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Research Paper

Integrated weed management in blackgram (*Vigna mungo*) under mid hills of Arunachal Pradesh

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ABSTRACT

Field investigation was carried out during pre *kharif* seasons of 2009 and 2010 at ICAR, Research Complex NEH Region, Arunachal Pradesh Centre, Basar to develop integrated weed management for blackgram (*Vigna mungo* L.) var. 'PU-31' with pre plant incorporation of fluchloralin @ 1.5 lit/ha, pre-emergence application of pendimethalin @ 1.5 lit/ha and hand weeding. Pre-emergence application of pendimethalin @ 1.5 lit/ha + one hand weeding on 25 DAS was at par with 2 hand weeding at 15 and 25 DAS in respect of seed yield, net returns and B: C ratio. In weedy check, weeds removed 6 kg N, 2.8 kg P and 7.0 kg K/ha.

Key words : Economics, NPK removal, Weed dynamics, Weed control efficiency

Blackgram is an important pulse crops in India. It contains 48.0% carbohydrates, 22.3% protein, 154 mg calcium, 9.1 mg iron, 1.4 g fat, 0.37 g riboflavin and 0.42 mg thiamin in per 100 gm of blackgram (Asaduzzaman *et al.*, 2010). The green foliage of blackgram can also be used as animal feed and the residues as manure. The crop has special importance in intensive cropping system of the country due to it's short growing duration. However, the average yield of blackgram is very low.

This crop receives low priority as it is grown by low income farmers on marginal lands. Heavy weed infestation is the dominant reason for such a low yield of black gram (Rao *et al*., 2010). In general, yield loss due to uncontrolled weed growth in black gram ranges from 27 to 100% (Singh and Singh, 2010). Blackgram is less competitive against many weeds during early stage of crop and the most sensitive period of weed competition is between 3 to 6 weeks after sowing.

Due to high rainfall throughout the year, weeds grow luxuriantly and pose a serious threat to short statured crops like blackgram in Arunachal Pradesh. No systematic information regarding weed control is available and benefits of applied input cannot be fully utilized unless it is followed by a proper weed control programme. Manual removal of weed is labour intensive, tedious, back breaking and does not ensure weed removal at critical stages of crop weed competition due to non availability of labour, and bad weather conditions. To develop an effective crop management technology and to prevent the huge loss due to weeds one has to realize that the ecological relationship in weed-crop competition is a complicated phenomenon (Ganiger *et al*., 2003). Therefore, a field experiment was conducted to study the integrated weed management on productivity, weed dynamics, nutrient removal and economics of blackgram production.

MATERIALS AND METHODS

Field experiment was carried out at the experimental farm of ICAR Research Complex for NEH Region, Arunachal Pradesh Centre, Basar, located at West Siang District of Arunachal Pradesh, India during pre *kharif* 2009 and 2010. The area falls under the humid sub tropical climate. The daily temperature during the study period varied between a minimum of 17.4°C to a maximum of 35.2°C. The average annual rainfall was 2365 mm. The soil of the experimental field was a silty loam with moisture retention of 24.2% at 0.03 MPa and 14.5% at 1.5 MPa. The bulk density was 1.37 t/m^3. The soil was acidic in reaction (pH 5.3), high in soil organic carbon (Walkaley and Black, 1.50%), low in available N (alkaline permanganate N, 205.6 kg/ha), low in available phosphorus (Olsen P, 8.3 kg/ha) and medium in available K (Neutral normal ammonium acetate K, 260 kg/ha). The experiment was laid out in a randomized block design with three replications. There were seven treatments as follows; pendimethalin @ 1.5 lit/ha (pre-emergence), fluchloralin

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@ 1.5 lit/ha (pre plant incorporation), pendimethalin @ 1.5 lit/ha + hand weeding at 25 days after sowing (DAS), fluchloralin @ 1.5 lit/ha + hand weeding at 25 DAS, two hand weeding (15 and 25 DAS), weed free and weedy check as control. The seeds were placed in furrows at a depth of 2-3 cm from soil surface during March after the first shower. Row to row distance was maintained at 30 cm and plant to plant distance was 10 cm. The gross plot size was 3.6 m × 3.0 m. NPK@ 20:60:50 kg/ha was applied in the form of urea, single super phosphate and muriate of potash during the final land preparation. Weeding and thinning was done as per the treatments. Pre-plant incorporation and pre-emergence herbicides were done with the help of a hand operated knapsack sprayer fitted with flat-fan nozzle. No additional irrigation was given to the crop. Harvesting was done in the month of June when 90% of the pods became brown to black in colour. The harvested pods were hand picked from pre demarcated area of 3.0 m^2 at the centre of the plot.

The growth and yield attributes were recorded from five selected plants in each plot. Observations on weeds were recorded with the help of a quadrant 0.5 m x 0.5 m, placed randomly at two spots in each plot at 25 and 50 DAS. The data on weeds were subjected to square root transformation ($\sqrt{x+0.5}$) to normalize their distribution. Weeds were cut at ground level, washed with tap water, sun dried for a few days and than oven drying at 65°C for 48 hours and then weighted. Total dry matter was determined by the summing up the dry weight of each plant. Weed control efficiency was calculated using weed dry weight data at 50 DAS which was maximum during weed growth period irrespective of treatments. The N, P and K removal by weeds were recorded at 50 DAS. Economics was calculated as per the existing price of input and output at local market. The data for different parameters were statistically analyzed by SAS 9.2 programme. The mean differences were computed at 5% level of significance.

RESULTS AND DISCUSSION

Crop growth

All growth characters recorded significantly higher values in completely weed free plot and was followed by hand weeding twice, and integrated weed management plots (Table 1). This was due to least competition from weeds for the light, space, as well as above and below ground resources in weedy check. Weed infestation considerably reduces yield and crop must be maintained in such a way that crop-weed competition is minimum (Asaduzzaman *et al.*, 2010). Similar result was reported by Sultana *et al.*, 2009 in mungbean.

Nodulation

Weed management practices had a significant impact on nodulation. Better growth attributes induced higher accumulation and translocation of photosynthates to different plant parts, which helped the plant to develop more nodules. More nodule and higher nodule dry weight was recorded when plants were free from weeds followed by hand weeding twice. Herbicide application had no deleterious effect on nodule number and their weight.

Yield

All yield attributes *viz.* pods/plant, seeds/pod, seed and stover yield were significantly influenced by various weed management practices (Table 2). Complete weed free plot recorded significantly higher yield attributes over other weed management practices and was fairly close to hand weeding twice. Weed free plot recorded 68.7% higher seed yield and 42.5% higher stover yield over weedy check. However, harvest index was not significantly affected by weed control treatment. Application of pendimethalin @ 1.5 lit/ha and one hand weeding at 25 DAS increase the average crop yield of both the years by 47.4%. Similarly, fluchloralin @ 1.5 lit/ha and one hand weeding at 25 DAS recorded 41.3% higher yield over

Table 1. Effect of different weed management practices on growth characters and nodulation of blackgram (pooled data of 2 years)

Treatment	Plant height (cm)	Branches/ plant	Stem girth (cm)	Leaf area index	Total dry matter (g/plant)	Nodules/ plant	Nodules dry weight (mg/plant)
Pendimethalin @ 1.5 lit/ha	60.8	5.7	1.3	5.5	31.9	15.0	99.0
Fluchloralin @ 1.5 lit/ha	60.8	5.4	1.1	5.2	29.0	14.5	86.2
Pendimethalin @ 1.5 lit/ha + hand weeding at 25 DAS	62.9	6.4	1.4	6.2	31.6	15.7	108.0
Fluchloralin @ 1.5 lit/ha + hand weeding at 25 DAS	65.2	6.0	1.3	5.9	29.6	14.6	101.4
Two hand weeding at 15 and 25 DAS	64.4	6.7	1.5	6.9	36.1	16.3	115.7
Weed free	67.3	7.3	1.5	7.6	38.5	19.1	123.8
Weedy check	55.6	4.6	1.0	4.2	18.6	12.4	73.9
SEm±	2.17	0.24	0.09	0.18	0.55	0.63	2.12
CD (P=0.05)	6.07	0.68	0.27	0.49	1.60	1.83	5.95

weedy check. The findings are in conformity with earlier finding by Kalita *et al*., 1995. Applications of herbicides only increased the seed yield of 35.9% in case of pendimethalin and 25.1% in case of fluchloralin over weedy check. The increased yield in these treatments was due to effective control of weeds in early stage by treatments, which reduced weed growth and increased growth and yield attributes of black gram and finally leads to higher yield. The results are analogous to those reported by Rao and Murthy (2004) and Begum and Rao (2006).

Economics

Economic analysis of data (Table 2) showed that weed management practices differed with cost involved in production, return and net return per rupee investment. Weed free and hand weeding twice registered higher cost involved in production and net return. Pendimethalin @ 1.5 lit/ha followed by one hand weeding at 25 DAS registered highest net return per rupee investment followed by hand weeding twice.

Weed dynamics

The experimental field was dominated by natural infestation of broad leaf weed (BLW) like *Ageratum conyzoids, Boreria hispida, Cromolina odorata, Commelina banghalensis* and grasses like *Echinochloa colona, Cynodon dactylon, Paspalum scrobeculatum, Digiteria singuanalis* and sedges like *Cyperus rotundus*. Among the weed flora averaged over two years and various treatments, the maximum relative percentage was of *Ageratum conyzoids* (40.4%) followed by *Boreria hispida* (28.6%) and *Cynodon dactylon* (19.2%). The maximum weed density was recorded in weedy check followed by fluchloralin @ 1.5 lit/ha are given in table 3. As would be reported, weed free plot recorded no weeds at 25 and 50 DAS. The lowest weed density was recorded in hand weeding twice followed by pendimethalin @ 1.5 lit/ha and one hand weeding at 25 DAS (Table 3). Weed dry weight reflects the growth potential of the weeds and is a better indicator of its competitive ability with the crop plants. Weed dry weight followed the similar trend to weed density and weed check recorded the highest weed dry weight at 25 and 50 DAS followed by fluchloralin @ 1.5 lit/ha. However, hand weeding twice recorded the lowest weed dry weight. Un-weeded check recorded the highest weed growth and weed biomass. In general, sequential treatments were found to be superior to individual application of herbicides (Rao *et al*., 2010). Weed control efficiency followed similar trend as weed dry weight, wherein weed free plot recorded 100% WCE followed by hand weeding twice (86.2%) and pendimethalin @ 1.5 lit/ha and one hand weeding (78.8%) over weedy check. Similar finding was earlier reported by Singh *et al.*, 1991.

Nutrient removal

The N, P and K removal by weeds was significantly influenced by various weed management practices (Table 3). Nutrient removal by weeds was zero in weed free plot, followed by hand weeding twice. However, the highest removal of nutrient was recorded in weedy check plot. Application of pendimethalin @ 1.5 lit/ha followed by one hand weeding at 25 DAS recorded lower nutrient removal during both the years. Therefore, it is well augmented that the weeds should be eradicated at an early stage of crop growth. Any delay in weed control may result in robbing off nutrients by weeds and depriving the crop of its share (Naeem *et al*., 1999).

On the basis of present study it is suggested that weeds should not be allowed in blackgram fields to compete during early stage of crop. Weeds could be controlled effec-

Table 2. Effect of different weed management practices on yield attributes yields and economics of blackgram (pooled data of 2 years)

Treatment	Days to 50% flowering	Pods/ plant	Seeds/ pod	Seed yield (t/ha)	Stover yield (t/ha)	Harvest index (%)	Cost of cultivation ($\times 10^3$ ₹/ha)*	Net returns ($\times 10^3$ ₹/ha)	NPR
Pendimethalin @ 1.5 lit/ha	40.7	36.0	10.7	1.2	2.7	30.5	11.4	22.0	1.9
Fluchloralin @ 1.5 lit/ha	39.0	34.1	10.2	1.1	2.6	30.0	11.4	19.9	1.8
Pendimethalin @ 1.5 lit/ha + hand weeding at 25 DAS	42.3	38.1	11.3	1.3	3.2	28.5	11.9	26.0	2.2
Fluchloralin @ 1.5 lit/ha + hand weeding at 25 DAS	41.1	36.2	10.8	1.3	2.8	30.5	12.0	23.5	2.0
Two hand weeding at 15 and 25 DAS	43.5	39.1	11.1	1.4	3.3	24.5	12.7	25.9	2.0
Weed free	44.9	41.8	11.5	1.5	3.5	29.5	13.4	27.2	2.0
Weedy check	37.4	27.2	9.9	0.85	2.4	26.5	10.2	15.6	1.5
SEm±	0.80	0.87	0.29	0.04	0.10	0.98			0.05
CD (P=0.05)	2.26	2.59	0.81	0.13	0.29	3.00			0.14

*Economic parameters are interpreted as per the market price of the inputs and economic outputs during 2010; NPR: Net return per rupees of investment

tively and economically by two hand weedings at 15 DAS and 30 DAS. Pre plant incorporation and pre-emergence herbicides mainly reduce weeds in early stages and weed emergence at later stage of blackgram is not controlled well. Therefore a combination of herbicides and one hand weeding is recommended for better weed management and higher crop yield in black gram.

Table 3. Effect of different weed management practices on weed density, weed dry weight, weed control efficiency and nutrient removal by weeds (pooled data of 2 years)

Treatment	Weed density (number/m^2)		Weed dry weight (g/m^2)		Weed control efficiency (%)	Nutrient removal by weeds (kg/ha)		
	25 DAS	50 DAS	25 DAS	50 DAS		N	P	K
Pendimethalin @ 1.5 lit/ha	12.1 (146.7)	14.7 (217.4)	4.7 (21.6)	5.5 (29.2)	55.3	4.9 (24.0)	2.5 (5.5)	6.1 (36.4)
Fluchloralin @ 1.5 lit/ha	13.5 (181.0)	15.6 (246.0)	5.0 (24.0)	5.7 (32.9)	49.3	5.4 (28.3)	2.5 (5.7)	6.3 (39.7)
Pendimethalin @ 1.5 lit/ha + hand weeding at 25 DAS	10.7 (115.4)	9.0 (81.0)	4.2 (16.9)	3.8 (13.8)	78.8	4.6 (20.3)	2.1 (3.9)	5.1 (25.3)
Fluchloralin @ 1.5 lit/ha + hand weeding at 25 DAS	11.7 (135.7)	9.7 (93.0)	4.6 (20.4)	4.3 (18.4)	71.7	4.9 (24.2)	2.2 (4.7)	5.5 (29.9)
Two hand weeding at 15 and 25 DAS	9.1 (81.7)	7.3 (53.0)	3.6 (12.5)	3.1 (8.9)	86.2	3.6 (12.4)	1.9 (2.9)	4.3 (18.3)
Weed free	0.7 (0.0)	0.7 (0.0)	0.7 (0.0)	0.7 (0.0)	100.0	0.7 (0.0)	0.7 (0.0)	0.7 (0.0)
Weedy check	16.8 (282.7)	21.7 (469.2)	5.9 (35.3)	8.1 (58.7)	0.0	5.9 (34.8)	2.8 (7.3)	7.1 (49.2)
SEm±	0.23	0.30	0.11	0.13		0.10	0.06	0.10
CD (P=0.05)	0.63	0.86	0.32	0.37		0.29	0.17	0.29

DAS, Days after sowing; Data were subjected to square root transformation. Figures given in parenthesis are original values.

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