Original Research Article

AN INTEGRATED EFFECT OF WEED MANAGEMENT IN BLACKGRAM

ABSTRACT

A field experiment was conducted at Wetlands farm, Department of Agronomy, Tamil Nadu Agricultural University, Coimbatore during *summer season* (March-June) of 2023, to study the effect of different weed management practices on weed flora, weed growth and yield of summer irrigated blackgram (VBN11). The field experiment was laid out in Randomized Block Design with nine treatments and three replications. Treatments comprised of power operated weeder at 15 DAS and 30 DAS with 40 × 7.5 cm and 45 × 7.5 cm plant spacing; pre-emergence application of pendimethalin 30% EC @ 1 kg ha^{-1} *fb* (followed by) power operated weeder at 20 DAS with 40 × 7.5 cmand 45 × 7.5 cm plant spacing; pre-emergence application of pendimethalin30% EC @1 kg ha^{-1} *fb* early post emergence application of Imazethapyr @ 100 g ha^{-1} + Quizalofop-ethyl @ 50 g ha^{-1} (Tank mix) at 20 DAS with 40 × 7.5 cm plant spacing and 45 × 7.5 cm plant spacing; hand weeding at 20 DAS and 40 DAS with 30 × 10 cm plant spacing.The results revealed that among the various weed management practices, the weeds were effectively controlled by the pre-emergence application of pendimethalin 30 % EC @ 1 kg ha^{-1}*fb* power weeder at 20 DAS with 40 × 7.5 cm plant spacingwithsignificantly lower weed density, higher Weed Control Efficiency and higher grain yield (881 kg ha^{-1}).

Key words: Blackgram; Mechanical weeding; Power weeder; Pre-emergence; Early post emergence herbicides; Altering Crop geometry

Introduction

Pulses are the second most staple food crop following cereals. A special role is assumed by pulses in India's nutritional food security. These are nutritious foods with long shelf-life. They are an excellent source of protein, fiber, minerals, vitamins and phenolic compounds which plays a prominent role in control of chronic diseases. Vieira *et al.* [1] have reported reduced childhood obesity with regular consumption of pulses and in addition to the control of glycemic response in diabetic children. Blackgram (*Vigna mungo* L., Family: Leguminosae) is the fourth most important pulse crop in India with 8% of the total pulse area. The area under blackgram in India is 4.14 million hectares with an annual production of 2.22 million tonnes and productivity of 538 kg ha^{-1}. Madhya Pradesh is the leading state in India with an area of 1.3 million hectares accounting for a production of 0.44 million tonnes. In Tamil Nadu, the area under blackgram is 0.402 million hectares with an annual production

of 0.22 million tonnes (INDIASTAT, 2020-2021) [2]. Pulses are majorly grown by the farmers under poor resource conditions with poor management practices which are restricting its potential yield. Among the various factors affecting the yield of blackgram, weeds play a decisive role. An initial period of 20 to 40 days is very critical which reduces yield to the extent of 87% depending upon the weed density and flora [3]. The critical period of crop weed competition in blackgram is 20 – 40 days after sowing [4]. Most of the farmers fail to manage the weeds which reduces the crop's potential yield by 46 – 53% in the *summer* [3, 5] and by 43.2 – 64.1% in the *kharif* [6, 5]. This put forth for the emergency of weed management in blackgram. Weeds can be controlled by different methods like physical, chemical, mechanical and biological. Manual weeding is tedious and because of labour scarcity at peak period of weeding, thereby facing difficulty to complete weeding on schedule. With the introduction of mechanization, it is now more important than ever to complete tasks promptly in order to acquire the best yields from various crops [7].Plant density plays a vital role in yield of most of the legumes. Maintenance of optimum spacing facilitates plants to grow comfortably in both aerial and underground and thus utilizing resources such as water, nutrients and solar radiation effectively, thereby producing more yield [8].The crop geometry was altered to 40×7.5 cm, 45×7.5 cm instead of 30×10 cm in order to promote the usage of power operated weeder.

2. MATERIALS AND METHODS

2.1 Experimental site

A field experiment was conducted at Wetlands farm, Department of Agronomy, Tamil Nadu Agricultural University, Coimbatore during *summer* irrigated season (March-June) of 2023. The geographical location of field is, with a latitude of $11^0$0'9.0648"N, longitude of $76^0$55'40.7028"E and 462.2 m above the mean sea level in Tamil Nadu Western agro-climatic zone. The texture of the soil in the experimental field was clay loam. The experiment was laid in Randomized Block Design with nine treatments and three replications. The treatment details are mentioned in Table 1.

Table 1.Treatment details of Field Experiment

T_1-Power Operated Weeder at 15 DAS and 30 DAS with 40 × 7.5 cm plant spacing
T_2- Power Operated Weeder at 15 DAS and 30 DAS with 45 × 7.5 cm plant spacing
T_3- PE Pendimethalin 30% EC @ 1 kgha^{-1} *fb* Power operated weeder at 20 DAS with 40 × 7.5 cmplant spacing

T_4- PE Pendimethalin 30% EC @ 1 kgha^{-1} *fb* Power operated weeder at 20 DAS with 45 × 7.5 cmplant spacing

T_5- PE Pendimethalin 30% EC @1 kgha^{-1} *fb* EPoE Imazethapyr @ 100 g ha^{-1} + Quizalofop-ethyl @ 50 g ha^{-1}(Tank mix) at 20 DAS with 40 × 7.5 cm plant spacing

T_6- PE Pendimethalin 30% EC @ 1 kgha^{-1} *fb* EPoE Imazethapyr @ 100 g ha^{-1} + Quizalofop-ethyl @ 50 g ha^{-1}(Tank mix) at 20 DAS with 45 × 7.5 cm plant spacing

T_7- Hand weeding at 20 DAS and 40 DAS with 30 × 10 cm plant spacing

T_8- Weedy check with 30 × 10 cm plant spacing

T_9- Weed free with 30 × 10 cm plant spacing

DAS – Days After Sowing; PE - Pre emergence; EPoE - Early post emergence; *fb*- Followed by

Tank mix: It is a process in which two different herbicides are mixed in a spray tank prior to spraying.

2.2 Sowing and Crop management practices

Blackgram variety VBN 11 was used as a test variety for the experiment. For irrigated blackgram, the recommended fertilizer dose was 25 kg ha^{-1} N, 50 kg ha^{-1} P_2O_5 , 25 kg ha^{-1} K_2O and 40 kg ha^{-1} of sulphur, which were applied in the form of urea, single super phosphate and muriate of potash.The entire dose of fertilizers was applied at the time of sowing as basal. For irrigated blackgram, the seed rate of 20 kg ha^{-1} was used. Weed management was done as per the schedule of the treatments. PE and EPoE herbicides were applied with a spray fluid of 500 litres ha^{-1} using Knapsack battery operated hand sprayer in certain treatments at 3 DAS and 20 DAS respectively (Fig. 1 and Fig. 2).The power operated weeder (blade width of 30 cm) was used for removing weeds in certain treatments according to the intervals mentioned in the treatments (Fig. 3).

Fig1. PE application of Pendimethalin 30% EC @ 1 kg ha^{-1}

Fig2. EPoE application of Imazethapyr @ 100 g ha^{-1} + Quizalofop-ethyl @ 50 g ha^{-1} (Tank mix) at 20 DAS

Fig3. Power operated weeding

2.3 Observations on Weed:

Weed flora

Weeds were identified and are classified into three categories such as grasses, sedges and broad-leaved weeds.

Weed density (No. m^{-2})

The weeds were counted by placing a quadrat with dimensions of 0.5 m × 0.5 m (0.25 m^2) at four random places in each plot at 15, 30, and 45 DAS. The total sum of all weeds was expressed in No. m^{-2} Bumside and Wicks [9].

Weed dry weight (g m^{-2})

The weeds were taken from each plot by placing quadrat (0.25 m^2) at four random places and the samples were shade dried and then it was placed in hot air oven at 70°C until constant weight was attained and then dry weight was taken and expressed in g m^{-2}. All the weed data were statistically analysed by subjecting with Analysis of Variance as reported by Gomez and Gomez [10]. The pooled data of weeds were transformed to square root method ($\sqrt{X+0.5}$) and probability of significant difference made at P≤0.05.

Weed Control Efficiency (WCE)

Weed control efficiency was calculated by the formula proposed by Mani *et al*. [11].

$$WCE(\%) = \frac{\text{Weed density in weedy check plot} - \text{Weed density in treatment plot}}{\text{Weed density in weedy check plot}} \times 100$$

Weed Control Index (WCI)

WCI was calculated as per the formula suggested by Mishra and Tosh [12].

$$WCE\ (\%) = \frac{\text{Weed dry weight in weedy check plot} - \text{Weed dry weight in treatment plot}}{\text{Weed dry weight in weedy check plot}} \times 100$$

Yield

The pods after got matured, were separated from each plot and dried in the sun. Later, the pods were threshed manually, winnowed and the seeds were dried till the moisture content in it was reduced to 12 %. The seeds were weighed and thus obtained value was expressed in kg ha^{-1}.

3. RESULTS AND DISCUSSION

3.1 Weed flora

The experimental field was observed more with grass species followed by broad leaved weeds. The major grass species found in the experimental plots were *Echinochloa colona*, *Echinochloa crusgalli* and broad leaf weed species *viz., Abutilon indicum, Trianthema portulacastrum, Portulaca oleracea, Cleome viscose* and *Corchorus olitorius*; sedges were not found in the experimental field.

3.2 Weed density

The data related to weed density is presented in Table 2. At 15 DAS, among the different treatments, T_3,T_4,T_5,T_6 which were statistically on parhave shown less in weed density (30.33, 34, 31.33 and 37.67 No. m^{-2} respectively) over the weedy check (319.67 No. m^{-2}) due to the suppression of weed growth by the usage of pendimethalin 30% EC @1 kg ha^{-1}. Similarly, Reddy *et al.* [13] also reported lower weed density by the usage of Pendimethalin 30% EC @ 1kg ha^{-1}. The remaining treatments have shown more weed density due to uninterrupted weed growth. At 30 DAS, T_3 and T_4 treatments which were statistically on par have shown lower weed growth (8 and 11.33 No. m^{-2}) due to the management of weeds using power weeder which was followed by T_5, T_6 treatments with weed growth of 17 and 21.67 No. m^{-2}) due to the EPoE application of Imazethapyr 10 % SL + Quizalofop-ethyl 5 % EC (Tank mix) over the weedy check (389.33 No. m^{-2}). At 45 DAS, T_3 and T_4 recorded least weed growth (18 and 20.67 No. m^{-2}) compared to other treatments, however there was a slight increase in number of weeds when compared to 30 DAS but was on par with T_5 and T_7treatments. More weed densitywas observed in T_1 and T_2 due to regrowth of weeds.

3.2 Weed dry weight

Weed management practices followed at different growth stages has shown a significant impact on weed dry weight (Table 2). At 15 DAS, T_3,T_4,T_5,T_6 treatments have shown lesser weed dry weight (1.88, 2.17, 1.93 and 2.33 g m^{-2},respectively) due to the restriction of weed germination by the action of pendimethalin 30 % EC @1 kg ha^{-1}over the weedy check and other treatments with more dry weight (10.72g m^{-2}) due to undisturbed weed growth. At 30 DAS, T_3 and T_4 treatments which were statistically on par have shown lower weed dry weight (5.22 and 6.43 g m^{-2}) due to the management of weeds using power weeder at 20 DAS. Similar results of weed management using power weeder at 20 DAS were reported by Lavanya *et al.* [14]. Nextbest treatment T_5 with lower weed dry weight (11.19 g m^{-2}) was statistically on par with T_6 treatment (13.41 g m^{-2}) due to the control of weeds by the EPoE application of Imazethapyr 10 % SL + Quizalofop-ethyl 5 % EC (Tank mix). At 45 DAS, T_3 and T_4 recorded lower weed dry weight(8.27 and 9.2 g m^{-2}) compared to other treatments however, there was a slight increase in number of weeds when compared to 30 DAS and was on par with T_5 and T_7 treatments. Weed dryweight was more inT_1 and T_2 due to regrowth of weeds.

Table 2. Effect of weed management methods on weed density(No. m^{-2}) and weed dry weight(g m^{-2})

Treatments	Weed density (no. m^{-2})			Weed dry weight(g m^{-2})		
	15 DAS	30 DAS	45 DAS	15 DAS	30 DAS	45 DAS
T_1	16.83 (284.33)	9.72 (94)	6.49 (41.67)	3.21 (9.79)	5.00 (24.56)	4.37 (18.77)
T_2	17.25 (297)	10.00 (99.67)	6.98 (48.33)	3.21 (9.84)	5.18 (26.34)	4.53 (20.07)
T_3	5.57 (30.33)	2.91 (8)	4.29 (18)	1.50 (1.88)	2.39 (5.22)	2.94 (8.27)
T_4	5.87 (34)	3.44 (11.33)	4.59 (20.67)	1.63 (2.17)	2.63 (6.43)	3.11 (9.2)
T_5	5.59 (31.33)	4.13 (17)	5.05 (25)	1.56 (1.93)	3.42 (11.19)	3.76 (13.73)
T_6	6.17 (37.67)	4.70 (21.67)	5.53 (30.67)	1.68 (2.33)	3.73 (13.41)	4.08 (16.31)
T_7	17.41 (302.67)	7.03 (49)	4.94 (24)	3.24 (9.98)	4.51 (19.89)	2.74 (7.13)
T_8	17.89 (319.67)	19.74 (389.33)	15.13 (228.33)	3.35 (10.72)	13.48 (182.16)	12.79 (163.27)

T_9	0.71 (0)	0.71 (0)	0.71 (0)	0.71 (0)	0.71 (0)	0.71 (0)
SEd	0.501	0.336	0.341	0.14	0.319	0.323
CD(P=0.05)	1.061	0.712	0.723	0.297	0.677	0.685

(The values in the table are square root transformed values, original values are represented in parenthesis).

3.3 Weed Control Efficiency

The data related to WCE were represented in Table 3. Among the treatments, weed control efficiency was highest in T_3 and T_4 treatments due to the control of weeds initially by pendimethalin and later by the usage of power weeder followed by T_5,T_6 as the weeds were controlled initially by pendimethalin 30 % EC @1 kg ha^{-1}, later by EPoE application of Imazethapyr 10 % SL + Quizalofop-ethyl 5 % EC (Tank mix). Similar results were reported by Sukumar and Kunjammal [15] with higher weed control efficiency of 91.27%.

3.4 Weed Control Index

The different weed management methods had a significant impact on weed control (Table 3). The lowest weed control was recorded in T_1 and T_2 treatments due to regrowth of weeds after weeding and higher weed control index of 82.4% at 15 DAS, 97% at 30 DAS and 94.9% at 45 DAS was observed in T_3 treatment due to the continual interruption to the weeds at 3 DAS and 20 DAS which was statistically on par with T_4 treatment with weed control index of 79.80% at 15 DAS, 96.40% at 30 DAS and 94.35% at 45 DAS as similar weed management practices were followed. The results were also confirmed by Mahilang *et al.* [16] with less weed population as the more weeding efficiency of power weeder (91%).

Table 3. Effect of weed management methods on Weed Control Efficiency (WCE) and Weed Control Index (WCI)

Treatments	WCE(%)			WCI(%)		
	15 DAS	**30 DAS**	**45 DAS**	**15 DAS**	**30 DAS**	**45DAS**
T_1	10.96	75.79	81.73	8.74	86.17	88.34
T_2	7.07	74.34	78.84	8.22	95.70	87.64
T_3	90.52	97.95	92.10	82.47	97.07	94.93
T_4	89.36	97.08	90.93	79.80	96.40	94.35
T_5	90.21	95.58	89.03	82.02	93.78	91.63
T_6	88.21	94.45	86.57	78.25	92.50	89.85
T_7	5.34	87.42	89.50	6.94	88.86	95.55
T_8	0.00	0.00	0.00	0.00	0.00	0.00
T_9	100	100	100	100	100	100

3.5 Grain Yield

Grain yield has shown significant difference among the various weed management practices (Fig 4). Pre-emergence application of pendimethalin 30 % EC @1 kg ha^{-1} followed by power operated weeding at 20 DAS with 40 × 7.5 cm spacing (T_3) produced higher grain yield of (881 kg ha^{-1}) which was statistically on par with (T_4) pre-emergence application of pendimethalin 30 % EC @1 kg ha^{-1} followed by power operated weeding at 20 DAS with 45 × 7.5 cm spacing obtained grain yield of 871 kg ha^{-1} followed by remaining treatments. The lesser grain yield of 553 kg ha^{-1} was observed in T_8 (Weedy check).Thus, there was 41.5% reduction in yield in weedy check over weed free condition. Similar results were reported by Kumar *et al.* [17] with 48.1% reduction in grain yield of blackgram under uncontrolled weed condition.

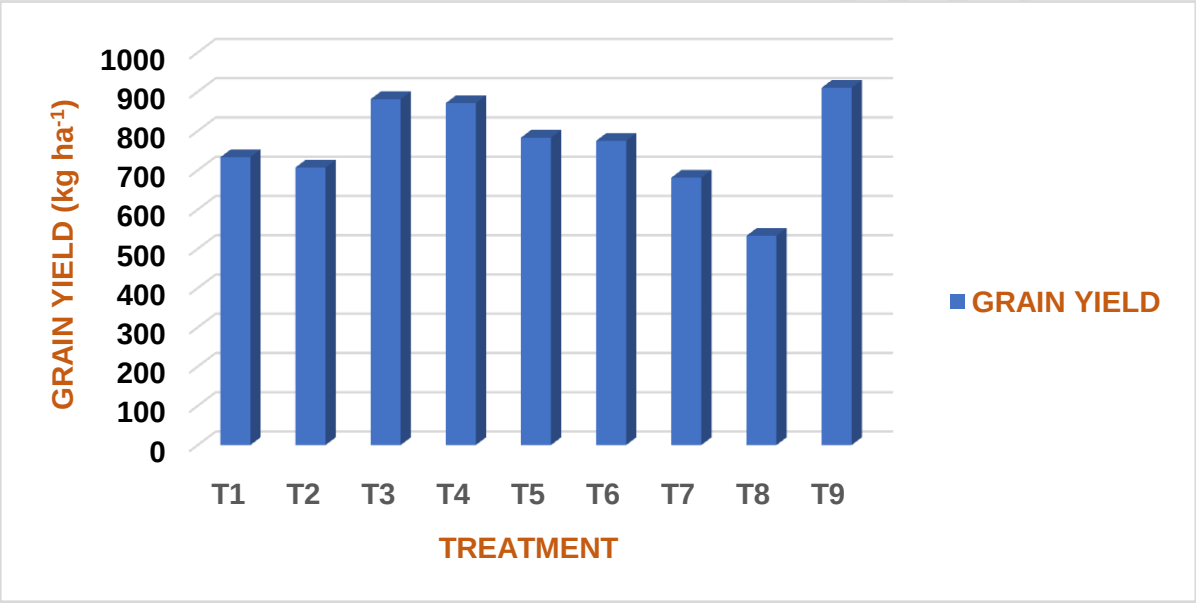

Fig 4. Effect of different weed management methods on grain yield (kg ha^{-1}) of blackgram

4. CONCLUSION

The results revealed that the integrated approach of pre-emergence application of Pendimethalin 30 % EC @ 1 kg ha^{-1} followed by power operated weeder at 20 DAS with crop geometry of 40 × 7.5 cm was the best option to manage the weeds in summer irrigated blackgram to get higher grain yield (881 kg ha^{-1}) with higher weed control efficiency due to the decreased competition to the plants by weeds at critical growth stages of the crop.

Fig 5. PE Pendimethalin 30% EC @ 1 kg ha^{-1} *fb* Power operated weeder at 20 DAS with 40 × 7.5 cm plant spacing (T_3)

Fig 6. PE Pendimethalin 30% EC @ 1 kg ha^{-1} *fb* Power operated weeder at 20 DAS with 45 × 7.5 cm plant spacing (T_4)

Fig 7. Weedy Check plot

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