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Influence of KNO_3 and GA_3 on Vegetative Growth of Dragon Fruit [*Hylocereus costaricensis* (Web.) Britton and Rose]

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ABSTRACT: Dragon fruit has become a promising high-value crop in India but has not so much awareness about its production technology. The present investigation was planned to evaluate the effect of some chemical and growth regulator applications on the growth of dragon fruit. The investigation had 9 treatments (T_1 control, T_2 - KNO_3 @ 3 %, T_3 - KNO_3 @ 4 %, T_4 - GA_3 @ 50 ppm, T_5 -GA_3 @ 100 ppm, T_6 - KNO_3 @ 3% + GA_3 @ 50 ppm, T_7 - KNO_3 @ 3 % + GA_3 @ 100 ppm, T_8 - KNO_3 @ 4 % + GA_3 @ 50 ppm, T_9 - KNO_3 @ 4 % + GA_3 @ 100 ppm) with three replications laid out in Randomized Block Design. Different concentrations of GA_3 and KNO_3 were found to have a significant impact on the vegetative growth variables of dragon fruit plants. As a result, the present investigation found that combining the effect of GA_3 and KNO_3 in the form of treatment T_7, i.e. KNO_3@3% + GA_3@100 ppm would be most effective for better vegetative growth such as average increase plant height (10.33cm), distance between areoles (0.21), the arch height (0.6mm), increased number of spines per areole (6.0) and growth of newly emerged shoots (26.6) of dragon fruit plant or in Northern India climatic conditions. Hence, the application of KNO_3@3% + GA_3 @100 ppm could be used for better plant growth and development of the dragon fruit.

Keywords: Dragon fruit, vegetative growth, KNO_3, GA_3.

INTRODUCTION

Dragon fruit (*Hylocereus costaricensis* (Web.) Britton and Rose.) is a unique and recently recognized fruit crop in India. It is seasonal and likely perishable in ambient condition, but they have great near future in the food industry as a functional food and natural food colorant (Vinod *et al.*, 2021). Dragon fruit undergoes rapid senescence during storage (Prashanth *et al.*, 2022). This fruit crop comes under the *Cactaceae* family and *Cactoideae* subfamily and has a chromosome number 2n=2x=22. In different regions, people acknowledge it with different things like Pitaya, Night blooming cereus, Strawberry pear, Queen of Night, Jesus in the crib, Honorable Queen, and Belle of Night. It originated in Mexico, Central and South America (Britton and Rose 1963, and Mizrahi & Nerd 1999) and is now cultivated in China, Australia, Hawaii, Indonesia, Guatemala, Israel, Taiwan, Malaysia, Vietnam, and Thailand. In India, it is mainly cultivated in states like Maharashtra, Karnataka, Gujarat, West Bengal, and Uttar Pradesh. The three types of dragon fruits are widely cultivated: *Hylocereus undatus*— white flesh with pink skin, *Hylocereus polyrhizus*– red flesh with pink skin, *Hylocereus costaricencis*– with violet red flesh and pink skin and *Hylocereus (Selenicerus) megalanthus* – white flesh with yellow skin (Perween *et al*., 2018 and Hamidah *et al*., 2017). Dragon fruit is used in having medicinal importance and is used to control asthma, cough, and cholesterol, prevent cancer, and boost your immune system. (Hossin *et al.*, 2021). It is cultivated using simple scientific techniques, requires low maintenance costs, and is less susceptible to pests and diseases (Maji, 2019). The vegetative growth period for this crop is 18 months after transplantation. It produces five to eight vines per season depending on the environmental conditions. Dragon fruit has a superficial root system that requires a high amount of nutrients for optimum vegetative growth. Dragon fruit is extremely adaptable to new environments. Succulent stems, lack of leaves, the presence of a waxy covering on the stem, night-time stomatal opening, and the existence of the CAM (Crassulacean Acid metabolism) photosynthetic pathway allow plants to adapt to adverse climatic circumstances due to its capability to resist abiotic stress such as drought and temperature fluctuations (Nie *et al*., 2015). Only a few studies have been undertaken on the spray of KNO_3 and GA_3 on new and important crops like dragon fruits. Thus, the objective of this study was to know the effects of KNO_3 and GA_3 in alone and combination on the phenotypic parameters of the plants.

MATERIALS AND METHODS

The present investigation was conducted at the dragon fruit orchard of the Department of Horticulture, Babasaheb Bhimrao Ambedkar University, Lucknow, situated at 26° 55′ N latitude and 80° 54′ E, longitudes,

and an altitude of 123 meters above mean sea level (MSL). Lucknow shows a subtropical climate with an average rainfall of about 110 cm and relative humidity of 60-90%. It has a scorching summer and a cold winter depending upon the weather and other climatic factors.

There were 9 treatments with three replications laid out in Randomized Block Design (RBD). There were 4 plants per pole and poles were spaced at 4 × 2 m. The application of treatment was done in a foliar spray method on two-year-old dragon fruit. The application frequency will be determined by the particular treatment combination, the stage of the plant's growth, and the intended consequence. Since the end of January, four split dosages have been applied at 14-day intervals. Growth regulators KNO_3 and GA_3 were both given topically as prescribed by the treatment dose. The vegetative growth parameters were measured and observations were recorded as per the treatments. Various growth parameters were determined by measuring the length of the plant, the distance between areoles, and the growth of newly emerged shoots at three poles of each replication (5-45 DAT) with the help of a measuring tape. To test the significance of variance in the data obtained from the various vegetative growth characters, the technique of analysis of variance was adopted as suggested by Panse and Sukhatme (1985) for Randomized Block Design (RBD). The significance of the difference in the treatment effect was tested through the 'F' test at a 5% level of significance and critical difference (CD) was calculated, whether the result was found significant.

RESULTS AND DISCUSSION

Plant height. It is evident from Table 1 that there are significant differences among various nutritional treatments at 60 and 90 days after treatment (DAT) and a significant increase in plant 30 DAT to 60 DAT and at 60 DAT from 90 DAT. The maximum increase in plant height (10.17 and 10.33cm) was recorded with T_7 i.e. (KNO_3@3%+ GA_3@100 ppm) at 60 and 90 days after treatment, respectively after T_5 (GA_3@100 ppm). T_1 (Control plants) showed the lowest increase (6.33 and 3.33cm at 60 and 90 DAT, respectively). The result is similar to the study of Eshghi *et al.* (2012). They were carried out to evaluate the effects of Volk oil (2.5, 5%), Dormex (0.5, 1%), GA_3 (50,100 mg. L^{-1}), and KNO_3 on vegetative (plant height) and reproductive growth of strawberries. Dev *et al.* (2020) also observed maximum plant height under GA_3 500 ppm and KNO_3 (1%) treatment in Grey-leaved Saucer-berry (*Cordia Sinensis* Lam.) In conclusion, it can be stated that the application of GA_3 (250 ppm) and KNO_3 (1%) is a simple, effective, and practical method for improving the seedling growth of *Cordia sinensis.* Hegazi *et al.* (2011) studied the effective concentration and application time of potassium nitrate (KNO_3) on vegetative growth, nutritional status, yield, and fruit quality of Picual olive trees under sandy soil conditions, and concluded that the application of KNO_3 growth season at 4%, the first following final fruit set to increase tree nutritional status and vegetative (plant canopy) development which also corroborates with the present study.

Distance between areoles. The data on the increase in Distance between areoles of dragon fruit as influenced by GA_3 and KNO_3 treatments under study is presented in Table 1 which clearly showed a significant effect due to the various treatments. According to the statistical analysis, the significant maximum increase of Distance between areoles (0.20cm and 0.21 cm), respectively at 60 and 90 DAT) was recorded in T_7 i.e. (KNO_3@3%+ GA_3@100 ppm). Which was found to be at par with T_9 (KNO_3 @4% + GA_3@100 ppm). The increased distance between areoles of dragon fruit was significantly influenced by GA_3 and KNO_3. The current findings of the study indicate that foliar treatment of GA_3@150 ppm is beneficial in promoting vegetative (plant growth) development as seen by Singh *et al.* (2017).

Table 1: Effect of GA_3 and KNO_3 on vegetative growth of dragon fruit.

	Plant Height (cm)		Distance between areoles (cm)		Arch height (mm)		Number of areoles/segments	
Treatment	**Increase in plant Height (cm) at (60DAT)**	**Increase plant Height (cm) at (90 DAT)**	**Increase in Distance between areoles at(60DAT)**	**Increase in Distance between areoles at(90DAT)**	**Increase in Arch Height at(60DAT)**	**Increase in Arch Height at(90DAT)**	**Increase in the number of areoles/segments at 60 DAT**	**Increase in the number of areoles/segments 90 DAT**
T_1	6.33	3.33	0.05	0.04	0.1	0.3	2.0	2.0
T_2	8.33	4.50	0.06	0.02	0.1	0.4	3.0	5.0
T_3	8.67	7.67	0.06	0.07	0.1	0.3	2.0	4.0
T_4	9.00	7.00	0.03	0.08	0.2	0.4	3.0	2.0
T_5	9.67	7.67	0.04	0.05	0.1	0.4	3.0	2.0
T_6	8.00	6.33	0.06	0.03	0.2	0.5	2.0	3.0
T_7	10.17	10.33	0.20	0.21	0.2	0.6	4.0	6.0
T_8	7.67	7.00	0.05	0.03	0.1	0.4	2.0	2.0
T_9	6.67	6.67	0.11	0.13	0.2	0.4	2.0	2.0
SEm(±)	**0.20**	**0.20**	**0.17**	**0.17**	**NS**	**0.00**	**0.07**	**0.03**
CD(P=0.05)	**0.61**	**0.62**	**0.54**	**0.52**	**NS**	**0.01**	**0.23**	**0.09**

Note - T_1 control, T_2 KNO_3@3%, T_3 KNO_3@4%, T_4 GA_3 @50 ppm, T_5 GA_3 @100 ppm, T_6 KNO_3@3% + GA_3 @50 ppm, T_7 KNO_3@3% + GA_3 @100 ppm, T_8 KNO_3 @4% + GA_3 @50 ppm, T_9 KNO_3 @4% + GA_3 @100 ppm

Arch height. Table 1 showed that T_7(KNO_3@3% + GA_3@100 ppm) also increased the maximum Arch height (0.02 mm and 0.06 mm) at 60 DAT from 90 DAT. Arch height is non-significant at 60 DAT and increases significantly at 90 DAT, respectively. Control plants had 0.1 cm and 0.2 cm minimum improvements in Arch height, respectively.

Increase in the number of Areoles/segment. The results from Table 1 showed there are significant differences in treatments at 60 and 90 days, with a significant growth in the increased number of areoles/segments at 90 DAT from 60 DAT. The maximum increase in the number of areoles/segment (4.0) and (6.0) at 60 and 90 DAT respectively was recorded at T_6 treatment (KNO_3@3%+ GA_3 @50 ppm) followed by T_2 treatment (KNO_3@4%). Whereas, the minimum increase i.e. (2.0) and (2.0) was found in T_1 (Control plants) at 60 and 90 DAT, respectively

Growth of newly emerged shoot / per plant. Fig. 1 showed that initially (5 DAT to 45 DAT), the highest level of new growth of shoots occurs in T_7 (25.3), which is at par with T_5 (GA_3 @100 ppm) and the lowest amount of new shoot growth occurs in T_4 (10.3) (Deshmukh. *Et al.*, 2015). GA_3 @ 50 ppm in June recorded the highest increase in plant height, canopy spreads, canopy volume, and shoot length, resulting in the highest number of days taken to flowering. However, KNO_3 @ 2 % in October induced the earliest flowering in acid lime

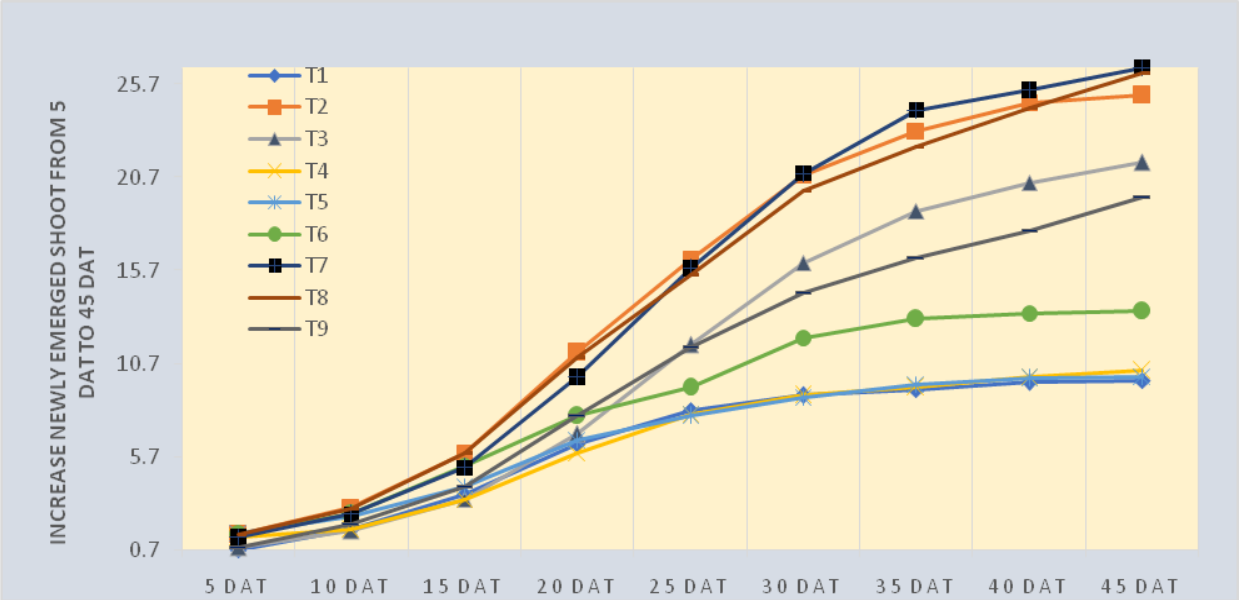

Fig. 1. Effect of KNO_3 and GA_3 on increase newly emerged shoot from 5 DAT to 45 DAT.

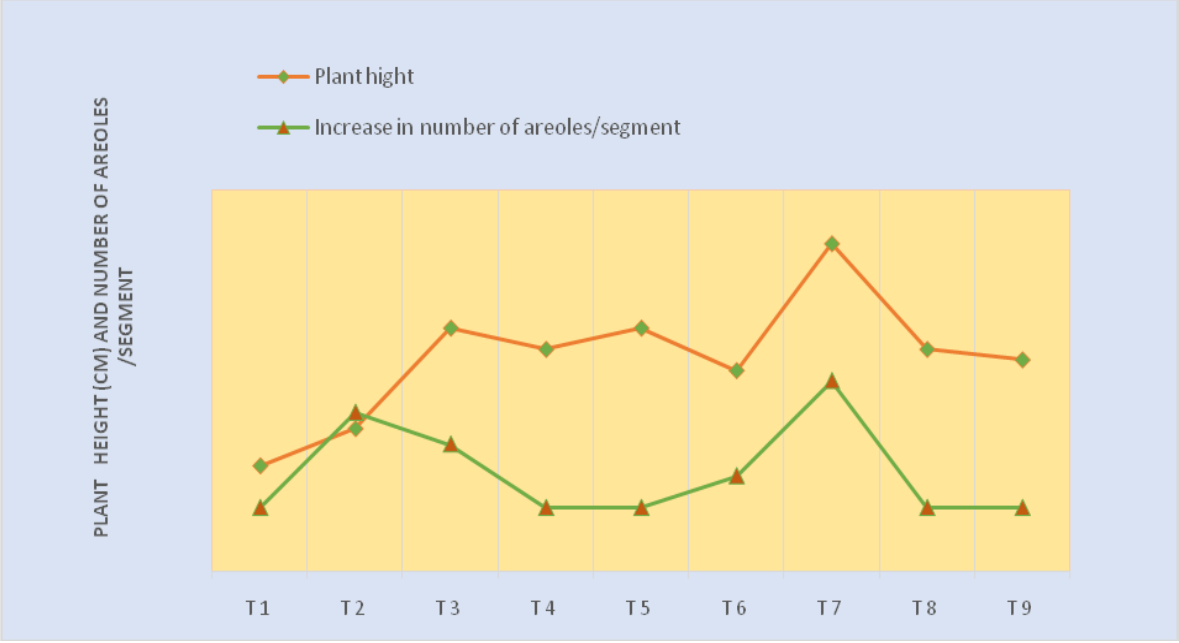

Fig. 2. Effect of KNO_3 and GA_3 on the increase of plant height and Increase in the number of Areoles/segment from 60 DAT to 90 DAT.

CONCLUSION

As a result, the present investigation found that combining the effect of GA_3 and KNO_3 in the form of treatment T_7, i.e. KNO_3@3% + GA_3@100 ppm would be most effective for better vegetative growth such as an average increase in plant height (10.33cm), distance between areoles (0.21), the arch height (0.6mm), increased number of spines per areole (6.0) and growth of newly emerged shoots (26.6) of dragon fruit plant or in Northern India climatic conditions.

FUTURE SCOPE

The present study suggested that there is a scope for further study of the effect of biochemicals on the vegetative growth of dragon fruit. The physiology and pattern of growth may be observed along with its effect on fruit yield and quality.

Conflict of interest. There is no conflict of interest and there is no ethical issue on animal behavior.

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