DOI : 10.5958/0974-0112.2019.00026.4

Indian J. Hort. 76(1), March 2019: 180-183

Short communication

Growth, yield and quality of dragon fruit as influenced by NPK fertilization

Tamanna Perween[*,] and Md. Abu Hasan**

Department of Fruit Science, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia 741252, West Bengal

ABSTRACT

The present investigation was carried out to delineate the best performing combinational doses of NPK on Dragon fruit (*Hylocereus costaricensis*) cv. Royal Moroccan Red with eight fertilizer treatments *viz*., T_1 - N_{250} P_2O_5 $_{150}$ K_2O $_{100}$ g/pillar : T_2 - N_{300} P_2O_5 $_{200}$ K_2O $_{150}$ g/pillar; T_3 - N_{350} P_2O_5 $_{250}$ K_2O $_{200}$ g/pillar; T_4 - N_{400} P_2O_5 $_{300}$ K_2O $_{250}$ g/pillar; T_5 - N_{450} P_2O_5 $_{350}$ K_2O $_{300}$ g/pillar:; T_6 - N_{500} P_2O_5 $_{400}$ K_2O $_{350}$ g/pillar; T_7 - N_{550} P_2O_5 $_{450}$ K_2O_{400} g/pillar and T_8 – Control. Organic manure @ 20 kg/pillar containing four plants was also applied.The experiment was laid out in Randomized Block Design with four replications under the new alluvial zone of west Bengal. There was significant difference in terms of plant height (cladode length), number of fruits, average individual fruit weight, fruit size, TSS, other quality attributes, moisture and dry matter content of cladode and fruit pulp and fruit yield. The maximum number of fruits per pillar (68.00), average individual fruit weight (222.03 g), and fruit yield (24.15 t/ha) were observed in T_5. The minimum number of fruits per pillar (23.75) and fruit yield (5.61 t/ha) and lowest average individual fruit weight (152.28 g) were found in control in (T_8). The highest TSS (18.58° B) was recorded in control and lowest (16.65° B) in T_2.

Keywords: *Hylocereus costaricensis*, moisture content, new alluvial zone.

Dragon fruit or Red Pitaya has botanically known as (*Hylocereus costaricensis* [F.A.C. Weber] Britton & Rose) is an important underutilized fruit originated in Mexico, Central and South America. It is considered as an exotic future fruit of India (Perween *et al*., 5). It is a fast growing, climbing perennial vine cactus species with 3 angled stems and mostly with nocturnal flowers and glabrous berry with large scales and many small black edible seeds. Dragon fruit is consumed fresh or used for jellies, marmalades, jams, wine and beverages**.** It is additionally rich in betalains which is used for extraction of natural food colourant. Poor fruit setting, low crop yield and substantial depletion of nutrients occurred with the yields where no NPK fertilizer was applied which could be improved by proper nutrient application. Dragon fruit requires a judicious amount of fertilizer for higher yields. In spite of its valuable nutraceutical properties dragon fruit cultivation is still not very known and popular in India. However, it is now gaining popularity in some parts of India like south Gujarat, West Bengal and Andhra Pradesh but research related to this crop is still at very infancy stage. The research on improvement in plant growth and yield of dragon fruit with application of NPK nutrient is needed under Indian condition. For commercial exploitation of this crop it is necessary to know the nutrient requirement and performance of the crop in the new alluvial zone of Bengal.

The experiment was conducted at the adjacent area of the faculty of Horticulture, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia district, West Bengal during the year 2015-2017 situated at 23.50 N latitude and 890 E longitude on elevation 9.75 above mean sea level (MSL). The present investigation was carried out to standardize the proper NPK fertilizer dose for higher yield and quality of dragon fruit cv. Royal Moroccan Red. The climate of the research station is sub-tropical humid and the maximum temperature ranging from 25.05°C to 38.21°C and that of minimum temperature ranging from 9.85°C to 25.38°C during the period of investigation. Major rainfall was received during the month of July and September. The relative atmospheric humidity prevailed during the period of the experiment varied from 48.33% to 98.00%. The soil texture of the experimental field was sandy loam with organic carbon 0.45%, available nitrogen 250.37 kg/ha, available P_2O_5 30.67 kg/ha and K_2O 300.19 kg/ha. Four plants/pillar were transplanted on 25 March 2015 maintaining a distance of 2.5m × 2.5m spacing. The experimental design was a randomized complete block with eight treatments of the following doses of fertilizers T_1 = N_{250} P_{150} K_{100}, T_2 = N_{300} P_{200} K_{150}, T_3 = N_{350} P_{250} K_{200}, T_4 = N_{400} P_{300} K_{250}, T_5 = N_{450} P_{350} K_{300}, T_6 = N_{500} P_{400} K_{350}, T_7 = N_{550} P_{450} K_{400}, T_8 = Control. Fertilizers were applied in 4 split doses. The first dose of inorganic nutrients was applied in the month of November 2015 at the vegetative stage, the second dose in the month of June 2016 at fruit set, the third in the month of December 2016 and the last one in the month of February 2017. In addition to the application

*Corresponding author's Email: tamanna.bckv@gmail.com

of inorganic nutrients as per above schedule in each treatment was also supplied with organic manure @ 20 kg/pillar in the month of December 2015. Cladode length (initially, 60 cm length of cladode was chosen from each pillar for observing the cladode length at 10 days intervals) and other vegetative parameters (*viz*., Distance between areole, diameter of areole, length of spine, thickness of rib, rib width and stem circumference), number of fruits/pillar, total weight of fruit/pillar, yield t/ha and quality characters (*viz*. Total soluble solids, Total sugar, reducing sugar, non-reducing sugar, Ascorbic acid and Acidity) were observed. Moisture and dry matter content of cladode and fruit were also observed. The data was analyzed using SPSS-16 and presented in Table 1 and 2 as well as Fig. 1.

The data on increasing in cladode length was recorded at 10 day intervals from December 2015 to April 2016. It was observed that the treatment T_7 (152.18 cm) showed the highest length of cladode which was supplied with the higher dose of NPK fertilizer (N_{550} $P_2O_{5\ 450}$ K_2O_{400} g/pillar) followed by T_6 (141.25 cm). The maximum increase in length was observed after one month of fertilizer application. Initially, the vegetative growth was more and later on ceased when the cladode got mature and flower bud differentiation started. Other treatments also exhibited good vegetative growth except for T_1 (N_{250} $P_2O_{5\ 150}$ K_2O_{100} g/pillar) and T_8 (control) having minimum vegetative growth. The results were also supported by the researcher Chakma *et al*., 1 who observed that the total cladode length increased with the application of the higher dose of the nutrient.

The distance between areoles, diameter of areole, length of spine, thickness of rib, rib width and stem circumference varied insignificantly among the treatments. However, a slight effect of NPK dose was found among the treatments. The distance

Table 1. Effect of nutrients on different morphological characters and yield parameters of dragon fruit.

Treatments	Distance between areoles (mm)	Areole diameter (mm)	Spine length (mm)	Rib thickness (mm)	Rib width (mm)	Stem circumference (cm)	Total number of fruits /pillar	Yield (Kg/ pillar)	Yield (t/ ha)
T_1	30.73	3.85	2.98	6.77	18.77	16.08	31.25	5.62	9.23
T_2	31.53	3.30	2.59	9.55	18.30	14.68	37.25	7.12	11.38
T_3	31.78	3.40	2.66	10.58	20.23	13.70	45.50	8.97	14.34
T_4	31.20	4.08	3.33	11.10	19.31	13.725	54.75	11.11	17.77
T_5	31.23	4.33	3.45	11.96	19.77	17.55	68.00	15.10	24.15
T_6	37.04	4.10	3.53	9.16	22.69	16.25	42.75	8.07	12.91
T_7	36.72	3.98	3.33	9.65	21.08	17.48	31.00	5.31	8.49
T_8	29.43	3.63	3.16	6.56	20.56	13.50	23.75	3.68	5.61
CD at $_{0.05}$	NS	NS	NS	NS	NS	NS	5.2302	0.9908	1.6451

Table 2. Effect of nutrients on fruit quality, moisture and dry matter content of dragon fruit.

Treatments	TSS (°Brix)	Total sugar (%)	Reducing sugar (%)	Non-reducing sugar (%)	Ascorbic acid (mg/ 100g pulp)	Titratable Acidity (%)	Cladode moisture (%)	Dry matter (%)	Fruit pulp moisture (%)	Fruit pulp dry matter (%)
T_1	18.54	14.43	11.71	2.58	8.14	0.144	89.79	10.21	86.78	13.22
T_2	18.29	14.19	11.53	2.55	8.17	0.136	88.43	11.57	86.64	13.36
T_3	17.99	13.36	11.13	2.12	8.33	0.136	88.18	12.11	86.61	13.39
T_4	17.88	13.15	10.98	2.06	8.35	0.136	87.87	12.20	86.45	13.55
T_5	17.74	13.12	10.96	2.05	8.65	0.176	87.30	12.70	86.35	13.66
T_6	17.13	12.13	10.13	1.90	8.45	0.160	87.14	12.86	85.98	14.02
T_7	16.65	11.95	10.13	1.72	8.12	0.160	86.92	13.08	85.57	14.43
T_8	18.58	13.12	9.55	3.39	8.09	0.104	90.44	9.57	87.64	12.37
CD at $_{0.05}$	1.0587	1.4742	1.1597	0.4502	0.1464	0.0304	1.6205	1.5978	0.7992	0.7992

T_1 - N_{250} $P_2O_{5\ 150}$ K_2O_{100}; T_2 - N_{300} $P_2O_{5\ 200}$ K_2O_{150}; T_3 - N_{350} $P_2O_{5\ 250}$ K_2O_{200}; T_4 - N_{400} $P_2O_{5\ 300}$ K_2O_{250}; T_5 - N_{450} $P_2O_{5\ 350}$ K_2O_{300}; T_6 - N_{500} $P_2O_{5\ 400}$ K_2O_{350}; T_7 - N_{550} $P_2O_{5\ 450}$ K_2O_{400} g / pillar; T_8 – Control.

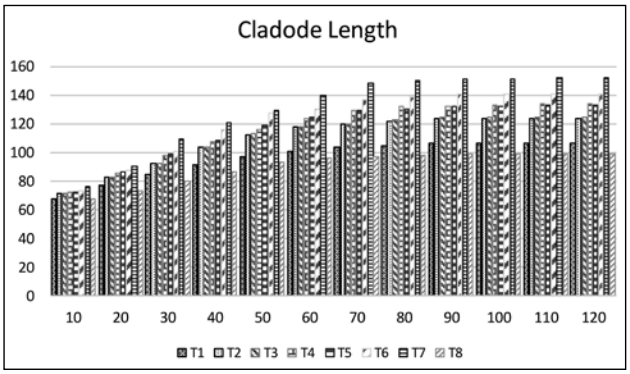

Fig. 1. Effect of nutrients on cladode length of dragon fruit.

between areoles was found highest value of 37.04 mm recorded in T_5 followed by T_7 (36.72 mm) and the lowest was found in control (29.43 mm). This effect might be due to the fast increase in the length of cladode. Highest areole diameter was observed in T_5 (4.33 mm) followed by T_6 (4.08 mm) and lowest in treatment T_2 (3.30 mm). Spine length recorded highest in T_6 (3.53 mm) followed by T_5 (3.45 mm) and lowest in T_2 (2.59 mm). Highest rib thickness of 11.96 mm was observed in T_5 followed by T_4 (11.10 mm) and the lowest was 6.56 mm in T_8 (control). Highest rib width 22.69 mm in T_6 followed by 21.08 mm in T_7 and lowest 18.30 mm was observed in T_2. Highest stem circumference was observed in T_5 (17.55 cm) followed by T_7 (17.48 cm) whereas the lowest 13.5 cm was observed in T_8 (control).

The highest number of fruits/pillar was recorded in T_5 supplied with $N_{450}P_2O_{5\,350}K_2O_{300}$ g/pillar (68.00 fruits /pillar) followed by T_4 (54.74 fruits / pillar) whereas lowest number was observed in control (23.75 fruits / pillar). Nonsignificant variation was found between the treatments T_1 (31.25 fruits/pillar) and T_7 (31.00 fruits/pillar). The number of fruits increased with increasing rate of fertilizers doses to a certain level (T_5 - $N_{450}P_2O_{5\,350}K_2O_{300}$) and beyond this level the number of fruits per plant tends to decrease again. Present findings on total number of fruits/ pillar were also supported in dragon fruit (Chakma *et al*., 1). Native fertility was significantly reduced individual fruit yield comparing to treated treatments (Sarker and Rahim, 6). Highest total weight of fruit/ pillar was 15.10 kg in treatment T_5 followed by 11.11 kg in plant supplied with fertilizer dose of $N_{400}P_2O_{5\,300}K_2O_{250}$ and lowest fruit weight /pillar was 3.68 kg observed in treatment T_8 (control). Native fertility was significantly reduced individual fruit yield comparing to treated treatments. The highest yield (24.15 t/ha) was observed in T_5 ($N_{450}P_2O_{5\,350}K_2O_{300}$) which was followed by T_4 (17.77 t/ha), T_3 (14.34 t/ha) and T_6 (12.91 t/ha). On the other hand, the lowest fruit yield (5.61 t/ha) was found in control (T_8). Monga *et al.* 3 also found similar results where application of NPK fertilizer increased fruit yield of Kinnow mandarin significantly over control. The present finding of fruit yield increased to a certain level (T_5) and then it started to reduce again was supported by the findings of Chakma *et al*., 1.

The highest total soluble solid (18.58°B) was recorded in T_8 (control) that was insignificantly similar to T_1 (18.54°B) and T_2 (18.29°B), whereas the lowest in T_7 (16.65°B). TSS (°B) was increased with the decreasing dose of fertilizers and got peak at native fertility. Sarker and Rahim, 6 reported that nitrogen application has a negative effect on TSS. Wrona, 8 reported that the content of soluble solids or sucrose production decreases with a high application of nitrogen. The highest so far has recorded was 20% for a red-fleshed variety. The highest total sugar (14.43 %) was recorded in T_1 that was insignificantly similar to T_2 which was 14.19% and with control (13.12%) whereas the lowest total sugar was found in (11.95%) in T_7. Highest reducing sugar (11.71%) was recorded in T_1 that was insignificantly similar to T_2 which was 11.53% and 11.13% in T_3 whereas the lowest was 9.55% in T8 (control). Highest non- reducing sugar (3.39%) was recorded in control followed by 2.58% T_1 and 2.53 % in T_2 whereas the lowest (1.72%) in T_7 ($N_{550}P_2O_{5\,450}K_2O_{400}$). The highest ascorbic acid content was 8.65 mg recorded in T_5 followed by 8.45 mg in T_6 whereas the lowest (8.09 mg) in T_8 (control). Moshfeghi *et al*., 4 reported that red flesh dragon fruit represents a significant source of antioxidants and vitamin C. Titratable acidity was found highest (0.176 %) in plant supplied with $N_{450}P_2O_{5\,350}K_2O$ 300 g/ pillar followed by 0.160 % in T_6 whereas the lowest (0.104 %) in T8 (control). The effect of various doses of the nutrient on acidity was found significant but the result was not consistent. The highest moisture content in cladode (90.44 %) and fruit pulp (87.64 %) was found in control (T_8) and lowest was observed in T_7 which was 85.57% in fruit and 86.92 % in cladode. Vaillant *et al*. 7 reported that the mesocarp of fruit contains 82-88%. Jamilah *et al*., 2 reported in their experiment that moisture content of *Hylocereus polyrhizus* varies from 92.65 ± 0.10%. Highest dry matter content for fruit pulp (14.43 %) and cladode (13.08 %) was observed in T_7 received fertilizer dose of $N_{550}P_2O_{5\,450}K_2O_{400}$ g/pillar whereas dry matter content recorded for fruit pulp (12.37 %) and cladode (9.57 %) was found lowest in control (T_8). Nitrogenous fertilizer had a direct effect on dry matter content of plant parts. Vaillant *et al*. 7 in their experiment found that dry matter content of fruit pulp is 12 ± 1 %.

The results of the experiment revealed that application of fertilizers at the rate of $N_{450}P_2O_{5\,350}$

K_2O_{300} g/pillar along with 20 kg of organic manure or N_{113} $P_2O_{5\ 88}$ K_2O_{75} g/plant along with 5 kg of organic manure would be optimum for the higher yield and acceptable quality of dragon fruit under the New Alluvial Zone of West Bengal.

REFERENCES

1. Chakma, S. P., Harunor Rashid, A. S. M., Roy, S. and Islam, M. 2014. Effect of NPK Doses on the Yield of Dragon Fruit (*Hylocereus costaricensis* [F.A.C. Weber] Britton & Rose) in Chittagong Hill Tracts. *Amer. Eura. J. Agric. Environ. Sci*. **14**: 521-26.
2. Jamilah, B., Shu, C. E., Kharidah, M., Dzulkifly, M. A. and Noranizan, A. 2011. Physico-chemical characteristics of red pitaya (*Hylocereus polyrhizus*) peel. *Int. Food Res. J.* **18**: 279-86.
3. Monga, P. K., Vij, V. K. and Sharma, J. N. 2004. Effect of N, P and K on the yield and fruit quality of Kinnow mandarin. *Indian J. Hort*. **61**: 302-04.
4. Moshfeghi, N., O. Mahdavi, F., Shahhosseini, S., Malekifar, S. Taghizadeh, 2013. Introducing a New Natural Product from Dragon Fruit. *Int. J. Res. Rev. Appl. Sci*. **15**: 269-72.
5. Perween, T. Mandal, K.K and Hasan, M.A. 2018. Dragon fruit: An exotic super future fruit of India**.** *J. Pharmac. Phytoc.* **7**: 1022-26.
6. Sarker, B.C. and Rahim, M. A. 2012. Effects of doses and splits of fertilizer application on harvesting time, yield and quality of mango cv. Amrapali. *Bangladesh J. Agril Agric*. *Res*., **37**: 279-93.
7. Vaillant, F., Perez, A., Davila, I., Dornier, M. and Reynes, M. 2005. Colorant and antioxidant properties of red pitahaya (*Hylocereus* sp.). *Fruits*, **60**: 1-7.
8. Wrona, D. 2004. Effect of nitrogen fertilization on growth, cropping and fruit quality of 'Sampion' apple trees during nine years after planting. *Folia Hort.* **16**: 55-60.

Received : May, 2018; Revised : February, 2019;
Accepted : February, 2019