Integrated approaches proven better weed control, productivity and quality in blackgram *(Vigna mungo* L.*)*

Abstract

A field experiment was conducted during *kharif* 2023 to study the efficacy of early post-emergence herbicides against weeds in blackgram. The experiment was laid out in a randomized block design with 12 treatments and three replications. Weed free recorded significantly higher seed and stover yield (1077 and 2657 kg/ha, respectively). Next to weed free, significantly higher seed and stover yields were observed in interculturing followed by hand weedings at 20 and 40 DAS (960 and 2258 kg/ha, respectively) and was found at par with post-emergence application of imazethapyr + imazamox at 50 (25 + 25) g/ha *fb* interculturing at 40 DAS (932 and 2224 kg/ha, respectively) and imazethapyr + imazamox at 60 (30 + 30) g/ha *fb* interculturing at 40 DAS (916 and 2169 kg/ha, respectively). Whereas, weed free recorded significantly higher protein yield (242.11 kg/ha) which was followed by interculturing followed by hand weedings at 20 and 40 DAS (214.46 kg/ha) and other treatments.

Keywords: Blackgram, Herbicides, Interculturing, Weeds, Yield

Introduction

Blackgram (*Vigna mungo* L.) is one of the important pulse crops of India belongs to the *Fabaceae* or *Leguminosae* family and *Papilionacaae* sub family. India is primary centre of origin of blackgram and central Asia as a secondary centre. People in various regions of India use different names for the blackgram, for example Urid or Kalai in Hindi; Mashkalai in Bengali; Manipapappu in Telugu; Ulathamparuppu in Tamil; Uddinabele in Kannda; Uzhunnu in Malayalam; Adad in

Gujarati; Udid in Marathi and Mash in Punjabi. Blackgram is mainly cultivated in Asian countries including Pakistan, Myanmar, Sri Lanka, Thailand, Burma, Bangladesh and parts of South Asia. India is the largest producer as well as consumer of blackgram. In India, blackgram are during *kharif* 2022-23 was to the tune of 19.21 lakh acres (www.agricoop.nic.in). It is well known crop for its hardiness, comparatively more resistance against pests and diseases and withstand against drought conditions. Hence, there is a great scope of increasing the productivity of this crop with adoption of high yielding varieties and suitable agro-technologies. Among various biotic and abiotic factors, weed infestation is the major biotic factor responsible for low productivity of blackgram. Weed emergence in blackgram begins almost with the crop emergence leading to crop-weed competition from initial stages and reduce yields to the extent of 78% and sometimes lead to the total crop failure (Kumar *et al*., 2015). Weed management with conventional hand weeding was observed to be highly expensive among different weed control methods due to the non-availability and increased cost of labour at some of the most important and critical stages of the crop weed competition. Hence, the timely control of weeds in blackgram using herbicides would be preferable and the use of post-emergent herbicides could be better option for the control of weeds during the early stages of the crop growth (Thimmegowda *et al*., 2022). Hence, the chemical weed control method is becoming popular among the farmers. The use of post-emergence herbicides alone or in combination may broaden the window of weed management by broad spectrum weed control. Considering the above facts and views, the present experiment was conducted to study the effect of different weed management practices for theory influence on weed control, productivity and quality in blackgram.

Material and Methods

A field experiment was conducted during *Kharif* season of 2023 at the Agronomy Instructional Farm, C. P. College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, Banaskantha (Gujarat) to study the effect of different weed management practices for theory influence on weed control, productivity and quality in blackgram. Geographically, Sardarkrushinagar Dantiwada Agricultural University is situated at 24˚19’ North latitude and 72˚19’ East longitude with an elevation of 154.52 metre above the mean sea level. The experiment was laid out in randomised block design with three replications having twelve treatments *viz*., T_1:Pendimethalin at 750 g/ha (PE) *fb* interculturing at 40 DAS T_2: Quizalofop-p-ethyl at 38 g/ha (PoE) *fb* interculturing at 40 DAS T_3: Quizalofop-p-ethyl at 50 g/ha (PoE) *fb* interculturing at 40 DAS T_4: Imazethapyr at 50 g/ha (PoE) *fb* interculturing at 40 DAS T_5: Imazethapyr at 75 g/ha (PoE) *fb* interculturing at 40 DAS T_6: Fenoxaprop-p-ethyl at 56.25 g/ha (PoE) *fb* interculturing at 40 DAS T_7: Fenoxaprop-p-ethyl at 67.5 g/ha (PoE) *fb* interculturing at 40 DAS T_8: Imazethapyr + imazamox at 50 (25 + 25) g/ha (PoE) *fb* interculturing at 40 DAS T_9: Imazethapyr + imazamox at 60 (30 + 30) g/ha (PoE) *fb* interculturing at 40 DAS T_{10}: Interculturing followed by hand weedings at 20 and 40 DAS T_{11}: Weed free T_{12}: Unweeded check. The soil of the experimental plot was loamy sand in texture and slightly alkaline in reaction (pH=7.40), low in organic carbon (0.24%) and available nitrogen (149.0 kg/ha) and medium in available phosphorus (39.3 kg/ha) and potassium (267.45 kg/ha). Blackgram cultivar (GU 1) was sown on 15th July, 2023 with a spacing of 45 cm and harvested on 10th October, 2023. The spraying was done by using knapsack sprayer with flat fan nozzle having 15 litre capacity. Pendimethalin was applied as pre-emergence at two DAS, while, quizalofop-p-ethyl, fenoxaprop-p-ethyl, imazethapyr and imazethapyr + imazamox were applied as post-emergence at 20 DAS. The herbicides were applied as per the treatments in respective plots by using the spray volume of 500 litres /ha. The sedges, grasses, broad leaf weeds were uprooted from 0.25 m^2 (50 cm × 50 cm quadrate) in ring area of plots at 15, 40 DAS and at harvest and were kept in separate brown paper packets for sun drying and later they were kept in hot air oven at 60 ^{0}C for 72 hours till the dry weight becomes constant. Later, category wise weed dry weight of sedges, grasses and broad leaf weeds were noted down separately by weighing in weighing balance and later total weed dry weight of each stage were calculated. Further, the data was multiplied with four to convert the data into g/m^2. Since the weed dry weight data does not follow normal distribution, the weed dry weight data were analyzed after subjecting to$\sqrt{x+0.5}$ transformation. The weed control efficiency was calculated by using the following formula (Kondap and Upadhyay, 1985). Total five plants were selected randomly from net plot and tagged in each plot for recording plant height, no. of branches per plant. The data on pod, seed and stover yield were recorded from net plot and converted on hectare basis. Weed index was worked out on the basis of formula suggested by Gill and Kumar (1969). The protein content (%) in seed was determined by Near Infrared Spectroscopy and recorded separately for each treatment. Protein yield was calculated by using the following formula (Gassi *et al*., 1973). The statistical analysis of the data collected for different parameters were carried out following the procedures of as described by Panse and Sukhatme (1967) using computer system at the Computer Centre, Department of Agricultural Statistics, C. P. College of Agriculture, S. D. Agricultural University, Sardarkrushinagar.

Results and discussion

Weed flora, Weed dry weight and Weed control efficiency

The different weed species observed at 15, 40 DAS and harvest were *Cyperus rotundus* L. and *Bulbostylis barbata* Rottb. among sedges, *Cynodon dactylon* L., *Setaria viridis* L. and *Digitaria sanguinalis* L. among grasses and *Digera arvensis* L., *Amaranthus viridis* L., *Amaranthus spinosus* L., *Amaranthus polygonoides* L., *Portulaca oleracea* L., *Boerhavia erecta* L., *Tribulus terrestris* L., *Commelina benghalensis* L. and *Leucas aspera* L. among broad leaf weeds. The assessment and scrutiny of data on weed dry weight at 15 DAS (Table 1) indicated that, among different weed management practices, weed free treatment recorded significantly lower dry weight of sedges, grasses, broad leaf and total weeds and higher weed control efficiency as compared to other treatments. Following weed free, the pre-emergence application of pendimethalin at 750 g/ha *fb* interculturing at 40 DAS depicted significantly lower dry weight of sedges, grasses, broad leaf and total weeds. Whereas, all the post-emergence herbicides, interculturing followed by hand weedings at 20 and 40 DAS and unweeded check treatment showed significantly higher dry weight of sedges, grasses, broad leaf and total weeds with lower weed control efficiencies because of no any weed control measures initiated by/before 15 DAS. The dry weight of weeds at 40 DAS and at harvest (Table 2 and 3) revealed that weed free treatment recorded significantly lower dry weight of sedges, grasses, broad leaf and total weeds. Subsequent to weed free, significantly lower dry weight of sedges, grasses, broad leaf and total weeds were noticed under interculturing followed by hand weedings at 20 and 40 DAS and found at par with post-emergence application of imazethapyr + imazamox at 60 (30+30) g/ha *fb* interculturing at 40 DAS and imazethapyr + imazamox at 50 (25+25) g/ha *fb* interculturing at 40 DAS. Yet, under the unweeded check, significantly far greater dry weights of sedges, grasses, broad leaf and total weeds were noted. The lower weed dry weight in post-emergence application of imazethapyr + imazamox at 60 (30+30) g/ha *fb* interculturing at 40 DAS and imazethapyr + imazamox at 50 (25+25) g/ha *fb* interculturing at 40 DAS at 40 DAS was attributed to effective suppression of weeds due to inhibition of ALS enzyme in the target weeds after imazethapyr + imazamox applied and subsequent killing of emerged weeds through interculturing. Mansoori *et al*. (2015) further reported lower weed dry weight in imazethapyr + imazamox (premix) as compared to pendimethalin and imazethapyr applied plot. Weed free treatment resulted 100% weed control efficiency across all the crop growth stages. The results made it abundantly evident that the higher level of weed control efficiency at 15 DAS was recorded by the pendimethalin at 750 g/ha (PE) *fb* interculturing at 40 DAS (56.46%). Furthermore, the data on weed control efficiency at 40 DAS and harvest was found superior under weed free (100% and 100%, respectively), which was followed by interculturing followed by hand weedings at 20 and 40 DAS (82.74% and 89.87%, respectively), post-emergence application of imazethapyr + imazamox at 60 (30 + 30) g/ha (PoE) *fb* interculturing at 40 DAS (80.99% and 88.39%, respectively) and imazethapyr + imazamox at 50 (25 + 25) g/ha (PoE) *fb* interculturing at 40 DAS (78.49% and 86.16%, respectively). These results are in conformity with Kumar *et al*. (2015) and Barla and Upasani (2022).

Growth and yield parameters

An exploration of data in Table 4 stipulated that weed free treatment recorded significantly higher plant height and number of branches per plant at harvest (51.60 cm and 6.93, respectively) which was statistically at par with interculturing followed by hand weedings at 20 and 40 DAS (50.13 cm and 6.07, respectively), post-emergence application of imazethapyr + imazamox at 50 (25 + 25) g/ha (PoE) *fb* interculturing at 40 DAS (49.64 cm and 6.02, respectively) and imazethapyr + imazamox at 60 (30 + 30) g/ha (PoE) *fb* interculturing at 40 DAS (49.40 cm and 5.94, respectively). Further, the reasons for significantly higher plant height and number of branches per plant noted under weed free plot was mainly due to significantly lower weed density and weed dry weight recorded under this treatment due to effective suppression of different categories of weeds. Higher plant height and number of branches per plant observed in interculturing and hand weeding was due to lower weed density and dry weight recorded which is primarily on account of better removal and control of category wise weeds in blackgram crop. Similar results were obtained by Jakhar *et al*. (2015) and Manohar *et al*. (2019) who noticed better growth parameters in weed free treatment.

Among different weed management practices, weed free recorded significantly higher pod yield, seed yield and stover yield (1460, 1077 and 2657 kg/ha, respectively). After weed free, interculturing followed by hand weedings at 20 and 40 DAS realized significantly higher pod yield, seed yield and stover yield (1302, 960 and 2258 kg/ha, respectively) which became statistically at par with post-emergence application of imazethapyr + imazamox at 50(25 + 25) g/ha *fb* interculturing at 40 DAS (1263, 932 and 2224 kg/ha, respectively) and imazethapyr + imazamox at 60 (30 + 30) g/ha *fb* interculturing at 40 DAS (1242, 916 and 2169 kg/ha, respectively). Whereas, significantly lower pod yield, seed yield and stover yield were observed under unweeded check (585, 432 and 999 kg/ha, respectively). This might be due to better growth parameters recorded under these treatments which in turn due to better weed control in these treatments as expressed in terms of significant lower weed dry weight higher weed control efficiencies in these treatments. This is indicated by significantly negative correlation between weed dry weight at 40 DAS, weed dry weight at harvest and seed yield of blackgram (-0.9880** and -0.9830**, respectively). In addition, regression equations explored that every one/m^2 increase in weed dry weight at 40 DAS and at harvest reduced the seed yield of blackgram by 6.043 and 7.074 kg/ha, respectively. This is further indicated by significantly negative correlation between weed dry weight at 40 DAS, weed dry weight at harvest and stover yield of blackgram (-0.9823** and -0.9764**, respectively). In addition, regression equations explored that every one/m^2 increase in weed dry weight at 40 DAS and at harvest reduced the seed yield of blackgram by 15.100 and 17.600 kg/ha, respectively. Hence, as the weed dry weight were lowered in weed free and other better treatments, the seed and stover yields were increased. These findings were in close vicinity with those reported by Choudhary *et al*. (2012), Gupta *et al*. (2013) and Dhakad *et al*. (2023).The semblance of data asserted that weed free recorded lower weed index (00%) which was followed by interculturing followed by hand weedings at 20 and 40 DAS (10.9%), post-emergence application of imazethapyr + imazamox at 50 (25 + 25) g/ha *fb* interculturing at 40 DAS (13.5%) and imazethapyr + imazamox at 60 (30 + 30) g/ha *fb* interculturing at 40 DAS (15.0%). Whereas, the higher weed index was observed under unweeded check (59.9%). Similar findings were correspondingly reported by Komal *et al*. (2015) and Sahoo *et al*. (2017).

Quality parameters

The analysis of data indicated that various weed management practices have not created significant difference on protein content of blackgram seeds. Among different weed management practices, weed free treatment recorded significantly higher protein yield (242.11 kg/ha). After weed free, significantly higher protein yield was found under interculturing followed by hand weedings at 20 and 40 DAS (214.46 kg/ha) and was noted as at par with post- emergence application of imazethapyr + imazamox at 50 (25 + 25) g/ha (PoE) *fb* interculturing at 40 DAS (209.74 kg/ha) and imazethapyr + imazamox at 60 (30 + 30) g/ha (PoE) *fb* interculturing at 40 DAS (205.83 kg/ha). Whereas, significantly lower protein yield was observed under unweeded check (94.74 kg/ha). This might be due to effective control of weeds resulting in the significant reduction in crop-weed competition which benefited the crop with more nutrients and water, which reflects in higher seed yield, accordingly higher protein yield. The similar consequences were also witnessed by Khot *et al*. (2016).

Conclusion

Based on the results of the one year experiment, it is concluded that carry out interculturing followed by hand weedings at 20 and 40 DAS orapply imazethapyr + imazamox at 50 (25 + 25) g/ha at 15-20 DAS *fb* interculturing at 40 DASfor effective control of weeds and to secure higher seed yield and protein yield in blackgram.

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Table 1: Effect of weed management practices on category wise weed dry weight and WCE at 15 DAS in blackgram

Treatments	Weed dry weight (g/m^2)				WCE (%)
	Sedges	Grasses	Broad leaf weeds	Total	
T_1: Pendimethalin at 750 g/ha (PE) *fb* interculturing at 40 DAS	1.20b(1.07)	1.94b(3.26)	2.37b(5.10)	3.15b(9.43)	56.46
T_2: Quizalofop-p-ethyl at 38 g/ha (PoE) *fb* interculturing at 40 DAS	1.69a (2.36)	2.58a (6.14)	3.45a (11.43)	4.52a (19.94)	7.99
T_3: Quizalofop-p-ethyl at 50 g/ha (PoE) *fb* interculturing at 40 DAS	1.97a (3.40)	2.74a (7.03)	3.35a (10.98)	4.67a (21.41)	1.17
T_4: Imazethapyr at 50 g/ha (PoE) *fb* interculturing at 40 DAS	1.84a (2.91)	2.99a (8.60)	3.47a (11.58)	4.85a (23.08)	-6.54
T_5: Imazethapyr at 75 g/ha (PoE) *fb* interculturing at 40 DAS	1.85a (2.99)	2.61a (6.97)	3.58a (12.35)	4.76a (22.31)	-2.95
T_6: Fenoxaprop-p-ethyl at 56.25 g/ha (PoE) *fb* interculturing at 40 DAS	1.95a (3.32)	3.04a (8.76)	3.53a (12.00)	4.96a (24.08)	-11.15
T_7: Fenoxaprop-p-ethyl at 67.5 g/ha (PoE) *fb* interculturing at 40 DAS	1.74a (2.52)	2.64a (6.47)	3.62a (12.67)	4.70a (21.66)	0.03
T_8: Imazethapyr + imazamox at 50 (25 + 25) g/ha (PoE) *fb* interculturing at 40 DAS	2.01a (3.54)	2.84a (7.54)	3.41a (11.43)	4.78a (22.51)	-3.89
T_9: Imazethapyr + imazamox at 60 (30 + 30) g/ha (PoE) *fb* interculturing at 40 DAS	1.79a (2.83)	3.01a (8.59)	3.66a (12.89)	4.98a (24.31)	-12.21
T_{10}: Interculturing followed by hand weedings at 20 and 40 DAS	1.93a (3.25)	3.06a (8.88)	3.10a (9.21)	4.67a (21.35)	1.47
T_{11}: Weed free	0.71c (0.00)	0.71c (0.00)	0.71c (0.00)	0.71c (0.00)	100.00
T_{12}: Unweeded check	1.89a (3.07)	2.94a (8.15)	3.31a (10.45)	4.71a (21.67)	0.00
S.Em.$\pm$	0.13	0.19	0.20	0.17	NA
C.V.%	12.69	12.51	11.19	6.91	

Table 2: Effect of weed management practices on category wise weed dry weight and WCE at 40 DAS in blackgram

Treatments	Weed dry weight (g/m^2)				WCE (%)
	Sedges	Grasses	Broad leaf weeds	Total	
T_1: Pendimethalin at 750 g/ha (PE) *fb* interculturing at 40 DAS	3.19c(9.85)	4.05c(16.10)	4.43c(19.20)	6.76c(45.16)	60.32
T_2: Quizalofop-p-ethyl at 38 g/ha (PoE) *fb* interculturing at 40 DAS	3.86b (14.49)	4.91b (23.68)	5.40b (28.72)	8.21b (66.88)	41.22
T_3: Quizalofop-p-ethyl at 50 g/ha (PoE) *fb* interculturing at 40 DAS	3.84b (14.33)	4.85b (23.11)	5.36b (28.39)	8.14b (65.82)	42.15
T_4: Imazethapyr at 50 g/ha (PoE) *fb* interculturing at 40 DAS	3.03c (8.70)	3.94c (15.44)	4.39c (18.89)	6.60c (43.03)	62.19
T_5: Imazethapyr at 75 g/ha (PoE) *fb* interculturing at 40 DAS	2.92c (8.10)	3.86c (14.44)	4.34c (18.40)	6.44c (40.94)	64.02
T_6: Fenoxaprop-p-ethyl at 56.25 g/ha (PoE) *fb* interculturing at 40 DAS	4.00b (15.64)	4.97b (24.26)	6.01b (35.67)	8.72b (75.57)	35.59
T_7: Fenoxaprop-p-ethyl at 67.5 g/ha (PoE) *fb* interculturing at 40 DAS	3.90b (14.81)	4.92b (23.76)	5.88b (34.11)	8.55b (72.69)	36.12
T_8: Imazethapyr + imazamox at 50 (25 + 25) g/ha (PoE) *fb* interculturing at 40 DAS	2.26d (4.77)	2.94d (8.24)	3.39d (11.47)	4.99d (24.48)	78.49
T_9: Imazethapyr + imazamox at 60 (30 + 30) g/ha (PoE) *fb* interculturing at 40 DAS	2.16d (4.18)	2.56d (6.17)	3.43d (11.29)	4.70d (21.63)	80.99
T_{10}: Interculturing followed by hand weedings at 20 and 40 DAS	2.12d (4.02)	2.42d (5.55)	3.16d (10.07)	4.45d (19.64)	82.74
T_{11}: Weed free	0.71e (0.00)	0.71e (0.00)	0.71e (0.00)	0.71e (0.00)	100.00
T_{12}: Unweeded check	4.63a (20.99)	6.33a (39.93)	7.29a (52.88)	10.67a (113.79)	0.00
S.Em.$\pm$	0.20	0.25	0.28	0.22	NA
C.V.%	11.60	11.15	11.00	5.87	

Table 3: Effect of weed management practices on category wise weed dry weight and WCE at harvest in blackgram

Treatments	Weed dry weight (g/m^2)				WCE (%)
	Sedges	Grasses	Broad leaf weeds	Total	
T_1: Pendimethalin at 750 g/ha (PE) *fb* interculturing at 40 DAS	3.47c (11.57)	2.88c (7.84)	3.35c (10.78)	5.54c (30.19)	66.25
T_2: Quizalofop-p-ethyl at 38 g/ha (PoE) *fb* interculturing at 40 DAS	4.53b (20.18)	3.60b (12.48)	4.77b (22.31)	7.44b (54.97)	38.54
T_3: Quizalofop-p-ethyl at 50 g/ha (PoE) *fb* interculturing at 40 DAS	4.28b (17.82)	3.58b (12.33)	4.69b (21.55)	7.24b (51.70)	42.20
T_4: Imazethapyr at 50 g/ha (PoE) *fb* interculturing at 40 DAS	3.46c (11.44)	2.85c (7.62)	3.29c (10.75)	5.49c (29.82)	66.66
T_5: Imazethapyr at 75 g/ha (PoE) *fb* interculturing at 40 DAS	3.33c (10.58)	2.60c (6.29)	2.97c (8.32)	5.07c (25.19)	71.83
T_6: Fenoxaprop-p-ethyl at 56.25 g/ha (PoE) *fb* interculturing at 40 DAS	4.63b (21.03)	3.80b (13.93)	4.89b (23.43)	7.67b (58.39)	34.71
T_7: Fenoxaprop-p-ethyl at 67.5 g/ha (PoE) *fb* interculturing at 40 DAS	4.57b (20.44)	3.68b (13.02)	4.82b (22.87)	7.54b (56.32)	37.03
T_8: Imazethapyr + imazamox at 50 (25 + 25) g/ha (PoE) *fb* interculturing at 40 DAS	2.48d (6.02)	1.81d (2.80)	1.99d (3.55)	3.58d (12.37)	86.16
T_9: Imazethapyr + imazamox at 60 (30 + 30) g/ha (PoE) *fb* interculturing at 40 DAS	2.24d (4.54)	1.65d (2.63)	1.93d (3.22)	3.27d (10.39)	88.39
T_{10}: Interculturing followed by hand weedings at 20 and 40 DAS	2.08d (4.20)	1.56d (1.99)	1.82d (2.86)	3.08d (9.06)	89.87
T_{11}: Weed free	0.71e (0.00)	0.71e (0.00)	0.71e (0.00)	0.71e (0.00)	100.00
T_{12}: Unweeded check	5.93a (34.74)	5.00a (24.55)	5.51a (30.15)	9.48a (89.43)	0.00
S.Em.$\pm$	0.22	0.17	0.21	0.18	NA
C.V.%	10.73	10.56	10.56	5.64	

Table 4: Effect of weed management practices on various growth parameters in blackgram

Treatments	Plant height (cm) at harvest	Number of branches per plant	Yield (kg/ha)			Protein content (%)	Protein yield (kg/ha)	Weed index (%)
			Pod	Seed	Stover			
T_1: Pendimethalin at 750 g/ha (PE) *fb* interculturing at 40 DAS	40.65	4.90	1054	777	1808	22.22	172.65	27.8
T_2: Quizalofop-p-ethyl at 38 g/ha (PoE) *fb* interculturing at 40 DAS	33.15	4.25	867	640	1402	21.99	140.74	40.6
T_3: Quizalofop-p-ethyl at 50 g/ha (PoE) *fb* interculturing at 40 DAS	33.51	4.29	895	660	1443	22.06	145.60	38.7
T_4: Imazethapyr at 50 g/ha (PoE) *fb* interculturing at 40 DAS	42.35	5.10	1070	789	1824	22.10	174.37	26.8
T_5: Imazethapyr at 75 g/ha (PoE) *fb* interculturing at 40 DAS	42.82	5.14	1074	792	1857	22.03	174.48	26.4
T_6: Fenoxaprop-p-ethyl at 56.25 g/ha (PoE) *fb* interculturing at 40 DAS	31.11	4.17	757	559	1356	22.45	125.50	48.1
T_7: Fenoxaprop-p-ethyl at 67.5 g/ha (PoE) *fb* interculturing at 40 DAS	32.22	4.21	778	574	1391	22.27	127.83	46.7
T_8: Imazethapyr + imazamox at 50 (25 + 25) g/ha (PoE) *fb* interculturing at 40 DAS	49.64	6.02	1263	932	2224	22.48	209.51	13.5
T_9: Imazethapyr + imazamox at 60 (30 + 30) g/ha (PoE) *fb* interculturing at 40 DAS	49.40	5.94	1242	916	2169	22.47	205.83	15.0
T_{10}: Interculturing followed by hand weedings at 20 and 40 DAS	50.13	6.07	1302	960	2258	22.34	214.46	10.9
T_{11}: Weed free	51.60	6.93	1460	1077	2657	22.48	242.11	0.0
T_{12}: Unweeded check	30.73	3.29	585	432	999	21.93	94.74	59.9
S.Em.$\pm$	2.13	0.26	49.12	36.23	104.26	0.37	9.13	NA
CD at 5%	6.25	0.75	144.07	106.25	305.77	NS	26.77	
C.V.%	9.10	8.81	8.27	8.27	10.13	2.87	9.35	

Table .5: Correlation and regression equations for various dependent and independent parameters of blackgram

Sr. No.	Independent variable (x)	Dependent variable (y)	Correlation coefficient (r)	Regression equation y	R^2
1	Total weed dry weight at 40 DAS (g/m^2)	Seed yield (kg/ha)	-0.9880**	y = 1055.867 – 6.043x	0.9762
2	Total weed dry weight at harvest (g/m^2)		-0.9830**	y = 1011.133 – 7.074x	0.9662
17	Total weed dry weight at 40 DAS (g/m^2)	Stover yield (kg/ha)	-0.9823**	y = 2524.150 – 15.100x	0.9648
18	Total weed dry weight at harvest (g/m^2)		-0.9764**	y = 2411.851 – 17.660x	0.9534

** = Significant at 1% * = Significant at 5%