Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2020; 9(1): 1284-1288
Received: 01-11-2019
Accepted: 03-12-2019

Sooraj Chandra Pankaj
(Ph. D. Scholar) Department of Agronomy, Ranchi Agriculture College, Birsa Agricultural University, Ranchi, Jharkhand, India

RR Upasani
Department of Agronomy, Ranchi Agriculture College, Birsa Agricultural University, Ranchi, Jharkhand, India

Sheela Barla
Department of Agronomy, Ranchi Agriculture College, Birsa Agricultural University, Ranchi, Jharkhand, India

Pradeep Kumar Dewangan
Department of Agronomy, Ranchi Agriculture College, Birsa Agricultural University, Ranchi, Jharkhand, India

Corresponding Author:
Sooraj Chandra Pankaj
(Ph. D. Scholar) Department of Agronomy, Ranchi Agriculture College, Birsa Agricultural University, Ranchi, Jharkhand, India

Influence of different weed management practices on weed dynamics, yield attributes and economics of black gram

Sooraj Chandra Pankaj, RR Upasani, Sheela Barla and Pradeep Kumar Dewangan

DOI: https://doi.org/10.22271/phyto.2020.v9.i1v.10633

Abstract
A field experiment was conducted at Birsa Agricultural University, Ranchi, Jharkhand during rainy & winter seasons of 2015-16 and 2016-17. The experiment was laid out in randomized block design with 12 treatments i.e. haloxyfop 81 g/ha, haloxyfop 108 g/ha, haloxyfop 135 g/ha, haloxyfop 270 g/ha, fenoxaprop-p-ethyl 61.9 g/ha, quizalofop-ethyl 43.8 g/ha, imazethapyr 100 g/ha each applied at 20 DAS, pendimethalin 1000 g/ha, oxyfluorfen 100 g/ha each applied at 3 DAS, two mechanical, two hand weeding each performed at 25 and 45 DAS and weedy check, replicated thrice. Black gram *var.* Birsa Urd-1 was sown at 30 cm using 30 kg seed/ha fertilized with recommended level of nutrients N:P_2O_5:K_2O:Si.e. 25:50:25:25 kg/ha. Mustard *var.* Pusa-Bold was sown at 30 cm using 5 kg seed/ha fertilized with recommended level of nutrients N:P_2O_5:K_2O:S i.e. 80:40:20:20 kg/ha. The experimental field was mainly infested with *Eleusine indica*, *Echinocloa* spp. *Commelina* spp., *Alternanthra sessilis* and *Cyperus* species. Two hand weeding at 25 & 45 DAS recorded higher number of pods/plant, 1000-seed weight, seed yield and harvest index to the extent of 28.90, 16.10, 104.09 and 38.87 per cent, respectively as compare to weedy check i.e. 10.72 pods/plant, 33.80 g, 621 kg/ha and 19.15 per cent, respectively. However, application of haloxyfop 108 g/ha at 20 DAS recorded ₹ 10,513 and ₹ 13,878/ha higher net return compared to conventional practice of weed control i.e. two hand weeding at 25 & 45 DAS (₹ 26,789/ha) and two mechanical weeding at 25 & 45 DAS (₹ 23,421/ha), respectively and also recorded maximum B: C ratio (1.56).

Keywords: Black gram, economics, weed flora, yield attributes, yield

Introduction
Black gram is one of the important pulse crops grown in India. It is also known as urdbean, mash and black maple etc. It being a short duration crop suits well in the cropping system, as it vacates field well in time giving the opportunity to many winter crops like mustard, lentil *etc* grown in limited irrigation and rainfed situation. Black gram is grown in about 3.62 million ha with productivity of 537 kg/ha in India (Anonymous, 2017b) [3]. In Jharkhand, it is grown in about 94.9 thousand ha with an average productivity of 760 kg/ha (Anonymous, 2017c) [4].

Among various production factors, weed plays vital role in influencing black gram yield. Weeds compete with the resources like nutrient, moisture and light. High temperature coupled with frequent rains during growing period infests the crop heavily with weeds which adversely affect the productivity of this crop. An initial period of 20-40 days is very critical for crop-weed competition (Goud *et al*., 2013 and Mundra and Maliwal, 2012) [10, 14]. Black gram is infested with different categories of weeds. Among grassy weeds *Echinochloa spp*., *Setaria glauca*, *Digera arvensis*, *Elusine indica*, *Dactyloctenium aegyptium*, *Cynodon dactylon*, broad leaved weed P*arthenium hysterophorus*, *Phyllanthus niruri*, *Amaranthus viridis*, *Celosia argentea*, *Cleome viscosa*, *Trianthema portulacastrum*; and among sedges weeds *Cyperus rotundus* and *Cyperus difformis* dominate. Initial slow growth of black gram gives ample opportunity to weeds to smother crop. Cultural and mechanical methods of weed control are not always effective in first 45 days (Prabhakar *et al*., 1992) [17]. Frequent rains and wet soil condition further aggravates the situation. Depending on the nature, density and period of occurrences, weeds can cause losses of grain yield varying from 27 to 90 per cent (Singh *et al*., 2010 and Kumar *et al*., 2016) [20, 12]. Manual and mechanical weeding is labor intensive and tedious. Many times laborers are not available during peak time of requirement for weeding. Even if they are available the escalating cost of laborers further limits its option. The cultural method of weed control like adoption of suitable crop rotation, stale seed bed method, reduced tillage and soil solarization *etc* are long term planning.

The chemical method of weed control is not only cost effective but also is efficient in minimizing weed infestation for longer period provided they are applied judiciously i.e. suitable herbicide, it's proper dose and appropriate time of application.

Materials and Methods

A field experiment was conducted during rainy & winter seasons of 2015-16 and 2016-17 at Birsa Agricultural University, Ranchi, Jharkhand. Ranchi situated at 23º17" N latitude, 85º10"E longitude and 625 m above mean sea level in the Chhotanagpur plateau range. The experimental soil was sandy-loam in texture with low organic carbon (0.33 %), moderately acidic (pH 5.5) in nature, low available nitrogen (185.30 kg/ha), medium phosphorus (21.32 kg/ha), medium potassium (161.28 kg/ha) and high sulphur (11.54 kg/ha) content. A total rainfall 521.4 mm (27 rainy day) during 2015-16 and 949.7 mm (35 rainy days) during 2016-17 was received at experimental site during crop period. The crop period (July to March) was characterized by 30.6 to 21.1 ^{0}C of mean monthly maximum temperature and 30.3 to 23.9 ^{0}C mean monthly minimum temperatures. The experiment was laid out in randomized block design with 12 treatments i.e. haloxyfop 81 g/ha, haloxyfop 108 g/ha, haloxyfop 135 g/ha, haloxyfop 270 g/ha, fenoxaprop-p-ethyl 61.9 g/ha, quizalofop-ethyl 43.8 g/ha, imazethapyr 100 g/ha each applied at 20 DAS, pendimethalin 1000 g/ha, oxyfluorfen 100 g/ha each applied at 3 DAS, two mechanical, two hand weeding each performed at 25 and 45 DAS and weedy check, replicated thrice. Black gram *var.* Birsa Urd-1 was sown at 30 cm using 30 kg seed/ha fertilized with recommended level of nutrients N:P_2O_5:K_2O:S i.e. 25:50:25:25 kg/ha. Mustard *var.* Pusa-Bold was sown at 30 cm using 5 kg seed/ha fertilized with recommended level of nutrients N:P_2O_5:K_2O:S i.e. 80:40:20:20 kg/ha. Prior to sowing black gram seeds were treated with bavistin and rhizobium culture. The crop was irrigated immediately after sowing to insure uniform germination. All the herbicides were applied at 20 days after sowing of the crop using Knapsack sprayer fitted with flat fan nozzle with 750 litre water/ha. Hand weeding and mechanical weeding was done as per the treatment schedule. For manual weeding treatment, two hand weeding were given at 25 and 45 DAS. Cultural practices recommended for black gram were adopted during the crop growth period. Weed density (species wise) was counted at 25, 45 DAS and at maturity stage of crop. At maturity, observations pods/plant, seeds/pod were taken from 10 random plants/plot. Pods were collected from 10 plants in each plot and threshed manually to record seeds/pod. A 1000-seed sample was collected from each plot for recording 1000-seed weight. The harvesting was done by cutting the plants at ground level after complete maturity. The two border rows on four sides of the plot were first harvested and then net plots were harvested separately. The plants from net plot were bundled separately and dried. Threshing was done manually and seeds were separated and yield was recorded per plot at a moisture content of 12 per cent and given as kg/ha. Biological yield and grain yield were recorded on a plot basis and harvest index was calculated. Gross returns were calculated by taking the sale price of black gram as ₹50 per kg. Net returns (₹/ha) were calculated as: Net returns = Gross returns - cost of cultivation including the cost of individual treatments. Benefit: cost ratio was calculated after dividing net returns with the cost of cultivation. Statistical analysis was carried out by method of Gomez and Gomez (2008) [9]. Wherever statistical significance was observed, critical difference (CD) at 5 per cent level of probability was worked out for comparison.

Results and Discussion

Effect on weed flora

Experimental field was naturally infested with all three categories of weeds i.e. grassy, broad-leaf and sedges covering seven families (Table 1). Altogether 14 weed species existed. Among grassy, *Eleusine indica* Gaerts, *Echinochloa crusgalli* (L.) P Beauv., *Digitaria sanguinalis* (L.), *Dactyloctenium aegyptium* (L.); among broad-leaf *Commelina benghalensis* (L.), *Commelina nodifolia* (L.), *Alternanthra sessilis* (L.), *Ageratum conyzoides* (L.), *Lactuca virosa* (L.), *Oldenlandia corymbosa* (L.); and among sedges, *Cyperus rotundus*(L.) and *Cyperus esculentus* (L.), were dominant. The relative composition of grassy, broad-leaf and sedges weeds accounted for 38.74, 34.58 and 37.11 per cent; 50.77, 54.38 and 52.66 per cent; 10.48, 10.04 and 10.23 per cent during 2015, 2016 and under pooled data, respectively.

The relative composition of major weed species accounted for *Eleusine indica* Gaerts - 16.43, 14.78 and 15.56 per cent; *Commelina benghalensis* (L.) - 14.28, 15.74 and 15.03; *Alternanthra sessilis* (L.) - 7.84, 8.03 and 7.94; *Cyperus rotundus* (L.) - 7.99,7.48 and 7.71; *Digitaria sanguinalis* (L.) - 7.84, 7.12 and 7.47; *Commelina nodifolia* (L.) - 6.74, 7.53 and 7.1 and *Echinochloa crusgalli* (L.) P Beauv. - 7.29, 6.80 and 7.04 per cent during 2015, 2016 and under pooled data, respectively. Mundra and Maliwal (2012) [14] reported *Echinochloa spp.* and *Cynodon dactylon*, *Digera arvensis* and *Elusine indica* among grasses, *Cyperu srotundus and Cyperus difformis* among sedges and *Parthenium hysterophorus*, *Amaranthus viridis*, *Triantherma portulacstrum* etc were among broad-leaved were dominant weed flora in black gram crop. Similar findings at different locations were also observed by Das *et al.*, (2014) [8], Aggarwal *et al.*, (2014) [1], Punia (2014) [18], Jakhar *et al.*, (2015) [11] Pankaj and Dewangan (2017) [16].

Table 1: Weed flora observed in weedy check plot at maturity stage in black gram

Category	Common Name	Botanical Name	Family	Relative composition (%)		
				2015	2016	Pooled
Grassy	Goose grass	*Eleusine indica Gaerts.*	Poaceae	16.43	14.78	15.56
	Barnyard grass	*Echinocloa crusgalli* (L.) P. Beauv	Poaceae	7.29	6.80	7.04
	Crab grass	*Digitaria sanguinalis* (L.)	Poaceae	7.84	7.12	7.47
	Crow foot grass	*Dactyloctenium aegyptium* (L.)	Poaceae	7.19	6.89	7.04
Broad-leaf	Day flower	*Commelina bengalensis* (L.)	Commelianaceae	14.28	15.74	15.03
	Common day flower	*Commelina nodifolia* (L.)	Commelianaceae	6.74	7.53	7.14
	Wetland amaranth	*Alternanthra sessilis* (L.)	Amaranthaceae	7.84	8.03	7.94
	Bill goat weed	*Ageratum conyzoides* (L.)	Asteraceae	5.99	6.48	6.23
	Wild lettuce	*Lactuca virosa* (L.)	Asteraceae	5.49	6.80	6.18
	Diamond flower	*Oldenlandia corymbosa* (L.)	Rubiaceae	5.94	5.66	5.80
	Potato weed	*Galinsoga parviflora* (L.)	Asteraceae	3.49	2.74	3.09

	Scarlet pimpernel	*Anagallis arvensis* (L.)	Primulaceae	1.00	1.41	1.24
Sedges	Purple nut sedge	*Cyperus rotundus* (L.)	Cyperaceae	7.99	7.48	7.71
	Yellow nut sedge	*Cyperus esculentus* (L.)	Cyperaceae	2.50	2.55	2.52
Total				100.00	100.00	100.00

Effect on crop yield and yield attributes, yield and harvest index

Number of pods per plant

Number of pods per plant of black gram was significantly influenced during 2015, 2016 and under pooled data (Table 2). Two hand weeding at 25 and 45 DAS followed by two mechanical weeding at 25 and 45 DAS recorded higher pods per plant to the extent of 31.20, 26.30 & 28.90 and 29.22, 23.09 & 26.32 higher pods respectively compared to minimum pods observed under weedy check pods/plant during 2015, 2016 and under pooled data, respectively.

Among herbicides, application of haloxyfop 108 g/ha at 20 DAS recorded significantly higher pods/plant compared to weedy check to the extent of 31.14, 25.97 and 28.67 per cent during 2015, 2016 and under pooled data, respectively. Similar findings were reported earlier by Nirala *et al*., (2012) [15] and Mundra and Maliwal (2012) [14].

Number of seeds per pod

Number of seeds per pod of black gram did not differ significantly by weed control methods during 2015, 2016 and under pooled data (Table 2). However, hand weeding at 25 and 45 DAS recorded maximum number of seeds per pod followed by haloxyfop 108 g/ha at 20 DAS during 2015, 2016 and under pooled data, respectively.

Similar finding was reported earlier by Punia (2014) [18].

Table 2: Yield attributes of black gram as influenced by weed control methods

Tr. No.	Treatments	Yield attributes								
		Number of pods per plant			Number of seeds per pod			1000-gseed weight (g)		
		2015	2016	Pooled	2015	2016	Pooled	2015	2016	Pooled
T_1	Haloxyfop 10.8% EC @ 81 g/ha at 20 DAS	14.03	13.73	13.88	5.33	5.00	5.17	39.57	39.18	39.38
T_2	Haloxyfop 10.8% EC @ 108 g/ha at 20 DAS	15.93	14.13	15.03	5.37	5.03	5.20	38.57	40.67	39.62
T_3	Haloxyfop 10.8% EC @ 135 g/ha at 20 DAS	15.47	14.03	14.75	5.00	5.00	5.00	38.07	38.78	38.43
T_4	Haloxyfop 10.8% EC @ 270 g/ha at 20 DAS	13.10	13.17	13.13	4.83	4.83	4.83	36.80	37.16	36.98
T_5	Fenoxaprop-p-ethyl 9.3% EC @ 61.9 g/ha at 20 DAS	11.03	12.87	11.95	5.13	4.97	5.05	36.80	37.13	36.97
T_6	Quizalofop-ethyl 5% EC @ 43.8 g/ha at 20 DAS	12.60	11.87	12.23	5.03	5.03	5.03	38.97	39.04	39.00
T_7	Imazethapyr 10% SL @ 100 g/ha at 20 DAS	13.60	13.40	13.50	5.23	5.23	5.23	39.47	35.47	37.47
T_8	Pendimethalin 30 EC @ 1000 g/ha at 3 DAS	15.20	13.14	14.17	5.10	4.97	5.03	38.33	38.92	38.63
T_9	Oxyfluorfen 23.5% EC @ 100 g/ha at 3 DAS	15.70	13.47	14.59	5.27	5.37	5.32	39.43	38.20	38.82
T_{10}	Two mechanical weeding at 25 and 45 DAS	15.50	13.60	14.55	5.33	5.23	5.28	37.67	38.57	38.12
T_{11}	Two hand weeding at 25 and 45 DAS	15.95	14.20	15.08	5.47	5.53	5.50	39.60	41.07	40.33
T_{12}	Weedy check	10.97	10.46	10.72	4.87	4.93	4.90	35.93	31.57	33.75
SEm (±)		0.98	0.87	0.56	0.28	0.30	0.25	1.24	1.21	0.86
CD (P=0.05)		2.89	2.56	1.64	NS	NS	NS	3.64	3.55	2.53
CV (%)		12.10	11.46	7.09	9.33	10.31	8.28	5.61	5.51	3.92

1000-seed weight

The 1000-seed weight of black gram was significantly influenced during 2015, 2016 and under pooled data (Table 2). Two hand weeding at 25 and 45 DAS being recorded significantly higher 1000-seed weight to the tune of 9.30, 23.10 and 16.10 per cent compare to minimum observed under weedy check i.e. 35.93, 31.60 and 33.80 g during 2015, 2016 and under pooled data, respectively.

Among herbicides, application of haloxyfop 108 g/ha at 20 DAS herbicides recorded significantly higher 1000-seed weight compared to weedy check to the extent of 9.20, 22.36 and 14.65 per cent during 2015, 2016 and under pooled data, respectively. Similar findings was reported earlier by Sangeetha *el al.*, (2012) [19] and Pankaj and Dewangan (2017) [16].

Seed yield

Two hand weeding at 25 and 45 DAS being similar to rest of the treatments except recorded 103.40, 104.80 and 104.09 per cent higher seed yield compared to minimum observed under weedy check during 2015, 2016 and under pooled data, respectively. Two mechanical weeding at 25 and 45 DAS 32.02 and 39.47, 35.53 & 37.64 per cent higher seed yield compared to lower yield obtained during 2015, 2016 and under pooled data, respectively.

Among herbicides, application of haloxyfop 108 g/ha at 20 DAS recorded 50.08, 48.38 & 49.28 per cent higher seed yield compared to lowest yield observed under weedy check, respectively. Similar results were also reported by Chhodavadia *et al.*, (2012) [6], Mundra and Maliwal (2012) [14].

Straw yield

Straw yield of black gram was not influenced significantly by different weed control methods during 2015, 2016 and under pooled data (Table 3). However, two mechanical weeding at 25 and 45 DAS recorded maximum straw yield i.e. 2709, 2646 and 2678 kg/ha during 2015, 2016 and under pooled data, respectively as compare to all other treatments. Similar results were also reported by Chaudhary *et al.*, (2011) [5] and Mundra and Maliwal (2012) [14], Kumar (2014) [13] and Punia (2014) [18].

Table 3: Seed yield, straw yield and harvest index of black gram as influenced by weed control methods

Tr. No.	Treatments	Seed yield (kg/ha)			Straw yield (kg/ha)			Harvest Index (%)		
		2015	2016	Pooled	2015	2016	Pooled	2015	2016	Pooled
T_1	Haloxyfop 10.8% EC @ 81 g/ha at 20 DAS	1187	1104	1145	2553	2419	2486	31.80	31.57	31.68
T_2	Haloxyfop 10.8% EC @ 108 g/ha at 20 DAS	1296	1151	1223	2502	2459	2480	34.24	32.02	33.13
T_3	Haloxyfop 10.8% EC @ 135 g/ha at 20 DAS	1220	1075	1148	2549	2459	2504	32.35	30.47	31.41
T_4	Haloxyfop 10.8% EC @ 270 g/ha at 20 DAS	998	884	941	2524	2584	2554	28.82	25.58	27.20
T_5	Fenoxaprop-p-ethyl 9.3% EC @ 61.9 g/ha at 20 DAS	776	767	771	2687	2498	2593	22.32	23.63	22.98
T_6	Quizalofop-ethyl 5% EC @ 43.8 g/ha at 20 DAS	1040	896	968	2653	2558	2605	28.15	26.02	27.08
T_7	Imazethapyr 10% SL @ 100 g/ha at 20 DAS	1135	993	1064	2582	2444	2513	30.64	28.85	29.74
T_8	Pendimethalin 30 EC @ 1000 g/ha at 3 DAS	1087	945	1016	2616	2580	2598	29.42	26.90	28.16
T_9	Oxyfluorfen 23.5% EC @ 100 g/ha at 3 DAS	660	693	676	2682	2605	2644	19.70	21.12	20.41
T_{10}	Two mechanical weeding at 25 and 45 DAS	1069	922	995	2709	2646	2678	28.28	25.84	27.06
T_{11}	Two hand weeding at 25 and 45 DAS	1316	1217	1266	2556	2493	2525	33.98	32.80	33.39
T_{12}	Weedy check	647	594	621	2659	2582	2621	19.50	18.80	19.15
SEm (±)		85.64	66.48	55.78	172.86	181.8	164.3	2.23	1.92	1.54
CD (P=0.05)		251.14	194.95	163.58	NS	NS	NS	6.55	5.62	4.52
CV (%)		14.32	12.29	9.80	11.49	12.5	11.1	13.68	12.31	9.67

Harvest index

Harvest index of black gram was significantly influenced during 2015, 2016 and under pooled data (Table 3). Two hand weeding at 25 and 45 DAS being similar to rest of the treatments during 2015, 2016 and under pooled data, respectively. The increase was 42.60, 42.70 and 42.60 per cent compare to weedy check per i.e. 19.50, 18.80 and 19.15% during 2015, 2016 and under pooled data, respectively, while, two mechanical weeding at 25 and 45 DAS recorded 31.05, 27.24 & 29.23 per cent higher harvest index compared to weedy check, respectively.

Among herbicides, application of haloxyfop 108 g/ha at 20 DAS being similar to all treatments except fenoxaprop-p-ethyl 61.9 g/ha and imazethapyr 100 g/ha each applied at 20 DAS during 2015 recorded 75.59, 70.32 and 73.00 per cent higher harvest index compared to lower harvest index observed under weedy check. Similar results were also reported by Chaudhary *et al.*, (2011) [5] and Mundra and Maliwal (2012) [14], Kumar (2014) [13] and Punia (2014) [18].

Effect on crop economics

Gross return

Two hand weeding at 25 and 45 DAS recorded significantly higher gross return to the extent of 50.80, 51.17 and 51.00 per cent compared to minimum gross return observed under weedy check i.e. during 2016 and under pooled data respectively.

Two mechanical weeding at 25 and 45 DAS recorded 39.47, 35.54 and 37.64 per cent higher gross return compared to minimum observed under weedy check during 2015, 2016 and under pooled data, respectively.

Among herbicides, application of haloxyfop 108 g/ha at 20 DAS data recorded 50.08, 48.38 and 49.28 per cent higher gross return compared to minimum observed under weedy check during 2015, 2016 and under pooled data, respectively. Similar results were also reported by Chaudhary *et al.*, (2011) [5], Mundra and Maliwal (2012) [14], Kumar (2014) [13] and Punia (2014) [18].

Net return

Application of haloxyfop 108 g/ha at 20 DAS being similar to haloxyfop 81 g/ha and haloxyfop 108 g/ha each applied at 20 DAS during 2015 and 2016; haloxyfop 81 g/ha under pooled data recorded 3.92, 4.32 and 4.09 times higher net return to minimum net return observed under weedy check i.e. 10,430, 7799 and 9115/ha during 2015, 2016 and under pooled data, respectively (Table 4).

Two hand weeding at 25 and 45 DAS followed by two mechanical weeding at 25 and 45 DAS recorded 3.04, 3.43 and 3.22 times higher net return compared to minimum observed under weedy check during 2015, 2016 and under pooled data, respectively. Similar results were also reported by Chaudhary *et al.*, (2011) [5], Mundra and Maliwal (2012) [14], Kumar (2014) [13] and Punia (2014) [18].

Benefit: cost ratio

Application of haloxyfop 108 g/ha at 20 DAS recorded 4.75, 3.92 and 3.71 times higher benefit: cost ratio compared to minimum observed under weedy check i.e. 0.48, 0.36 and 0.42 during 2015, 2016 and under pooled data, respectively (Table 4).

Two hand weeding at 25 and 45 DAS being similar to rest of the treatments recorded 1.94, 2.19 and 2.05 times higher benefit: cost ratio compared to minimum observed under weedy check during 2015, 2016 and under pooled data, respectively. Similar results were also reported by Chaudhary *et al.*, (2011) [5] and Mundra and Maliwal (2012) [14].

Table 4: Gross return, net return and B: C ratio of black gram as influenced by different weed management practices

Tr. No.	Treatments	Gross return (₹/ha)			Net return (₹/ha)			B: C ratio		
		2015	2016	Pooled	2015	2016	Pooled	2015	2016	Pooled
T_1	Haloxyfop 10.8% EC @ 81 g/ha at 20 DAS	59353	55180	57266	35830	31657	33743	1.52	1.35	1.44
T_2	Haloxyfop 10.8% EC @ 108 g/ha at 20 DAS	64784	57560	61172	40911	33687	37299	1.71	1.41	1.56
T_3	Haloxyfop 10.8% EC @ 135 g/ha at 20 DAS	61012	53760	57386	36790	29537	33163	1.52	1.22	1.37
T_4	Haloxyfop 10.8% EC @ 270 g/ha at 20 DAS	49879	44225	47052	23906	18252	21079	0.92	0.70	0.81
T_5	Fenoxaprop-p-ethyl 9.3% EC @ 61.9 g/ha at 20 DAS	38796	38346	38571	15059	14609	14834	0.63	0.62	0.63
T_6	Quizalofop-ethyl 5% EC @ 43.8 g/ha at 20 DAS	52011	44779	48395	27735	20503	24119	1.14	0.84	0.99
T_7	Imazethapyr 10% SL @ 100 g/ha at 20 DAS	56729	49628	53179	33416	26315	29866	1.43	1.13	1.28
T_8	Pendimethalin 30 EC @ 1000 g/ha at 3 DAS	54326	47258	50792	30053	22985	26519	1.24	0.95	1.09
T_9	Oxyfluorfen 23.5% EC @ 100 g/ha at 3 DAS	32984	34663	33824	9596	11275	10436	0.41	0.48	0.45

T_{10}	Two mechanical weeding at 25 and 45 DAS	53432	46081	49756	30772	23421	27096	1.36	1.03	1.19
T_{11}	Two hand weeding at 25 and 45 DAS	65793	60853	63323	31726	26786	29256	0.93	0.79	0.86
T_{12}	Weedy check	32342	29711	31027	10430	7799	9115	0.48	0.36	0.42
SEm (±)		4281.88	3323.77	2788.88	1831.52	1648.19	1281.70	0.08	0.07	0.05
CD (P=0.05)		12557.20	9747.41	8178.78	5371.17	4833.54	3758.77	0.23	0.19	0.16
CV (%)		14.32	12.29	9.80	11.67	12.84	8.98	12.24	12.61	9.16

Acknowledgement
The authors acknowledge Dow Agro Sciences India Pvt. Ltd., for funding the project.

References

1. Aggarwal N, Singh G, Ram H and Khanna V. Effect of post-emergence application of imazethapyr on symbiotic activities growth and yield of black gram (*Vigna mungo* L.) cultivars and its efficacy. Indian Journal of Agronomy. 2014; 59(3):421-426.
2. Anonymous. Pulses in India: Retrospect and Prospects. Publication: DPD/Pub.1/ Vol.2/2016. Published by Director, Govt. of India, Ministry of Agri. & Farmers Welfare, Directorate of Pulses Development, Vindhyachal Bhavan, Bhopal, Madhya Pradesh, 2017a.
3. Anonymous: Economics Survey of India, Directorate of Economics and Statistics, Government of India; 2017b.
4. Anonymous. Directorate of Agriculture, Jharkhand, Annual Report, 2017c.
5. Chaudhary SU, Iqbal J, Hussain M and Wajid A. Economical weed control in lentil crop. The Journal of Animal and Plant Science. 2011; 21(4):734-737.
6. Chhodavadia SK, Sagarka BK, Gohil BS, Dobariya VK. Herbicidal weed control in green gram. Agriculture: towards a new paradigm of sustainability. 2012, 207-211.
7. Choudhary VK, Kumar SP, Bhagawati R. Integrated weed management in black gram (*Vigna mungo* L.) under mid hills of Arunachal Pradesh. Indian Journal of Agronomy. 2012; 57(4):382-385.
8. Das R, Patra BC, Mandal MK, Pathak A. Integrated weed management in black gram (*Vigna mungo* L.) and its effect on soil microflora under sandy loam soil of West Bengal. The Bioscan. 2014; 9(4):1593-1596.
9. Gomez KA, Gomez AA. Statistical procedures for agricultural Research. A Willey- Interscience Publication, John Willey and Sons, New York, 2008.
10. Goud VV, Murade NB, Khakre MS, Patil AN. Efficacy of imazethapyr and quizalofop-ethyl herbicides on growth and yield of chickpea. The Bioscan. 2013; 8(3):1015-1018.
11. Jakhar P, Yadav SS, Choudhary R. Response of weed management practices on the Productivity of urdbean (*Vigna mungo* L. Hepper). Journal of Applied and Natural Science. 2005; 7(1):348-352.
12. Kumar N, Hazra KK, Nadarajan N. Efficacy of post-emergence application of Imazethapyr in summer mungbean (*Vigna radiata* L.). Legume Research. 2016; 39(1):96-100.
13. Kumar, S. Evaluation of herbicides in black gram and their residual effect on succeeding mustard crop. M.Sc. (Ag) Thesis (Agronomy) College of Agriculture, Chaudhary Charan Singh Haryana Agricultural University, Hisar, 2014.
14. Mundra SL, Maliwal PL. Influence of quizalofop-ethyl on narrow-leaved weeds in black gram and its residual effect on succeeding crops. Indian Journal of Weed Science. 2012; 44(4):231-234.
15. Nirala H, Choubey NK, Bhoi S. Performance of post-emergence herbicides and hand weedings with respect to their effects on weed dynamics and yields of black gram (*Vigna mungo* L.). International Journal of Agricultural and Statistics Sciences. 2012; 8(2):679-689.
16. Pankaj SC, Dewangan PK. Weed management in black gram (*Vigna mungo* L.) and residual effect of herbicides on succeeding mustard (*Brassica juncea* L.) crop. International Journal of Current Microbiology and Applied Sciences. 2017; 6(11):865-881.
17. Prabhakar T SP, Bhatnagar PS. Production technology for augmenting soybean productivity in India. Journal of Oilseeds Research. 1992; 9:1-13.
18. Punia R. Evaluation of some herbicides in green gram (*Vigna radiata* L.) and their residual effect on succeeding mustard crop. M.Sc. (Ag) Thesis (Agronomy) College of Agriculture, Chaudhary Charan Singh Haryana Agricultural University, Hisar, 2014.
19. Sangeetha C, Chinnusamy C, Prabhakaran NK. Efficacy of imazethapyr on productivity of soybean and its residual effect on succeeding crops. Indian Journal of Weed Science. 2012; 44(2):135-138.
20. Singh VP, Singh SP, Kumar A, Tripathi N, Nainwal RC. Efficacy of Haloxyfop, a post-emergence herbicide on weeds and yield of soybean. Indian Journal of Weed Science. 2010; 42(1&2):83-86.