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Response of Groundnut (*Arachis hypogaea*) to the Exogenous Application of Growth Hormones (IAA, IBA, Kin, GA3, 2-4 D and BAP)

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Abstract: ***Groundnut (Arachis hypogea L.) or peanut is an oil, food and fodder crop which plays an important role in the agricultural economies of countries of the semi-arid tropics. Groundnut (Arachis hypogea L.) or peanut is an oil, food and fodder crop which plays an important role in the agricultural economies of countries of the semi-arid tropics. Groundnut (Arachis hypogea L.) or peanut is an oil, food and fodder crop which plays an important role in the agricultural economies of countries of the semi-arid tropics. Experiments were carried out to study the effect of growth hormones on groundnuts (G-24, KRANTI, G-20). In this study, the effect of growth regulators was studied on morphological as well as yield parameters of groundnut plants. The sowing of seed was carried out in 21 plots of 1m x 3m, Groundnut (G-24, KRANTI, G-20) seeds were sown in these plots. Groundnut (G-24, KRANTI, G-20) seeds were soaked in different hormones for 24 hours one day before sowing date. Physical parameters of each groundnut plant were checked on 30th day and 45th day after sowing date. Compared to IAA, GA3 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 GA3 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 GA3 can be suggested for higher yield of groundnut.***

Keywords: Arachis hypogaea, growth hormone, IAA, IBA, Kin, GA3, 2-4 D and BAP

1. Introduction

Indian economy is greatly influenced by various agricultural activities, production and agribusiness. 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 shouldbe 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 GA3 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 GA3 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.

2. Materials and Methodology

Collection of Cultivar

A popular groundnut Kranti, Gujarat-24 and G-20 cultivar was collected from my farm (Located in Bhimpura, talod taluka, sabarkantha district of Gujarat state).

Figure 1: Varieties of Groundnut G-24, Kranti and G-20

Laboratory study: The experiment was carried out in the Department of Biotechnology, Parul institute of applied sciences and research, Ahmedabad campus, India from 5 August 2022 to 27 November 2022 to study the effect of IAA, IBA, Kin, GA3, 2-4 D and BAP on morphological and yield parameters of Groundnuts (G-24, KRANTI and G-20)

Germination percentage: Germinated to the number of seeds that were planted germinated. For example, if you planted 50 radish seeds and 30 sprouted, you would write 30/50=60/100=60%. Thegermination rate is 60%.

Shoot Length: Shoots consists of stems including their appendages, the leaves and lateral buds, flowering stems and flower buds.

Root + Hypocotyl length: The hypocotyl is the stem of a germinating seedling, found below the cotyledons and above the radicle.

Fresh Weight: While you can technically measure the fresh weight of plants without harming them, the simple act of removing a plant from its growing "medium" can cause trauma and affect the ongoing growth.

Dry Weight: "Blot the plants removing any free surface moisture. (Ziploc bag will keep moisture out).

Secondary roots: A secondary root is a side branch of main root, a root or a fine rootlet that derives from the primary root. Secondary root is also used to describe an adventitious root that develops on stem or leaves.

Standardization of Hormone:

Figure 2: Different hormone preparation

Requirements: We used selected groundnut cultivar, different hormones like Indole acetic acid (IAA), Indole butyric acid (IBA), kinetin (Kin), 2, 4-Diclorophenoxyacetic acid (2, 4-D), Gibberellic acid (GA3), Benzyl aminopurine (BAP), sterilized glass wears and laboratory instruments which is shown in Fig.2

Preparation of Hormonal Solution:
To prepare hormonal solution, different hormone concentration was taken by adding 1ml of 95% ethanol (IAA; IBA; 2, 4-D), 1ml of 1 N NAOH (Kin; BAP) and 1ml of D/W (GA3) mixing it well and make up to 20ml by adding distilled water.

Table 1: Concentration of hormonal solution

Hormone	Concentration	Molecular weight according to concentration
IAA	10^{-5} M	175.18g
IBA	10^{-5} M	203.24g
KIN	10^{-5} M	215.21g
GA3	10^{-5} M	346.37g
2, 4-D	10^{-5} M	221.04g
BAP	10^{-5} M	225.24g

To examine the effect of hormone on the groundnut:
To study the effect of growth hormones on growth and yield parameters Plots of 1meter x 3meter were prepared. Groundnut (G-24, KRANTI, G-20) seeds were sown in these plots. Groundnut (G-24, KRANTI, G-20) seeds were soaked in different hormones for 24 hours one day before sowing date. Physical parameters of each groundnut plant were checked on 30th day and 45th day after sowing date. Plant height and Root length was measured physically using a scale in centimetre. The number of root nodules and the number of pods per plant was counted numerically. Each assay was replicated three times and mean values were tabulated in Table 1.

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. / √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).

3. Results & Discussion

Figure 3: Seed germination of cultivars

The seed germination was visible on 7th day after the emergence of radical and thereafter plumule& it was observed on 30th day. The percentage of seed germination varied among the various growth regulators. Seed germination was observed maximum at 44%in Kinand 38% in GA3 in KRANTI. In G-24 Maximum at 60% in IAA and 58% in GA3 &It was observed maximum at 68% in 2-4 D and 56% in GA3 in G-20. The increased germination per cent of GA3 is also reported earlier works done by Chauhan et al., (2009). Seed germination status depends on embryo growth potential or inhibitors (Koorneef et al., 2002). This potential depends on the seed structure, especially embryo structure and affective factors on embryo (Mares, 2005). Shoot length increased gradually wish the advancement of the growth of the plant in all treatments. The growth regulators had stimulatory affected at plant height. Maximum shoot length was observed at KRANTI (19 cm) in GA3 and atG-24 (23 cm) in GA3 and (24 cm) in IAA at G-20. GA3 was found to be more efficient in stem elongation than IAA. Results of hormonal treatments are showing in Table 2.

GA3 is regarded as the prime regulator of stem height in plants (Reid, 1987) and IAA is known to be active in promoting the growth of isolated stem segments.

Table 2: The effect of Hormonal treatment, Different growth hormones in seed germination and seedling growth characters of Groundnut

Seed germination		Fresh weight of plant	Dry weight of plant	Shoot length	Root length	No. of leaf	No. of root	No. of flower	No. of pods
KRANTI	IAA		23.47	16Cm	11Cm	144	19	07	14
	IBA		39.93	17Cm	05Cm	160	24	05	12
	Kin		21.34	15Cm	12Cm	132	16	01	07
	GA3		26.46	19Cm	15Cm	146	22	03	10
	2-4 D		15.28	14Cm	14Cm	128	23	04	14
	BAP		32.15	11Cm	09Cm	115	09	03	06
	None		15.86	09Cm	07Cm	104	03	01	11
G-24	IAA		17.18	19Cm	16Cm	174	14	02	15
	IBA		18.52	13Cm	11Cm	192	21	04	14
	Kin		15.75	18Cm	16Cm	176	17	00	15
	GA3		21.83	23Cm	21Cm	152	12	01	20
	2-4 D		12.75	10Cm	09Cm	140	09	05	21
	BAP		15.27	15Cm	12Cm	127	06	02	13
	None		12.93	09Cm	07Cm	100	01	02	11
G0-20	IAA		10.87	24Cm	09Cm	172	30	02	16
	IBA		15.83	20Cm	13Cm	164	27	02	16
	Kin		17.58	23Cm	11Cm	152	20	02	09
	GA3		19.63	20Cm	10Cm	109	19	01	13
	2-4 D		20.79	21Cm	13Cm	156	23	03	05
	BAP		22.30	19Cm	12Cm	132	21	03	18
	None		26.84	16Cm	15Cm	160	26	02	04

4. Conclusion

From the above experiment, it is evident that all hormones are playing very important role to increase height of the groundnut plant while GA3 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. Salinity severely affects the growth and germination at early seedling stage, present research work was undertaken to study physiological, biochemical and enzymatic changes occur during early seedling stage. Experiment results revealed that the germination percent and seedling characters could be modified by plant growth regulators brought about an improvement in growth and further developments of groundnut.

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