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EFFECT OF ORGANIC MANURES AND BIO-FERTILIZER ON GROWTH PARAMETERS AND FIELD ESTABLISHMENT OF DRAGON FRUIT (*HYLOCERUS POLYRHIZUS*)

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ABSTRACT

The present investigation was conducted with the objectives to find out the field establishment & vegetative growth of dragon fruit were observed in that various treatments consisting of (T_1)- Control, (T_2)- RDF (250gm: 150: 125g), (T_3)- RDF+(1.25Kg) Vermicompost, (T_4)-RDF+(1.25kg) F.Y.M,(T_5)-R.D.F. + (1.25kg) Vermicompost + (50g) Azotobacter, (T_6)- R.D.F + (1.25kg) F.Y.M + (50g) Azotobacter, (T_7)- R.D.F + (1.25kg) Vermicompost + (1.25kg) F.Y.M, (T_8)-R.D.F + (1.25kg) Vermicompost + (1.25kg) F.Y.M + (50g) Azotobacter, respectively. Hence, treatment combination (T_8) can be considered as best treatment for enhancing vegetative growth characters in dragon fruit under Prayagraj, humid subtropic conditions. The results clearly revealed that growth and growth attributing characters were significantly influenced by integrated of organic and bio-fertilizers. The maximum plant height (63.79 cm), Length of new shoot (cm) (22.97), number of thorns (22.88), Stem length between two nodes (11.37 cm), Girth of the main stem (11.65 cm), number of sprouts (3.58) and survival percentage (98.42%).

Key words : Dragon plant, RDF, Vermicompost, F.Y.M., Azotobacter.

Introduction

Dragon fruit a recently introduced super fruit in India, is considered to be a promising, remunerative fruit crop. Fruit has very attractive colour and mellow mouth melting pulp with black colour edible seed embedded in the pulp along with tremendous nutritive property which attract the growers from different part of India to cultivate this fruit crop which is originated in Mexico and Central and South America (Britton and Rose, 1963; Morton, 1987 and Mizrahi *et al*., 1997).

The origin of Dragon fruit is tropical and subtropical forest regions of Mexico and Central South America (Mirzahi and Nerd,1996).

The biggest advantage of this crop is that once planted it will grow for about 20 years, and one hectare could accommodate up to 800 plants. Dragon fruit is a fast return fruit crop with production in the second year after planting and full production within five years with regular bearing (Barthlott and Hunt, 1993; Bellec, 2004; Mizrahi and Nerd, 1996).

It is a long day plant with beautiful night blooming flower that is nicknamed as “Noble Woman” or “Queen of the Night”. The fruit is also known as Strawberry Pear, Dragon fruit, Pithaya, Night blooming Cereus, Belle of the night, Conderella plant and Jesus in the Cradle. Fruit is named as pitaya because of the bracts or scales on the fruit skin and hence the name of pitaya meaning ‘‘the scaly fruit’’. It has ornamental value due to the beauty of their large flowers (25 cm) that bloom at night; they are creamy white in color. It is considered as a fruit crop for future (Gunasena and pushpakumara, 2006 and Gunasena *et al*., 2006).

Dragon fruit also possess medicinal properties especially the red-fleshed varieties are rich in anti-oxidants. Regular consumption of fresh dragon fruit greatly controls the asthma, cough, cholesterol, high blood pressure, helps with stomach disorders, good for heart health, helps in preventing cancer, prevents congenital glaucoma, boosts immune power, reduces arthritis pain, good for pregnant women, prevents renal bone disease, good for bone health, repairs body cells, helps in improving appetite, good for eye health, boosts brain health. The flowers are used in aromatherapy. (Tao *et al*, 2014 and Choo and Yong, 2011).

The juicy flesh part of the fruit is delicious in taste when eaten as a fresh fruit. The fresh fruit contains 82.5 to 83.0 per cent moisture, 0.16 to 0.23 per cent protein, 0.21 to 0.61 per cent fat and 0.7 to 0.9 per cent fiber. Every 100 g of fresh fruit pulp contains 6.3 to 8.8 mg of calcium, 30.2 to 36.1 mg of phosphorous, 0.5 to 0.61 mg of iron and 8 to 9 mg of Vitamin-C (Morton, 1987).

Proximate nutraceutical values in g or mg per 100 g edible portion of white-flesh dragon fruit are as follows: moisture (85.3 %), protein (1.1), fat (0.57), crude fiber (1.34), energy (Kcal) (67.7), ash (0.56), carbohydrates (11.2), glucose (5.7), fructose (3.2), sucrose (not detected), sorbitol (0.33); vitamin C (3.0), vitamin A (0.01), niacin (2.8), Ca (10.2), Fe (3.37), Mg (38.9), P (27.75), K (272.0), Na (8.9) and Zn (0.35) and for red-flesh fruit, moisture (82.5-83.0), protein (0.159-0.229), fat (0.21-0.61), crude fiber (0.7-0.9) and ascorbic acid (8-9) (Jaafar *et al*., 2009).

However, few species are of economic value. The genus *Opuntia* Mill. is probably the most widely cultivated for its fruits (cactus pear, prickly pear, Barbary fig or tuna) and *Dactylopius coccus* O. Costa, the host of the cochineal insect from which red dye is extracted (Mizrahi *et al*., 1997).

Even if pitahaya can survive with very low rainfall, many months of drought, when good quality fruits are required, a regular water supply is needed. Regular irrigation is important, because it enables the plant to build sufficient reserves not only to flower at the most favourable time but also to ensure the development of the fruits. Local micro irrigation is recommended. In addition to the efficiency of the water supplied by this system, micro-irrigation avoids uneven and excess watering that can result in the flowers and the young fruits falling off (Barbeau, 1990).

The biggest advantage of this crop is that once planted, it will grow for about 20 years, and 1 hectare could accommodate about 800 dragon fruit plant. It is being grown commercially in Israel, Vietnam, Taiwan, Nicaragua, Australia and the United States (Merten, 2003).

Hand pollination although laborious, can be done easily by alternate brushing of anthers or collected pollen and stigma. After anthesis, pollen can be collected on to a plate using a fine paintbrush (Weiss *et al*., 1994).

It has ornamental value due to the beauty of their large flowers (25cm) that bloom at night; they are creamy white in colour. Dragon fruit production is gaining and it is receiving more recognition as a crop in India. It is a nutritious fruit with a variety of uses. The fruit pulp can be eaten fresh and can be made into various valuable processed products. The fruit possesses medicinal properties. It is known to prevent colon cancer and diabetes, neutralizes toxic substances such as heavy metals, reduce cholesterol and high blood pressure. It is also reported to control high sugar levels. It is rich in vitamin C, phosphorous and calcium which help to develop strong bones, teeth and skin. The fruit is considered a 'health fruit'. Betalains have a great potential in colouring a broad array of food. In this view, betacyanins from red coloured dragon fruit are most promising, not only as colouring agents, but also in possessing antiradical potential. It is considered as a fruit crop for future. Hence, widely favoured (Gunasena and pushpakumara, 2006 and Gunasena *et al*., 2006).

Materials and Methods

The present investigation was carried out on the "Effect of organic manures and bio fertilizer on field establishment of Dragon fruit (*Hylocerus polyrhizus*)" during 2022-2024. The experiment was conducted at Horticulture Research Farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj (UP). All the facilities necessary for cultivation, including labour were made available in the department. The materials used, techniques adopted and observations recorded during the course of the investigation are furnished in this chapter.

The experiment was conducted in Randomized Block Design (RBD) with 08 treatments in three replications via [T_1]- Control, [T_2]- RDF (250gm:150:125g), [T_3]- RDF + Vermicompost (1.25kg), [T_4]- RDF + F.Y.M(1.25kg), [T_5]- RDF +Vermicompost (1.25kg) + Azotobacter (50g), [T_6]- RDF+F.Y.M (1.25kg)+Azotobacter(50g), [T_7]- RDF+Vermicompost(1.25kg)+F.Y.M(1.25kg), [T_8]-RDF + Vermicompost (1.25kg) + F.Y.M (1.25kg) + Azotobacter (50g). The experiment was conducted at central Research

Farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj (UP) during 2023-2024. All the facilities necessary for cultivation, including labor will be made available in the department.

Observations Recorded

The leaf cutting Dragan plant was stabilizing in the field on May 2023. Research was done by taking $3m^2$ area from each plot. The observations were recorded for plant height(cm), Number of sprouts, stem length (cm) between two nodes, girth of main stem (cm), length of new shoot (cm), number of new thorns, survival percentage (%). The observed data was statistically analysed using analysis of variance (ANOVA).

Table 1 : Treatment combination.

Treatment	Treatment Combination
T_1	[Absolute control]
T_2	[RDF (250gm :150 :125g N.P.K)]
T_3	[RDF + 1.25Kg (Vermicompost)]
T_4	[RDF + 1.25kg (F.Y.M)]
T_5	[RDF + 1.25kg (Vermicompost) + 50g (Azotobacter)]
T_6	[RDF +1.25kg (F.Y.M) + 50g (Azotobacter)]
T_7	[RDF +1.25 (Vermicompost) + 1.25kg (F.Y.M)]
T_8	[RDF + 1.25 (Vermicompost) + 1.25kg (F.Y.M) + 50g (Azotobacter)]

Results and Discussion

Growth Parameters

Height of plant at 30, 60, 90 DAT

The influence of organic manures and bio fertilizer for plant height was highly significant. The plant height was measured at certain time after transplanting which it gave different results on different combination of different organic manures and bio fertilizers. Inquisition of the data in Table 2 and Fig. 1, showed that plant hight (33.89cm, 44.74cm and 63.79 cm) is higher recorded in T_8 with the application of R.D.F + 1.25kg (Vermicompost) + 1.25kg (F.Y.M) + 50g (Azotobacter) and lowest (26.78cm, 38.65cm and 49.98cm) number of plants height was recorded in T_1, where the treatment was control.

This might be due to the fact that FYM enhances the uptake of nitrogen. This nitrogen helps in the synthesis of tryptophan which is a precursor for the biosynthesis of auxins which hastened the metabolic activities in the plants resulting in stimulation of these vegetative parameters (Singh *et al.*, 2022).

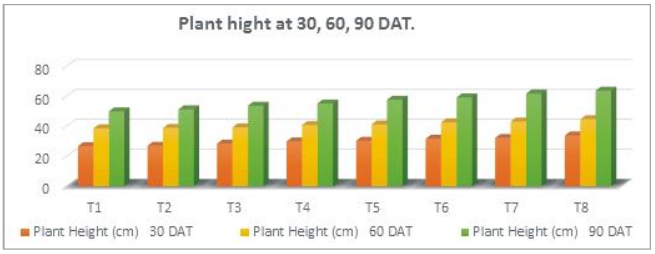

Fig. 1 : Graphical representation of plant growth on the effect of organic manures and bio fertilizer on field establishment of Dragon fruit.

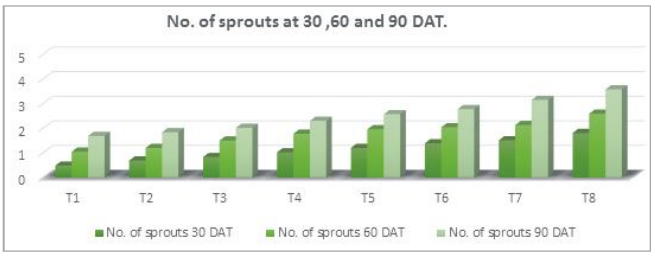

Fig. 2 : Graphical representation of No. of sprouts, on the effect of organic manures and bio fertilizer on field establishment of Dragon fruit.

Number of sprouts at 30, 60, 90 DAT

The data on number of sprouts of dragon plant is presented in Table 2, Fig. 2. The data on number of sprouts of dragon plant showed that there were significant differences among the treatments.

At 90 DAT the data analysis was significant, the highest number of sprouts of dragon plant (1.81, 2.59, 3.58) found was observed in T_8. In the similar with treatment T_7- (1.51, 2.13, 3.15) observed with the application R.D.F +1.25 (Vermicompost) + 1.25kg (F.Y.M) during the analysis. Minimum number of sprouts of dragon plant observed was the treatment T_1- (0.48, 1.05, 1.69,) where the treatment combination was control (Patil and Patil, 2020).

Stem length (cm) between two nodes at 90 DAT

The data on effect of various treatment combinations of organic manures and bio fertilizer on stem length between two nodes of dragon plant is presented in Table 2, Fig. 4. The data of stem length showed that there were significant differences among the treatments.

There was significant increase in the Stem length of dragon fruit plant among different treatments. After analysis, data enumerated in Table 2, varied significantly for stem length with application of and bio fertilizers organic manures and bio fertilizer Significantly, the maximum stem length in dragon fruit plant (11.37 cm) was observed in (T_8) where the treatment combination was R.D.F + 1.25kg (Vermicompost) + 1.25kg (F.Y.M)

Table 2 : Effect of organic manures and bio fertilizer on plant growth parameters of Dragon fruit (*Hylocerus polyrhizus*).

Treatments	Plant Height (cm)			No. of sprouts			Survival (%)		
	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT
T_1	26.78	38.65	49.98	0.48	1.05	1.69	79.23	75.78	69.87
T_2	27.04	38.94	51.32	0.69	1.2	1.84	83.45	89.55	85.94
T_3	28.41	39.31	53.75	0.83	1.5	2.02	86.27	92.12	91.11
T_4	29.87	40.76	55.23	1.02	1.78	2.3	88.52	93.57	93.35
T_5	30.29	41.2	57.71	1.2	1.96	2.57	92.61	95.86	95.92
T_6	31.72	42.63	59.25	1.39	2.04	2.78	94.19	96.04	96.07
T_7	32.25	43.17	61.89	1.51	2.13	3.15	95.94	96.26	96.38
T_8	33.89	44.74	63.79	1.81	2.59	3.58	96.86	97.94	98.42
F- Test	S	S	S	S	S	S	S	S	S
S.Ed. (±)	0.25	0.92	0.70	0.04	0.07	0.11	9.04	0.84	0.97
C.D.@5%	0.54	0.90	1.49	0.08	0.16	0.24	1.60	1.81	2.08
C.V.	1.02	1.25	1.50	4.06	4.99	5.50	1.02	1.21	1.30

+ 50g (Azotobacter), In treatment (T_7) the treatment combination was R.D.F +1.25 (Vermicompost) + 1.25kg (F.Y.M) and the stem length between two nodes at 90 days was (11.11 cm) and in treatments (T_6) the treatment combination was R.D.F +1.25kg (F.Y.M) + 50g (Azotobacter) where the result came (11.02 cm). Minimum stem length between two nodes was in observed was the treatment (T_1), (10.11 cm), where the treatment combination was zero. The increased stem length might be due to the application of organic manures and bio fertilizer out on younger mother plants due to the presence of actively dividing cells and higher levels of growth hormones. The increase in the length might be due to the fact that exogenous application of biofertilizer which plays a vital role in inducing cell elongation as well as cell division, which is apparently dependent on the natural macro and micro nutrients. This may be due to increased growth promoting substances from vermicompost as well as availability of more nutrients under this treatment, which enhanced the stem length. (Kumar *et al.*, 2022 and Kishore *et al.*, 2016).

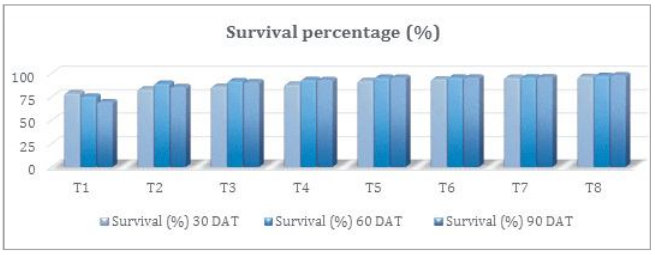

Fig. 3 : Graphical representation of Survival percentage , on the effect of organic manures and bio fertilizer on field establishment of Dragon fruit.

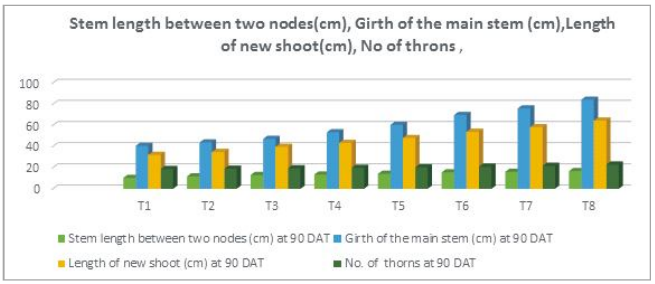

Fig. 4 : Graphical representation of stem length between two nodes, girth of main stem, length of new shoot, no of thorns, on the effect of organic manures and bio fertilizer on field establishment of Dragon fruit.

Girth of the main stem (cm) at 90 DAT

There was subsequent increase in the girth of the main stem at 90 DAT of dragon fruit plant among different treatments. After statical analysis, data enumerated in Table 3, Fig. 4 depicted that girth main stem varied significantly by application of organic manures and bio fertilizer azotobacter. Significantly, the maximum girth of the main stem of dragon fruit plant (11.65 cm) was observed in T_8 and significantly similar with treatment T_7 (11.61 cm) and followed by treatments T_6 (11.46 cm), during the analysis. Minimum girth of the main stem (cm) of dragon plant observed was the treatment T_1 (10.29 cm).

The higher girth of the main stem (cm) may be due to the fact that optimum organic manures and bio fertilizers the result of less time needed for callus formation and as a result consequent enhanced cambium dedifferentiation, producing numerous cells which will then differentiate to form root cells. It was possibly due to the fact that organic manures and bio fertilizer along with Phloroglucinol accelerates the initiation of root meristem and consequently resulted in the production of the greater number of roots (Tuan and Hung, 2016)

Length of new shoot (cm) at 90 DAT

Table 3 : Effect of organic manures and bio fertilizer on vegetative growth parameters of Dragon fruit (*Hylocerus polyrhizus*).

Treatments	Stem length between two nodes (cm) at 90 DAT	Girth of the main stem (cm) at 90 DAT	Length of new shoot (cm) at 90 DAT	No. of Thorns at 90 DAT
T_1	10.28	40.56	31.98	18.71
T_2	11.72	43.69	34.77	19.01
T_3	12.94	47.12	39.63	19.37
T_4	13.45	53.37	43.26	19.74
T_5	14.12	60.41	47.94	20.25
T_6	15.52	69.78	53.82	20.89
T_7	16.01	75.97	58.29	21.66
T_8	16.75	84.22	64.44	22.88
F-Test	S	S	S	S
S.Ed. (±)	0.45	0.62	0.51	0.17
C.D. @ 5%	0.96	1.32	1.08	0.37
C.V.	3.90	1.19	1.26	1.03

The data on length of new shoots in a layer per month is presented in Table 3, Fig. 4. The data on length of new shoots in dragon plant showed that there were significant differences among the treatments.

After analysis, data enumerated in Table 3 varied significantly for organic manures and bio fertilizer on growth and establishment of dragon plant in respect to length of new shoots of dragon plant in the study. Significantly, the highest length of new shoots of dragon plant (22.97 cm) found was observed in T_8 and significantly similar with treatment T_7 (21.03 cm) and followed by treatments T_6 (20.49 cm), during the analysis. Minimum length of new shoots of dragon plant observed was the treatment T_1 with (17.75 cm) (Gupta and Sharma, 2018).

Number of thorns at 90 DAT

The data on number of thorns in dragon plant is presented in Table 3, Fig. 4. The data on number of thorns in dragon plant showed that there were significant differences among the treatments.

There was a subsequent increase in the Number of thorns in dragon plant among different treatments, with an increase in months. After analysis, data enumerated in Table 3, varied significantly for organic manures and bio fertilizer on growth and establishment of dragon plant in respect to Number of thorns of dragon plant in the study. Significantly, the highest Number of thorns of dragon plant (22.88) found was observed in T_8 and significantly similar with treatment T_7 (21.66) and followed by treatments T_6 (20.89), during the analysis. Minimum Number of thorns of dragon plant observed was the treatment T_1 with (18.71).

Organic manures and bio fertilizer can growth and development of new roots and shoots, which can lead to the production of new leaves. Phloroglucinol can induce the formation of adventitious buds, which can potentially grow into new leaves, which can all contribute to the growth and development of new leaves in plants. Overall, the application of these supplements might have potentially enhanced the overall health and vigour of the plants, promoted the growth of new leaves and ultimately contributed to the overall growth and development of the plant (Singh *et al.*, 2022).

Survival percentage at 30, 60, 90 DAT

The data on effect of various treatment combinations on survival percentage is presented in Table 2, Fig. 3. The survival percentage showed that there were significant differences among the treatments.

There was subsequent increase in the survival percentage among different treatments. At 30 DAT, Data enumerated in Table 2 varied significantly for organic manures and bio fertilizer on growth and establishment of dragon plant in respect to plant survival percentage in the study. Significantly, the highest survival percentage of dragon plant (96.86) was observed in T_8 and significantly similar with treatment T_7 (95.94) and followed by treatments T_2 (83.45), during the analysis. Minimum survival percentage of dragon plant observed was the treatment T_1 with (79.29).

Similarly at 60 DAT, the highest survival percentage of dragon plant (97.94) was observed in T_8 and significantly similar with treatment T_7 (96.26) and followed by treatments T_2 (89.55), during the analysis. Minimum survival percentage of dragon plant observed was the

treatment T_1 with (75.78).

Similarly at 90 DAT, the highest survival percentage of dragon plant (98.42) was observed in T_8 and significantly similar with treatment T_7 (96.38) and followed by treatments T_2 (85.94), where the treatment combination was RDF (250gm :150 :125g N.P.K), during the analysis. Minimum survival percentage of dragon plant observed was the treatment T_1 with (69.87).

The research analyzed how integrated nutrient management strategies, including the use of RDF along with organic amendments and biofertilizers, influence the survival rates of dragon fruit during the critical establishment phase (Chakraborty and Singh, 2020).

The survivability of dragon plant in combined organic manures and bio fertilizer treatments is maximum and this might be due to a greater number of roots and root length in these treatments which could have caused the absorption of nutrients and water from the soil, ultimately resulting in high survival rate. It also might be probably due to the fact that rooting co factors and their balance with macro and micro substances. These results are in concurrence with reports of findings on the effectiveness of organic and inorganic fertilizers in promoting the survival and growth of dragon fruit plants, with detailed survival data at various stages of plant development (Das and Sharma, 2018).

Conclusion

On the basis of this experiment, it is concluded that use of organic fertilizer like F.Y.M., Vermicompost and bio-fertilizer, Azotobacter drastically enhance the plant height (63.79cm), number of new sprouts per plant (3.58), number of thorns (22.88), survival percent (98.42%), days to stem length (cm) between two nodes (11.37 cm) and stem girth (11.65cm) of dragon fruit plant at 90 DAT From the above experimental finding, the treatment T_8 - RDF +(1.25kg) Vermicompost + (1.25 kg) F.Y.M + (50g) Azotobacter was found best in terms of vegetative growth and field establishment of dragon plant.

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