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Effect of various doses of inorganic fertilizers on growth and yield of dragon fruit (*Hylocereus polyrhizus* L.) in Assam condition

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ABSTRACT

The present study was carried out in five Krishi Vigyan Kendras of different districts of Assam, *viz.* Dibrugarh, Jorhat, Nagaon, Nalbari and Chirang; to standardize the fertilizer requirement by dragon fruit plants in Assam condition. The growth and yield parameters recorded over two years revealed that the growth as well as the yield attributing characters were significantly influenced on application of Urea: SSP: MOP @70: 90: 40 g per plant in first year followed by Urea: SSP: MOP @ 150:150:300 g per plant from second year onwards (Treatment T_2) as compared to the other treatments such as T_0: Control, T_1: 53:68:30 Urea, SSP, MOP g/plant(1st year) and 113:113:225 Urea, SSP, MOP g/plant (2nd year) and T_3: 88:113:50 Urea, SSP, MOP g/plant (1st year) and 188:188:375 Urea, SSP, MOP g/plant (2nd year).The Maximum stem diameter of 6.3 cm after 2nd year of establishment was found on application of T_2 dose along with the maximum number of fruits per pole (25.82), maximum average fruit weight (272.04 g) and highest annual yield per pole (7.103 kg) as well as maximum fruit volume (279.6 cc) and the highest pulp: peel ratio (4.11). Therefore, considering the significance of T_2 dose of fertilizer in various districts of Assam, it can be concluded that treatment T_2 can be considered as the appropriate dose of fertilizer to be considered for Assam condition.

Key words: *Dragon fruit, Fertilizer dose, Yield and yield attributing characters.*

Introduction

Dragon fruit (*Hylocereus polyrhizus* L.) is a cactus like flowering plant that produces some of the very nutritious fruits. It belongs to family Cactaceae and the fruits are generally attractive red in colour when ripe.There are three major variants commonly found within the genus *Hylocereusviz.*, fruits with red skin and white pulp (*Hylocereus undatus*), red skin fruit with red pulp (*H. polyrhizus*) and yellow skin fruit with white pulp (*Hylocereus megalanthus previously known as Selenicereus megalanthus*) (Nangare *et al.*, 2020). The varieties belonging to *H. polyrhizus* are relatively rich in antioxidants and are preferred over the other two species. Most *Hylocereus* species mainly originated in Mexico and Central and South

America. Presently, dragon fruit is commercially cultivated in most of the tropical and sub-tropical areas of the world. In India, dragon fruit was introduced during late 90s in the state of Gujarat and by the end of 20th century, it spread to the southern and western states of the country as well as to West Bengal (Tripathi *et al.*, 2014). In the entire North-eastern region, dragon fruit gained popularity during the 2nd decade of 21st century and today, it is being grown in most of the districts of Assam. As a new and emerging crop many aspects of its cultivation needs attention including crop, nutrient, pest and disease management and post-harvest handling and value addition. Yield of dragon fruit is highly affected by the balanced use of inorganic as well as organic nutrition. Proper use of fertilizer can directly affect the yield and quality of fruits of dragon (Huang *et al.*, 2019). Considering the soil conditions of Assam, this new crop needs to be evaluated for suitable fertilizer requirement throughout the state and, therefore, this trial was undertaken to evaluate the effect of various doses of inorganic fertilizer on growth and yield of Dragon fruit in Assam.

Materials and Method

The present study was undertaken during 2020-2023 in five different districts across the state of Assam *viz.*, Dibrugarh, Jorhat, Nagaon, Nalbari and Chirang to standardize the nutrient requirement for dragon fruit in Assam condition. The experimental design considered was Randomized Block design. The red fleshed variant *H. polyrhizus* was taken as the test sample with three different fertilizer doses- T_1, T_2 and T_3 along with T_0 as control (Table 1). The experimental design considered was Randomized Block design with 5 replications in five different locations. The time of fertilizer application was as follows-

1. In the 1st year, the full dose of fertilizer along with 15 kg of organic manure was applied in two equal splits; 1st half at 3 months after planting and the 2nd half at 6 months after planting.
2. From 2nd year onwards, the complete annual dose of fertilizer along with 15 kg of organic manure was applied in 3 equal splits; in the months of April, July-August and December.

Intercultural practices like training- pruning, weeding- irrigation *etc* were followed as per the package of practices of Horticultural crops for Assam to get a good crop. During the experimental period, various growth parameters such as plant height, stem diameter number of primary branches, Distance between areoles (cm), Arch height (cm), Number of spines and Presence or absence of light brown coloration on the edges of stem *etc* were recorded. By the 3rd year of planting the crop attained a good growth yielding a considerable amount of fruit production. Annually the flowering starts during April-May and the harvesting is continued upto November. During the flowering seasondays from transplanting to flower bud initiation, days from bud initiation to anthesis, Time of anthesis, Duration of anthesis (hours), Time taken from anthesis to fruit harvest (Days) were recorded along with the yield attributing characters such as number fruits per pole, Weight of fruit (g), Fruit length (cm), Fruit breadth (cm), Fruit volume (cc), Fruit yield per pole (kg), fruit skin and pulp colour, edible portion (%), Pulp: peel ratio and TSS (°B) *etc.* The recorded data are then analysed using Statistical Software Package for Agricultural Research Workers (Sheoran *et al.*, 1998).

Results and Discussion

The parameters recorded during the experimental period were analysed and presented in Table 2 (Vegetative growth characters), Table 3 (flowering parameters), Table 4 (yield and yield attributing

Table 1. Treatment combinations

Treatments (T)	Particulars
T_0 (Control)	Organic Manure (Vermicompost/FYM @15 kg per pole per year)
T_1	53 : 68 : 30 g per plant (Urea: SSP: MOP) in first year followed by 113:113:225 g per plant (Urea: SSP: MOP) from second year onwards
T_2	70: 90: 40 g per plant (Urea: SSP: MOP) in first year followed by 150:150:300 g per plant (Urea: SSP: MOP) from second year onwards
T_3	88: 113: 50 g per plant (Urea: SSP: MOP) in first year followed by 188:188:375 g per plant (Urea: SSP: MOP) from second year onwards

parameters) and Table 5 (Correlation analysis among various characters studied). Among the vegetative growth characters studied, plant height was found significantly high in case of T_2 (247.52 cm) and T_3 (255.36 cm) and lowest in control T_0 (205.308 cm). Law-Ogbomoand Law-Ogbomo (2009) also found that optimum dose of NPK fertilizer is responsible for plant height in maize. Similar results were found considering stem diameter (significantly high in T_2: 6.3 cm and T_3:5.9 cm and lowest in T_0: 4.58 cm) as well as number of primary branches (Maximum in T_2: 10.74 and T_3: 11.084 and minimum in T_0: 7.184). The study suggested that there are no significant differences among the effect of various fertilizer doses considering the distance between aeroles (4.18-4.3 cm), Arch height (0.47-0.52 cm) and number of spines per areole (2-3 numbers); as these characters are mostly driven by the species or varietal characteristics. Variation study among different species of dragon fruit considering these characters was

Table 2. Effect of various doses of fertilizer on Vegetative growth characters of dragon fruit (*Hylocereus polyrhizus*)

Treatment	Plant height (cm)	Diameter of stem (cm)	Number of primary branches	Distance between areoles (cm)	Arch height (cm)	Number of spines per areole	Presence of light brown coloration on the edges of stem
T_0	205.308^{c}	4.58^{c}	7.184^{c}	4.20	0.47	2-3	No
T_1	228.444^{b}	5.44^{b}	9.21^{b}	4.30	0.50	2-3	No
T_2	247.52^{ab}	**6.3^{a}**	**10.74^{a}**	4.18	0.52	2-3	No
T_3	**255.36^{a}**	5.9^{a}	**11.084^{a}**	4.23	0.49	2-3	No
Se(d)	9.029	0.3	0.619	-	-	-	-
CD (5%)	19.89	0.662	1.363	NS	NS	-	-

(Values with same superscript have no significant differences)

Table 3. Effect of various doses of fertilizer on flowering parameters of dragon fruit (*Hylocereus polyrhizus*)

Treatment	Days from transplanting to flower bud initiation	Days from bud initiation to anthesis	Time of anthesis	Duration of anthesis (hours)	Anthesis to harvesting (Days)
T_0	413.42^{b}	20.68^{c}	7:30-8:30 pm	10.2	28.26^{c}
T_1	403.84^{ab}	19.72^{b}	7:30-8:30 pm	10.2	27.22^{bc}
T_2	**388.66^{a}**	**18.74^{a}**	7:30-8:30 pm	10.2	**25.48^{a}**
T_3	**385.7^{a}**	**18.46^{a}**	7:30-8:30 pm	10.2	26.3^{ab}
Se(d)	9.223	0.225	-	-	0.481
CD (5%)	20.317	0.497	-	-	1.06

(Values with same superscript have no significant differences)

Table 4. Effect of various doses of fertilizer on yield and yield attributing parameters of dragon fruit (*Hylocereus polyrhizus*)

Treatment	Number of fruits per pole	Average fruit weight (g)	Fruit length (cm)	Fruit breadth (cm)	Fruit volume (cc)	Fruit yield per pole (kg)	Skin color/ pulp color	Edible portion (%)	Pulp: peel ratio	TSS (^{o}B)
T_0	10.66^{b}	210.44^{b}	8.56^{b}	5.38^{c}	202.40^{c}	2.305^{c}	Red/pink	74.12^{c}	2.96^{c}	12.6
T_1	22.6^{a}	227.75^{b}	9.22^{ab}	5.66^{b}	246.00^{b}	5.237^{b}	Red/pink	77.28^{b}	3.46^{b}	12.4
T_2	25.82^{a}	272.04^{a}	9.82^{a}	6.06^{a}	279.60^{a}	7.103^{a}	Red/pink	80.36^{a}	4.11^{a}	12.5
T_3	22.8^{a}	250.5^{a}	9.68^{a}	5.94^{a}	264.80^{ab}	5.821^{b}	Red/pink	79.00^{ab}	3.80^{ab}	12.5
Se(d)	1.586	11.684	0.468	0.093	12.409	0.57	-	1.07	0.168	-
CD (5%)	3.456	25.74	1.031	0.205	27.336	1.257	-	2.357	0.371	NS

(Values with same superscript have no significant differences)

done by Patwary *et al*. (2013) which supports the fact that these characters are governed by genotype rather than environment.

In case of the treatment combination of T_2 and T_3 significant earliness in flowering was observed taking in view of the parameters such as time taken from transplanting to flower bud initiation (385.7 days- $T_3$and 388.66 days in T-$_2$), Days from bud initiation to anthesis (T_2- 18.74 days and T_3- 18.46 days), and time taken from anthesis to harvesting (T_2- 25.48 days and T_3- 26.3 days).

The yield and yield attributing characters (Table 4) studied during the experiment were found to be greatly governed by proper dose of nutrition provided. Treatment T_2 was found to attain significantly high values regarding number of fruits per pole (25.82), average fruit weight (272.04 g), Fruit length (9.82 cm), Fruit breadth (6.06 cm), Fruit volume (279.60 cc), Fruit yield per pole (7.103 kg), maximum edible portion (80.36%) and highest pulp: peel ratio (4.11). A proper nutrient application, regardless of the source of nutrition, is associated with the increase in fruit yield and in turn in yield attributing characters (Maity *et al*., 2006). Monga *et al.* (2004) also noted similar results with application of NPK fertilizer in increasing fruit yield of Kinnow mandarin. This result is also supported by the findings of Chakma *et al.* (2014) who stated fruit yield of dragon fruit increases to a certain level of nutrition and then it starts to reduce again.

The correlation analysis have shown the significant positive correlation of fruit yield with Diameter of stem (0.989), number of fruits per pole (0.982), fruit length (0.975), fruit breadth (0.962), fruit volume (0.993), edible portion percentage (0.989) and pulp:peel ratio (0.979). Similarly, positive significant correlation could also be seen in case of plant height with respect to number of primary branches (0.997), Fruit length (0.969) and Fruit breadth (0.952). From the table of correlation, it is evident that due to presence of highly significant positive correlation among the characters such as Average fruit weight, Fruit length, Fruit breadth, fruit volume, edible portion percentage and pulp: peel ratio; increase in average fruit weight directly correlates with increase in fruit length, breadth, volume, percent edible portion and pulp:peel ratio and in the experiment highest fruit weight corresponds to the use of treatment T_2. This table have also shown significant negative correlation of time taken from anthesis to harvest with average fruit weight (-0.995), Fruit length (-0.977), Fruit

Table 5. Correlation analysis among various characters studied

	Fruit yield per pole (kg)	Plant height (cm)	Diameter of stem (cm)	Number of primary branches	Days from transplanting to flower bud	Days from bud initiation to anthesis initiation	Anthesis to harvesting (Days)	Number of fruits per pole	Average fruit weight (g)	Fruit length (cm)	Fruit breadth (cm)	Fruit volume (cc)	Edible portion (%)
Plant height (cm)	0.897^{NS}												
Diameter of stem (cm)	0.989^{*}	0.931^{NS}											
Number of primary branches	0.929^{NS}	0.997^{**}	0.955^{*}										
Days from transplanting to flower bud initiation	-0.880^{NS}	-0.990^{*}	-0.931^{NS}	-0.984^{*}									
Days from bud initiation to anthesis	-0.900^{NS}	-0.999^{**}	-0.938^{NS}	-0.996^{**}	0.995^{**}								
Anthesis to harvesting (Days)	-0.964^{*}	-0.908^{NS}	-0.990^{**}	-0.930^{NS}	0.928^{NS}	0.922^{NS}							
Number of fruits per pole	0.982^{*}	0.873^{NS}	0.949^{NS}	0.907^{NS}	-0.829^{NS}	-0.866^{NS}	-0.899^{NS}						
Average fruit weight (g)	0.934^{NS}	0.876^{NS}	0.970^{*}	0.897^{NS}	-0.910^{NS}	-0.895^{NS}	-0.995^{**}	0.852^{NS}					
Fruit length (cm)	0.975^{*}	0.969^{*}	0.992^{**}	0.984^{*}	-0.963^{*}	-0.973^{*}	-0.977^{*}	0.942^{NS}	0.951^{*}				
Fruit breadth (cm)	0.962^{*}	0.952^{*}	0.992^{**}	0.967^{*}	-0.964^{*}	-0.962^{*}	-0.993^{**}	0.907^{NS}	0.980^{*}	0.993^{**}			
Fruit volume (cc)	0.993^{**}	0.939^{NS}	0.997^{**}	0.963^{*}	-0.928^{NS}	-0.943^{NS}	-0.977^{*}	0.967^{*}	0.950^{*}	0.994^{**}	0.984^{*}		
Edible portion (%)	0.989^{*}	0.936^{NS}	1.000^{**}	0.959^{*}	-0.935^{NS}	-0.943^{NS}	-0.989^{*}	0.951^{*}	0.968^{*}	0.994^{**}	0.992^{**}	0.998^{**}	
Pulp: peel ratio	0.979^{*}	0.920^{NS}	0.997^{**}	0.942^{NS}	-0.929^{NS}	-0.930^{NS}	-0.998^{**}	0.926^{NS}	0.986^{*}	0.986^{*}	0.994^{**}	0.989^{*}	0.996^{**}

breadth (-0.993), percent edible portion (-0.989) and Pulp: peel ratio (-0.998) indicating shorter time taken from anthesis to harvest to be associated with vigorous fruit growth which also gets back to the treatment combination T_2. In contrast, significant positive correlation could be found in case of number of primary branches and yield attributing characters.

Conclusion

From the above results, it is evident that dragon fruit could be successfully grown in Assam if proper nutrition is provided. And the experiment conducted across locations have resulted that the nutrition dose of 70: 90: 40 g per plant (Urea: SSP: MOP) in first year followed by 150:150:300 g per plant (Urea: SSP: MOP) from second year onwards promisingly increases the yield of dragon fruit and hence may be recommended for the state of Assam. However, research may be further strengthened on different cultural practices as well as effect of various levels of macro as well as micro nutrient on growth and yield of dragon fruit in near future.

Conflict of Interest: None

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