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Research Article

EFFECT OF WEED CONTROL MEASURES ON WEED, GROWTH AND YIELD OF MUNGBEAN (*Vigna radiata L.*)

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Abstract: The field experiment was carried out during three consecutive kharif seasons of 2014, 2015 and 2016 at Pulses research station, S. D. Agricultural University, Sardarkrushinagar, Gujarat, to study the effect of different weed management practice on growth and yield of mungbean. Significantly the higher seed yield of 694, 1388 and 886 kg/ha was recorded with treatment T_8 (Two manual weeding at 20 and 35-40 DAS) during the year 2015, 2016 and in pooled results, respectively. However T_8 remains at par with treatments T_7, T_3 and T_6 in pooled analysis. Maximum net returns of Rs. 32750 per hectare and B: C ratio of 1.94 was incurred in treatment T_8 (Two manual weeding at 20 and 35-40 DAS) followed by T_2 and T_7 with B: C ratio of 1.69 and 1.68 per hectare, respectively.

Keywords: Seed yield, Herbicides, Pre-emergence, Post-emergence, weed

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Introduction

Among the pulses, green gram crop (*Vigna radiata* L.) is one of the most important and extensively cultivated crops of the arid and semi-arid regions of the India. Green gram is locally known as "moong". It contains about 25 % protein, 1.3 % fat, 3.5% mineral, 4.1 % fiber and 56.7 % carbohydrate. In spite of the importance of this crop in our daily diet average productivity of this crop is very low in India as well as in the Gujarat. The low production of this crop is mainly due to crop-weed competition and other reasons. Weeds spread easily, because of their enormous seed production and once established are not easily eradicated. Life cycle of most of them coincide with that of crop they invade, thus ensuring mixing of their seed with those of the crops [1]. Weed management is an important key factor for enhancing the productivity of green gram, as weeds compete for nutrient, water, light and space with crop plants during early growth period. Moreover, besides low yield of crop, they increase production cost, harbor insect-pest and diseases, decreasing quality of farm produce and reduce land value of the different factors known for reduction in crop production, among them weed stand first [2]. Being a rainy season crop, it is invaded by a large numbers of fast growing weeds. The critical period of weed competition in greengram is during the first 30–40 days after sowing. Weeds grow quickly during this time taking the advantage of crops' slow initial growth [3]. Depending on weed type and crop weed competition it reduces crop yield up to 96.5 % [4]. Whereas the loss of mung bean yield due to weeds ranges from 65.4 to 79.0 % [5]. The magnitude of losses largely depends upon the composition of weed flora, period of weed-crop competition and its intensity. Weeds emerge with the summer sown crops and create severe competition unless controlled timely and effectively [1]. Manual weeding is no doubt quite effective, but it is time consuming, costly and tedious one. Under such situation, the use of effective herbicide at appropriate rate may prove as an effective weed control method and replace conventional methods of weed control. Selective herbicides or chemical weeding is better, as it is economical, easy and efficient. Therefore, it is an essential to control weeds by any means during crop weed competition. This paper deals with the objective of to study effect of different weed control practices on growth and yield and efficacy of different herbicides for controlling weeds in green gram.

Materials and Methods

The field experiment was conducted during *Kharif* seasons of 2014, 2015 and 2016 at Pulses Research Station, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, Gujarat, to study the effect of weed control measures on weed, growth and yield of mungbean (Vigna radiata L.). The soil of experimental site was loamy sand in texture with 7.7 pH, low in organic carbon (0.16 %), medium in available nitrogen (275 kg ha-1), available P_2O_5 (47.6 kg ha-1) and available K_2O (213.4 kg ha-1) and were estimated by combined glass electrode pH meter method, Walkey and Black's rapid titration method, Modified macro Kjeldahl method, Olsen's method and Flame photometer method, respectively [6]. The mungbean variety Gujarat mungbean 4 (GM 4) was sown at month of July in all the years at a row spacing of 45 cm X 10 cm using seed rate of 18 kg ha-1 and Mungbean seed was treated with carrier based Rhizobium and PSB, each at the rate of 25 g per kg seed and mixed well to ensure the inoculums to stick on to the surface of the seeds. The recommended dose of fertilizer 20-40-00 kg/ha N-P_2O_5-K_2O through urea and di-ammonium phosphate was applied as basal at the time of sowing. Protective irrigations were applied whenever it was necessary during the crop growth. The experiment with total nine treatments of weed management were evaluated in randomized block design with three replications i.e., T_1: Pendimethalin @ 1.0 kg /ha –Pre-emergence (PE), T_2: Pendimethalin 30 EC + imazethapyr 2 EC [Ready mixture (Vallore 32)] @ 1.0 kg/ha-PE, T_3: T_1 + Quizalofop-ethyl @ 50 g/ha at 15-20 DAS- Post-emergence (POE) , T_4: T_2 + Quizalofop-ethyl @ 50 g/ha at 15-20 DAS- POE, T_5: T_1 + Imazathapyr @ 40 g /ha at 15-20 DAS - POE, T_6: T_1 + Manual weeding at 25-30 Days after sowing (DAS), T_7: T_2 + Manual weeding at 25-30 DAS, T_8: Two manual weeding at 20 and 35-40 DAS and T_9: Weedy check. Herbicides were applied with their respective doses as per treatments, pre-emergence herbicide was sprayed at 1 day after sowing and post-emergence herbicide sprayed at 15-20 days after sowing as per schedule.

Table-1 Effect of different weed control practices on seed and straw yield and economics of mungbean

SN	Treatment	Seed Yield (kg/ha)				Straw Yield (kg/ha)				Net return (Rs/ha)	BCR
		2014	2015	2016	Pooled	2014	2015	2016	Pooled		
T_1	Pendimethalin @ 1.0 kg /ha -PE	460	467	1094	674^{bc}	2181	1319	2787	2096	22724	1.50
T_2	Pendimethalin 30 EC + imazethapyr 2 EC (Vallore 32) @ 1.0 kg/ha-PE	505	491	1219	738^{abc}	2190	1128	3095	2138	25850	1.69
T_3	T_1 + Quizalofop-ethyl @ 50 g/ha POE at 15-20 DAS	644	630	1025	766^{ab}	2374	2037	3089	2500	26061	1.51
T_4	T_2 + Quizalofop-ethyl @ 50 g/ha POE at 15-20 DAS	416	600	1185	734^{abc}	2181	1396	2940	2173	23596	1.35
T_5	T_1 + Imazathapyr @ 40 g /ha –POE at 15-20 DAS.	407	590	1187	728^{abc}	2359	1571	3126	2352	24723	1.51
T_6	T_1 + Manual weeding at 25-30 DAS	528	492	1233	751^{abc}	2407	1209	3219	2278	26059	1.62
T_7	T_2 + Manual weeding at 25-30 DAS	574	485	1267	775^{ab}	2362	1553	3272	2396	27317	1.68
T_8	Two Manual weeding at 20 and 35-40 DAS	577	694	1388	886^{a}	2476	2092	3417	2661	32750	1.94
T_9	Weedy check	404	443	984	610^{c}	2093	890	2247	1743	20861	1.59
	S.Em.+	44.98	36.05	75.99	47.81	60.47	104.01	175.10	117.72	-	-
	C.D. at 5%	134.8	108.1	227.8	143.34	181.3	311.8	524.9	352.92	-	-
	C.V. %	15.53	11.49	11.20	12.88	4.57	12.29	10.04	9.40	-	-
	Y	-	-	-	Sig	-	-	-	Sig	-	-
	Y x T	-	-	-	Sig	-	-	-	Sig	-	-

Note: Treatment means with the letter/ letters in common are not significant by Duncan's New Multiple Rang Test at 5 % level of significance

Table-2 Effect of different weed control treatments on growth and yield attributes in mungbean (pooled data of three years)

SN	Treatment	Plant height (cm)	No. of branches/plant	No. of pods/ plant	Pod length (cm)	No. of seeds/ pod	Initial plant stand/ net plot	Final plant stand/ net plot	No. of nodules/ plant
T_1	Pendimethalin @ 1.0 kg /ha -PE	50.1	2.9	13.8	7.9	10.1	135	132	18.4
T_2	Pendimethalin 30 EC + imazethapyr 2 EC (Vallore 32) @ 1.0 kg/ha-PE	50.1	2.9	13.4	7.9	10.4	136	133	18.6
T_3	T_1 + Quizalofop-ethyl @ 50 g/ha POE at 15-20 DAS	51.6	3.1	15.1	8	11	137	134	18.2
T_4	T_2 + Quizalofop-ethyl @ 50 g/ha POE at 15-20 DAS	49.3	3	14.4	8	10.2	136	133	17.6
T_5	T_1 + Imazathapyr @ 40 g /ha –POE at 15-20 DAS.	49.7	3	15.1	7.9	11	136	133	19.7
T_6	T_1 + Manual weeding at 25-30 DAS	49.3	3	15	8.2	11.2	135	132	18.7
T_7	T_2 + Manual weeding at 25-30 DAS	51.4	2.8	15.1	8	10.9	135	133	17.3
T_8	Two manual weeding at 20 and 35-40 DAS	56.1	3.5	17.1	8.2	10.9	138	135	20.3
T_9	Weedy check	46.7	2.6	11.4	7.4	9.7	132	129	18.1
	SEm ±	1.28	0.2	1.05	0.12	0.37	0.71	0.79	0.9
	C. D. (0.05 %)	3.84	0.59	3.16	0.35	1.11	2.14	2.36	2.69
	Y	Sig	Sig	Sig	Sig	NS	Sig	NS	Sig
	Y x T	NS	Sig	Sig	NS	NS	NS	NS	NS
	C. V. (%)	9.51	12.49	14.25	5.38	10.13	2.46	2.39	15.43

Table-3 Effect of different treatments on weed dry weight (g/m2) at 30 DAS and at harvest in mungbean

SN	Treatment	Weed dry wt. at 30 DAS (g/m^2)				Weed dry wt. at harvest (g/m^2)			
		2014	2015	2016	Pooled	2014	2015	2016	Pooled
T_1	Pendimethalin @ 1.0 kg /ha -PE	3.8(13.81)	4.1(16.33)	4.6(20.83)	4.18(16.99)	6.1(36.59)	10.0(101.33)	7.2(51.67)	7.98(63.20)
T_2	Pendimethalin 30 EC + imazethapyr 2 EC (Vallore 32) @ 1.0 kg/ha-PE	2.8(7.47)	3.0(8.67)	4.2(17.07)	3.40(11.07)	5.9(38.40)	9.2(83.33)	6.7(44.23)	7.47(55.32)
T_3	T_1 + Quizalofop-ethyl @ 50 g/ha POE at 15-20 DAS	2.6(6.37)	2.5(6.00)	4.4(18.53)	3.29(10.30)	3.8(14.29)	9.1(82.00)	6.8(45.33)	6.91(47.21)
T_4	T_2 + Quizalofop-ethyl @ 50 g/ha POE at 15-20 DAS	1.9(3.13)	1.8(2.73)	4.0(15.33)	2.75(7.07)	5.6(32.43)	8.7(76.00)	6.3(39.00)	7.05(49.14)
T_5	T_1 + Imazathapyr @ 40 g /ha –POE at 15-20 DAS.	2.4(5.30)	1.8(2.93)	3.9(14.67)	2.85(7.63)	5.9(35.95)	9.1(82.00)	6.1(37.17)	7.23(51.70)
T_6	T_1 + Manual weeding at 25-30 DAS	1.7(2.60)	1.8(2.60)	0.7(0.00)	1.49(1.73)	5.6(31.89)	9.3(86.00)	5.4(28.89)	7.03(48.93)
T_7	T_2 + Manual weeding at 25-30 DAS	1.9(3.00)	1.7(2.27)	0.7(0.00)	1.50(1.76)	5.4(29.23)	8.8(77.67)	5.1(25.60)	6.68(44.16)
T_8	Two manual weeding at 20 and 35-40 DAS	1.9(3.27)	1.9(3.13)	3.3(10.40)	2.47(5.60)	5.8(33.39)	8.0(64.00)	5.0(24.60)	6.42(40.66)
T_9	Weedy check	4.7(21.76)	5.2(26.67)	6.4(40.43)	5.49(29.62)	8.4(71.47)	13.1(173.33)	8.9(78.40)	10.40(107.73)
	S.Em.+	0.21	0.11	0.24	0.41	0.80	0.48	0.38	0.37
	C.D. at 5%	0.6	0.3	0.7	1.22	NS	1.4	1.1	1.12
	C.V. %	13.96	7.44	11.62	11.51	23.70	8.72	10.22	13.88
	Y	-	-	-	Sig	-	-	-	Sig
	Y x T	-	-	-	Sig	-	-	-	NS

Figures in the parenthesis are original values. All Figures are square root (√ x + 0.5) transformed values

Table-4 Effect of different treatments on weed control efficiency (%) at 30 DAS and at harvest in mungbean

SN	Treatment	Weed control efficiency (%) 30 DAS				Weed control efficiency (%) 30 DAS			
		2014	2015	2016	Pooled	2014	2015	2016	Pooled
T_1	Pendimethalin @ 1.0 kg /ha -PE	50.78	40.81	48.47	46.69	78.89	41.54	34.10	51.51
T_2	Pendimethalin 30 EC + imazethapyr 2 EC (Vallore 32) @ 1.0 kg/ha-PE	75.81	71.08	57.79	68.23	77.85	51.92	43.58	57.78
T_3	T_1 + Quizalofop-ethyl @ 50 g/ha POE at 15-20 DAS	80.16	81.60	54.16	71.97	91.75	52.69	42.18	62.21
T_4	T_2 + Quizalofop-ethyl @ 50 g/ha POE at 15-20 DAS	92.92	94.50	62.07	83.16	81.29	56.15	50.26	62.57
T_5	T_1 + Imazathapyr @ 40 g /ha –POE at 15-20 DAS.	84.37	93.71	63.72	80.60	79.26	52.69	52.59	61.51
T_6	T_1 + Manual weeding at 25-30 DAS	95.03	95.03	100.00	96.69	81.60	50.38	63.15	65.04
T_7	T_2 + Manual weeding at 25-30 DAS	93.45	96.34	100.00	96.60	83.14	55.19	67.35	68.56
T_8	Two manual weeding at 20 and 35-40 DAS	92.39	92.92	74.28	86.53	80.74	63.08	68.62	70.81
T_9	Weedy check	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table-5 Bio-assay studies, Plant stand of Rabi succeeding crops at 15 DAS (Per meter row length)

SN	Treatment	Wheat	Fieldpea	Rajmash
T_1	Pendimethalin @ 1.0 kg /ha -PE	17	10	10
T_2	Pendimethalin 30 EC + imazethapyr 2 EC (Vallore 32) @ 1.0 kg/ha-PE	17	9	9
T_3	T_1 + Quizalofop-ethyl @ 50 g/ha POE at 15-20 DAS	16	9	10
T_4	T_2 + Quizalofop-ethyl @ 50 g/ha POE at 15-20 DAS	17	10	9
T_5	T_1 + Imazathapyr @ 40 g /ha –POE at 15-20 DAS.	17	10	10
T_6	T_1 + Manual weeding at 25-30 DAS	17	9	9
T_7	T_2 + Manual weeding at 25-30 DAS	16	10	10
T_8	Two manual weeding at 20 and 35-40 DAS	18	10	10
T_9	Weedy check	17	10	10
	S.Em. ±	1.22	0.66	0.51
	CD @ 0.05	NS	NS	NS
	CV %	12.5	11.76	9.21

Spraying was done with flat fen nozzle with knapsack sprayer using 500 litre water per hectare. Weed flora and dry weight of weeds were taken at 30 days after sowing and at harvest by placing the quadrate of 50 cm × 50 cm size and values were converted to g/m^2. Collected weed samples were oven dried at 70ºC for three days and dry weight of weeds were recorded one day after removal from oven and expressed in g m^{-2}. Weed data were subjected to square root transformation (x+0.5) for uniformity before statistical analysis. Yield attributing characters, seed and straw yield recorded as per standard practices and presented for subsequent analysis. Rests of the agronomical practices were carried out as per recommendation adhering to the schedule. The weed control efficiency (WCE) for each treatment was worked out on the basis of formulas.

$$WCE\ (\%) = \frac{DWC - DWT}{DWC} \times 100$$

Where,
DWC = Dry weight of weeds in unweeded control plot
DWT = Dry weight of weeds in treated plot

Result and Discussion

Effect on weeds

Data showed that dry weight of weed at 30 days after sowing [Table-3] differed significantly during all the individual years as well as in pooled result. Significantly the lowest dry weight of weed at 30 DAS was recorded in treatment T_6 during all the years and pooled analysis except in 2015. Further treatment T_6 was at par with treatments; T_4, T_7 and T_8 during 2014, T_4, T_5, T_7 and T_8 in 2015, T_7 and T_8 in 2016 and T_7 on pooled basis. Significantly the highest dry weight of weed at 30 DAS was recorded in weedy check in all the years. One hand weeding done at 25 days after sowing (DAS) reduced the density and dry matter of weeds significantly also been recorded by [7]. Data also revealed that different treatments had significant influenced on dry weight of weed at harvest [Table-3] during all the years and in pooled except in 2014. Weedy check recorded significantly the highest dry weight of weed of 173.33 g/m^2 in 2015, 78.40 g/m^2 in 2016 and 107.73 g/m^2 on pooled basis at harvest. Two manual weeding at 20 and 35-40 DAS (T8) recorded the lower dry weight of weeds on pooled basis and at par with treatments T7 (6.68 g/m^2), T3 (6.91 g/m^2), T_6 (7.03 g/m^2), T_4 (7.05 g/m^2) and T_5 (7.23 g/m^2). At all the stages, hand weeding twice at 20 and 40 DAS (T_9) gave the best management of monocot and dicot weeds than other treatments because initially weeds were controlled by interculturing and hand weeding carried out at 20 DAS and whatever weeds emerged later were effectively removed by subsequent interculturing and hand weeding carried out at 40 DAS. Effective control of weeds through cultural practices was also reported by [8,9].

Effect on weed control efficiency

Maximum weed control efficiency [Table-4] at 30 DAS was observed with Treatment T_6; Pendimethalin @ 1.0 kg/ha-PE *fb* manual weeding carried out at 25-30 DAS of 95.03, 100.00 and 96.69 per cent in the year 2014, 2016 and in pooled data, respectively while treatment T_7; Pendimethalin 30 EC + imazethapyr 2 EC (Vallore 32) @ 1.0 kg/ha-PE *fb* manual weeding carried out at 25-30 DAS was recorded maximum weed control efficiency (96.34 %) in the year of 2016. At the time of harvest maximum weed control efficiency (63.08, 68.62 and 70.81 %) was recorded by treatment T_8; two manual weeding carried out at 25-30 DAS in the year 2015, 2016 and in pooled analysis, respectively. While in the year 2014 treatment T_3 (T_1 + Quizalofop-ethyl @ 50 g/ha POE at 15-20 DAS) recorded maximum weed control efficiency (91.75 %). Higher weed control efficiency with combinations of chemical control and manual weeding, might be due to higher efficacy of the herbicides at early growth stage and one hand weeding at later stage was effective in controlling weed dry matter in the different integrated approaches of weed management. The well-developed foliage canopy, intercepting solar energy effectively covered the ground area which reduced the weed emergence and increased the weed control efficacy [10]. Also reported higher weed control efficiency in hand weeding at 20 and 30 DAS in finger millet crop.

Effect on Seed and straw yield

Data presented in [Table-1] revealed that seed yield of mungbean affected significantly due to different weed management practices during all individual years and in pooled also. Significantly the higher seed yield of 694, 1388 and 886 kg/ha was recorded with treatment T_8 (Two manual weeding at 20 and 35-40 DAS) during the year 2015, 2016 and in pooled results, respectively. However T8 remains at par with treatments T_7, T_3 and T_6 in pooled analysis. During *kharif* 2014 T_3 (T_1 + Quizalofop-ethyl @ 50 g/ha at 15-20 DAS- POE) recorded significantly higher seed yield (644 kg/ha) and remain at par with T_8, T_7 and T_6. Integrated weed management increase seed yield of mung reported by [11] instead of sole chemical weed control method. Amongst the chemical weed control, treatment T_7 (Pendimethalin 30 EC + imazethapyr 2 EC (Vellore 32) @ 1.0 kg/ha-PE + manual weeding at 25-30 DAS) recorded significantly the higher yield during the

year 2016 and pooled and T_3 (T_1 + Quizalofop-ethyl @ 50 g/ha POE at 15-20 DAS) during the year 2014 and 2015. Significantly the lowest seed yield was recorded in weedy check (T_9) during all the years as well as in pooled. Pendimethalin and hand weeding was superior in controlling weeds and increasing the seed yield reported by [1, 12, 13]. Results showed that straw yield also affected significantly due to different treatments during the year 2014, 2015, 2016 and in pooled. T_8 (Two manual weeding at 20 and 35-40 DAS) recorded significantly the highest straw yield of 2476, 2092, 3417 and 2661 kg/ha during the year 2014, 2015, 2016 and pooled, respectively. Whereas treatment T_9 (weedy check) recorded significantly the lowest straw yield during all the individual years and in pooled results also [Table-1].

Economics

Net monetary returns and B: C ratio was higher (32750 Rs/ha and 1.94, respectively) under the two manual weeding at 20 and 35-40 DAS (T8) than other weed management practices and followed by the combination of chemical and cultural weed control treatment (T_7) *i.e*., Pendimethalin 30 EC + imazethapyr 2 EC (Vallore 32) @ 1.0 kg/ha-PE *fb* manual weeding carried out at 25-30 DAS. Patel *et al*., (2005) also reported maximum additional profit over control in twice IC *fb* hand weeding carried out at 30 and 45 DAS. Among herbicides application of Pendimethalin + imazethapyr (pre-mixed) @ 800 g ha-1 PE *fb* HW at 30 DAS incured higher net return and B: C ratio. Jha and Soni, (2013) reported same trend in case of herbicide combination.

Bio-assay Study: Persistence effect of different herbicides on bioassay parameter on germination of wheat, fieldpea and rajmash crops at 15 DAS in all plots in which herbicidal study were made found satisfactory [Table-5].

CONCLUSION

In *kharif* season field should be kept weed free by two hand weeding at 20 and 35 to 40 DAS for getting higher seed yield and net return. Under constraint of labours it is advisable to apply either Pendimethalin 30 EC + imazethapyr 2 EC (ready mixture) @ 1.0 kg a.i./ha as pre emergence followed by manual weeding at 25-30 DAS or Pendimethalin @ 1.0 kg /ha –PE + Quizalofop-ethyl @ 50 g/ha at 15-20 DAS- POE.

Application of research: This research finding will help farmers to effective control of weeds in Green gram

Research Category: weed management

Abbreviations

PE: Pre-emergence
POE: Post-emergence
DAS: Days after Sowing
WCE: Weed control efficiency

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