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Response of groundnut (*Arachis hypogeal*) to the exogenous application of growth hormones (IAA and GA_3)

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ABSTRACT

Experiments were carried out to study the effect of Indole Acetic Acid (IAA) and Gibberellic Acid (GA_3) on groundnut (TAG-24). In this study, the effect of growth regulators was studied on morphological as well as yield parameters of groundnut plant. The sowing of seed was carried out in eleven plots of 1m x 1m, one for control and with 10ppm, 20ppm, 30ppm, 40ppm and 50ppm concentrations of IAA and GA_3. Different concentrations of IAA and GA_3 were applied twice 30 and 60 days after sowing. Compared to IAA, $GA_{3\ hr}$ hormone was found more effective to increase the height of the plant, the number of root nodules, the size of the seeds, number of pods, weight of seeds as well as the yield of groundnut. IAA has affected all the parameters, but except the height of the plant and length of the root, all the parameters showed non-significant change. Exogenous application of GA_3 enhanced the number of root nodules and number of pods per plant, but it was found reduced due to the application of IAA. Thus, application of GA_3 (i.e. GA_3 at 50ppm) can be suggested for higher yield of groundnut.

Key Words: IAA, GA_3, Root nodules, Morphological characters and Groundnut yield

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I. Introduction

Indian economy is greatly influenced by various agricultural activities, production andagribusinesss. As India has different of geographical and climatic conditions, hence a variety of crops are cultivated and grown year-round. In India, oilseeds contribute 14% of the total area under cultivation (GOI, 2015). India is the fourth largest edible oil economy in the world and contributes about 10% of the world oilseed production. Groundnut is one of the major nine oilseeds in India. Groundnut is one of our country's largest cash crops. It is a commodity that is low-priced but a precious source of all nutrients. But the area under cultivation and production of groundnut was decreased during 2015-16 periods due to shortage of rainfall and drought conditions. There were nine states with more than 100 thousand tons of groundnut production; in 2015-16, Gujarat, Rajasthan, Tamil Nadu, Andhra Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Telangana and West Bengal (OGD PMU Team 2017). However, compared to the world scenario yield of groundnut is very less (GOI 2015) in India. Hence, efforts should

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be made to increase the yield to attract farmers towards the cultivation of groundnut. Growth hormones can contribute to the improved growth and development of field crops with higher yields, e.g. groundnut (Khan et al. 2011). In addition, auxins and GA_3 are important growth hormones that can affect the development of plant morphological and yield contributing attributes. Besides their primary role in growth regulation, growth hormones also affect timing of flowering, the sex of the flowers, senescence of leaves and fruits, fruit development, etc. Most of the workers have studied the effect of growth regulators on seed germination (Chauhan et al. 2009; Patil et al. 2012; Dhoran and Gudadhe, 2012; Patil and Bhosle, 2017). Recent studies (Emonger and Ndambole, 2011; Rastogi et al. 2013; Khairul Mazed, et al. 2015) have focused on the impact of growth regulators on yield contributing parameters, hence it can increase the yield of the crop. This present study deals with the response of groundnut to the IAA and GA_3 in relation to morphological and yield contributing attributes, such as height of plant, number of root nodules, number of pods per plant, seed size, seed weight and yield.

II. Materials and Methods

The experiment was carried out in the Department of Botany, Late Ramesh Warpudkar Arts, Commerce and Science College, Sonpeth, Parbhani (MS) district, India, from December 2013 to March 2014 to study effect of IAA and GA_3 on morphological and yield parameters of Groundnut (TAG-24). A Stock solution of 100 ppm GA_3 and IAA was prepared by dissolving 50mg into 500 ml of water (Before preparation of Stock solution GA_3 was dissolved in small quantity of alcohol). It was diluted to prepare different concentrations of growth hormones using $N_1V_1=N_2V_2$ formula to prepare 10ppm, 20ppm, 30ppm, 40ppm and 50ppm IAA and GA_3. To study effect of growth hormones on growth and yield parameters plots of 1meter X 1meter were prepared. Groundnut (TAG-24) seeds were sowed in these plots. Growth hormones were applied twice first 30 days after and second 60 days after date of sowing. Spraying of growth hormones was carried out early in the morning with hand spray. The height of the plant and length of the root was measured physically with help of Scale in centimeter. The number of root nodules and the Number of pods per plant were counted numerically. Each treatment was replicated three times and average values were tabulated in Table 1.

Size of seed: Size of the seed was determined by pouring seeds into the 25 ml measuring cylinder as number of seeds per 25ml increases size of the seed decreases and vice-versa.

Weight of seed: After harvesting, 100 seeds were selected randomly from each plot and they were weighed using electronic balance and represented in gram.

Yield: At the end of the season, crop from each plot of 1x1m was harvested and threshed separately and weighed using the electronic balance in kilograms. It was multiplied by 10000 and converted into kg/hectare.

Statistical analysis: The mean, standard deviation (SD) and coefficient of variation (CV) have been calculated as described by Mungikar (2003). Standard error (SE) was calculated as S.D. / $\sqrt{n}$ (n = number of observations), and Critical difference (CD) was calculated as SE multiplied with t value for n^{-1}. (C.D.= S.E. x t value for n^{-1}).

III. Results and Discussion

In control, the average height of the groundnut plant was 35cm while maximum height of the plant was recorded in plants treated with 50ppm IAA which was 40.2cm (Table 01). Application of IAA and GA_3 has shown increase in the height of the plant. This increase in the height of the plant was highly significant in all treatments. The same results were found by Bora and Sarma (2006), Rahman et al. (2004) and Patil (2017) to increase plant height due to application of plant growth hormones. Different concentrations of the IAA and GA_3 have shown significant increase in the length of roots. The average length of roots in control was 20cm (Table 01). Application of GA_3 increased length of roots up to 30ppm concentration it was decreased at higher concentrations of GA_3 (40 and 50ppm). There was direct proportion between the concentration of IAA and length of root.

An increase in the root length was statistically significant at p=0.01 in all concentrations of IAA and in 30ppm GA_3. In 10 and 20ppm IAA it was significant at p=0.05. The concentration of Gibberellic acid has

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shown direct effect on the number of root nodules in the groundnut. In control the number of root nodules per plant was 28 which were increased up to 38 in plants treated with 50ppm GA_3(Table 01). An increase in the number of nodules per plant in 10ppm and 20ppm GA_3 was statistically non-significant while in 30ppm 40ppm and 50ppm GA_3 increase in the number of nodules was statistically significant at p=0. 001. Plants treated with different concentrations of IAA have shown variable effect on the number of root nodules per plant. 10 and 20 ppm concentration of IAA increases but this increase in the number of nodules is statistically non-significant. It was decreased (26 per plant) than control (28/plant) in the plants treated with 40 and 50ppm IAA but this decrease was statistically non-significant. Such type of increased nodulation was recorded by Dobert (1992), Lievens (2005) and Emonger and Ndambole (2011) due to the application of Growth Hormones. While the results obtained by Williams and Mallorca (1984) in Soybean were contrast with the results obtained here.

The number of pods per plant was constantly increased with the concentration of GA_3. Increased number of pods due to application 10ppm GA_3 is significant at p=0.05 while other four concentrations of GA_3 have shown increase in the number of pods which was significant at p=0.01. The maximum number of pods per plant was recorded in plants applied with 50ppm GA_3 that was 38 pods per plant. The role of IAA to increase number of pods in groundnut is very little. The number of pods per plant was increased up to 30ppm IAA concentration which was non-significant statistically. The plants applied with 40ppm IAA show no increase in the number of pods while 50ppm IAA shows reduction in the number of pods per plant (23 pods per plant) this decrease is also statistically non-significant. The same results were found by Emonger (2007) in Cowpea, Resmi and Gopalkrishnan (2004) with NAA (15, 30, and 45 ppm) and 2-4D (2ppm) in *Vignaunguiculata*. Rathod et al. (2015) recorded maximum number of green pods per plant in French bean due to application of 100 ppm GA_3.

The size of the seed was influenced only by higher concentration of GA_3. 10ppm GA_3, as well as all the concentrations of IAA, has no significant effect on size of the seed. 20ppm GA_3 has shown significant increase in the size of groundnut seeds it is significant at p=0.05, while 30, 40 and 50 ppm GA_3 has maximum seed size which is significant at p=0.01.

The weight of 100 seeds of groundnut in control was 34.9gm. Only 40ppm and 50ppm GA_3 was effective to increase weight of the seeds. A maximum weight of 100 seeds was found in the plants applied with 50ppm GA_3 (39.2gm). The increase in the weight of 100 seeds in the plant applied with 40 and 50ppm GA_3 was statistically significant at p=0.01 lower concentrations of GA_3 had shown increase in the seed weight which was non-significant. IAA did not show any significant change in the weight of 100 seeds compared to control.

Increase in the weight of seeds was also recorded by earlier workers like Ghodrat et al. (2012) in *Zea mays* due to application of IBA and GA_3 in 4-6 leaf stage, Emonger (2007) in Tswana Cowpea due to application of GA_3 and Patil (2017) in sunflower due to application of IAA and GA_3. Growth hormones had no same results in all kinds of plants Ginnakoula et al. (2012) in Lentil recorded decrease in 1000-seeds weight was by 26% in plots applied with GA_3.

It was found that 50ppm GA_3 was statistically significant at the p=0.01 level while 40ppm GA_3 was statistically significant at p=0.05 level to increase yield of Groundnut. Besides these two treatments, any other treatment was not significant statistically to enhance Yield of Groundnut. In control, yield was 1500 kg/hectare while it was maximum in 50ppm GA_3 applied plants that were 2250kg/hectare followed by 50ppm GA_3 where it was 1670 kg/hectare. Many workers have worked on this parameter and found that growth hormones are able to increase yield of the crop. Resmi and Gopalkrishnan (2004), Emonger (2007) and Rastogi et al. (2013) have recorded increased yield in Long bean, Cowpea, and Linseed respectively. Ernst et al. (2016) and Patil (2017) have also recorded increase in the sunflower yield due to application of Gibberellic acid. Sarkar et al. (2002) and Agawane and Parhe (2015) found increased yield in soybean due to 100 ppm IAA and 100 ppm GA_3 respectively.

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Table 01. Influence of growth hormones morphological and yield parameters of groundnut

Treatments	Height of plant(cm)	Length of Root(cm)	No. of root nodules	Size of seed (seed/25ml)	Number of pods	100 seeds Weight (gm)	Yield (kg/ha)
Control	35	20.0	28.0	38.3	24.0	34.9	1500.0
GA 10ppm	37.1**	20.3*	30.0	37.7	28.0*	35.0	1500.0
GA 20ppm	37.2**	20.3*	30.0	37.3*	32.0**	35.5	1550.0
GA 30ppm	38.1**	20.4**	33.0**	36.3**	33.0**	35.7	1510.0
GA 40ppm	37.8**	19.9	34.0**	35.0**	34.0**	37.3**	1670.0*
GA 50ppm	37.6**	19.8	38.0**	35.0**	38.0**	39.2**	2250.0**
IAA 10ppm	35.8**	20.4**	30.0	38.3	26.0	34.8	1480.0
IAA20ppm	36.2**	20.6**	30.0	38.7	25.0	34.8	1510.0
IAA30ppm	37.4**	21.0**	28.0	38.3	25.0	35.0	1610.0
IAA40ppm	38.9**	21.0**	26.0	38.0	24.0	34.9	1520.0
IAA50ppm	40.2**	21.1**	26.0	38.3	23.0	35.0	1490.0
Mean	*37.4*	*20.4*	*30.3*	*37.4*	*28.4*	*35.7*	*1599.1*
S.D.	*1.4*	*0.4*	*3.4*	*1.3*	*4.8*	*1.3*	*213.0*
C.V.	*5.5*	*2.1*	*11.3*	*3.4*	*17.0*	*3.7*	*13.3*
S.E.	*0.4*	*0.1*	*1.0*	*0.4*	*1.5*	*0.4*	*64.2*
C.D. 5 %	*1*	*0.3*	*2.3*	*0.9*	*3.2*	*0.9*	*143.2*
C.D. 1 %	*1.4*	*0.4*	*3.3*	*1.2*	*4.6*	*1.3*	*203.6*

(* Significant at p=0.05; ** Significant at p=0.01).

IV. Conclusion

From the above experiment, it is evident that IAA and GA_3 both are playing very important role to increase height of the groundnut plant while GA_3 can be applied to increase number of root nodules, number of pods per plant, seed size, seed weight and consequently the higher yield of groundnut.

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