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Effect of PGRs and nutrients on flowering and productivity of groundnut (*Arachis hypogaea* L.)

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Abstract
An experiment was carried out to assess the impact of foliar spray of plant growth regulators (PGRs) and nutrients on flowering and productivity of groundnut (*Arachis hypogeal* L.) var. TMV13. Different plant growth regulators and nutrients such as ethephon, mepiquat chloride, mono ammonium phosphate (MAP), and potassium chloride (KCl) were sprayed at different stages. Among the treatments, foliar spray of ethephon @ 50 ppm + mepiqout chloride 125ppm @ 25 DAE (days after emergence) + ethephon @ 50 ppm at 60 DAE found to be best treatment by means of yield. The study clearly showed that foliar spray of PGRs and nutrients can increase the productivity of groundnut.

Keywords: Ethephon, mepiquat chloride, yield traits, productivity, groundnut, flowering, nutrients

Introduction
Groundnut (*Arachis hypogea* L.) is an important oilseed crop in the tropical and subtropical regions of the world. It is a unique crop, matching the attributes for both legume and oilseed crop. Groundnut is one of the principal economic plants as a resource for edible oil and protein. It is the world's 13th most important food crop, 4th most important source of edible oil and 3rd most important source of vegetable protein. Groundnut naturally possesses racemose and indeterminate flowering pattern hence, growth and development during the growth phases overlaps. This causes low fruiting efficiency due to inter organ competition for photo assimilates and other metabolites. Consequently there is improper partitioning of assimilates to the developing pods and seeds at the time of harvest. Yet another constraint in groundnut productivity is early and late flowering extended duration of flowering which causes uneven maturity.

In groundnut, flowering begins within 21 DAS and daily flower production varies with stage of the crop, environment and cultural practices. Indeterminate growth habit of groundnut results in overlap in the growth of both vegetative and reproductive organs. This leads to inter organ competition for photo assimilates. In groundnut, all the flowers produced are not converted into mature pods. The peak flowering is observed in between 40 DAS to 55 DAS, these are the main flowers which will directly help in productivity of crop. Flowers produced till 70 DAS will turn into mature sound kernels while the flowers which are produced at later stages of crop growth will lead to production of immature pods there by decrease the productivity. Vinothini *et al.*, (2018) [10] recorded that the flowers formed during later stages would lead to production of immature and ill filled pods, there by decrease the pod yield and the efficiency of pod filling.

Ethylene has been found to regulate flowering process in many crops. In groundnut foliar spray of etherl have been found to arrest flower production irrespective of stages. Ketring (1977) and Schubert (1980) [2] observed that ethephon if sprayed in beginning of blooming stage, it efficiently advances flowering for a period of time and there by promotes termination of flower development at early stage.

Groundnut normally produces more number of flowers and it was recorded that less than 15% to 20% of flowers produced are turned into mature pods (Lim and Hamdan, 1984; Ramanatha Rao and Murty, (1994) [7]. Many studies reported that foliar application of PGR and nutrients, alone or in combinations were found to be potential in arresting basting the growth of the groundnut at particular growth stage. Krishnamurthy (1981) [8] stated that it is possible to increase the yield of groundnut either through increasing or suppressing the flower production using growth regulators. In groundnut early formed pods will germinate as soon as they mature and late formed pods will be immature pods at the time of harvest, there two pods, viviparously germinated pods and ill filled pods may significantly affect the productivity of the crop. If the number of early and late formed flowers are reduced means there is a chance to get more mature pods with same or comparable level of maturity.

The use of growth retardants to manipulate the source-sink relationship of groundnut is widely reported Parmar *et al.* (2003) [6] have demonstrated 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 in groundnut (*Arachis hypogaea* L.). Kiruthika *et al*., 2018 [4] recorded maximum number mature pods per plant as a result of foliar spraying of ethephon by arresting late formed flowers. In this study, it was hypothesized that by arresting or reducing early and late formed flowers which in turn might improve the peg to pod ratio. And also by modifying source sink relationship using PGRs and nutrients might reduce the wastage of photo assimilates, In turn leads to development of matured sound kernels. With this background the current research work was initiated with the objective to standardize the foliar spray to reduce the early and late formed flowers and viviparous germination. And also to manipulate the source sink relationship to avoid the wastage of resources by the way of immature pods, late developed pegs and ill filled pods.

Materials and Methods

The present field experiment was conducted at Eastern block Farm of TNAU, Coimbatore during 2018 in randomized block design (RBD). Groundnut variety TMV 13 was used for the study. Plant growth regulators were sprayed at 25th and 60th DAE and nutrients at 40th and 70th DAE. The treatments imposed were as follows, T_1 - Control, T_2 – Ethephon @ 50 ppm at 25 DAE + Ethephon @ 50ppm at 60 DAE, T_3 - Ethephon @ 50 ppm+Mepiquat chloride @ 125ppm at 25 DAE+ at 60 DAE, T_4 -Ethephon @ 50 ppm at 25 DAE + Mepiquat chloride @ 125 DAE + Ethephon @ 50ppm at 60 DAE, T_5 - T2+ MAP (1%) at 40DAE, KCl (1%) at 70 DAE, T_6 -T3+ MAP (1%) at 40 DAE, KCl (1%) at 70 DAE, T_7 – Ethephon @ 50 ppm at 60 DAE. The observations like the number of flowers per plant, total number of pods per plant, number of double seeded pods per plant (mature and immature), number of single seeded pods per plant (mature and immature), number of ill filled pods per plant, total weight of pods per plant, number of viviparously germinated pods per plant and yield per plant were observed for each treatments.

Result and Discussion

Results showed that the foliar spray of plant growth regulators and nutrients had shown significant effect on flowering and yield traits of groundnut. The highest value on total number of flowers were recorded in T_1 (87.33) followed by T_7 (74.90) while the least value were recorded in T_3 (63.66) All other treatments were on par with each other compared to control. Flower production in early stages were significantly reduced by spraying of ethephon and mepiquat chloride (Table.1, plate No 1). Krishnamoorthy (1972) [5] reported that the application of ethephon inhibited flowering, before the initiation of flowers and intern reduced the number of flowers produced. Ketring (1977) and Schubert (1980) [2] observed that ethephon if sprayed in beginning of blooming stage, it efficiently advances flowering for a period of time and there by promotes termination of flower development at early stage.

Among the treatments, the number of pods per plant was ranged from 19.3 to 22.9. More number of pods was observed in T_1 Control (22.3) followed by T_2 (20.8). The least number of pods per plant were observed in T_3 (18.0). More number of double seeded mature pods per plant was recorded in T_4 (11.6) followed by T_2 (11.1) and lowest number of double seeded mature pods was observed in T_1 control (8.4). Highest number of immature double seeded pods were recorded in T_1 (4.1) followed by T_7 (2.9). The least number of double seeded immature pods were recorded in T_4 (2.3).

Number of single seeded mature pods were recorded highest inT_2 (2.8) followed by T_1 (2.4) and lowest number of pods were observed in T_6, T_7 (1.9). More number of single seeded immature pods were observed in T_1 control (3.11) followed by T_5 (2.67) less number of pods in T_4 (1.22) and all other treatments were significantly differed. The least number of ill filled pods were recorded in T_5 (1.0) followed by T_3 (1.2) and highest number of pods were recorded in T_1 control (4.9) (Table 2). These findings were in accordance with Lone (2001) [3] where work in chickpea observed a more number of mature pod set percentage due to application of ethephon treated plants. Beneficial effects of ethephon on pod number of mustard have also been reported by (Khan *et al.*, 2000; Mir *et al.*, 2008) [3].

Among the treatments the highest number of mature pods were recorded in T_4 (17.11) followed by T_2 (15.89) and lowest number was observed in T_1 control (10.22). Number of immature pods per plant were recorded highest in T1 control (7.22) and less number of immature pods was observed in T_4 (1.67) followed by T_3 (2.56). Lowest number of viviparous germination were observed in T_4 (0.5) and highest number of viviparous germination was observed in T_1 control (4.5) followed by T_7 (3.2) (Table.3).

The highest was pod yield per plant was recorded in T_4 (3.20) followed by T_2 (2.52) and least value was recorded in T_3 (2.05). The highest computed pod yield per hectare was recorded in T_4 (2553) followed by T_5 (2389) least observation was recorded in treatment T_1 control (1890). 100 kernel weight per plant was highest in T_4 (44.2) followed by T_2 (40.3) and least value was observed in treatment T_1 control (32.8) (Table 4). The findings were in accordance with the observations made by Singh *et al.*, 1987 [6]: Saxena *et al.*, (2007) [9] in soybean. As reported in studies, increased yield by foliar application of PGRs and nutrients has been recorded due to the reasons that the growth regulators have been found to reduce the flowering at early and late stages and better assimilate translocation towards reproductive parts of plants.

Conclusion

The foliar administration of plant growth regulators and nutrients were found to have profound impact on increasing the productivity of groundnut. The application of ethephon and mepiquat chloride altered the flower production there by pod yield and improved the partitioning efficiency of the translocating assimilates to the sink organs in groundnut.

Table 1: Effect of foliar application of PGRs and nutrients on total number of flowers in groundnut

Treatment	35DAE	50DAE	65DAE	90DAE	Total
T1	12.33	22.67	39.00	13.33	87.33
T2	5.00	21.66	41.33	2.33	70.32
T3	3.33	19.66	37.00	3.67	63.66
T4	6.00	18.33	37.67	2.67	64.67
T5	5.67	18.33	37.33	3.00	64.33
T6	4.33	22.33	40.00	3.00	69.66
T7	14.24	21.66	37.67	1.33	74.90
Mean	7.22	20.66	38.57	4.19	70.64
SEd	0.0675	0.1392	0.2607	0.0770	
CD (P=0.05)	0.1470	0.3032	0.5681	0.1677	

Table 2: Effect of foliar application of PGRs and nutrients on number of pods in groundnut

Treatment	Total number of pods plant^{-1}	Number of double seeded pods plant^{-1}		Number of single seeded pods plant^{-1}		Number of ill filled pods plant^{-1}
		Mature	Immature	Mature	Immature	
T_1	22.9	8.4	4.1	2.4	3.11	4.9
T_2	20.8	11.1	2.6	2.8	1.56	1.3
T_3	18.0	10.2	2.7	2.0	2.11	1.2
T_4	20.1	11.6	2.4	2.3	1.22	1.3
T_5	18.6	9.8	2.8	2.2	2.67	1.0
T_6	20.0	9.6	2.6	1.9	2.22	1.9
T_7	19.3	9.8	2.9	1.9	1.67	3.1
Mean	21.0	10.1	2.87	2.2	2.08	3.3
SEd	0.1393	0.0698	0.0272	0.0178	0.0241	0.0234
CD (P=0.05)	0.3034	0.1520	0.0593	0.0388	0.0526	0.0510

Table 3: Effect of foliar application of PGRs and nutrients on number of pods/ viviparous germination in groundnut

Treatment	Number of mature pods plant^{-1}	Number of immature pods plant^{-1}	Number of viviparous germinated pods plant^{-1}
T_1	10.22	7.22	4.5
T_2	15.89	2.89	0.9
T_3	14.22	2.56	0.8
T_4	17.11	1.67	0.5
T_5	14.00	2.56	0.7
T_6	13.33	2.78	0.8
T_7	13.56	2.67	3.2
Mean	14.04	3.62	1.62
SEd	0.0920	0.0371	0.0178
CD (P=0.05)	0.2005	0.0808	0.0388

Table 4: Effect of foliar application of PGRs and nutrients on yield in groundnut

Treatment	Pod yield plot^{-1}(kg)	Computed pod yield ha^{-1} (kg)	100 kernel weight
T1	2.15	1890	32.8
T2	2.52	2313	40.3
T3	2.05	1912	38.3
T4	3.20	2553	44.2
T5	2.61	2389	34.6
T6	2.32	1980	36.2
T7	2.41	2127	38.1
Mean	2.47	2166.29	32.8
SEd	0.0272	13.6373	0.2376
CD (P=0.05)	0.0593	29.7135	0.5177

Fig 1: Effect of PGRs and nutrients during peg formation stage of groundnut

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