



International Journal of Research in Agronomy

E-ISSN: 2618-0618

P-ISSN: 2618-060X

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www.agronomyjournals.com

2024; 7(8): 832-836

Received: 11-06-2024

Accepted: 16-07-2024

Saketh Pallerla

M.Sc. Research Scholar,
Department of Agronomy,
Agricultural College, Polasa,
Jagtial, Telangana, India

G Satyanarayana Reddy

Assistant Professor, Department of
Agronomy, Agricultural College,
Polasa, Jagtial, Telangana, India

E Rajanikanth

Scientist (Agronomy), NARP,
RARS, Polasa, Jagtial, Telangana,
India

G Venu Gopal

Assistant Professor, Department of
Soil Science and Agricultural
Chemistry, Agricultural College,
Polasa, Jagtial, Telangana, India

Effect of weed management practices on weed dynamics and performance of black gram (*Vigna mungo* L.)

Saketh Pallerla, G Satyanarayana Reddy, E Rajanikanth and G Venu Gopal

DOI: <https://doi.org/10.33545/2618060X.2024.v7.i8k.1390>

Abstract

The field experiment was conducted at Agricultural College, Polasa, Jagtial, during *rabi* 2023-24 to study the effect of weed management practices on weed dynamics and performance of black gram. Total eight treatments with three replications were evaluated on blackgram. The results showed that, application of hand weeding treatment at 15 and 30 DAS drastically lowered total weed density and dry weight at 15 and 30 DAS, and recorded significantly higher crop growth parameters, yield attributes and yield when compared to the other treatments which was followed by the post emergence application of Fomesafen + Fluzifop-p-butyl 11.1% + 11.1% SL 220 g ha⁻¹ (pre-mix) at 20 DAS and Aciflurfen-sodium + Clodinafop-propargyl 16.5%+8% EC 245 g ha⁻¹ (pre-mix) at 20 DAS. Unweeded check treatment recorded the highest weed density, dry weight and significantly lowest crop growth parameters, yield attributes and yield.

Keywords: Weed density, weed dry weight, growth parameters, yield attributes

1. Introduction

Black gram [*Vigna mungo* L.] is one of the major grain legumes cultivated throughout the country. Because of its quick growth, short growth period, and ability to fix nitrogen, it works well in a variety of multiple and intercropping systems. It is extensively grown because of its excellent nutritional value, especially its high protein content and because it is used in traditional Indian cuisine. The main producing states are Telangana, Andhra Pradesh, Maharashtra, Madhya Pradesh, Tamil Nadu, and Uttar Pradesh. Tropical and subtropical areas are ideal for black gram growth. It is usually cultivated in the months of *Rabi* (winter) and *Kharif* (monsoon), and it needs a warm environment with moderate rainfall.

Black gram might suffer a 42-51% yield loss due to weed competition (Balyan *et al.*, 2016) [2]. Kumar *et al.*, 2018 [7], stated that weed management has become essential to maintain the production of this crop. Certain weed species or groups may be controlled with selective herbicides, while other weed species may not respond well to them. In this case, one set of weeds gets efficiently wiped off, while another group takes over and presents a serious threat to the crop. Chemical weed control is used by very few farmers when growing pulses like black gram. Pre-emergence herbicide pendimethalin is applied to suppress the first flush of weeds in most pulses, including black gram. This is insufficient on its own to manage the black gram's varied weed flora. Singh *et al.* (2014) [11] addressed about the necessity of post-emergence herbicide in order to lessen the demand for human labour and manage the second flush of weeds in pulses. In order to maintain the productivity of black gram, Kumar (2010) [6] emphasized the significance of discovering the broad-spectrum effective group of pre and post-emergence herbicides. In view of these considerations, an experiment was carried out to study the effectiveness of various weed management practices in black gram.

2. Materials and Methods

The field experiment was conducted at the College Farm, Agricultural College, Polasa, Jagtial (T.G), India, during *rabi* 2023-24 to investigate the effects of pre and post-emergence herbicide combinations on weed dynamics and performance of black gram.

Corresponding Author:

Saketh Pallerla

M.Sc. Research Scholar,
Department of Agronomy,
Agricultural College, Polasa,
Jagtial, Telangana, India

Eight weed management treatments consist of T₁-Pendimethalin 30% EC 1000 g ha⁻¹ Pre-emergence (PE) at 1 DAS, T₂-Imazethapyr + Imazamox 35%+35% WG (pre-mix) 80 g ha⁻¹ PE at 1 DAS, T₃-Fomesafen + Fluzifop-p-butyl 11.1%+11.1% SL (pre-mix) 220 g ha⁻¹ post-emergence (PoE) at 20 DAS, T₄-Aciflurfen-sodium+Clodinafop-propargyl 16.5%+8% EC (pre-mix) 245 g ha⁻¹ PoE at 20 DAS, T₅-Propaquizafop + Imazethapyr 2.5%+3.75 ME (pre-mix) 125 g ha⁻¹ PoE at 20 DAS, T₆-Haloxifop R-methyl 10.5 % EC 108 g ha⁻¹ PoE at 20 DAS, T₇-Hand weeding twice at 15 and 30 DAS, T₈-Unweeded check were assessed using a randomized block design with three replications. The well-drained sandy clay loam soil at the experimental location featured a texture of 65.86 % sand, 6.37% silt, and 27.70% clay and its chemical properties included a pH of 6.95, EC of 0.722 d. Sm⁻¹ has a bulk density of 1.52 g.cm⁻³ and a medium level of organic carbon content of 0.52%. Before crop sowing, the soil's nutritional status was low in nitrogen (250 kg ha⁻¹), high in phosphorus (35 kg ha⁻¹), and high in potassium (296 kg ha⁻¹). The mean maximum and lowest temperatures for the experimental period were 30.8°C and 17.13°C, respectively. The black gram variety MBG₁070, which harvests in 80-85 days, was seeded at a seed rate of 20-25 kg ha⁻¹ with a spacing of 30 × 10 cm. At the time of sowing, the soil was applied as 20:50:0 kilogram per hectare fertilizer treatment in the form of urea (kg ha⁻¹) and single super phosphate (kg ha⁻¹).

Weed management treatments were applied as per the treatment schedule. Herbicides were applied using a knapsack sprayer with

a flat fan nozzle and spray volume of 500 Litres of water per hectare. The crop was grown following package of practices of black gram. Weed density of grasses, sedges, and broad-leaved weeds were counted in randomly chosen locations in each plot using a 0.5 × 0.5 m quadrant (0.25 m²) at every 15 days interval up to the crop physiological maturity stage. For statistical analysis, the data on the total number of weeds and the dry matter of weeds were recorded, gathered, and then transformed using the square root method ($\sqrt{x+0.5}$) to standardize their distribution (Gomez and Gomez 1984) [3]. The removed weeds from the quadrats were dried for 24 hours at 65°C to record their constant weight, which was then reported in grams per square meter. The formula used to compute the weed control efficiency (WCE) was proposed by Patil and Patil (1983) [9]

$$WCE\% = \frac{WD_c - WD_t}{WD_c} \times 100$$

Where, WD_C = Dry weight of weeds in unweeded control plot (g)

WD_t = Dry weight of weeds in the treated plot (g)

The experimental design data were statistically analysed using Fisher's analysis of variance approach, and treatment means were compared using an F-test and the least significant difference test at a 5% probability level to determine CD values. On all of the gathered data, analysis of variance was carried out.

Table 1: Effect of weed management practices on crop growth parameters of black gram

T. No.	Treatment details	Plant height at harvest (cm)	Crop dry matter at harvest (g m ⁻²)	Total number of branches plant ⁻¹ at harvest
T ₁	Pendimethalin 30% EC 1000 g ha ⁻¹ PE at 1 DAS	16.13	173	31.22
T ₂	Imazethapyr + Imazamox 35%+35% WG (pre-mix) 80 g ha ⁻¹ PE at 1 DAS	15.33	169	28.60
T ₃	Fomesafen + Fluzifop-p-butyl 11.1%+11.1% SL (pre-mix) 220 g ha ⁻¹ PoE at 20 DAS	18.87	213	36.64
T ₄	Aciflurfen-sodium + Clodinafop-propargyl 16.5%+8% EC (pre-mix) 245 g ha ⁻¹ PoE at 20 DAS	17.70	207	33.05
T ₅	Propaquizafop + Imazethapyr 2.5%+3.75 ME (pre-mix) 125 g ha ⁻¹ PoE at 20 DAS	16.93	175	30.62
T ₆	Haloxifop R-methyl 10.5 % EC 108 g ha ⁻¹ PoE at 20 DAS	17.27	185	31.54
T ₇	Two hand weedings at 15 and 30 DAS	18.07	245	33.58
T ₈	Un-weeded (Check)	15.20	115	26.76
	CD (P=0.05)	1.90	20.7	2.6
	SEM±	0.60	6.7	0.8

Table 2: Yield attributes as influenced by different weed management practices of black gram

Tr. No.	Treatment details	Number of pods branch ⁻¹	Total no. of pods plant ⁻¹	Pod Weight (g) plant ⁻¹	No. of seed pod ⁻¹	100-seed weight (g)
T ₁	Pendimethalin 30% EC 1000 g ha ⁻¹ PE at 1 DAS	4.9	14.93	3.16	6.37	3.65
T ₂	Imazethapyr + Imazamox 35% + 35% WG (pre-mix) 80 g ha ⁻¹ PE at 1 DAS	4.73	13.53	3.01	6.28	3.54
T ₃	Fomesafen + Fluzifop-p-butyl 11.1% + 11.1% SL (pre-mix) 220 g ha ⁻¹ PoE at 20 DAS	5.89	18.13	3.82	6.34	3.85
T ₄	Aciflurfen-sodium + Clodinafop-propargyl 16.5%+8% EC (pre-mix) 245 g ha ⁻¹ PoE at 20 DAS	5.61	16.47	3.86	6.47	3.72
T ₅	Propaquizafop + Imazethapyr 2.5%+3.75 ME (pre-mix) 125 g ha ⁻¹ PoE at 20 DAS	5.29	15.40	3.34	6.40	3.78
T ₆	Haloxifop R-methyl 10.5 % EC 108 g ha ⁻¹ PoE at 20 DAS	5.45	15.93	3.65	6.20	3.85
T ₇	Two hand weedings at 15 and 30 DAS	7.14	20.0	3.93	6.53	3.93
T ₈	Un-weeded(Check)	4.13	11.13	2.48	6.12	3.62
	CD (P=0.05)	0.6	1.7	0.3	0.5	0.4
	SEM±	0.2	0.5	0.1	0.2	0.1

Table 3: Weed density (No. m⁻²) at 15 and 30 DAS as influenced by different weed management practices of black gram

Tr. No.	Treatment details	At 15 DAS				At 30 DAS			
		Grasses	Sedges	BLW	Total	Grasses	Sedges	BLW	Total
T ₁	Pendimethalin 30% EC 1000 g ha ⁻¹ PE at 1 DAS	3.62 (12.63)	6.35 (39.8)	7.96 (62.90)	10.76 (115.34)	5.30 (27.64)	9.37 (87.30)	9.07 (81.71)	14.04 (196.65)
T ₂	Imazethapyr + Imazamox 35%+35% WG (pre-mix) 80 g ha ⁻¹ PE at 1 DAS	3.89 (14.63)	5.32 (27.8)	7.96 (62.86)	10.29 (105.29)	5.59 (30.71)	9.20 (84.20)	9.30 (86.0)	14.19 (200.91)
T ₃	Fomesafen + Fluzifop-p-butyl 11.1%+11.1% SL (pre-mix) 220 g ha ⁻¹ PoE at 20 DAS	5.72 (32.22)	8.87 (78.20)	11.38 (129.0)	15.49 (239.4)	3.50 (11.75)	6.39 (40.30)	7.65 (58.02)	10.52 (110.07)
T ₄	Aciflurfen-sodium + Clodinafop-proparyl 16.5%+8% EC (pre-mix) 245 g ha ⁻¹ PoE at 20 DAS	5.89 (34.23)	8.93 (79.30)	11.16 (68.06)	15.43 (237.5)	3.70 (13.19)	7.33 (53.20)	8.28 (68.06)	11.62 (134.45)
T ₅	Propaquizafop + Imazethapyr 2.5%+3.75 ME (pre-mix) 125 g ha ⁻¹ PoE at 20 DAS	5.64 (31.26)	8.78 (76.0)	11.25 (118.0)	4.31 (20.67)	3.10 (9.11)	9.10 (82.30)	10.89 (118.0)	14.49 (209.41)
T ₆	Haloxypop R-methyl 10.5 % EC 108 g ha ⁻¹ PoE at 20 DAS	5.73 (32.33)	8.76 (76.20)	11.31 (132.0)	0.71 (0.00)	4.45 (19.30)	8.88 (78.30)	11.51 (132.0)	15.17 (229.60)
T ₇	Two hand weedings at 15 and 30 DAS	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)
T ₈	Un-weeded(Check)	5.80 (33.12)	9.06 (81.50)	11.56 (149.0)	5.09 (247.75)	6.52 (42.01)	9.66 (92.80)	11.56 (149.0)	16.86 (380.0)
	CD(P=0.05)	0.2	0.3	0.3	0.5	0.2	0.4	0.4	0.6
	SEm±	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.2

Note: Values in parenthesis are the original; square root transformation ($\sqrt{x+0.5}$) used for statistical analysis

Table 4: Weed dry weight (g m⁻²) at 15 and 30 DAS as influenced by different weed management practices of black gram

T. No.	Treatment details	At 15 DAS				At 30 DAS			
		Grasses	Sedges	BLW	Total	Grasses	Sedges	BLW	Total
T ₁	Pendimethalin 30% EC 1000 g ha ⁻¹ PE at 1 DAS	1.58 (2.00)	2.41 (5.30)	4.58 (20.47)	5.30 (27.80)	3.91 (14.80)	5.74 (32.50)	6.45 (41.07)	9.40 (88.40)
T ₂	Imazethapyr + Imazamox 35%+35% WG (pre-mix) 80 g ha ⁻¹ PE at 1 DAS	1.45 (1.60)	2.77 (7.20)	4.59 (20.55)	5.50 (29.40)	3.75 (13.60)	4.98 (24.30)	6.73 (44.86)	9.10 (82.80)
T ₃	Fomesafen + Fluzifop-p-butyl 11.1%+11.1% SL (pre-mix) 220 g ha ⁻¹ PoE at 20 DAS	2.93 (8.10)	5.00 (24.50)	6.30 (39.20)	8.50 (71.80)	2.02 (3.60)	3.62 (12.60)	4.83 (22.80)	6.30 (39.00)
T ₄	Aciflurfen-sodium + Clodinafop-proparyl 16.5%+8% EC (pre-mix) 245 g ha ⁻¹ PoE at 20 DAS	2.57 (6.10)	5.08 (25.30)	6.07 (36.40)	8.30 (67.80)	2.17 (4.20)	4.44 (19.20)	5.58 (30.60)	7.40 (54.00)
T ₅	Propaquizafop + Imazethapyr 2.5%+3.75 ME (pre-mix) 125 g ha ⁻¹ PoE at 20 DAS	2.59 (6.20)	4.67 (21.30)	6.22 (38.20)	8.10 (65.70)	2.12 (4.00)	5.65 (31.40)	8.77 (76.40)	10.60 (111.80)
T ₆	Haloxypop R-methyl 10.5 % EC 108 g ha ⁻¹ PoE at 20 DAS	2.97 (8.30)	4.79 (22.40)	6.25 (38.60)	8.40 (69.30)	3.83 (14.20)	5.49 (29.60)	9.68 (93.2)	11.70 (137.00)
T ₇	Two hand weedings at 15 and 30DAS	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)
T ₈	Un-weeded (Check)	3.78 (13.80)	5.17 (26.2)	6.59 (42.90)	9.10 (82.90)	6.56 (42.50)	5.97 (35.20)	10.19 (103.4)	13.50 (181.10)
	CD(P=0.05)	0.1	0.2	0.1	0.3	0.2	0.2	0.1	0.3
	SEm±	0.002	0.1	0.2	0.1	0.1	0.1	0.4	0.1

Note: Values in parenthesis are the original; square root transformation ($\sqrt{x+0.5}$) used for statistical analysis

Table 5: Weed control efficiency (%) as influenced by different weed management practices of black gram

T. No.	Treatment details	15 DAS	30 DAS
T ₁	Pendimethalin 30% EC 1000 g ha ⁻¹ PE at 1 DAS	66.5	51.2
T ₂	Imazethapyr + Imazamox 35%+35% WG (pre-mix) 80 g ha ⁻¹ PE at 1 DAS	64.6	54.3
T ₃	Fomesafen + Fluzifop-p-butyl 11.1%+11.1% SL (pre-mix) 220 g ha ⁻¹ PoE at 20 DAS	-	78.5
T ₄	Aciflurfen-sodium + Clodinafop-proparyl 16.5%+8% EC (pre-mix) 245 g ha ⁻¹ PoE at 20 DAS	-	70.2
T ₅	Propaquizafop + Imazethapyr 2.5%+3.75 ME (pre-mix) 125 g ha ⁻¹ PoE at 20 DAS	-	38.3
T ₆	Haloxypop R-methyl 10.5 % EC 108 g ha ⁻¹ PoE at 20 DAS	-	24.4
T ₇	Two hand weedings at 15 and 30DAS	100.0	100.0

Table 6: Seed yield (kg ha⁻¹), Haulm yield (kg ha⁻¹) and Harvest index (%) as influenced by different weed management practices of black gram

T. No.	Treatment details	Seed yield (kg ha ⁻¹)	Haulm yield (kg ha ⁻¹)	Harvest index (%)
T ₁	Pendimethalin 30% EC 1000 g ha ⁻¹ PE at 1 DAS	530	1036	34
T ₂	Imazethapyr + Imazamox 35%+35% WG (pre-mix) 80 g ha ⁻¹ PE at 1 DAS	512	1012	34
T ₃	Fomesafen + Fluzifop-p-butyl 11.1%+11.1% SL (pre-mix) 220 g ha ⁻¹ PoE at 20 DAS	725	1234	37
T ₄	Aciflurfen-sodium + Clodinafop-proparyl 16.5%+8% EC (pre-mix) 245 g ha ⁻¹ PoE at 20 DAS	680	1280	35
T ₅	Propaquizafop + Imazethapyr 2.5%+3.75 ME (pre-mix) 125 g ha ⁻¹ PoE at 20 DAS	584	1096	35
T ₆	Haloxypop R-methyl 10.5 % EC 108 g ha ⁻¹ PoE at 20 DAS	576	1084	35

T ₇	Two hand weeding at 15 and 30 DAS	795	1485	35
T ₈	Un-weeded(Check)	350	720	33
	CD (P=0.05)	50	64	NS
	SEm±	17	21	1.0

3. Results and Discussion

3.1 Weed flora

The common weeds observed in the experimental site were *Cyperus rotundus*, *Cyperus iria* among sedges and *Echinochloa colona*, *Echinochloa crus-galli*, *Cynodon dactylon*, *Digitaria sanguinalis*, *Dactyloctenium aegyptium*, *Setaria glauca*, *Eleusine indica* among grasses and *Commelina benghalensis*, *Ageratum conyzoides*, *Euphorbia hirta*, *Amaranthus spinosus*, *Phyllanthus niruri* and *Trianthema monogyna*, *Ipomoea pestigridis*, etc. among broad-leaved weeds. Among the different groups of weeds broad leaved weeds are predominant followed by sedges and grasses.

3.2 Weed parameters

Different weed management practices significantly reduced weed parameters, including total weed density, total weed dry weight and increased weed control efficiency (Tables no. 3, 4 and 5). T₂-Imazethapyr + Imazamox 35%+35% WG (pre-mix) 80 g ha⁻¹ PE at 1 DAS, recorded lower weed density (105.29 no. m⁻²) at 15 DAS followed by T₁ treatment. Whereas, T₁ treatment recorded lowest total weed dry weight (27.80 g m⁻²) and highest weed control efficiency of 66.5 % at 15 DAS. With T₃ treatment (Fomesafen + Fluzifop-p-butyl 11.1%+11.1% SL (pre-mix) 220 g ha⁻¹ PoE at 20 DAS), recorded lowest total weed density (110 no. m⁻²) and total weed dry weight (39 g m⁻²) at 30 DAS and highest weed control efficiency of 78.5 % among all other chemical treatments. In sensitive species, it inhibits enzymes involved in chlorophyll and lipids synthesis by the combination of Fomesafen + Fluzifop-p-butyl controlled certain grasses, sedges and broad leaved weeds. T₃ treatment followed by T₄-Aciflufen-sodium + Clodinafop-proparyl 245 g ha⁻¹ with total weed density of 134.45 no.m⁻² and total weed dry weight of 54.0 g m⁻² and with weed control efficiency of 70.2 % at 30 DAS. Similar results were observed by Aher *et al* (2023) [1]. Among the weed management practices, T₇ treatment (Two hand weeding at 15 and 30 DAS) observed complete removal of weeds. T₈ treatment (unweeded check) recorded with the highest total weed density (247.75, 380 no. m⁻²) and total weed dry weight (82.90, 181.1 g m⁻²) at 15 and 30 DAS respectively.

3.3 Growth parameters

Among the weed management practices, T₃-Fomesafen + Fluzifop-p-butyl 11.1%+11.1% SL (pre-mix) 220 g ha⁻¹ PoE at 20 DAS treatment recorded significantly highest plant height (18.87cm) and total number of branches per plant (36.64) at harvest stage followed by T₇-hand weeding twice at 15 and 30 DAS treatment. Whereas, significantly highest crop dry matter (245 g m⁻²) recorded in T₇-hand weeding at 15 and 30 DAS treatment may be due to the complete removal of weeds at 15 and 30 DAS, which was followed by T₃ treatment. The performance of T₃ treatment (Fomesafen + Fluzifop-p-butyl 11.1%+11.1% SL (pre-mix) 220 g ha⁻¹ PoE at 20 DAS) may have contributed to a reduction in crop-weed competition by significantly lowering total weed density and total weed dry weight at 30 DAS which may be the critical stage for black gram growth and development. Similar findings were noticed by Harisha *et al* 2021 [4].

3.4 Yield attributes

It was observed that there is a significant effect of weed management practices on yield attributing characters of the crop

including the number of pods branch⁻¹, total number of pods plant⁻¹, pod weight (g) and 100 seed weight (g). The highest average number of pods branch⁻¹, total number of pods plant⁻¹, pod weight (g) and 100 seed weight (g) was observed in T₇-hand weeding twice at 15 and 30 DAS treatment (7.14, 20.00, 3.93, 6.53 and 3.93 respectively) followed by T₃- Fomesafen + Fluzifop-p-butyl 220 g ha⁻¹ at 20 DAS treatment (5.89, 18.13, 3.82, 6.34 and 3.85 respectively except no. of seeds plant⁻¹). The results find support and similar findings were observed by Harisha *et al.*, 2021 [4] and Suryavanshi *et al.* (2018) [12]. Better results for T₇ treatment may be due to the clearance of complete weeds at most critical crop-weed competition (15-30 DAS) for black gram made available nutrients, space, moisture, etc. needed for better growth and development of the crop.

3.5 Yield parameters

Significantly highest seed yield (795 kg ha⁻¹) and haulm yield (1485 kg ha⁻¹) was recorded with hand weeding twice at 15 and 30 DAS treatment. Similar results were noticed by Sahoo *et al.* (2017) [10], and Nirala *et al.* (2016) [8]. Whereas, among the herbicidal treatments post-emergence application of Fomesafen + Fluzifop-p-butyl 220 g ha⁻¹ at 20 DAS treatment recorded the highest seed yield (725 kg ha⁻¹), haulm yield (1280 kg ha⁻¹) and harvest index (37%) which was at par with post-emergence application of Aciflufen-sodium + Clodinafop-proparyl 245 g ha⁻¹ at 20 DAS (680 kg ha⁻¹) and haulm yield (1234 kg ha⁻¹). Jagadesh and Raju (2021) [5], Yadav *et al.*, 2022 [13] found that better weed control practices reduced the crop-weed competition created favourable conditions and produced better yields for the black gram.

4. Conclusion

Among the weed management practices, T₇ treatment (hand weeding at 15 and 30 DAS) was superior in growth parameters, yield attributes and yield; recorded lower weed density, and lower weed weight. Among the herbicide-applied plots, post-emergence application of Fomesafen + Fluzifop-p-butyl 11.1% + 11.1% SL (pre-mix) 220 g ha⁻¹ at 20 DAS was found to be effective for controlling weeds, thereby enhanced crop growth and yield parameters, resulting in highest seed, haulm yield and harvest index.

5. Acknowledgement

I am greatly pleased to express my heartfelt gratitude to the Department of Agronomy, Agricultural College, Jagtial, PJTSAU.

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