7	41.3	0.73	1.23	1.79
Pendimethalin + imazethapyr *fb* HW 1000 g/ha 1 *fb* 30 DAS	0	32.53	18.73	2110	17.4	6.3	41.6	0.80	1.25	1.84
Propaquizafop + imazethapyr 127 g/ha 15 DAS	0	32.49	15.66	1731	15.8	5.0	38.0	0.62	1.00	1.75
Sodium-acifluorfen + clodinafop-propargyl 180 g/ha 15 DAS	0	32.03	15.59	1685	15.5	4.9	37.9	0.59	0.99	1.69
Pendimethalin 1000 g/ha 1 DAS	0	32.22	18.09	1769	16.1	5.1	38.2	0.63	1.03	1.72
Imazethapyr 75 g/ha 15 DAS	1	32.62	15.44	1670	15.4	4.6	36.8	0.58	0.98	1.62
HW twice 15 *fb* 30 DAS	0	32.59	18.45	2101	17.3	6.1	41.3	0.79	1.25	1.58
Unweeded check (control)	0	32.79	15.34	1197	12.7	3.9	34.3	0.33	0.79	1.02
LSD (p=0.05)		1.27	1.27	76	0.94	0.58	1.55	0.08	0.02	0.04

The figures in parentheses are original values

phytotoxicity by 30 days after application of diclosulam. Due to its phytotoxicity, the crop was stunted and reduced the initial plant population by 15.18% compared to unweeded check. This might be due to increased concentration of diclosulam as a result of its better leaching potential and low absorption coefficient. Naveen *et al.* (2019) also reported that diclosulam 20 g/ha showed phytotoxicity rating of '1' in 0-10 scale in groundnut on sandy loam soils. It clearly indicate the size of the crop seed and depth of seeding also play an important role in deciding herbicide selectivity.

Pendimethalin + imazethapyr 1000 g/ha *fb* HW recorded significantly higher plant height, dry matter production, higher number of pods/plant, seeds/pod, test weight, seed and haulm yield of blackgram **(Table 2)** and it was comparable with HW twice at 15 and 30 DAS. This might be due to broad-spectrum weed control because of dual mode of action of ready-mix herbicide, pendimethalin + imazethapyr which resulted in better growth and development. The reduction in yield (%) due to weeds was minimum with HW twice followed by diclosulam 20 g/ha PE *fb* HW at 30 DAS. The reduction in seed and haulm yield in blackgram was 58.4 and 37.1 per cent, respectively. Mishra *et al.* (2017) and Mansoori *et al.* (2015) also reported similar results.

It was concluded that pendimethalin + imazethapyr 1000 g/ha (pre-mix) PE *fb* HW at 30 DAS resulted in higher seed yield and benefit-cost ratio, besides broad-spectrum weed control in rainy season shown blackgram and comparable with HW twice at 15 and 30 DAS with respect to seed yield. However, due to higher cost involved, HW twice at 15 and 30 DAS resulted in lesser benefit-cost ratio than former weed management treatment.

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