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Influence of plant growth regulators on dry matter production and yield attributes of *Kharif* groundnut cv. GJG-31

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Abstract
A field experiment was conducted during the *kharif* 2018 to study the effect of plant growth regulators on dry matter production and yield attributes of groundnut. The investigation was carried out in randomized block design (RBD) with three replications and foliar application of different concentration of growth regulators such as Paclobutrazol PBZ (200, 250 ppm), Triacontanol TRIA (5, 10 ppm), Brassinosteroids BR (10, 15 ppm), Salicylic acid SA (25, 50 ppm), and water spray at 40 & 55 days after sowing (DAS). Experiment results revealed that application of PGRs increased the total dry matter production and increase was more in SA @ 50 ppm treated plants. Highest partitioning of dry matter to reproductive parts was also observed in SA @ 50 ppm treated plants. Significantly higher no. of filled pods per plant (14.44), shelling percentage (74.64%) and yield (1986.49 kg ha-1) were observed in SA @ 50 ppm treated plants.

Keywords: BR (Brassinosteroids), groundnut, PBZ (Paclobutrazol), SA (salicylic acid), TRIA (Triacontanol), yield

Introduction
Cultivated groundnut (*Arachis hypogaea* L.) is commonly known as monkey-nut, peanut, goobernut, manillanut, earthnut and popularly called as *magphooli*, which is one of the principal economic crops of the world, ranking 13th among food crops. It is also first ranking oilseed crop of India. It is a self-pollinated, autotetraploid legume crop with 2n=4x=40 chromosomes and belong to the family *Fabaceae*. It has superior edible oil quality and protein in the meal. It is rich source of edible oil (49.2%), protein (25.8%), carbohydrates (16.1%), minerals and vitamins (Arnarson, 2015) [2]. It has a distinct position among the oilseeds, as it can be consumed and utilized in diverse ways. It is grown throughout the tropics and its cultivation is extended to the subtropical countries lying between 45° north and 35° south and up to an altitude of 1000 meters. It is grown on 26.4 million hectares worldwide with a total production of 37.1 million metric tons and an average productivity of 1.4 metric t/ha (Anon., 2018) [1].

In a given environment the physiological performance like dry matter production and partitioning of dry matter to the economic product will indicate some of the characters which are essentially involved in contributing to higher yield.

The intent of the present study is to evaluate effects of different plant growth regulators on total dry matter production, yield attributes and finally yield.

Materials and Methods
The present investigation was conducted at Cotton Research Station, JAU, and Junagadh during *kharif* season of 2018. The soil of the experimental plot was clayey in texture and medium black in reaction with pH 7.78 and EC 0.64 dS/m. The soil has available nitrogen (318 N kg/ha) and available phosphorus (82.07 P2O5 kg/ha) while available potash (344 K2O kg/ha). The experiment constituted of 10 treatment combinations were laid out in RBD design with three replications. Solutions of PBZ (200, 250 ppm), TRIA (5, 10 ppm), BR (20, 40 ppm), SA (25, 50 ppm) and water sprayed on plants at 40 & 55 DAS with the help of hand sprayer as per treatment while in untreated control nothing sprayed. The crop was fertilized with a uniform dose of nitrogen, phosphorus and potassium at the rate of 12.5, 25 and 12.5 kg ha-1, respectively. The below mentioned observations were recorded at 50, 70, 90 DAS and at harvest.

Statistical analysis

The data were analyzed by method of analysis of variance obtained by Panse and Sukhatme (1984) [9]. Significance was tested by "F" value at 5 percent level of probability. Critical differences were worked out for the effects which are significant.

Results and Discussion

Dry matter accumulation and partitioning

Dry matter is the end product of assimilates from source organs *via* a transport path to the sink organs. The potential growth rate and potential capacity to accumulate assimilates has been shown to be an important parameter that quantitatively reflects the sink strength of an organ. A perusal of data in Table 1 revealed that different growth regulator treatments showed their significant effect on total dry matter production per plant. Significantly the mean highest total dry matter production observed in treatment T8 (33.80 g plant-1), it was statistically at par with by treatment T5 (30.55 g plant-1), T6 (31.06 g plant-1) and T7 (31.52 g plant-1), while control T10 (22.06 g plant-1) recorded the lowest total dry matter production. A higher amount of dry matter accumulation was observed due to salicylic acid application since exogenous application of salicylic acid enhanced photosynthesis and higher photosynthetic rate as reflected through the total dry matter. Kataria and Bhatt (1994) [7] reported that the dry matter accumulation in root, stem, leaf and whole plant increased with crop age. Kaur *et al.* (2015) [8] reported that application of salicylic acid @ 50 mg/L significantly increased dry matter accumulation.

The data summarized in Table 1 revealed that different growth regulator treatments showed their significant effect on dry matter partitioning to lamina, stem, root and reproductive part at harvesting stage. Highest dry matter partitioning in lamina recorded from T3 treatment (18.29%) which was at par with T4(18.12%), T7 (17.73%), T2 (17.70%) and T8 (17.69%) while control T10 recorded lowest dry matter partitioning in lamina (15.55%). Partitioning of dry matter in stem recorded highest value (39.63%) by control due to lowest dry matter partitioning (40.01%) in reproductive part and lowest partitioning to stem recorded by treatment T8 (32.04%) and it showed highest portioning to reproductive part (45.30%). Highest dry matter partitioning in root recorded from treatment T1 (6.89%) which statistically at par with T6 (6.48%), T2 (6.16%), and T5 (5.99%), while lowest recorded from control (4.81%). The highest dry matter partitioning in reproductive part (45.30%) recorded by T8 which was at par with T7 (45.24%), T4 (44.04%), T3 (43.73%) and T6 (43.72%), while control recorded lowest (40.01%). Jeyakumar *et al.* (2008) [5] reported an increase in dry matter production and it's partitioning to pods with the application of salicylic acid.

The dry matter partitioning in leaf and stem decreased with the age of the crop whereas it increased in reproductive parts. This decline in leaf and stem dry weight compared to seed at later stages of crop might be due to translocation of stored photosynthates towards reproductive organs. More than 40 per cent of dry matter was partitioning in reproductive parts of the plant at harvest. Different PGRs induced higher yields are mainly due to altered photosynthate distributive patterns within the plant by coordinating plant processes to synthesize maximum dry matter and partitioning the major quantum of this increased dry matter into effective yield contributing factors.

The dry weight of reproductive parts showed an increasing trend throughout the growing period of the crop due to growth regulator treatments. The enhanced dry weight of reproductive parts by growth regulators could be due to increased size, number of pods per plant and also efficient translocation of assimilates from leaf and stem to reproductive parts.

Yield and yield attributes

The yield of crop plants is attributed to total assimilation achieved during the growing season and the way it is partitioned between the desired storage structures and rest of the plant. The number of filled pods per plant were recorded at harvest are furnished in Table 2. A perusal of data revealed that different growth regulator treatments showed their significant influence on number of filled pods per plant as compared to control (T10). The number of filled pods per plant was found significantly highest in treatment T8 plant (14.44) which was statistically at par with treatments T3 (13.67), T7 (13.64), T6 (13.54) and T4 (13.53), while control recorded the lowest (9.13) number of filled pods per plant at harvest. In the present study, it is revealed that the application of plant growth regulators significantly increased number of pods per plant and finally kernel yield per plant which is the most important yield determining components in groundnut. Ramraj *et al.* (1997) [10] who examined the effect foliar sprays of different concentrations of homobrassinolide in groundnut (0.25 and 0.50 mg per liter). The homobrassinolide treatments significantly increased pod yield in groundnut as compared to control. Benjamin (1998) [4] reported that double spray of salicylic acid @ 50ppm resulted in increased yield components such as number of inflorescence per plant, number of pods and number of seeds per pod.

The data regarding 100 pod weight are furnished in Table 2. A calculated data in Table 2 revealed that different growth regulator treatments did not exhibit their significant influence on 100 pod weight. An appraisal of data Table 2 indicated that growth regulator treatments exerted their significant consequence on shelling percentage. Significantly highest shelling percentage (74.64%) was registered under treatment T8 and it was found statistically at par with treatments T4 (68.58%), T7 (67.90%) and T6 (67.36%), while control T10 recorded the lowest (57.15%) shelling percentage. Tafsira Naz (2006) [11] reported that foliar spray of salicylic acid @ 500 ppm increased shelling%, harvest index, test weight and oil% of kernels in groundnut cv. JL-24.

An appraisal of data Table 2 indicated that growth regulator treatments exerted their significant consequence on yield. At harvest, significantly highest yield (1986.49 kg/ha) was registered under treatment T8 and it was found statistically at par with treatments T7 (1936.42 kg ha-1), T6 (1921.27 kg ha-1), T4 (1888.21 kg ha-1) and T3 (1841.26 kg ha-1), while control T10 recorded the lowest (1504.38 kg ha-1) yield. The photosynthetic productivity and partitioning of photosynthate finally lead to the economic yield which is the pods in groundnut. The yield in groundnut depends upon the accumulation of photo-assimilates during the growing period and the way in which they are partitioned between desired storage organs of plant. Seed yield and its related parameters in groundnut were influenced by the application of different growth regulators, which indicated that these growth regulators have differential influence on the distribution of assimilates between vegetative and reproductive organs. The increase in yield due to growth regulators in groundnut might be due to an increase in per cent distribution of peg and pod dry weight, higher partitioning of dry matter towards reproductive organs, increase in leaf thickness, number of pods per plant, higher no. of peg and total dry matter production. Similarly increases in yield were reported by Karimian *et al.* (2015) [6] who reported that application of 3 mM salicylic acid had significant and positive effects on shelling%, test weight, no. of pods per plant and ultimately improves yield of groundnut plants.

Table 1: Effect of growth regulators on total dry matter production and partitioning of groundnut cv. GJG-31

Treatments		Total dry matter production (g plant1)					Dry matter partitioning (%)			
		50 DAS	70 DAS	90 DAS	At Harvest	Mean	Lamina	Stem	Root	Reproductive part
T1	PBZ @ 200 ppm	13.12	28.85	32.11	38.41	28.12	17.13	32.60	6.89	43.38
T2	PBZ @ 250 ppm	13.07	29.06	33.23	39.53	28.72	17.70	33.59	6.16	42.54
T3	TRIA @ 5 ppm	12.10	28.97	33.49	39.79	28.59	18.29	32.50	5.48	43.73
T4	TRIA @ 10 ppm	11.50	29.22	33.22	39.52	28.37	18.12	32.44	5.39	44.04
T5	BR @ 20 ppm	14.05	30.38	35.73	42.03	30.55	17.24	32.84	6.48	43.44
T6	BR @ 40 ppm	14.09	30.98	36.43	42.73	31.06	16.99	33.30	5.99	43.72
T7	SA @ 25 ppm	14.01	31.11	37.33	43.63	31.52	17.73	32.11	4.92	45.24
T8	SA @ 50 ppm	15.46	34.69	39.38	45.68	33.80	17.69	32.04	4.97	45.30
T9	Water spray	9.46	22.28	26.36	32.66	22.69	16.95	36.78	4.87	41.39
T10	Control	9.28	21.76	25.45	31.75	22.06	15.55	39.63	4.81	40.01
	S.Em.±	0.63	1.44	1.76	2.01	1.46	0.72	1.44	0.32	1.24
	C.D. at 5%	1.88	4.27	5.24	6.01	4.35	2.14	4.27	0.95	3.71
	C.V.%	8.16	8.96	10.46	9.87	9.36	8.16	8.96	10.46	9.87

Table 2: Effect of growth regulators on yield and yield attributes of groundnut cv. GJG-31

Treatments		No. of filled pods per plant	100 pod weight(g)	Shelling percentage (%)	Yield (kg ha'')
T1	PBZ @ 200 ppm	12.53	103.15	65.68	1756.59
T2	PBZ @ 250 ppm	12.44	102.45	65.95	1732.60
T3	TRIA @ 5 ppm	13.67	101.63	64.03	1841.26
T4	TRIA @ 10 ppm	13.53	102.94	68.58	1888.21
T5	BR @ 20 ppm	12.65	100.96	65.26	1780.02
T6	BR @ 40 ppm	13.54	102.83	67.36	1921.27
T7	SA @ 25 ppm	13.64	107.16	67.90	1936.42
T8	SA @ 50 ppm	14.44	107.91	74.64	1986.49
T9	Water spray	9.88	95.50	58.58	1560.88
T10	Control	9.13	94.73	57.15	1504.38
	S.Em.±	0.61	4.87	2.47	93.61
	C.D. at 5%	1.83	NS	7.34	278.14
	C.V.%	8.08	8.28	6.54	9.02

Conclusion

This study showed that application of PGRs was increased the total dry matter production, number of filled pods per plant and seed yield of groundnut. There was a net reduction in dry weight of leaves and stem at the peak period of pod filling, however, the dry matter content of pods increased linear up to harvest. The highest yielding treatment SA @ 100 ppm resulted higher production of photosynthate due to that more partitioning of dry matter transported from leaf to pods and ultimately gave higher pod yield.

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