Original Research Article

Impact of Nitrogen Dosage and various sources on Growth of Dragon Fruit in mid-hill conditions of Nagaland

ABSTRACT

Aims: To evaluate optimum dose of nitrogen through various sources for growth and development of dragon fruit grown under mid-hill condition of Nagaland

Study design: Randomized Complete Block Design

Place and Duration of Study: The present experiment was carried out during the year of 2021 and 2022 has been conducted in the research experimental block of Department of Horticulture, School of Agricultural Sciences, Medziphema Campus, Nagaland, India.

Methodology: Different levels of nitrogen with and without organic manures were applied to the one-year-old plants to evaluate the optimum dose for growth and development of dragon fruit plants. Ten treatments of different doses of nitrogen and combinations of organic manures (Farm Yard Manure (FYM), Pig manure), common doses of phosphorous and potassium were applied to plants. [N_0 Control (T_1); N_{100g}/plant (T_2); N_{125g}/plant (T_3); N_{150g} /plant (T_4); 75% of N_{100g}+$FYM_{1.0\ kg}$/plant (T_5); 75% of N_{125g}+$FYM_{1.25\ kg}$/plant (T_6); 75% of N_{150}+$FYM_{1.5kg}$ /plant (T_7); 75% of N_{100g}+Pig $manure_{1.66kg}$/plant (T_8); 75% of N_{125g}+Pig $manure_{2.1kg}$/plant (T_9); 75% of N_{150g}+Pig $manure_{2.5kg}$/plant (T_{10})]

Results: The data of two-year study revealed that the maximum cladode length (232.04 cm) and number of areoles/cladode (79.32) were recorded in the treatment with 75% of N_{150g}+Pig $manure_{2.5kg}$/plant (T_{10}) whereas maximum cladode diameter (5.02 cm), cladode girth (15.78 cm), distance between areoles (3.30 cm) and area of areoles (0.18 mm^2) were recorded in the treatment 75% of N_{125g}+Pig $manure_{2.1kg}$/plant (T_9) and minimum values were recorded mostly in treatments supplied with only inorganic manures (T_1 and T_2)

Conclusion: The combined application of both organic and inorganic manures (Pig manure + NPK) (T_9 and T_{10}) found to be most superior treatment combination with regard to vegetative growth in *Hylocereus polyrhizus*.

1. INTRODUCTION

Dragon fruit (*Hylocereus* spp.), a climbing cactus vine native to tropical regions of Mexico, Central and South America (Mizrahi *et al.,* 2010) is an emerging super crop among farmers for its economic value and rich in nutrient content. It is commonly known as kamalam, strawberry pear, pithaya, night-blooming cereus, Belle of the night, Jesus in the cradle etc. It is a fast-growing, herbaceous, perennial, epiphytic, cacti crop which has been introduced into India in late 90's and is considered as a promising remunerative fruit crop and future crop of India (Arivalagan *et al*., 2019). With its high nutritional value, resilience against pests and diseases, minimal orchard maintenance, low water needs, frequent yields throughout the year and the potential for high output lasting up to 20 years, this crop has enticed numerous growers to cultivate it. This surge in cultivation has also amplified the fruit's export potential, catering to the growing market demand. The growing importance of dragon fruit cultivation in India, major emphasis should be given to standardize the fertilizer doses in different agro-climatic conditions in order to help farmers take up its cultivation on commercial scale and gain economic rewards as it is a nutrient loving plant.

Plant nutrition is one of the most important factors that plays crucial role in growth, yield and quality attributes in dragon fruit. Indiscriminate and prolonged use of

chemical fertilizers without adding organic fertilizers deteriorated the health of soil and increase soil pollution by decreasing the microbial activity (Singh and Kallo, 2000). This calls for a holistic approach to maintain soil health as well as obtain high productivity in the crop grown. A new farming strategy therefore entails a plant nutritional package, which would provide all elements through both organic, inorganic and biofertilizers, which would not only reduce the soil pollution but also produces quality produce with greater production and productivity and also keep the production cost at bearable level to the average farmer. Several reports show that the integration of organic and inorganic fertilizers proved superior to the sole application (Abusaleha and Shanmugavelu, 1988). Use of biofertilizers along with organic and inorganic fertilizers created a lot of impact in horticulture. Most soils in the North East region of India are acidic in nature where phosphorous content in soil is high but is not be readily available to the plant. Organic acids secreted during organic matter decomposition and phosphobacteria makes the insoluble form of phosphorous to available form and saves up to 30-50 kg of superphosphate (Chen *et al*., 2006). Nitrogen occupies a conspicuous place in plant metabolism system, and it plays a key role in agriculture aimed at increasing the crop yields. Being as an important constituent of protein, protoplasm, enzymes, the biological catalytic agents, nitrogen has established roles including chlorophyll formation, photosynthesis, and source to sink translocation, which speed up the life processes (Singh *et al*., 2024). Nitrogen is also present as a part of nucleoprotein, amino acids, amines, amino sugar, polypeptides and other organic compounds in plants and serve as an important structural element.

North Eastern India is considered as a hub of organic products because there is minimal or no use of chemical fertilizers by most farmers. The fertile soil and congenial climatic conditions in the region contribute as positive factor in the growing of several exotic crops including dragon fruit. Although dragon fruit belongs to cactaceae family, it requires water during critical periods of its growth because unlike other cacti it is from tropical rainforest. According to the studies conducted on dragon fruit for adaptability and production aspects by Karunakaran *et al.* (2014) it was reported that dragon fruit prefers dry tropical climate with optimum temperature of 20-29°C and can withstand temperatures up to 38-40°C and as low as 0°C for shorter periods. Heavy rainfall during flowering season may lead to flower and fruit drop and high temperatures exceeding 40°C may lead to flower burn. These conditions make the north eastern regions even more suitable for dragon fruit cultivation except during the high rainfall season which may negatively impact flowering and fruit setting. Considering the importance of this emerging crop with high potential in commercialization it was a felt need to conduct the present study which would augment dragon fruit crop cultivation and add fillip to the economy of average farmers.

2. MATERIAL AND METHODS

The present investigation was carried out during the year of 2021 and 2022 at research experimental block of Department of Horticulture, School of Agricultural Sciences, Medziphema Campus, Nagaland situated at 25° 45′ 53″ N latitude and 93° 53′ 04″ E longitudes at an elevation of 310 m above sea level. The established field of dragon fruit with three-year-old plants were used for the phenological studies in the present experiment. The nutrients *i.e.,* nitrogen (N), phosphorus (P) and potassium (K) were applied in the form of urea, single super phosphate and muriate of potassium, respectively. The different does of organic fertilizers (Farm yard manure and Pig manure) were applied in the month of March followed by inorganic fertilizers in the month of May. Nitrogen was applied in split doses. Doses of FYM and Pig manure were calculated on basis of N content in the recommended dose of fertilizers (RDF) (N: P: K) - 135:78:63g/plant. Common doses of P_{50g} and K_{75g}/plant was applied to every plant in the fields. PSB @ 30 g/pillar was supplied in equal doses to all treatments. The experiment was laid out in randomized complete block design with three replications.

Various treatments consisting of organic (FYM, Pig manure) and inorganic manures (NPK) were applied. Treatment details: N_0 Control; N_{100g}/plant; N_{125g}/plant; N_{150g}

/plant; 75% of N_{100g}+$FYM_{1.0\ kg}$/plant; 75% of N_{125g}+$FYM_{1.25\ kg}$/plant; 75% of N_{150}+$FYM_{1.5kg}$ /plant; 75% of N_{100g}+Pig $manure_{1.66kg}$/plant; 75% of N_{125g}+Pig $manure_{2.1kg}$/plant; 75% of N_{150g}+Pig $manure_{2.5kg}$/plant. Growth parameters like cladode length, diameter, girth, number of areoles, spines, distance between areoles, area of areoles, fresh weight and dry weight of cladode were observed. The data collected and computed was completed by using SPSS software (Gomez and Gomez, 2010).

3.RESULTS AND DISCUSSION

Marked variations were observed with respect to morphological characteristics among the different treatments by the application of nitrogen through various sources. The data recorded revealed that the treatment 75% of N_{150g}+Pig $manure_{2.5\ kg}$/plant (T_{10}) recorded the maximum cladode length (232.04 cm) and was found highly significant whereas the minimum was recorded in N_0 Control (T_1) (82.16 cm) (Table 1). According to Verma *et al.* (2019) maximum plant height (129.30 cm) in dragon fruit was recorded in the treatment supplied with FYM+NPK+ Azotobactor + PSB whereas in the present investigation pig manure recorded significantly better results compared to the above treatment.This might be due to the high nitrogen content in the pig manure compared to FYM and vermicompost. The combination of inorganic and organic fertilizers might have improved the soil health thus resulting in creating favourable nutrient environment for plant growth (Lodhi *et al.,* 2017). Samant et al., (2023) observed minimum cladode length in treatments supplied with no nitrogen.

Table 1. Effect of various nitrogen sources on physical cladode characteristics of dragon fruit

Treatments	Cladode length (cm)	Cladode diameter (cm)	Cladode girth (cm)	No. of spines/ areoles
N_0 Control	82.16	3.86	12.15	4.00
N_{100g}/ plant	105.33	3.80	12.12	4.00
N_{125g}/plant	106.06	4.00	12.59	3.50
N_{150g} /plant	117.46	4.35	13.66	4.16
75% of N_{100g}+ FYM_{1kg} /plant	130.20	4.44	13.97	3.66
75% of N_{125g}+$FYM_{1.25\ kg}$/plant	135.27	4.51	14.17	3.50
75% of N_{150g} + $FYM_{1.5\ kg}$ /plant	154.04	4.59	14.43	3.50
75% of N_{100g}+ Pig $manure_{1.66\ kg}$/plant	178.69	4.87	15.32	3.50
75% of N_{125g}+ Pig $manure_{2.1\ kg}$/plant	215.65	5.02	15.78	3.50
75% of N_{150g}+ Pig $manure_{2.5\ kg}$ /plant	232.04	4.87	15.33	3.16
S Em±	2.44	0.05	0.50	0.23
CD at 5%	7.32	0.15	1.51	NS

Olusegun (2014) supported these findings stating that pig manure in combination with NPK significantly increased the plant height.

The maximum cladode diameter (5.02 cm) and minimum in treatment N_{100g}/ plant (T_2) (3.80 cm). Ringphawon (2018) reported that 25% pig manure gave best results regarding the diameter of dragon fruit compared to mineral fertilizers. This might be because of availability of more nutrients due to the addition of organic and inorganic fertilizers (Lodhi *et al.,* 2017).

Table 2. Effect of various nitrogen sources on areole characteristics of dragon fruit

Treatments	No. of areoles/cladode (cm)	Distance between areoles (cm)	Area of areoles (mm^2)
N_0 Control	53.32	1.71	0.07
N_{100g}/ plant	66.49	1.80	0.07
N_{125g}/plant	41.45	2.83	0.08
N_{150g} /plant	43.34	3.11	0.09
75% of N_{100g}+ FYM $_{1kg}$ /plant	49.13	3.14	0.12
75% of N_{125g}+FYM $_{1.25\ kg}$/plant	62.14	2.26	0.13
75% of N_{150g} + FYM $_{1.5\ kg}$ /plant	72.46	2.28	0.13
75% of N_{100g}+ Pig manure $_{1.66\ kg}$/plant	68.02	3.41	0.14
75% of N_{125g}+ Pig manure $_{2.1\ kg}$/plant	67.00	3.53	0.18
75% of N_{150g}+ Pig manure $_{2.5\ kg}$ /plant	79.32	3.26	0.15
S Em±	2.76	0.31	0.01
CD at 5%	8.27	0.94	0.03

Cladode girth (15.78 cm) was recorded maximum in 75% of N_{125g}+Pig manure$_{2.1\ kg}$/plant (T_9) and treatment 75% of N_{150g}+Pig manure$_{2.5\ kg}$/plant (T_{10}) was found statistically at par with it whereas minimum was recorded in the treatment N_{100g}/ plant (T_2) (12.12 cm). The results are in agreement with Awosika *et al*. (2014) and Iren *et al*. (2016) where the combination of NPK and pig manure significantly increased the stem girth. This might be due to the increase in soil nutrients because of addition of organic manures, which helped in modifying the soil properties and boosted the soil health. The maximum number of spines (4.16) were recorded in treatment N_{150g}/plant (T_4) and minimum in 75% of N_{150g}+Pig manure$_{2.5\ kg}$/plant (T_{10}) (3.16). Rawat *et al*. (2022) reported similar results, where number of spines were found statistically non-significant with the different nutrient sources.

The distance between areoles (0.53 cm) and area of areoles (0.18 mm^2) (Table 2) were recorded highest in treatment supplied with 75% of N_{125g}+Pig manure$_{2.1\ kg}$/plant (T_9) and lowest in N_0 Control (T_1) (1.17 cm and 0.07 mm^2). The results showed that the dragon fruit responded well to the application of pig manure when combined with chemical fertilizers. Abo Sedera *et al*. (2009) stated that nitrogen fertilizer when used along with compost had enhanced the vegetative growth. This might also be due to the availability of chemical fertilizers in the initial stages and organic manures in latter stages which might have helped in improving the soil organic matter, total nitrogen and soil carbon (Kumar *et al.,* 2016 and Reza and Jafar, 2007). The least supply of N, P and K in control might have resulted in limited plant growth and development altering photosynthesis and carbohydrate production (Zekri and Obreza, 2003).

4.CONCLUSION

From the above experiment it can be stated that pig manure with highest amount of nitrogen along with inorganic manures resulted in rapid growth of cladode length, diameter, girth, distance between areoles, area of areoles stating that the combined

application of pig manure with inorganic fertilizers (NPK) found to be most superior treatment combination with regard to vegetative growth in *H. polyrhizus*. As dragon fruit is important source of rich nutrients, growing it by using naturally available manures helps to produce organic fruit compared to growing with chemical fertilizers. Hence the study is useful for the environment also as it helps to lower the use of chemical nutrients.

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REFERENCES

Abo Sedera, F.A., Shafshak, S.N., Eid, M.S., & Mohamed, M.H.M. (2009). Improving productivity and quality of strawberry via organic fertilization and application of some natural growth stimulants. Indian Journal of Horticulture, 1:481-485.

Abusaleha & Shanmugavelu, K.G. (1988). Studies on the effect of organic vs inorganic source of nitrogen on growth, yield and quality of okra (*Abelmoschus esculentus*). Indian Journal of Horticulture, 45 (4): 312-318.

Arivalagan, M., Sriram, S., & Karunakaran, G. (2019). *Dragon fruit country report from India. FFTC Agricultural Policy Platform* (FFTC-AP). 1-8.

Awosika, O.E., Awodun, M.A., & Ojeniyi, S.O. (2014). Comparative effect of pig manure and NPK fertilizer on agronomic performance of tomato (*Lycopersicon esculentum mill*). American Journal of Experimental Agriculture, 4 (11): 1330-1338.

Chen, Y. P., Rekha, P. D., Arun, A. B., Shen, F. T., Lai, W. A., & Young, C. (2006). Phosphate solubilizing bacteria from subtropical soil and their tricalcium phosphate solubilizing abilities. Applied Soil Ecology, 34: 33–41.

Gomez, A. K. & Gomez, A. A. (2010). Statistical procedures for agricultural research (2nd ed.). Wiley India Private Limited. New Delhi. pp 134-138.

Iren, O.B., Ijah, C.J., Asawalam, D.O., & Osodeke, V.E. (2016). Comparative effect of pig manure, urea fertilizer and their combinations on the performance of *Amaranthus cruentus* in a rainforest ultisol, Nigeria. Journal of Agricultural Science and Practice, 1: 52-57.

Karunakaran, G., Tripathi, P.C., Sankar, V., Sakthivel, T. & Senthilkumar, R.(2014). Dragon Fruit - A new introduction crop to India: A potential market with promising future. **In:** Proceeding of National Seminar on Strategies for conservation, Improvement and utilization of underutilized fruits, 138-139.

Karunakaran, G., Tripathi, P.C., Sankar, V., Sakthivel, T., & Senthilkumar, R. (2014). Dragon Fruit - A new introduction crop to India: A potential market with promising future. In: Proceeding of National Seminar on Strategies for conservation, Improvement and utilization of underutilized fruits, 138-139.

Kumar, N., Attar, S.K., & Patel, S.N. (2016). Effect of organic and inorganic sources of nitrogen on growth, yield and quality of mango. Annals of Plant and Soil Research, 18 (1): 29-32.

Lodhi, P., Singh, D., & Tiwari, A. (2017). Effect of inorganic and organic fertilizers on yield and economics of Broccoli (*Brassica oleracea var. italica*). International Journal of Current Microbiology and Applied Sciences, 6: 562-566.

Mizrahi, Y., Nerd, A., & Nobel, P. S. (2010). Cacti as a crops. Horticultural Reviews, 18: 291-320.

Olusegun, O.S. (2014). Influence of NPK 15-15-15 fertilizer and pig manure on nutrient dynamics and production of cowpea, *Vigna unguiculata L*. Walp. American Journal of Agriculture and Forestry, 2(6): 267-273.

Reza, M.T., & Jafar, K. (2007). Influence of organic and chemical fertilizers on growth and yield of tomato (*Lycopersicon esculentum L*.) and soil chemical properties. *Annual Report,* Tehran, Iran: Shahid Beheshti University.

Ringphawon. H. (2018). Effect of various nutrient sources on the vegetative growth of dragon fruit. *M.Sc. Thesis*, Nagaland University, School of Agricultural Sciences and Rural Development, Medziphema Campus, India.

Samant, V. A., Rani, C. I., Shanmugasundaram, K. A., Janaki, P., Djanaguiraman, M., Neelavathi, R., & SG, P. (2023). Effect of Inorganic Fertilizer and Spacing on the Plant Growth of Dragon Fruit (*Hylocereus costaricencis*) under Tamil Nadu Agro-Climatic Conditions. *International Journal of Environment and Climate Change*, *13*(10), 1411-1418. https://doi.org/10.9734/ijecc/2023/v13i102794

Singh, K.P., & Kalloo, G. (2000). Nutrient management in vegetable crops. Fertilizer News, 45: 77-81.

Singh, T., Sandhu, P.S., & Darrouzet-Nardi, A. (2024). Thiourea Supplementation Improves Drought Stress Response of Ridge-Sown and Mulch-Applied Rainfed Maize (*Zea mays* L.) via Improved Leaf Source to Grain Sink Dynamics. Journal of Agronomy and Crop Science,210 (5): 12755.**https://doi.org/10.1111/jac.12755**