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Yield Parameters Responses in a Spreading (cv. M-13) and Semi-Spreading (cv. Girnar-2) Types of Groundnut to Six Growth Regulators

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Abstract: Plants of spreading (cv. M-13) and semi-spreading (cv. Girnar-2) type 3 of groundnut (*Arachis hypogaea* L.*)* were foliar sprayed separately with different plant growth regulators (PGRs) *e.g*. Brassinolides (250 ppm), ethephon (250 ppm), Planofix (Naphthyl Acetic Acid; NAA; 50 ppm); Triacontanol (10 ppm), Cytozyme (Gibberellic acid (GA), 100 ppm), Bioenzyme (1000 ppm) and surfactant. The spraying was done in the evening on the plants 35 and 45 days after sowing (DAS). Several yield parameters *e.g*. pod yield (kg/ha), haulm yield (kg/ha), number of pods per plant, pod weight per plant (g), shelling percentage, test weight (g) and mature kernel weight (g) were analyzed and compared with controls (water sprayed). Some of the PGRs (Brassinolides, triacontanol, GA, NAA) were effective in inducing enhanced pod yield, number of pods per plant, pod weight per plant and shelling percentage significantly. In the plants treated with triacontanol and GA, the total number of flowers produced per plant was increased; however, the number of days required for the production of 100 flowers, was decreased. PGRs used presently stimulated many of the kernel and pod parameters. The increase in weight of kernels could be attributed to efficient mobilization of assimilates for an extended period of filling of pods.

Key words: PGRs % Spreading and semi-spreading cv. % Aliphatic alcohols % NAA % GA % Surfactant % Brassinolides % Ethephon

INTRODUCTION

Groundnut or peanut (*Arachis hypogaea* L.), is an important crop worldwide, distributed across the vast area in tropical, subtropical and temperate zones. It is a valuable source of edible oil and protein for human beings and of fodder for livestock.

Peanut is grown on approximately 37 million acres worldwide and is the third major oilseed crop, surpassed only by soybean and cotton. China leads the world in peanut production and exports, producing over 13 million metric tons in 2004. India is the second largest peanut producing nation in the world, harvesting almost 7 million metric tons in 2004.

Peanut accounts for approximately 50% of oilseed production in India and like China, half of the peanuts produced are used for oil production.

Groundnut has indeterminate growth habit and hence growth and development of reproduction and vegetative organs overlap. This causes low fruiting efficiency due to interorgan competition for photo assimilates and other metabolites. Consequently there is improper partitioning of photosynthates to developing pods and seeds. Most prominent constraint in low yield is extended duration of flowering; variable pods sizes.

Malik *et al.,* [1] and Parmar *et al.,* [2] have demonstrated that the translocation of photosynthates within groundnut plant is not random but has a definite pattern, that this pattern is changed during different phases of plant growth.

Different growth regulators are shown to influence different crop physiology parameters *e.g.* altering plant archetype; promote photosynthesis; alter assimilate partitioning; stimulate uptake of mineral ions; enhance nitrogen metabolism; promote flowering; uniform pod formation; increase mobilization of assimilates to defined sinks; improve seed quality; induce synchrony in flowering and delay senescence of leaves.

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The response of groundnut varieties to different growth regulators, aliphatic alcohols, phenolic compounds *etc*. varies and for details a reference be made to the studies of Parmar *et al.* [2]; Malik *et al.* [3], Malik *et al.,* [4] and Malik [5]. Malik [5] in his Presidential address has detailed plant growth regulators: software for plant development and crop productivity.

Very recently Verma A, *et al.,* [6, 7] has investigated the role of some PGRs on crop physiology parameters influencing productivity in semi-spreading type of groundnut.

Several studies have demonstrated the effect of plant growth regulators in altering several physiological parameters and hence the yield [1, 8, 5]. Menon and Srivastava [9] have emphasized the importance of PGRs in source and sink relationships leading to enhanced translocation of photo assimilates.

Wang *et al.,* [10] and Parmar *et al.,* [11] have demonstrated in their field studies that application of mepiquat chloride decreased partitioning of photo assimilates to the main stem branches but increased the mobilization of assimilates into the reproductive sinks.

Sharma and Malik [12] used three PGRs to investigate chemical regulation of carbon acquisition in groundnut.

The intent of the present study is to evaluate different kernel and pod parameters contributory to yield as affected by different growth regulators.

MATERIALS AND METHODS

Groundnut cultivars (spreading type; M-13 and semi-spreading; Girnar-2) were sown in July, 2007-08, in a randomized block design with 3 replications of each treatment. Each plot measured 5 x 3 m as recommended spacing for plants (10 cm between plants) and rows (35-40 cm). For fertilizer application and irrigation schedule the Package of Practices, were followed. Thus seeds were subjected to FIR treatment before sowing. Fertilizers were added as 15 Kg nitrogen and 60 Kg phosphorus pentoxide (P_2O_5) along with 250 Kg gypsum. Seeds were sown @ 80 Kg ha^{-1}. Foliar sprays of the following PGRs (Table 1) were separately done at two stages *i.e.* 35 days after sowing (DAS) and 45 DAS. Foliar sprays were done in the evening to avoid evaporation.

Table 1: Plant Growth Regulators (ppm) used for foliar spray

Plant Growth Regulator	Concentration used (ppm)
Brassinolides	250
Planofix (NAA)	50
Miraculan	10
Triacantinol	10
Gibberellic acid	100
Bioenzyme	1000
Surfactant	
Water	
Control	

Following Parameters Were Studied

Mature Pods: Total number of pods at 120 DAS/ harvest time from randomly selected plants from each plot was recorded. The weight of pods (g) per plant was taken at this stage. The data are set in Table 2 and 3.

Seeds: Pods from 5 randomly selected plants per replication were sampled to evaluate the data on number of seeds per pod. Following harvesting, the kernels were

Table 2: Field Efficacy of six PGRs and their potential to enhance yield in spreading cv. M-13 under field conditions

S.No.	Treatment	Pod yield (kg ha^{-1})	Haulm yield (kg ha^{-1})	Shelling %	Test wt. (g)	No. of pods/plant	Pod wt. /plant (g)
1	Foliar spray Brassinolides@250ppm at 35 & 45 DAS	2380	3225	65.96	59.45	17.90	23.88
2	Foliar spray Ethephon @250ppm at 10 & 5 days before harvesting	2431	3287	69.93	68.16	17.70	25.82
3	Foliar spray Planofix (NAA) @ 50ppm at 35 & 45 DAS	2621	3537	69.01	67.41	21.75	30.62
4	Foliar spray Tria@10ppm at 35 & 45 DAS(water base)	2415	3274	67.28	62.60	21.21	30.77
5	Foliar spray Tria@10ppm at 35 & 45 DAS (oil base)	2573	3462	66.00	60.33	21.22	28.22
6	Foliar spray Cytozyme (Gibbrelic Acid) @100 ppm at 35 & 45 DAS	2512	3387	69.59	68.19	19.60	31.08
7	Foliar spray Bioenzyme@1000ppm at 35 & 45 DAS	2234	3025	68.09	62.46	20.21	24.59
8	Foliar spray Surfactant	2380	3195	68.48	61.82	19.32	25.97
9	Water Spray	2247	3375	64.84	60.04	16.51	23.00
10	Without spray Control	2184	2787	64.16	57.38	15.14	19.55
	SEm±	82.8	120	1.42	1.86	0.81	0.80
	CD@5%	241	347	NS	5.42	2.36	2.50
	CD@1%	6.94	7.36	4.26	5.95	8.56	6.58

Table 3: Influence of six PGRs and their potential to enhance yield in semi-spreading cv. Girnar-2 under field conditions

S.No.	Treatment	Pod yield (kg ha^{-1})	Haulm yield (kg ha^{-1})	No. of pods/plant	Pod wt. /plant (g)	Shelling%	Test wt.(g)	Mature Kernel%
1	Foliar spray Brassinolides@250ppm at 35 & 45 DAS	3527	5460	21.40	33.80	68.85	62.75	93.44
2	Foliar spray Ethephon @250ppm at 10 & 5 days before harvesting	3575	4890	23.15	32.50	69.25	62.34	97.68
3	Foliar spray Planofix (NAA) @ 50ppm at 35 & 45 DAS	3710	5484	25.50	34.45	69.42	60.83	94.20
4	Foliar spray Tria@10ppm at 35 & 45 DAS(water base)	3556	5593	23.35	30.90	70.25	63.44	92.64
5	Foliar spray Tria@10ppm at 35 & 45 DAS (oil base)	3968	5437	26.72	35.62	69.35	62.72	93.18
6	Foliar spray Cytozyme (Gibbrelic Acid) @100 ppm at 35 & 45 DAS	3737	4984	25.20	34.55	68.17	60.60	92.57
7	Foliar spray Bioenzyme@1000ppm at 35 & 45 DAS	3598	5234	24.35	31.60	70.40	63.38	95.19
8	Foliar spray Surfactant	3506	5015	20.35	28.75	69.77	61.93	92.54
9	Water Spray	3380	4828	20.65	30.95	69.55	60.87	91.40
10	Without spray Control	3332	4796	20.85	30.85	67.92	62.62	95.93
	SEm±	116	223	1.38	1.14	1.41	1.80	1.8
	CD@5%	337	NS	4.03	3.33	NS	NS	NS
	CD@1%	6.47	8.61	11.99	7.09	4.09	5.79	3.9

removed from the pods. One hundred kernels were taken from each replicate randomly and their weight was determined in grams (g).

Seed Yield: Seed yield at harvest time was recorded from the net area (3.6x1.8 m) and expressed as kg ha^{-1}.

Shelling Percentage: The shelling percentage was calculated as given under:

Weight of kernels/ weight of pods x 100

The data on different pod and seed parameters were subjected to statistical analysis by computing correlation coefficient as the product movement correlation between them. Other statistical data are indicated in the tables.

RESULTS

Number of Mature Pods: In genotype M-13, number of pods per plant in control was 15.14, treatment of NAA, triacontanol and Bioenzyme responded in 21.75, 21.22 and 20.21 respectively; indicating enhanced number of pods per plant over control. Data in table no.2 indicate significant differences among the various PGRs; NAA and triacontanol causing well marked stimulatory effect in spreading type.

In the semi-spreading cv. Girnar-2, the number of pods in control was much more (20.85). The response of this cv. was found to be more significant to GA, triacontanol followed by NAA.

Significant differences were found in the two cultivars for their response to different PGRs.

Pod yield/plant: Pod yield was highest with NAA (2621), than triacontanol (2573 kg ha^{-1}) followed by Ethephon (2431 kg ha^{-1}) in M-13. On the other hand in Girnar-2, triacontanol and GA caused most pronounced stimulatory effect.

Pod weight/ plant: Weight of pods per plant enhanced to maximum with GA (31.08 g) followed by Triacontanol (30.77 g). Both the values were significantly more than the control (20.85 g) in M-13. In Girnar-2 triacontanol followed by GA enhanced pod weight. The values were significantly more than the control.

Shelling Percentage: In M-13 compared with control (67.92), bioenzyme (70.4), triacontanol (70.25) and NAA (69.42) caused promontory effects. On the contrary in Girnar-2 bioenzyme, triacontanol promoted this trait.

Haulm yield (Kg ha $^{-1}$): Compared with controls (2787), NAA caused maximum increase (3537) followed by Triacontanol (3462) in M-13. On the contrary in Girnar-2, brassinosteroids, triacontanol followed by NAA enhanced this trait.

DISCUSSION

In our studies a significant correlation existed in the presence of PGRs between number of pods per plant, pod weight per plant and pod yield per plant. Thus, the PGR which enhanced number of pods per plant and also pod weight per plant contributed to more pod yield (kg ha^{-1}). The significant differences at 1% and 5% levels were used to compare the means. Statistical analysis shows significant effect of PGRs on both the cultivars. Data presented in tables 2 and 3 show that both the

cultivars responded well to PGRs and values in the above sited tables were found to be significant at 1% and 5% level, proving that crop physiological parameters were influenced by the application of PGRs in both genotypes. Certain values were found to be insignificant like shelling percentage in M-13 indicating that this parameter in not influenced by the application of PGRs. From amongst the various PGRs tried presently NAA and aliphatic alcohols was most effective in M- 13 whereas in Girnar-2, triacontanol and brassinosteroids had most pronounced effect. The two cultivars responded differently to various PGRs.

The present studies also demonstrate that plant growth regulators could be successfully employed to procure enhanced yield in this important oil seed crop. Increase in pod weight and also kernel weight by triacontanol, brassinosteroids and NAA suggests delayed senescence by these PGRs and thus contributing to the efficient pod and seed filling. Malik *et al*., [8], Malik *et al*., [1] and Verma *et al*., [6] have reported that foliar spray of aliphatic alcohols stimulated the mobilization of photosynthates to the kernels. Parmar *et al*., [11] showed that aliphatic alcohols established early and high sink potential and hence stimulated ability of translocation of photo assimilates. Malik *et al*., [1] used $^{14}CO_2$ and demonstrated efficient partitioning of the photo assimilates leading to increased productivity.

Unarguably in both the cv. of groundnut application of some PGRs altered the yield and related components. Earlier Malik *et al*., [1, 8] reported positive correlation between initial flower formation and yield parameters. Aliphatic alcohols are known to establish early potential sinks, mobilize assimilates for a longer period in the pods.

It would be interesting to observe the number of flowers produced in the initial 40 and 70 days after sowing in control and treated plants.

Some of the growth regulators e.g. aliphatic alcohols as well as monophenols are reported to delay senescence, prolong functional life of the leaves. Malik *et al*., [1] have demonstrated the shift in source-sink assimilates partitioning following foliar applications with a mixture of aliphatic alcohols. In the present studies this appears to be the case.

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