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Efficacy of herbicides controlling on weed flora and productivity of greengram

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Abstract
A field experiment was conducted at Research Farm, College of Agriculture, Gwalior, Madhya Pradesh, India during *Kharif*(rainy) seasons in 2016 to study the efficacy of pre- and Post-emergence herbicides on weeds, growth, yield and yield attributes traits of greengram. The minimum population of narrow and broad leaf weed species were recorded with hand weeding twice at 45 days stages, which was significantly highest weed control of treatments imazethapyr + imezamox (RM) @ 80 g/ ha PoE and pendimethalin + imazethapyr (RM) @ 1000 g/ ha PE at harvest stage. The maximum value of plant height, number of leaves and number of branches per plant; and yield characters number of pods/plant and number of seeds per pod parameters were recorded with Imazethapyr + Imazamox (RM) @ 80g / ha PoE, which was at par with two hand weeding at 20 and 40 DAS. It was followed by Pendimethalin + imazethapyr (RM) @ 750 g a. i./ ha PE. Weed free treatment provided the highest grain yield, gross returns and net returns. Among the herbicides, preemergence application of pre-mix imazethapyr + imezamox (RM) at 80 g per ha recorded higher grain yield (972 kg/ha) and provided higher net returns (Rs. 42490/-) and B:C ratio (3.18) than the other treatments of herbicides due to significant reduction in the dry weight of weeds and higher weed control efficiency and consequently improving the yield attributing parameters.

Keywords: Weed, greengram, herbicides, imazethapyr

Introduction
Greengram (*Vigna radiata* L.), also known as Mung bean, is grown in *Kharif*(rainy) season in many parts of India. Weeds are one of the most limiting factors in successful greengram production. Due to monsoon rainfall in rainy season, weeds grow luxuriantly and pose a serious threat to greengram. Weeds compete for nutrients, water, light and space with crop plants. Raising of greengram requires lot of labour due to more weeds and farmers generally do not harvest profitable yields. Weeds can cause 30- 85% yield losses in greengram (Raman and Krishnamoorthy 2005, Yadav and Singh 2005, Mirjha *et al*. 2013) [10, 5]. The effect of weed competition is greater during early growth period than the later one. Traditionally, weeds in greengram are controlled by manual weeding and hoeing at appropriate growth stages. Manual weeding is time-consuming and expensive and often not feasible due to intermittent rains during rainy season. The labour is also becoming scarce, not available in time and expensive to further increase the cost of cultivation. Under such situations, use of appropriate herbicide with suitable dose remains the pertinent choice for timely control of weeds. The effectiveness of pendimethalin and imazethapyr on weed control and productivity of greengram or pulses was reported (Kaur *et al*. 2010) [4]. Due to involvement of high cost and scarcity of labour for manual weeding, there is a need of evaluation of pre-emergence (PE) and postemergence (PoE) herbicides in green gram for effective weed control.

Therefore, an experiment was conducted to study the effect of pre- and post-emergence herbicides on weeds, growth, and grain yield of greengram.

Materials and Methods

The field experiment was conducted at Research Farm, College of Agriculture, Gwalior, Madhya Pradesh, India. An experiment was sown in randomized complete block design with 2 replications during the *kharif* season 2016. The trial consisted of ten herbicides such as T1=Quizalofop - p – ethyl 5EC @ 50 g a. i./ ha E Po E, T2=Quizalofop - p – ethyl 5EC @ 75 g a. i./ ha E Po E, T3= Quizalofop - p – ethyl 5EC @ 100 g a. i./ ha E Po E, T4= Fenoxaprop - p – ethyl 10 EC @ 100 g a. i./ ha E Po E, T5= Pendimethalin 30 EC @ 1000 g a. i./ ha PE, T6= Pendimethalin 30 EC + Imazethapyr 2EC @ (RM) 750g a. i./ ha PE, T7= Pendimethalin 30 EC +Imazethapyr 2EC (RM) @1000g a. i. / ha PE, T8= Imazethapyr + Imazamox (RM) E Po E @ 80 g a. i. / ha, T9= Weed Free (Two hand weeding at 20 and 40 DAS), and T10= unwedded control. The unit plot size was 5 m ×4 m. Seeds were sown on the July 19, 2010. The variety TJM 3 was grown with a fertilizer dose @ 20:50:20 kg ha -1 of N:P2O5:K2O in the form of urea, single superphosphate, muriate of potash, respectively as basal application during final land preparation. The seeds were sown @ 18 kg per ha in furrows at 40 cm x 10 cm spacing at a depth of 2 to 3 cm below the soil surface. The crop requires only 12-15 cm water throughout its growth period. Depending on rainfall the irrigation water applied in field. First irrigation was given at 45 DAS. Rainfall helped the crop to avoid further irrigations in between.

Intercultural operations such as mulching, thinning, applying insecticides were done as and when necessary. Weed samples were taken at 30, 45 DAS and harvesting from 1 m 2 area in each plot using quadrate and weed population and dry weights were recorded. The crop growth, weed dry weight and weed control efficiency were recorded at 40 days after sowing of the crop. Weed control efficiency (WCE%) and weed index were calculated following Kundu *et al*. (2009) [6] as:

$$\text{Weed control efficiency (\%)} = \frac{X - Y}{X} \times 100$$

Where,
X = Dry matter of weeds in un weeded plot.
Y = Dry matter of weeds in treated plot.

$$\text{Weed Index} = \frac{X - Y}{X} \times 100$$

Where,
X = Yield from maximum weed free plot.
Y = Yield from other treated plot.

Data on yield and yield attributes traits were recorded from five randomly selected plants from each plot and grain yield was recorded from the whole plot. The Data were statistically analyzed using the analysis of variance technique (Fisher, 1958). All types of variable production cost were recorded to find out the cost and return. Economic analysis with respect to gross margin was calculated to evaluate the profitability of different treatments.

Results and Discussion

Effect on weed flora

During the period of experimentation, The major narrow leaf weed species found in the experimental plots were three *viz. Cyperus rotundus*, *Echinochloa colona*, and *Setaria Glauca;* and broad leaf weed species were three *viz. Digera Arvensis*, *Commelina benghalensis* and *Phyllanthus Niruri*. These six species were most dominant, contributing about of the total weed flora (Table 1). In general, the population of narrow leaf and broad leaf weed species were reduced drastically with the use of herbicides at all the stages of the crop. These results are accordance with who Singh *et al.*, (2017) [13] and Mishra *et al*., (2017) [7] concluded that weed control measures significantly reduced the population of weed compared to the weedy check in greengram. Lowest weed population of narrow and broad weeds were recorded in hand weeding twice at 45 DAS while highest in weedy check. Similar result was also obtained by Muthuram *et al.* (2018) [8]. In general, herbicidal was treatments At 45 DAS and harvest stage, minimum population of narrow leaf weeds in species wise and in total was registered with imazethapyr + imazamox (RM) 80 g/ ha PoE followed by pendimethalin + imazethapyr (RM) 1000 g/ ha PE. These results are in close agreement with Mishra *et al*., (2017) [7] who had reported lowest narrow weeds density with application of imazethapyr + imezamox (RM). Tilgam *et al*. (2015) also reported that pendimethalin + Imazethapyr (RM) @ 1000 g/ ha as pre-emergence or application of imazethapyr + imazamox (RM) @ 80 g per ha as post-emergence are most effective weed management practices for controlling the narrow leaf weeds in greengram.

In case of population of broad leaf weeds species like *Digera arvensis*, *Commelina benghalensis* and *Phyllanthus Niruri* were obtained lowest under application of imazethapyr + imezamox (RM) @ 80 g/ ha PoE followed by, pendimethalin + imazethapyr (RM) @ 1000 g/ ha PE, pendimethalin @ 1000 g/ha PoE, and fenoxaprop-p-ethyl @ 100 g/ ha PoE and all these treatments were comparable to hand weeding twice at 20 and 40 DAS almost at all the stages. Minimum population of total broad leaf weeds was also found with imazethapyr + imezamox (RM) @ 80 g/ ha PoE at 45 harvest, which was statistically at par with two hand weeding at all the stages. However, post-emergence application of imazethapyr + imazamox (RM) @ 80 g/ ha was also comparable to two hand weeding treatment at 45 and harvest stages and alone application of fenoxaprop-p-ethyl @ 100 g/ ha PoE at harvest stage. The effectiveness of pendimethalin + imazethapyr (RM) @ 1000 g/ ha PE against broad leaf weed shas also documented by Kaur *et al*. (2016), Dungarwal *et al*. (2003) [2] and Singh Guriqbal *et al.*, (2017) [12]

The minimum population of total weed was recorded with hand weeding twice at 45 days stages, which was significantly lower over rest of other treatments except imazethapyr + imezamox (RM) @ 80 g/ ha PoE and pendimethalin + imazethapyr (RM) @ 1000 g/ ha PE at harvest stage. Among herbicidal treatments, lowest population of total weeds was found with application of imazethapyr + imezamox (RM) @ 80 g/ ha PoE followed by pendimethalin + imazethapyr (RM) @ 1000 g/ ha PE, quizalofop-p-ethyl @ 50 g/ ha, quizalo fop-p-ethyl @ 75 g/ ha, quizal ofop-p-ethyl @ 75 g/ ha and fenoxaprop-p-ethyl 100 g/ ha PoE. This may be due to batter control of narrow and broad leaf weeds under these treatments. Similar results were also obtained by Tomar (2011) [14], Dungarwal *et al.* (2003) [2] and Chaudhari *et al.*, (2016) [1]. Imazethapyr + imezamox (RM) 80 g/ ha PoE and pendimethalin + imazethapyr (RM) 1000 g/ ha PE, which was

significantly lower compared to remaining herbicidal treatments. All these herbicidal treatments demonstrated a very effective mortality of broad as well as narrow leaf weeds resulting decline in dry matter accumulation and proved best of all the herbicidal treatments for weed control in greengram field. Similar results were also obtained by Patel *et al.* (2016), Tomar (2011) [14] and Singh *et al*. (2017) [13] in case of pre-mix application of pendimethalin + imazathapyr.

Higher weed control efficiency was recorded in two hand weeding treated plot (88.51%) followed by imazethapyr + imezamox (RM) 80 g/ ha PoE (72.82%), pendimethalin + imazethapyr (RM) 1000 g/ ha PE (82.79%) and fenoxaprop-p-ethyl (100 g/ ha) PoE (51.76%). The higher weed control efficiency under these treatments was reflected through lower dry weight of weeds. These results are in tune with the finding of Patel *et al*., (2016), Raj *et al*., (2012) [9], Tilgam *et al.*, (2015) and Chaudhari *et al.* (2016) [1].

Weed index is indirectly related to the reduction in yield due to weed population and weed dry weight. Minimum reduction in seed yield of greengram (0%) due to least weed competition was found in application of imazethapyr + imazamox (RM) @ 80 g/ ha PoE, followed by two HW at 20 and 40 DAS (7.60%), pendimethalin + imazethapyr (RM) @ 750 g/ ha PE (15.00%), pendimethalin + imazethapyr (RM) @ 1000 g/ ha PE (22.12%), pendimethalin @ 1000g/ ha PE (27.85%), fenoxaprop-p-ethyl @ 100 g/ ha PoE (34.13%), quizalofop-p-ethyl @ 75 g/ ha PoE (30.93%). The infestation of weeds throughout the crop growth period caused 56.68% reduction in seed yield of greengram. Drastic reductions in seed yield of greengram due to higher weed competition in weedy check have been reported by several other workers Aktar *et al.*, (2015); Chaudhari *et al.*, (2016) [1] and Muthuram *et al.*, (2018) [18].

Effect on crop

All weed management practices resulted in significant in Plant height, Number of leaves per plant, Number of branches per plant, Number of nodules / plant, Number of pods/plant, Number of seeds / pods and Test weight except Plant population/row length and harvest index (Table 2). The maximum value plant height, number of leaves and number of branches per plant growth parameters were recorded with Imazethapyr+ Imazamox (RM) @ 80g / ha PoE, which was at par with two hand weeding at 20 and 40 DAS. The minimum values of these parameters were noted in weedy check. The highest number of nodules per plant was achieved in two hand weeding plot at 45 DAS of observation. However, it was statistically at par with Imazethapyr+ Imazamox (RM) @ 80g / ha PoE and Pendimethalin 1000 g/ ha PE. The treatment weedy check gave lowest number of nodules (27.89 / plant) over rest of treatments. The characters Number of pods/plant, Number of seeds / pods and Test weight characters were significantly increased over weed check by all weed control treatments. The difference amongst application imazethapyr + imazamox (RM) @ 80 g/ ha as post-emergence, two hand weeding at 20 and 40 DAS and application of pendimethalin + imazethapyr (RM) @ 750 g/ ha as pre-emergence in respect of all yield characters were significant and recorded highest values of these parameters. The weed control treatments had significant impact on seed and stover yield. Maximum seed yield and stover yield and were found in imazethapyr + imazamox (RM) 80 g/ ha, PoE followed by hand weeding twice at 20 and 40 DAS and pendimethalin + imazethapyr (pre-mix) 750 g/ ha PE these treatments were at par with each other. The highest value of harvest index (35.80%) was recorded with treatment weedy check and lowest with Quizalofop-p-ethyl @ 100 g/ ha PoE. Among herbicidal treatments, post - emergence application of Quizalofop-p-ethyl @ 75 g/ ha PoE recorded maximum harvest index (35.35%), followed by Pendimethalin @1000 g/ ha PE (35.13%).

The highest grain yield and stover yield was recorded with imazethapyr + imazamox (RM) 80 g/ ha PoE, while lowest in weedy check. Among the herbicidal treatments, two hand weeding (20 and 40 DAS) and pendimethalin + imazethapyr (RM) 750 g/ ha PE recorded significantly higher seed as well as stover yield and they were at par with treatment imazethapyr + imazamox (RM) 80 g/ ha PoE. Such superior weeded treatments minimized weed-crop competition in early stage and made more environmental resources available for crop plant that improved growth traits. This increased plant height which produced more assimilates to be synthesized, translocated and accumulated in various plants organs. This positively reflected on seed and stover yield. The superiority of these treatments over weedy check in increasing yield has also been reported by Jitendra *et al.* (2003) [3], Raj *et al.* (2012) [9]. Harvest index was not significantly affected due to weed control treatments. The maximum harvest index was recorded from weedy check followed byquizalofop-p-ethyl @ 75 g/ ha and pendimethalin @ 1000 g/ ha PE. It may possible due to lesser weed population under these plots hence increased NPK availability resulting increase harvest index of greengram crop.

Economics

Economics of different weed control treatments (**Table 3**) showed that weed free gave the maximum gross returns and net returns, followed by pre-mix application of imazethapyr+ imazamox (RM) @ 80 g/ ha PoE. Post - emergence application of imazethapyr+ imazamox (RM) @ 80 g/ ha PoEgave the highest B:C ratio followed by followed by pendimethalin + imazethapyr (RM) @ 750g/ ha PE (2.80), two hand weeding (2.60) and pendimethalin + imazethapyr (RM) @ 1000 g/ ha PE (2.53) while minimum B : C ratio with weedy check (1.46).Tamang *et al.* (2015) also observed maximum net returns and benefit: cost ratio obtained from pendimethalin + imazethapyr 1000 g/ha. Higher economic returns in these treatments could be due to higher grain yields as well as cost effectiveness for controlling weeds. It was concluded that Post - emergence application of imazethapyr+ imazamox (RM) @ 80 g/ ha as post-emergence effectively controlled the weeds, improved the grain yield (972 kg per ha) of greengram and provided high net returns (42490) and B:C ratio (3.18).

From the results of field experiments, it is concluded that hand hoeing at 20 and 40 DAS achieved best results but in paucity of labour, preemergence application of imazethapyr+ imazamox (RM) @ 80 g/ ha PoE or pendimethalin + imazethapyr (RM) @ 750 g/ ha PE was found suitable alternate for managing complex weed flora and obtaining higher seed yield, net return and return per rupees invested for *Kharif* greengram.

Table 1: Population of different weed species, dry weight, weed control efficiency and weed index as influenced by different weed control treatments in greengram

Treatments	Narrow leaf weeds			Broad leaf weeds			Total dry weight of weeds (g/m^2)	Weed control efficiency (%)	Weed index (%)
	weed count (no./m^2) at 45 DAS						at harvest		
	Cyperus rotundus	*Echinochloa colona*	*Setaria Glauca*	*Digera Arvensis*	*Commelina benghalensis*	*Phyllanthus Niruri*			
Quizalofop-p-ethyl @ 50 g/ ha PoE	10.81 (116.33)	2.12 (4.00)	2.04 (3.67)	2.97 (8.33)	2.92 (8.00)	2.80 (7.33)	8.2 (66.81)	27.53	41.11
Quizalofop-p-ethyl @ 75 g/ ha PoE	10.04 (100.33)	2.04 (3.67)	1.39 (1.67)	2.86 (7.67)	2.90 (8.00)	2.54 (6.00)	7.94 (62.56)	30.93	30.96
Quizalofop-p-ethyl @ 100 g/ ha PoE	8.93 (79.33)	2.03 (3.67)	1.38 (1.67)	2.35 (5.00)	2.48 (5.67)	2.34 (5.00)	6.64 (43.63)	51.76	45.18
Fenoxaprop-p-ethyl @ 100 g/ ha PoE	8.40 (70.00)	2.52 (6.00)	1.86 (3.00)	2.34 (5.00)	1.95 (3.33)	2.20 (4.33)	7.44 (54.88)	39.32	34.13
Pendimethalin @ 1000 g/ ha PE	9.34 (86.67)	2.27 (4.67)	2.35 (5.00)	1.76 (2.67)	2.61 (6.33)	1.39 (1.67)	7.43 (54.68)	39.49	27.85
Pendimethalin + imazethapyr (RM) @ 750 g/ ha PE	8.93 (79.33)	1.68 (2.33)	1.77 (2.67)	1.68 (2.33)	1.84 (3.00)	1.46 (1.67)	6.65 (43.66)	52.05	15.00
Pendimethalin + imazethapyr (RM) @1000 g/ ha PE	7.34 (53.33)	1.52 (2.00)	1.56 (2.00)	1.46 (1.67)	1.58 (2.00)	1.34 (1.33)	6.56 (42.56)	52.79	22.12
Imazethapyr + imazamox (RM) @ 80 g/ ha PoE	6.12 (37.00)	2.09 (4.00)	1.34 (1.67)	0.71 (0.00)	0.88 (0.33)	0.88 (0.33)	4.91 (23.61)	72.81	0.00
Hand Weeding at 20 and 40 DAS	5.34 (28.00)	1.77 (2.67)	1.68 (2.33)	0.71 (0.00)	0.71 (0.00)	0.88 (0.33)	3.38 (10.91)	88.51	7.60
Weedy check	12.27 (150.00)	2.37 (5.00)	1.86 (3.00)	3.54 (12.00)	3.44 (11.33)	3.01 (9.00)	9.67 (92.96)	0.00	56.68
S.E.(m)±	0.43	0.18	0.17	0.08	0.17	0.21	0.34	0.12	6.79
CD (at 5%)	1.29*	0.53*	0.49*	0.25*	0.49*	0.63*	1.0*	0.37*	20.16*

PE :Pre - emergence PoE : Post - emergence DAS :Days after sowing

Table 2: Influence of different weed control treatments on the symbiotic traits, plant characters and yield attributes of greengram

Treatments	Plant height (cm)	Number of leaves per plant	Number of branches per plant	Number of nodules / plant at 45 days	Number of pods/plant	Number of seeds / pods	Test weight (g)
	at Harvest						
Quizalofop-p-ethyl @ 50 g/ ha PoE	50.53	25.13	12.47	37.22	26.56	11.98	33.90
Quizalofop-p-ethyl @ 75 g/ ha PoE	49.73	24.80	13.13	32.56	31.22	12.09	33.90
Quizalofop-p-ethyl @ 100 g/ ha PoE	48.60	24.53	11.40	34.56	31.33	12.14	34.97
Fenoxaprop-p-ethyl @ 100 g/ ha PoE	48.93	24.40	12.33	34.11	35.56	12.57	35.20
Pendimethalin @ 1000 g/ ha PE	51.80	24.80	13.40	37.56	26.89	11.95	34.10
Pendimethalin + imazethapyr (RM) @ 750 g/ ha PE	49.40	24.60	14.00	34.44	32.33	12.44	35.73
Pendimethalin + imazethapyr (RM) @ 1000 g/ ha PE	50.20	25.07	13.53	33.22	29.78	12.34	34.67
Imazethapyr + imazamox (RM) @ 80g/ ha PoE	53.80	26.27	15.13	40.67	41.33	13.17	37.13
Hand Weeding at 20 and 40 DAS	52.20	25.73	14.60	44.33	38.44	12.71	35.37
Weedy check	46.47	24.07	11.00	27.89	24.11	11.90	32.77
S.E. (m)±	0.94	0.23	0.40	2.55	3.31	0.17	0.84
C.D. (at 5%)	2.79*	0.69*	1.20*	7.59*	9.84*	0.49*	NS

Table 3: Influence of different weed control treatments on biological yield, grain yield, harvest index and economics of green gram

Treatment	Grain yield (kg/ ha)	Stover yield (kg/ ha)	Biological yield (kg/ha)	Harvest index (%)	Gross return ($x10^3$ /ha.	Net return($x10^3$ /ha.	B:C ratio
Quizalofop-p-ethyl @ 50 g/ ha PoE	569	1176	1745	32.82	36.49	16.72	1.85
Quizalofop-p-ethyl @ 75 g/ ha PoE	676	1222	1898	35.35	43.00	22.43	2.09
Quizalofop-p-ethyl @ 100 g/ ha PoE	537	1163	1700	31.58	34.54	13.17	1.62
Fenoxaprop-p-ethyl @ 100 g/ ha PoE	639	1278	1917	33.58	40.89	21.22	2.08
Pendimethalin @ 1000 g/ ha PE	704	1289	1993	35.13	44.81	25.88	2.37
Pendimethalin + imazethapyr (RM) @ 750 g/ ha PE	824	1590	2414	34.05	52.62	33.84	2.80
Pendimethalin + imazethapyr (RM) @ 1000 g/ ha PE	754	1435	2189	34.35	48.11	29.13	2.53
Imazethapyr + imazamox (RM) @ 80 g/ ha PoE	972	1843	2815	34.70	62.00	42.49	3.18
Hand Weeding (20 and 40 DAS)	898	1747	2628	34.18	57.37	35.31	2.60
Weedy check	417	741	1158	35.80	26.50	83.32	1.46
S.E.(m)±	67.23	123.74	184.42	1.33			
CD (at 5%)	199.74*	367.65*	547.92*	NS			

Reference

1. Chaudhari VD, Desai LJ, Chaudhari SN, Chaudhari PR. Effect of weed management on weeds, growth and yield of summer greengram (*vigna radiata* L.) 2016; 11(1):531-534.
2. Dungarwal HS, Chaplot PC, Nagda BL. Chemical weed control in greengram (*Phaseolus radiatus* L.). Indian Journal of Weed Sci. 2003; 35:283-284.
3. Jitendra SN, Pandey RA, Mishra BN. Effect of weed management practices in a rice, mustard and greengram cropping system and yield of crops. Agronomy Division, India Agril. Res. Inst., New Delhi, India. Annals. Of Agril. Res. 2003; 24(4):737- 74.
4. Kaur G, Brar HS, Singh G. Effect of weed management on weeds, nutrient uptake, nodulation, growth and yield of summer Mung bean (*Vigna radiata*). Indian Journal of Weed Science. 2010; 42(1, 2):114-119.
5. Komal SP, Singh, Yadav RS. Effect of weed management on growth, yield and nutrient uptake of greengram. Indian journal of weed science. 2015; 47(2):206-210.
6. Kundu R, Bera PS, Brahmachari K. Effect of different weed management practices in summer Mung bean (*Vigna radiata* L.) under new alluvial zone of West Bengal. J. Crop Weed. 2009; 5(2):117-121.
7. Mishra A, Chaudhari DD, Patel HK, Patel VJ, Patel BD. Bio-efficacy of different herbicides in greengram under irrigated condition of middle Gujarat. Indian Journal of Weed Science. 2017; 49(4):341-345.
8. Muthuram T, Krishnan R, Baradhan G. Productivity enhancement of irrigated g greengram (*Vigna radiata* l.) through integrated weed management. Plant Archives. 2018; 1(18):101-105.
9. Raj VC, Patel DD, Thanki JD, Arvadia MK. Effect of integrated weed management on weed control and productivity of greengram (*Vigna radiata*). Bioinfolet. 2012; 9(3):392-396.
10. Raman R, Krishnamoorthy R. Nodulation and yield of mung bean (*Vigna radiata* L.) influenced by integrated weed management practices. Legume Res. 2005; 28:128-30.
11. Shamima Aktar, Hossain MA, Amin MR, Khatun F, Begum A. Efficacy of Herbicides in Controlling Weeds in Mung bean (*Vigna radiata* L. Wilczek) Field. The Agriculturists. 2015; 13(1):127-132.
12. Singh Guriqbal, Kaur VH, Sharma P. Efficacy of pre- and post-emergence herbicides for weed control in greengram. Indian Journal of Weed Science. 2017; 49(3):252-255,
13. Singh SP, Yadav RS, Bairwa RC, Kumawat A. Herbicides efficacy for managing weeds in greengram and their residual effect on succeeding mustard. Indian Journal of Weed Science. 2017; 49(3):248-251.
14. Tomar AS. Evaluation of quizalofop - p - tefuryl 4.41°/o EC against grassy weeds in black gram (*Vigna mungo* L.) Journal of Crop and Weed. 2011; 7:140-141.
15. Yadav VK, Singh SP. Losses due to weeds and response to pendimethalin and fluchloralin in varieties of summer sown Vigna radiate. Annals Pl. Protect. Sci., 2005; 13:454-7.