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RESEARCH NOTE

Evaluation of herbicides for economical weed management with increased productivity of blackgram

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ABSTRACT

Field experiment was conducted during *Rabi* 2022-23 at Wetland farm of S.V. Agricultural College, Tirupati, Andhra Pradesh, India in a randomized block design. The objective was to evaluate and identify effective and economic herbicide treatment to manage weeds and improve productivity of blackgram (*Vigna mungo* L.). Nine weed management treatments were evaluated in RBD with three replications. Among the tested weed management treatments, lower weed density and biomass with higher weed control efficiency was recorded with pre-emergence application (PE) of diclosulam 20 g/ha followed by (*fb*)1 hand weeding (HW) at 15 days after seeding (DAS), and it was on par with HW twice at 15 and 30 DAS and the later was on par with post-emergence application (PoE) of fluazifop-p-butyl + fomesafen 222 g/ha and sodium-acifluorfen + clodinafop-propargyl 245 g/ha PoE. Significantly higher values growth parameters, yield attributes and yield of blackgram were recorded with HW twice at 15 and 30 DAS, which was however, on par with fluazifop-p-butyl + fomesafen 222 g/ha as PoE at 20 DAS and sodium-acifluorfen + clodinafop-propargyl 245 g/ha PoE at 20 DAS, while the later two treatments resulted in higher net returns and benefit-cost ratio. It was concluded that fluazifop-p-butyl + fomesafen 222 g/ha PoE or sodium-acifluorfen + clodinafop-propargyl 245 g/ha PoE at 20 DAS provide the most effective and economical weed management in blackgram.

Keywords: Blackgram, Economics, fluazifop-p-butyl + fomesafen, Herbicides, Sodium-acifluorfen + clodinafop-propargyl, Weed management

India is the world's largest producer and consumer of blackgram by contributing about 70% of the world's production. Blackgram accounts for 19% of area and 23% of production of pulse crops in India. India produces approximately 24.5 lakh tonnes of blackgram per year from 4.6 million hectares of land with an average productivity of 533 kg per hectare in 2021-22 (www.agricoop.nic.in).

Weed management is an important component of blackgram cultivation to ensure optimal crop growth and yield. The critical period of crop weed competition in blackgram is 20-40 DAS (Sivakumar *et al.* 2019). Adequate control of weeds cannot be achieved by using any one method or single herbicide. Further continuous usage of the same herbicide may lead to a shift in weed composition, favouring the growth of the weeds that are less susceptible to the herbicide being used. This may also lead to an increase in the diversity of weed species in the field making weed control more challenging. Under such circumstances, pre- and post- emergence herbicides applied in sequence or in combination will control the weeds very effectively. Ready-mix herbicides are formulated to target specific weed species for broad-spectrum weed control (Yadav *et al.* 2015; Mudalagiriyappa *et al.* 2022). They contain effective active ingredients and appropriate adjuvants that optimize weed control efficacy resulting in improved crop growth, yield and quality. Thus, the present study was undertaken to assess the effectiveness of different weed management treatments for broad-spectrum weed control and for higher productivity in blackgram.

A field experiment was conducted during *Rabi* season of 2022-23 at Wetland farm, S.V. Agricultural College, Tirupati, located at 13.5°N latitude and 79.5°E longitude with an altitude of 182.9 m above mean sea level in the Southern Agro-Climatic Zone of Andhra Pradesh, India. The soil was sandy loam in texture, neutral in soil reaction, low in organic carbon (0.26) and available nitrogen (172 kg/ha) and medium in available phosphorus (29 kg/ha) and potassium (193 kg/ha). The total rainfall received during the

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crop growth period was 211.6 mm in 12 rainy days. The experiment was laid out in a randomized block design with nine weed management treatments replicated thrice. Treatments include: pre-emergence application (PE) of diclosulam 20 g/ha followed by (*fb*) 1 hand weeding (HW) at 15 days after seeding (DAS); post-emergence application (PoE) of imazethapyr 50 g/ha at 20 DAS; quizalofop-p-ethyl + imazethapyr 98 g/ha PoE at 20 DAS; imazethapyr + imazamox 70 g/ha PoE at 20 DAS; propaquizafop + imazethapyr 125 g/ha PoE at 20 DAS; sodium-acifluorfen 16.5% EC + clodinafop propargyl 8% EC (sodium-acifluorfen + clodinafop-propargyl) 245 g/ha PoE at 20 DAS; fluazifop-p-butyl 11.1% SL + fomesafen11.1% SL (fluazifop-p-butyl + fomesafen) 222 g/ha PoE at 20 DAS, HW twice at 15 and 30 DAS and weedy check. Blackgram variety*'TBG-104'* was sown on 16.11.2024 and raised with recommended package of practices except for the weed management. Blackgram was harvested on 04.02.2023. The crop was fertilized with 20 kg N, 40 kg P and 20 kg K/ha. Entire dose of nitrogen was applied in the form of urea, phosphorus as single super phosphate and potassium as muriate of potash basally at the time of sowing. The weed population was counted with the help of 0.5m^2 quadrat placed randomly at two places in each plot and expressed as density (no./m^2). Different weed species collected for assessing the density of weeds were dried separately in a hot air oven at 65ºC till constant dry weight was reached and expressed as weed biomass (g/m^2). Due to large variations in values of weed density and biomass, the corresponding data was subjected to square root transformation $\sqrt{x+0.5}$ and the corresponding transformed values were used for statistical analysis as suggested by Gomez and Gomez (1984). Five randomly selected plants were tagged ineach treatment and from each replication in the net plot area and used for making observations on growth parameters and yield attributes at harvest of blackgram. The seed and haulm yield of blackgram were recorded based on the yield obtained from the net plot. Net returns were calculated by subtracting the cost of cultivation from the gross returns. Benefit-cost ratio was calculated after dividing gross returns with cost of cultivation.

Effect on weeds

Weed flora associated with blackgram belonged to thirteen taxonomic families, of which the predominant weed species noticed in the experimental field were: *Dactyloctenium aegyptium* and *Digitaria sanguinalis,* among grasses, *Cyperus rotundus* a sedge, *Boerhavia erecta, Commelina benghalensis* and *Euphorbia hirta,* among the broad-leaved weeds.

Weed management treatments tested in blackgram significantly influenced weed density and biomass and weed control efficiency (WCE) at the harvest of blackgram (**Table 1**). Among the different weed management treatments, lower density and biomass of grasses, sedges, broad-leaved weeds as well as total weeds and higher WCE were recorded

Table 1. Weed density and biomass at harvest of blackgram as influenced by different weed management treatments

Treatment	Weed density (no./m^2)*				Weed biomass (g/m^2)*				WCE (%)
	Grasses	Sedges	BLW	Total	Grasses	Sedges	BLW	Total	
Diclosulam 20 g/ha *fb* 1 HW at 15 DAS	6.57 (42.67)	6.48 (41.67)	6.28 (39.00)	11.13 (123.34)	4.14 (16.60)	4.16 (16.77)	3.98 (15.43)	7.02 (48.80)	70.36
Imazethapyr 50 g/ha PoE at 20 DAS	9.04 (81.33)	7.06 (49.67)	8.14 (66.00)	14.03 (197.00)	5.57 (30.67)	4.50 (19.87)	5.76 (32.73)	9.15 (83.27)	53.02
Quizalofop-p-ethyl + imazethapyr 98 g/ha PoE at 20 DAS	7.97 (63.00)	7.92 (62.67)	8.07 (64.67)	13.80 (190.34)	5.43 (28.97)	5.14 (25.97)	5.60 (31.00)	9.30 (85.94)	52.19
Imazethapyr + imazamox 70 g/ha PoE at 20 DAS	9.40 (88.00)	6.72 (44.67)	8.32 (69.00)	14.22 (201.67)	5.71 (32.47)	4.28 (17.90)	5.87 (34.00)	9.21 (84.37)	44.29
Propaquizafop + imazethapyr 125 g/ha PoE at 20 DAS	7.87 (61.67)	7.80 (60.33)	7.80 (60.33)	13.52 (182.33)	5.16 (26.17)	4.99 (24.47)	5.51 (30.00)	9.01 (80.64)	51.73
Sodium-acifluorfen + clodinafop-propargyl 245 g/ha PoE at 20 DAS	6.89 (47.00)	8.03 (64.00)	6.67 (44.00)	12.46 (155.00)	4.64 (21.20)	5.16 (26.17)	4.41 (19.00)	8.18 (66.37)	60.09
Fluazifop-p-butyl + fomesafen 222 g/ha PoE at 20 DAS	6.45 (41.33)	8.21 (67.00)	6.44 (41.00)	12.24 (149.33)	4.51 (20.13)	5.24 (27.00)	4.12 (16.47)	8.03 (64.00)	64.64
Hand Weeding twice at 15 and 30 DAS	6.66 (44.00)	6.84 (46.33)	6.71 (44.67)	11.63 (135.00)	4.55 (20.47)	4.37 (18.63)	4.39 (18.80)	7.63 (57.9)	65.01
Weedy check (control)	10.66 (113.67)	10.54 (110.67)	10.41 (108.33)	18.24 (332.67)	7.17 (50.77)	7.26 (52.23)	7.68 (58.57)	12.73 (161.57)	-
LSD (p=0.05)	0.82	0.72	0.88	0.88	0.50	0.44	0.43	0.63	

*Data in parentheses are original values, which were transformed to $\sqrt{x+0.5}$ and analyzed statistically; WCE: Weed control efficiency; DAS: Days after sowing, PE = pre-emergence application; PoE = post-emergence application; *fb* = followed by BLW = broad-leaved weeds

with diclosulam 20 g/ha PE *fb* 1 HW at 15 DAS, and it was on par with HW twice at 15 and 30 DAS and the later was in turn on par with fluazifop-p-butyl + fomesafen 222 g/ha PoE and sodium-acifluorfen + clodinafop-propargyl 245 g/ha PoE. This might be due to the dual mode of action of applied herbicides, which controls all types of weeds effectively during the critical period of crop weed competition as observed by Tamang *et al*. (2015) and Choudhary *et al*. (2012), Dhayal *et al*.(2022).

Phytotoxicity

Observations on phytotoxicity of pre- and post-emergence herbicides on blackgram were recorded at 10th and 15th day after herbicide application (DAH). All the applied herbicides did not show any phytotoxicity except with pre-emergence application of diclosulam 20 g/ha. It resulted in phytotoxicity rating of '1' indicating stunted growth, due to reduced intermodal length but no stand loss. This may be due to inhibition of ALS, a key enzyme responsible for biosynthesis of branched chain amino acids, which in turn reduced protein synthesis in meristematic tissues leading to stunted growth and discoloration of foliage. The crop plants started recovering from diclosulam phytotoxicity after 20 DAH and were completely recovered by 30 DAH. These results are in accordance with findings of Naveen *et al.* (2019) in groundnut and Jakhar and Sharma (2015) in soybean.

Effect on blackgram

Growth parameters of blackgram, *viz*. plant height, leaf area index and dry matter production and yield attributes, *viz*. number of filled pods/plant, number of seeds/pod and test weight and seed and haulm yield were significantly higher with HW twice at 15 and 30 DAS, which was at par with fluazifop-p-butyl + fomesafen 222 g/ha PoE and sodium-acifluorfen + clodinafop-propargyl 245 g/ha PoE (**Table 2**). This might be due to lower crop weed competition for growth resources throughout the crop growing period enabling the crop for maximum utilization of nutrients, moisture, light and space, which enhanced the vegetative and reproductive potential of the crop as reported by Yadav *et al*.(2015).

Economics

Higher gross returns were realized with HW twice at 15 and 30 DAS **(Table 2)**, which was at par with fluazifop-p-butyl + fomesafen 222 g/ha PoE and sodium-acifluorfen + clodinafop-propargyl 245 g/ha PoE, whereas highest net returns and benefit-cost ratio were recorded with fluazifop-p-butyl + fomesafen 222 g/ha PoE, which was at par with sodium-acifluorfen + clodinafop-propargyl 245g/ha PoE. The higher net returns and benefit cost ratio might be due to increased yield and reduced cost of cultivation as reported by Singh *et al*. (2014) and Aliveni *et al*. (2016).

Table 2. Growth, yield attributes, yield and economics of blackgram as influenced by different weed management treatments

Treatment	Plant height (cm)	Leaf area index	Dry matter production (t/ha)	No. of filled pods/ plant	No. of seeds/ pod	Test weight (g)	Seed Yield (kg/ha)	Haulm Yield (kg/ha)	Gross returns (₹/ha)	Net returns (₹/ha)	B:C ratio
Diclosulam 20 g/ha *fb* 1 HW at 15 DAS	23.1	0.97	920	9.1	4.0	37.7	527	1021	34872	8134	1.30
Imazethapyr 50 g/ha PoE at 20 DAS	26.1	1.00	959	9.2	4.1	38.5	575	1075	37950	15598	1.69
Quizalofop-p-ethyl + imazethapyr 98 g/ha PoE at 20 DAS	29.3	1.14	1240	11.6	5.9	38.6	836	1390	55154	31301	2.31
Imazethapyr + imazamox 70 g/ha PoE at 20 DAS	26.6	1.01	988	9.5	4.2	38.5	589	1132	38852	14960	1.63
Propaquizafop + imazethapyr 125 g/ha PoE at 20 DAS	30.1	1.16	1282	12.2	6.0	40.1	840	1410	55440	31158	2.28
Sodium-acifluorfen + clodinafop-propargyl 245 g/ha PoE at 20 DAS	34.0	1.30	1422	16.00	6.0	40.9	910	1410	60038	36306	2.52
Fluazifop-p-butyl + fomesafen 222 g/ha PoE at 20 DAS	35.1	1.33	1431	16.5	6.2	41.4	957	1490	63184	39722	2.69
Hand Weeding twice at 15 and 30 DAS	36.1	1.39	1446	17.6	6.5	41.8	971	1501	64064	34582	2.17
Weedy check (control)	20.4	0.83	810	7.0	3.0	36.1	343	798	22638	1156	1.05
LSD (p=0.05)	2.4	0.12	107	1.9	0.7	1.4	67	216	4402	4404	0.1

*DAS: Days after sowing; PE = pre-emergence application; PoE = post-emergence application; *fb* = followed by.

In conclusion, fluazifop-p-butyl + fomesafen 222 g/ha PoE or sodium-acifluorfen + clodinafop-propargyl 245 g/ha PoE were found to be the most effective and economical weed management treatments to increase the productivity and the net returns in blackgram.

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