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INTEGRATED MANAGEMENT FOR IMPROVED WEED SUPPRESSION IN SUMMER GREEN GRAM (*VIGNA RADIATA* L. WILCZEK)

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ABSTRACT
Various rate of herbicide with hand weeding and interculturing were tried for weed suppression, grain yield and economics return of green gram at Instructional Farm, Junagadh Agricultural University, Junagadh (Gujarat) during the year of 2011. Result revealed that, hand weeding produced higher yield (1044 kg/ha) followed by two hand weeding with two interculturing 20 and 40 DAS (977 kg/ha). Among herbicide rates the lowest rate pendimethalin (0.900 kg//ha) yielded 768 kg/ha. All herbicidal rates including hand weeding significantlycontrolled the weeds. The maximum reduction of weed suppression were obtained in the weed free. This treatment was closely followed by the treatment two hand weeding with two interculturing 20 and 40 DAS to reduction of weed density (51 %), weed biomass (19.3 g/m^2) and the highest weed control efficiency (55.6 %) and weed index (2.68 %) were which also showed the maximum benefit: cost ratio (2.41) among all the treatments, and thus it was found to be the most economically sound treatment in summer green gram.Weedy check treatment produced least crop yield due to its maximum crop weed competition. In green gram crop has been found to be influenced by different parameters of climate.

INTRODUCTION

Green gram (*Vigna radiata* L.) is an important pulse crop in India and being cultivated in rainfed tract. One of the major constraints in greengram production is weed infestation. Frequent irrigations during summer season result in lot of weed population and weed growth in this crop. 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. (Mahroof *et al.*, 2009) Unchecked weeds have been reported to cause a considerable reduction in the grain yield of green gram, which in case of summer green gram could be 46.0- 53.0% (Vaishya *et al.*, 2003 and Bhandari *et al.*, 2004). The critical period of crop-weed competition in case of summer green gram is 10-40 days after sowing (Kumar and Tewari, 2004) which in certain situations could be 25-35 days after sowing (Randhawa *et al.*, 2002).

In green gram, weeds could be controlled by hand weeding (Chand *et al.*, 2004). However, hand weeding is laborious, time consuming, costly and tedious. When green gram were used in place of pre emergence herbicide treatments to control weeds in early, some weeds were present at the time of seed emergence but grain yield were not reduced as long as emerged weeds were controlled with a post emergence herbicides. In fields, the timing of weed seed emergence flushes is mostly depend on air and soil temperature and relative humidity. These parameters required in weed dynamics models to take into account the effects of soil conditions on weed suppression. These similar work done by Valverie *et al.* (2009) and Gardarina *et al.* (2010).The paper deals with yield attributes quality parameters and the efficacy of different herbicides for weed suppression.

MATERIALS AND METHODS

The field experiment was conducted to evaluate the effective weed management method of green gram in respect of growth, yield attributes and economics, during summer season 2011 at the Instructional farm of Junagadh Agricultural University, Junagadh (Gujarat) India. The experimental soil was well drained, medium black in texture having pH 8.10, EC 0.49 dS/m, low available nitrogen, medium in available phosphorus and medium in available potassium. The experiment was laid out in Randomized Block Design (RBD) with ten different weed management treatments each replicated trice. The different weed management treatments being, pendimethalin 0.900kg/ha (pre-emergence), pendimethalin 0.900kg/ ha (PRE) + HW + IC at 30 DAS, oxyfluorfen 0.180 kg/ha (PRE), oxyfluorfen 0.180 kg/ha (PRE) + HW at 30 DAS, fenoxaprop-p-ethyl 0.075 kg/ha (post emergence) at 20 DAS, quizalofop-ethyl 0.040 kg/ha (POE) at 20 DAS, one HW and one IC at 30 DAS, two HW and two IC at 20 and 40 DAS,

weed free and weedy check.

The green gram cv. Gujarat Green gram-4 (GM-4) was planted at end of February with recommended dose of fertilizers (20-40-0) NPK/ha. The seeds were sown 20 kg/ha in furrows at 30 cm x 10 cmspacing at a depth of 2-3 cm below the soil surface after seed inoculation with selected *Rhizobium* culture. Weed population and weed dry weight was recorded at 30, 60 days interval and at harvest. The weed dry weight was taken with the help of iron frame of 1 $m^2$from 2 places of each plot and then averaged. Weed index (WI) and weed control efficiency (WCE) was calculated.

$$WI = \frac{YHW - Yt}{YHW} X\ 100 \qquad WCE\ (\%) = \frac{DWC\ DWT}{DWC} X\ 100$$

The data on weeds were then analyzed by using square root transformation $\sqrt{X} + 0.5$ to normalize their distribution. The plant height, branches/plant, number of pods/plant, length of pod, number of grain/pod, grain weight/plant, weed biomass, weed index, and weed control efficiency (WCE) were recorded at different stages of the crop.(Gupta, 2011).

RESULTS AND DISCUSSION

Weed parameters

Sixteen weed species were observed in experimental field during summer 2011, among them monocots, dicots and sedges weeds. The predominant weed species were *Cynodon dactylon* L. *Panicum colonum* L. *Brachiaria Spp. Eluropus villosus*L. monocots weeds. *Digeraar vensis* Forsk. *Leucasaspera* Spreng. *Portulaca oleracea* L. *Indigoflora glandulosa*L. *Phyllanthus niruri*L. *Ahysicarpous rugosus* DC. *Acanthospermum hispidum*L. *Euphorbia hirta*L. *Boerhavia diffusa* L. *Tridex procumbens* L. and *Amaranthus viridis* L. among dicots weeds and *Cyperus rotundus* L. sedges weed. These similar work done by Kundu *et al.* (2009).

Weed parameters in green gram field (Table 2) *i.e.* number of monocots, dicots and sedges weeds suppression at two hand weeding and two interculturing at 20 and 40 DAS showed that the maximum reduction of weeds density, biomass (19.31 g/m^2) of grasses, lowest dry weight of weed (700 kg/ha), lowest weed index (2.68 %) and highest weed control efficiency (55.69 %) at all the growth stages followed by the integrated herbicidal treatments like oxyfluorfen 0.180 kg/ha + one HW at 30 DAS and pendimethalin0.900kg/ha+one HW + IC at 30 DAS were also more effective in weeds suppression. All the growth stage of green gram crop, the only chemical treatments pendimethalin 0.900 kg/ha continued to show higher population of monocots, dicots and sedges weeds recorded the maximum weeds population and biomass, exceptweedy check treatments. The highest suppression of monocot, dicot and sedges weeds were recorded in weed free. Two hand weeding at 15, 30 and 40 DAS were very effective to reduce the all categories of weed population. These results confirm the finding of Malik *et al.* (2005) and Rajib *et al.* (2011).

Growth and yield attributes

Highest plant height (39.32 cm), number of branches/plant at harvest (6.73), maximum number of pods/plant (15.4), length

Table 1: Monocot, dicot and sedges weed count at 30, 60 DAS and at harvest as integrated weed management in green gram

Treatments	Dose Kg/ha	Monocot weeds per m^2			Dicot weeds per m^2			Sedges weeds per m^2		
		30 DAS	60 DAS	Harvest	30 DAS	60 DAS	Harvest	30 DAS	60 DAS	Harvest
Pendimethalin	0.900	5.77(27.77)	5.85(28.62)	5.86(28.72)	5.10(21.16)	5.46(24.60)	5.88(28.94)	5.25(22.56)	5.36(23.61)	5.52(25.20)
Pendimethalin +1 HW + IC at 30 DAS	0.900	4.15(13.32)	4.26(14.13)	4.76(18.14)	3.11(6.81)	3.48(8.88)	4.02(12.39)	2.82(5.38)	3.13(6.91)	3.51(9.06)
Oxyfluorfen	0.180	5.48(24.80)	5.78(27.87)	5.87(28.83)	5.15(21.62)	5.24(22.46)	5.26(22.65)	5.06(20.79)	5.15(21.62)	5.51(25.10)
Oxyfluorfen + 1 HW at 30 DAS	0.180	3.76(10.62)	3.84(11.15)	3.12(13.10)	2.83(5.42)	2.75(5.06)	3.38(8.29)	2.58(4.32)	2.73(4.97)	2.63(4.53)
Fenoxaprop-P-ethyl at 20 DAS	0.075	5.38(23.81)	5.48(24.80)	5.58(25.80)	4.93(19.62)	4.96(19.89)	5.81(28.19)	4.97(19.98)	5.06(20.79)	5.11(21.25)
Quizalofop-ethyl at 20 DAS	0.040	5.03(2.52)	5.29(22.94)	5.44(24.40)	4.58(16.64)	4.66(17.30)	5.39(23.91)	4.46(15.68)	4.49(15.92)	4.93(19.62)
One hand weeding and one interculturing at 30 DAS		4.77(18.23)	5.06(2.79)	5.37(23.71)	4.12(13.10)	4.37(14.97)	4.90(19.36)	3.04(6.45)	3.87(11.35)	4.58(16.64)
Two hand weeding and two interculturing at 20 and 40 DAS		3.13(6.91)	3.16(7.07)	3.81(1.95)	2.47(3.88)	2.72(4.92)	2.88(5.66)	2.07(2.46)	2.35(3.42)	2.61(4.45)
Weed free		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Unweeded check		6.31(33.75)	6.36(34.33)	6.65(37.82)	5.50(25.00)	5.91(29.26)	6.35(34.22)	5.80(28.09)	5.68(26.83)	6.09(31.24)
CD (P=0.05)		0.93	0.97	1.20	0.90	0.89	1.01	0.84	0.93	0.93

Note: $\sqrt{X} + 0.5$ transformation (Figures in parenthesis are original values)

Table 3: Effect of weed-control treatments on growth, yield attributes, yield and economics of green gram

Treatments	Dose (kg/ha)	Plant height	Branches per plant at harvest	No. of Pods per plant	Length of pod (cm)	No.of Grain per pod	Grain wt. per plant(g)	Test weight (g)	Grain yield (kg/ha)	Stover yield (kg/ha)	Net return (`/ha)	Benefit: Cost Ratio
Pendimethalin	0.900	26.24	4.86	11.23	5.53	5.78	5.11	30.30	768	1131	12924	2.09
Pendimethalin +1 HW + IC at 30 DAS	0.900	36.65	6.13	14.66	7.46	6.72	6.21	35.33	955	1364	17623	2.35
Oxyfluorfen	0.180	28.20	5.00	12.10	5.96	5.98	5.39	32.10	779	1170	13308	2.12
Oxyfluorfen + 1 HW at 30 DAS	0.180	37.26	6.37	15.00	7.86	6.91	6.81	35.85	957	1365	18040	2.41
Fenoxaprop-P-ethyl at 20 DAS	0.075	31.20	5.33	12.93	6.40	6.25	5.69	32.61	801	1215	14436	2.26
Quizalofop-ethyl at 20 DAS	0.040	33.06	5.47	13.20	6.73	6.21	5.90	33.46	827	1265	15213	2.32
One hand weeding andone interculturing at 30 DAS		35.48	5.80	13.26	6.90	6.53	6.02	34.66	851	1303	15825	2.35
Two hand weeding andtwo interculturing at 20 and 40 DAS		39.32	6.73	15.40	8.10	7.03	6.99	35.96	977	1376	18354	2.41
Weed free		40.18	7.03	16.16	8.60	7.13	7.58	36.81	1004	1416	18424	2.33
Unweeded check		23.46	4.50	10.26	4.75	5.33	4.95	29.16	659	1068	11072	2.07
CD (P=0.05)		3.71	1.26	3.05	1.02	NS	1.12	4.78	139.06		211.55	- -

Table 4: Intercept (*a*), regression coefficient (*b*), correlation coefficient (*r*) and coefficient of determination (R^2) of green gram grain yield (dependent variable Y) with individual growth and yield attributes and weed parameters (independent variables X_i)

X_i	Independent variable	A	b	r	$100R^2$
X_1	Plant height at harvest (cm)	229	18.99	0.9659**	93.30
X_2	Branches per plant at harvest	110	130.61	0.9725**	94.58
X_3	No. of Pods per plant	77	58.16	0.9692**	93.93
X_4	Length of pod (cm)	236	91.02	0.9674**	93.58
X_5	No. of Grain per pod	-345	188.32	0.9616**	92.47
X_6	Grain wt. per plant (g)	106	124.02	0.9391**	88.20
X_7	Test weight (g)	-565	42.32	0.9302**	86.53
X_8	Monocot weeds count at harvest	1115	-54.61	-0.8962**	80.31
X_9	Dicot weeds count at harvest	1115	-57.76	-0.9538**	90.97
X_{10}	Sedge weed count at harvest	1088	-58.75	-0.7688**	59.11
X_{11}	Dry weight of weeds (kg)	1082	-0.24	-0.9582**	91.82

Note: ** Highly significant at 1% level (r= 0.561)* Significant at 5% level (r =0.444)

Correlation co-efficient between Weed species and weather parameters during *Summer*- 2011-12

Species of Weeds	Weather parameters Air temperature (°C) Max.	Min.	Relative humidity (%) Morning (08:00 hr)	Afternoon (14:00 hr)	Mean bright sunshine hours (hrs/day)	Soil temperature (°C) 5 cm	10 cm	20cm
Monocot	0.9963**	0.9938**	0.5386	0.4668	-0.3636	0.9997**	0.9994**	1.0000**
	-0.9561	(0.9950**)	-0.7033	-0.6419	(-0.5509)	(0.9828**)	(0.9842**)	(0.9785**)
Dicots	0.9523*	0.9937**	0.7122	0.6514	-0.5613	0.9805**	(0.9819**)	0.9759**
	(0.9511*)	(0.9932**)	-0.7149	-0.6544	(-0.5645)	(0.9797**)	(0.9812**)	(0.9750**)
Sedges	0.9839**	0.9998**	0.615	0.5474	-0.4491	0.9977**	0.9982**	0.9960**
	(0.9605**)	(0.9964**)	-0.6923	-0.63	(-0.5379)	(0.9850**)	(0.9868**)	(0.9816**)

*Significant at 0.05 level (r = 0.878), ** Highly Significant at 0.01 level (r=0.959)
Note: $\sqrt{x + 0.5}$ transformation value (Figures in parenthesis are original values)

pod (8.10 cm), no. of grain/pod (7.03), grain wt./plant (6.99 gm), 100-seed weight (35.96 gm) were significantly found in the treatment two HW and two IC at 20 and 40 DAS which was followed with the treatments like oxyfluorfen0.180 kg/ha + one HW at 30 DAS, one HW and one IC at 30 DAS and quizalofop-ethyl at 20 DAS (Table 3). It can be stated from the above findings that, though of pods/plant and length pod is a varietal character but tremendous weed infestation caused stressto the crop plant with respect to nutrient, light, moisture, space and other various aspects related to physiological processes of crop plant and thus enforced thecrop to have less number of pods per plant and this was highly evident in weedy check treatment. This is in agreement with the findings of Singh *et al.* (2001). It can be stated that 100 seed weight is generally varietal character and it is again proved in case of summer green gram (GG-4), as all the treatments had significant differences among them with regard to their effects on 100-seed weight of summer green gram. These similar work done by S. K. Verma (2014).

Highest grain and stover yield was recorded in weed free 1004 kg/ha and 1416 kg/ha which was followed with two HW and two IC at 20 and 40 DAS (977 kg/ha and 1376 kg/ha) and oxyfluorfen0.180 kg/ha + one HW at 30 DAS (957 kg/ha and 1365 kg/ha). The significantly lowest seed and stover yield (659 kg/ha and 1068 kg/ha) was observed in weedy check. From the results, it may be expressed that higher weed infestation was responsible for reducing seed yield, as the treatments with higher weed intensity were with lower seed

yield of the crop during summer season. This was quite clear from the seed yield produced in weedy check treatment, which faced the tremendous competition with vigorous weed infestation. Hand weeding at 20, 30 and 40 DAS reduced weed infestation most efficiently throughout the growing period of the crop and as a consequence it produced the highest seed yield of summer greengram. Similar results were also reported by Vivek *et al*. (2008).

Effect on uptake of nutrients and Quality parameter

There was vigorous growth of weed in weedy check resulted higher uptake of N, P and K nutrients. While treatments two hand weeding and two interculturing at 20 and 40 DAS recorded the least loss of nutrients by weeds and significantly increase protein content (22.15 %) followed by the oxyfluorfen0.180 kg/ha. It can be explained in the light of the facts that these treatments controlled the weeds effectively, might have made more nutrients available to crop and consequently encouraged higher concentration of nutrients and more yield and there by higher uptake of nutrients by the crop. These results confirm the finding of Sylvestre *et al*. (2013).

Correlation studies

Results revealed that growth and yield, weed parameters viz. monocots, dicots and sedge weeds count at harvest and dry weight of weed showed positive and significant correlation with seed yield of green gram. The highest significant positive correlation between seed yield and branches/plant harvest was the highest (0.9725), followed by number of pods/plant (0.9692),length of pod (0.9674), plant height (0.9659), number of grain/pod (0.9616), grain wt. per plant (0.9391) and test weight (0.9302), which attributed correspondingly 94.58, 93.93, 93.58, 93.30, 92.47, 88.20 and 86.53 % variation in grain yield of green gram (Table 4).

Monocots and sedges weeds had exhibited highly significant positive correlation with maximum temperature (r=0.9963 and 0.9839) followed by minimum temperature (r= 0.9938, 0.9839) and soil temperature at 5 cm, 10 cm, 20 cm (r= 0.9997, 0.9994, 1.0000 and r=0.9977, 0.9982, 0.9960) respectively. Highly significant positive correlation was observed in dicots weeds with minimum temperature (r= 0.9937) followed by soil temperature at 5 cm, 10 cm, 20 cm (r=0.9805, 0.9819, 0.9759) respectively, significant positive correlation was observed in maximum temperature(r= 0.9523).

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