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Effect of crop geometry and integrated weed management on chemical and bio assay studies of *kharif* groundnut (*Arachis hypogaea*)

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Abstract
A field experiment was conducted during *kharif* season of 2017 at Agronomy Instructional Farm, C.P. College of Agriculture, S. D. Agricultural University, Sardarkrushinagar to study the effect of integrated weed management and crop geometry on chemical and bio assay studies of *kharif* groundnut can be secured by growing crop with pair row sowing of 30-60-30 cm spacing. Interculturing followed by hand weeding at 25 and 40 DAS in *kharif* groundnut effectively controlled weeds and produced higher yield. Maximum yield and net profit from *kharif* groundnut can be secured by growing crop with pair row sowing of 30-60-30 cm spacing along with interculturing followed by hand weeding at 25 and 40 DAS. Under scarcity of labour, groundnut crop can be kept weed free by spraying of pendimethalin 1.0 kg/ha PE + interculturing followed by one HW at 30 DAS.

Keywords: Bio assay studies, post-emergence, day after sowing

Introduction
Groundnut (*Arachis hypogaea*) is one of the most important edible oil seed crop in the world. It belongs to Leguminosae family. The groundnut originated in South America from where, it spreaded to Asia, Africa, Sudan, Nigeria, U.S.A. and other parts of the world. Groundnut is extensively grown in India during the *kharif* season. Initial slow growth combined with prostate nature of its growth and hot humid climate prevailing during the *kharif* season permit early and severe crop weed competition resulting in loss of yield to the tune of 75 per cent (Gnanamurthy and Balsubramanian, 1998) [4]. Chemical control of weeds forms an excellent alternative to manual weeding. However, pre-emergence application of herbicides may allow the emergence of weeds after some time. Under such situation, integration of pre-emergence herbicidal treatments with hand weeding or post-emergence herbicides may help in reducing the losses caused by weeds. The present study was therefore initiated to find out an effective and economical weed control method in groundnut.

Looking to the demand of the edible oilseeds, the groundnut cultivation has extended to *rabi* and summer seasons also depending upon the existing temperature regimes. In India groundnut is grown on 4.56 m ha and production of 6.77 M.T. with an average productivity of 1486 kg/ha (DAC and FW, 2016) [1]. Total 80 per cent of the groundnut area and 84 per cent of the production in India is confined to the states of Gujarat, Andhra Pradesh, Tamil Nadu, Karnataka and Maharashtra. Among these, Gujarat ranks first both in area and production. In Gujarat, the area under *kharif* and summer groundnut is 1.599 m ha and 0.063 m ha with the production of 3.77 and 0.13 M.T., respectively during 2017-18. The average productivity of groundnut is 2360 kg/ha in *kharif* and 2140 kg/ha in summer (DOA, 2017-18) [3]. Major groundnut growing districts of Gujarat are Junagadh, Jamnagar, Rajkot, Amreli, Bhavnagar, Sabarkantha and Banaskantha.

Crop geometry, particularly in high density crops like groundnut plays important role in harvesting the environmental resources, which ultimately influence the crop productivity. Alterations in crop geometry by way of manipulation in row spacing may impart competing ability in crop plants with weeds. In light of the above facts and paucity of adequate research evidences, the present investigation entitled, "Effect of crop geometry and integrated weed management on chemical and bio assay studies of *kharif* groundnut (*Arachis hypogaea*)"

Materials and Methods

The field experiment entitled "Effect of crop geometry and integrated weed management on chemical and bio assay studies of *kharif* groundnut (*Arachis hypogaea*)" was conducted during *kharif* season of 2017 at Agronomy Instructional Farm, Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar which is situated in the North Gujarat Agro-climatic (Zone-IV of Gujarat). The climate of this region is sub-tropical monsoon type and falls under semi-arid region. In general, monsoon is warm and moderately humid, winter is fairly cold and dry, while summer is largely hot and dry. the soil of the experimental plot was loamy sand in texture, low in organic carbon (0.31 %) and available nitrogen (156.56 kg/ha) and medium in available phosphorus (43.41 %) and potash (253.02 kg/ha) content. Electrical Conductivity (EC) was very low showing that the soil was free from salinity hazard. Fifteen treatment combinations comprising, three treatments of crop geometry *viz.*, G_1 : Line sowing with 45 cm, G_2 : Paired row sowing with 22.5-45-22.5 cm and G_3 : Paired row sowing with 30-60-30 cm and five treatments of integrated weed management *viz.*, W_1 : Unweeded control, W_2 : Interculturing followed by hand weeding (HW) at 25 and 40 DAS, W_3 : Pendimethalin 1.0 kg/ha PE + interculturing and 1 HW at 30 DAS, W_4 : Imazethapyr 100 g/ha at 20 DAS PoE and W_5: Pendimethalin 1.0 kg/ha PE followed by imazethapyr 100 g/ha at 20 DAS PoE were evaluated in split plot design with three replications. The variety TG 37 was shown on 15th June and recommended dose of fertilizer was 12.5- 25-00 N-P-K kg/ha and all other recommended practices were adopted according to as per needed of crop requirement. Herbicides residue may persist in the soil and affect the succeeding crop. Therefore, Mustard crop was sown after harvest of *kharif* groundnut to test the residue effect of herbicides. The observations of plant population and yield of mustard crop were recorded from each treatment.

Result and Discussion

Yield parameters studies

Effect of crop geometry

Significantly higher pod yield of 2250 kg/ha was recorded under paired row sowing of 30-60-30 cm spacing (G_3), which was statically at par with paired row sowing with 22.5-45-22.5 cm (2118 kg/ha). Significantly the highest haulm yield of 4287 kg/ha was produced with treatment G_2 (paired row spacings, 22.5-45-22.5 cm), but remained at par with treatment G_3 (Paired row sowing with 30-60-30 cm) with the corresponding value of 3895 kg/ha.

Effect of integrated weed management

Significantly uppermost pod yield of 2428 kg/ha was obtained with treatment W_2 (interculturing followed by hand weeding at 25 and 40 DAS). Significantly lowest pod yield (1595 kg/ha) of groundnut was noticed under unweeded control plot (W_1). The treatment W_2 (interculturing followed by hand weeding at 25 and 40 DAS) gave higher haulm yield (4211 kg/ha). This treatment remained at par with treatment W_3 (Pendimethalin 1.0 kg/ha PE + interculturing and 1 HW at 30 DAS) and W_5 (Pendimethalin 1.0 kg/ha PE followed by imazethapyr 100 g/ha at 20 DAS PoE) with the corresponding haulm yield of 4110 kg/ha 4024 kg/ha, respectively. The magnitude of increase in pod yield due W_2, W_3 and W_5 over W_1 was to the extent of 52.23, 40.63 and 34.61 per cent, respectively. This might be due to effective weed control through integrated weed management practices resulted in decrease plant competition and increase in yield attributing parameters like pods per plant, and pod yield per plant. This might be also due to support the results like pod yield and haulm yield increase is due to decrease in number of weeds, dry weight and higher weed control efficiency. Cumulative effect of herbicides and hand weeding facilitating peg penetration and pod development with less weed competition and consequently higher pod yield has been reported by Kumar *et al.* (2004) and Dixit *et al.* (2016) [5, 2].

Interaction effect

Significantly the highest pod yield (2700 kg/ha) was observed under treatment combination G_3W_2 (paired row sowing of 30-60-30 cm spacing and interculturing followed by hand weeding at 25 and 40 DAS), but it remained at par with G_3W_3 (2553 kg/ha) and G_2W_2 (2468 kg/ha). This might due to paired row sowing and effective weed control through hand weeding at 25 and 40 DAS interval, which reduced crop weed competition, increased nutrient availability to crop that led to higher pod yield. These results are closely followed as reported by Patel *et al.* (2013) [6]. Interaction effect between different crop geometry and integrated weed management treatment was not observed significant with respect to haulm yield of groundnut.

Economic studies

An economics indicating total income, total cost of cultivation, net return and benefit : cost ratio (BCR) under various crop geometry and integrated weed management treatments are presented in Table 2.

Effect of crop geometry

Maximum net profit of Rs 42,036/ha with higher benefit : cost ratio (BCR) (1.75) was obtained when crop was sown at paired row spacing of 30-60-30 cm (G_3) followed by paired row spacing of 22.5-45-22.5 cm (G_2), which realized net profit of Rs 32,349/ha with benefit : cost ratio (BCR) of 1.53. Data further indicated the lowest net profit of Rs 25,027/ha and benefit : cost ratio (BCR) (1.45) were obtained under treatment G_1 (line sowing with 45 cm).

Effect of integrated weed management practices

Perusal of data presented in Table 3 revealed that the highest net profit of Rs 44,654/ha was obtained with treatment W_2 (Interculturing followed by hand weeding at 25 and 40 DAS) followed by W5 (Pendimethalin 1.0 kg/ha PE followed by imazethapyr 100 g/ha at 20 DAS PoE) realized worth Rs. 40,495/ha. Similar trend that of net return was also observed in case of benefit: cost ratio (BCR). Treatment W_2 (Interculturing followed by hand weeding at 25 and 40 DAS) recorded maximum benefit : cost ratio (BCR) value of 1.73. The minimum net profit (Rs 16,847/ha) and benefit: cost ratio (BCR) (1.31) were observed under treatment W_1 (Unweeded control).

Interaction effect

Data given in Table 5 indicated that the highest net return of Rs. 57,185/ha with benefit : cost ratio (BCR) value of 1.96 were realized under treatment combination G3W2 (Paired row spacing 30-60-30 cm along with interculturing followed by hand weeding at 25 and 40 DAS). The next best treatment combination was G3W3 (Paired row spacing 30-60-30 cm along with Pendimethalin 1.0 kg/ha PE + interculturing and 1 HW at 30 DAS) gave net return of Rs 52371/ha with benefit : cost ratio (BCR) of 1.90.

Conclusion

From the one year experimentation, it is concluded maximum yield from *kharif* groundnut can be secured by growing crop with pair row sowing of 30-60-30 cm spacing. Interculturing followed by hand weeding at 25 and 40 DAS in *kharif* groundnut effectively controlled weeds and produced higher yield. Maximum yield and net profit from *kharif* groundnut can be secured by growing crop with pair row sowing of 30-60-30 cm spacing along with interculturing followed by hand weeding at 25 and 40 DAS. Under scarcity of labour, groundnut crop can be kept weed free by spraying of pendimethalin 1.0 kg/ha PE + interculturing followed by one HW at 30 DAS.

Table 1: Effect of crop geometry and integrated weed management on available nutrients status in soil after harvest of kharif groundnut

Treatments			Available nutrients status in soil after harvest (kg/ha)		
			N	P_2O_5	K_2O
Main plot : Crop Geometry (G) :					
G_1	:	Line spacing with 45 cm	161.00	48.11	253.46
G_2	:	Paired row sowing with 22.5-45-22.5 cm	156.00	43.37	237.50
G_3	:	Paired row sowing with 30-60-30 cm	158.25	45.92	244.91
S.Em.±			4.35	1.36	5.19
C.D. at 5 %			NS	NS	NS
C.V. (%)			10.63	11.51	8.20
Sub-plot : Integrated Weed Management (W) :					
W_1	:	Unweeded control	145.62	43.30	233.28
W_2	:	Interculturing followed by hand weeding at 25 and 40 DAS	166.62	47.94	254.00
W_3	:	Pendimethalin 1.0 kg/ha PE + interculturing and 1 HW at 30 DAS	162.29	47.55	252.10
W_4	:	Imazethapyr 100 g/ha at 20 DAS PoE	159.17	45.34	244.90
W_5	**:**	Pendimethalin 1 kg/ha PE followed by imazethapyr 100 g/ha at 20 DAS PoE	158.37	44.87	242.17
S.Em.±			4.93	1.24	5.29
C.D. at 5 %			NS	NS	NS
Interaction (G × W) :			NS	NS	NS
C. V. (%)			9.35	8.13	6.47

Table 2: Effect of different treatments on plant population and seed yield of mustard

Treatments		Plant population Per meter row length	Mustard seed yield (kg/ha)	
Main plot : Crop Geometry (G) :				
G_1	:	Line spacing with 45 cm	8.51	960
G_2	:	Paired row sowing with 22.5-45-22.5 cm	8.61	1043
G_3	:	Paired row sowing with 30-60-30 cm	8.89	1010
S.Em.±			0.24	24
C.D. at 5 %			NS	NS
C.V. (%)			10.63	9.22
Sub-plot : Integrated Weed Management (W) :				
W_1	:	Unweeded control	8.97	994
W_2	:	Interculturing followed by hand weeding at 25 and 40 DAS	8.68	1042
W_3	:	Pendimethalin 1.0 kg/ha PE + interculturing and 1 HW at 30 DAS	8.62	1026
W_4	:	Imazethapyr 100 g/ha at 20 DAS PoE	8.60	972
W_5	:	Pendimethalin 1 kg/ha PE followed by imazethapyr 100 g/ha at 20 DAS PoE	8.47	989
S.Em.±			0.25	27
C.D. at 5 %			NS	NS
Interaction (G × W) :			NS	NS
C. V. (%)			8.74	8.19

Table 3: Yield (kg/ha) and economics (Rs/ha) of groundnut as influenced by various treatments

Treatments	Pod yield	Haulm yield	Gross realization	Cost of cultivation	Net return	BCR
Main plot : Crop Geometry (G) :						
G_1	1828	3534	80188	55161	25027	1.45
G_2	2118	4287	93294	60945	32349	1.53
G_3	2250	3895	97790	55754	42036	1.75
S.Em.±	67	133				
C.D. at 5 %	265	523				
C.V. (%)	12.64	13.20				
Sub-plot : Integrated Weed Management (W) :						
W_1	1595	3455	70710	53863	16847	1.31
W_2	2428	4211	105542	60888	44654	1.73
W_3	2243	4110	97940	59630	38310	1.64
W_4	1914	3726	85772	54899	30873	1.56
W_5	2147	4024	97648	57153	40495	1.71

S.Em.±	49	137				
C.D. at 5 %	143	399				
Interaction (G × W) :	Sig.	NS				
C. V. (%)	7.12	10.50				

Table 4: Interaction effect of crop geometry and integrated weed management on pod yield (kg/ha) of kharif groundnut

Treatments	**W_1**	**W_2**	**W_3**	**W_4**	**W_5**
G_1	1484	2115	1803	1821	1917
G_2	1628	2468	2372	1923	2198
G_3	1672	2700	2553	1999	2326
S.Em.+	85				
C.D. at 5%	248				
C.V. (%)	7.12				

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