**Influence of Vermicompost and Biofertilizers on Vegetative Growth and Yield of Dragon Fruit**

**ABSTRACT**

An experiment was carriedout in the Department of Fruit Science, C. S. Azad University of Agriculture and Technology, Kanpur (U.P.) for evaluating the Influence of vermicompost and biofertilizers on vegetative growthand yieldnewly planted Dragon Fruit (*Hylocereus costarecencis*) in Kanpur region using eleven treatments in Randomized Block Design with three replications. Data analyses revealed that in the second year after planting, growth, yield, and economics of dragon fruit were influenced by the use of vermicompost and biofertilizers. The maximum increase in plant length (37.93 cm), number of segments per plant (2.53), number of areoles per segment(9.13), number of spines per areole(0.62), distance between areoles(0.67 cm), stem thickness(0.47 cm), stem circumference(1.34 cm) and number of new sprouts per plant (3.97) was obtained under treatment T9. The highest number of fruits per pillar (12.64), andfruit yield (2.60 kg/pillar)were found with the treatment of T11 during the second year. Dragon fruit has high potential and is remunerative in the second year and onwards.

**Keywords:**Dragon fruit,Vermicompost, Biofertilizers, Growth, Fruit yield.

**INTRODUCTION**:

 Dragon fruit is aherbaceous perennial climbing cactus, plants which have colourful, tasty, attractive and nutritious fruit belongs to the familythe Cactaceae with chromosome number 2n=22. This plant originated in Central America and Mexico **(Wong and Siow, 2015)**. It is commonly known as Kamalam,Night blooming cereus, Queen of night in India. It is a highly potential and newly introduced exotic fruit which have crop in India. Dragon fruit has received worldwide recognition as a fruit crop and as well as an ornamental plant. The stem is a succulent with many-branched segments. The stem section forms aerial roots that adhere to the surface upon the trellis. The edible portion of the fruit is white and red, studded with numerous edible tiny black soft seeds. The fruit is round to oblong in shape, with red, or yellow coloured skin with green scales.

 In India, Gujarat, Karnataka and Maharashtra are the leading producers contributing about 70% of India’s dragon fruit production. Dragon fruit is highly valued in the fields of healthcare, food processing, nutraceutical, and cosmeceutical industries. Its consumption has immunity-building properties and it increases blood cells. It is rich in flavonoids that act against cardio-related diseases. It is low in calories and rich in vitamins, minerals and other nutrients.

Poor soil fertility is the major problem that causes lower production and there is little information is available on the interrelationship between soil properties and dragon fruit productivity. The recommendation of fertilizer rates also varies widely. Available reports indicate that the crop must be fertilized frequently in the early growth phase. Dragon fruit are also grown organically without applying inorganic fertilizers or pesticidesto produce healthy organic fruit. Vermicompost and biofertilizers like *Azotobactor, Azospirillum* and PSB are being used for improving the growth and quality of fruits by producing phytohormones, enhancing the uptake of plant nutrients thus helping in sustainable crop production through the maintenance of soil fertility and productivity. For commercial exploitation of this crop, necessaryattaints were made to know the influence of vermicompost and biofertilizers on vegetative growthand yield of dragon fruit cultivation in north Indian plains.

**MATERIAL AND METHODS**

The present investigation on the effect of Vermicompost and biofertilizers on vegetative growthand yield of newly planted dragon fruit was carried out in the Department of Fruit Science, C. S. Azad University of Agriculture and Technology, Kanpur (U.P.) for two consecutive years 2022 and 2023. The experimental site falls under sub-tropical climate in Indo-Gangetic central plains having alluvial soil and is located between 25º26’ to 26º28’ North latitude and 79º31’ to 80º34’ East longitude at an elevation of 125.90 meters above mean sea level and characterizes between semi and sub-tropical climate with hot dry summers and cold winters. The normal rainfall of the locality is about 750-1000 mm per annum, which is mostly received from last June to September with occasionally some scattered showers during winter months from N-E monsoon. The maximum temperature ranges between 20º to 44ºC and the minimum from 7.0º to 29ºC with relative humidity of 45-80% in different months of the year. The site has an assured irrigation facility by tube well. The pole was wrapped with green net. Four-month-old healthy plants were planted on 22 March 2022 at a distance of 2x2m around the pole. Three plants were placed around the pole at 15 cm apart.

The experiment was conducted in randomized block design with eleven treatments *viz.,*T1-Control, T2-Vermicompost (0.5kg/plant),T3-*Azotobacter* (50g/plant), T4-*Azospirillium* (50g/plant), T5-PSB (50g/plant), T6 -Vermicompost (0.5kg/plant) +*Azotobacter* (50g/plant), T7-Vermicompost (0.5kg/plant)+*Azospirillium* (50g/plant), T8-Vermicompost (0.5kg/plant) + PSB (50g/plant), T9-Vermicompost (0.5kg/plant)+ *Azotobacter*(50g/plant) + *Azospirillium*(50g/plant), T10-Vermicompost (0.5kg/plant)+*Azotobacter*(50g/plant) + PSB (50g/plant) and T11-Vermicompost (0.5kg/plant)+*Azospirillium*(50g/plant)+ PSB (50g/plant), whichwere applied in threeequal instalments, first imposition was carried out after planting on 06th March, second imposition was done before one month of flowering on 10th May and the last imposition was done before fruiting of plants on 20th June. Growth parameters in terms of plant length, distance of areoles, stem thickness and stem circumference were measured with the help of measuring tape and vernier calipers and expressed in centimetres (cm). Number of segments, number of areoles per segment, number of spines per areoles, and number of new sprouts per plant wasrecorded in the plant visually and manually andexpressed in numbers. The data was taken at 30, 60, 90 and 120 days after treatment (DAT).Theyield dragon fruit *viz.,* total number of fruits per pillar, fruit yield (kg/pillar), estimated fruit yield per hectare wererecorded during the investigation. The statistical analysis of the data wasmade as suggested by **Panse and Sukhatme (1985)**.

**RESULTS AND DISCUSSION**

**Plant length**

The maximum increase in plant length (37.93cm)was recordedwith the treatment of Vermicompost (0.5kg/plant) + *Azotobacter* (50g/plant) + *Azospirillum*(50g/plant) followed by 34.64cm length increased under treatment T11(Fig.1). In comparison, the minimum plant length (19.32cm) was recorded in plants kept under control.This might be due to the application of vermicompost resulted in the release of various nutrients andgrowth-stimulating substances excreted by earthwormsin vermicompost, which is a source of humus, N- fixers and nutrients, which resulted in higher values for plant length. These results are in agreement with the findings of **Siddiqua *et al.,* (2021), Dey*et al.,* (2022), Siddiqua *et al.,* (2022), Singh*et al.,* (2022), Maurya*et al.,* (2023)**and**Rawat*et al.,* (2023)** in dragon fruit.

**Number of segments per plant**

The maximum increase in number of segments per plant(2.53) was obtained under treatment T9{Vermicompost (0.5kg/plant) + *Azotobacter*(50g/plant)+*Azospirillum*(50g/plant)} followed by 2.38numberin treatment T11, while the minimum increase in number of segments per plant (1.41) was recorded under control(Fig. 2). Vermicompost improves microbial distribution and moisture retention capacity of the soil resulting in greater enzymatic (phosphatase and urease) activities which improved the growth and ultimately might have reflected in the number of segments per plant. These results are in line with the findings of **Kumar *et al.,* (2019),****Singh *et al.,* (2022), Samant *et al.,* (2023)**,**Maurya *et al.,* (2023), Rawat *et al.,* (2023)** in dragon fruit.

**Number of areoles per segment**

The study revealed that the maximum increase in number of areoles per segment (9.13) was obtained under treatment T9-Vermicompost (0.5kg/plant) + *Azotobacter* (50g/plant) + *Azospirillum*(50g/plant) followed by 8.62 in T11, while a minimum increase in number of areoles per segment (5.85) was recorded under control(Fig. 3).

The increase in the number of areoles per segmentmay be due to the improvement in physical properties of soil, higher nutrient uptake and increased activity of micro-organisms, which were manifested in the form of enhanced growth and higher carbohydrate production. The results are in agreement with the findings of **Kumar *et al.,* (2019), Maurya *et al.,* (2023), Rawat *et al.,* (2023)** in dragon fruit.

**Number of spines per areole**

The maximum increase in number of spines perareole (0.62) was recorded under treatment T9-Vermicompost (0.5kg/plant) + *Azotobacter* (50g/plant) + *Azospirillum*(50g/plant) followed by (T11)0.52, while minimum increase in number of spines per areole (0.16) was recorded in control(Fig. 4).

Bio-fertilizers like *Azotobactor, Azospirillum* and PSB help in solubilizing and mobilizing the nutrients present in the soil, therefore making more nutrients available to plants, this might have resulted in higher values concerning the number of spines perareole. These results conform with the findings of **Verma*et al.,* (2019b), Kumar *et al.,* (2019),Maurya*et al.,* (2023)** and**Rawat*et al.,* (2023)** in dragon fruit.

**Distance between areoles**

It was observed that the maximum increase in distance between areoles(0.67 cm) was obtained in the plants treated with Vermicompost (0.5kg/plant) + *Azotobacter* (50g/plant) + *Azospirillum*(50g/plant) followed by 0.61 cm in T11, while the minimum (0.14 cm) under control(Fig. 5).This was due the reason that Vermicompost has a huge quantity of various micro-organisms, especially bacteria along with a high concentration of various plant hormones, especially auxins, gibberellins and cytokinin’s.*Azotobacter* and *Azospirillum* intensify the activity of rhizosphere microflora involved in ammonification, nitrification, cellulose decomposition and phosphate mineralization. These results got the support with the findings of **Kumar *et al.,* (2019),Singh *et al.,* (2022), Maurya *et al.,* (2023), and Rawat *et al.,* (2023)** in dragon fruit.

**Stem thickness**

The maximum increase in stem thickness(0.47 cm)was obtained with the application of Vermicompost (0.5kg/plant) + *Azotobacter* (50g/plant)+ *Azospirillum*(50g/plant) followed by 0.41 cm increase under treatment T11, while minimum (0.16 cm)was recorded in control(Fig. 6).The increase in stem thickness could be attributed to the combined application of vermicompost and biofertilizers leading to increased nutrient availability and hence vigorous plant growth and diameter of stem. These observations are in line with the report of **Verma *et al.,* (2019b), Siddiqua *et al.,* (2021), Siddiqua *et al.,* (2022), Maurya*et al.,* (2023)** and**Rawat*et al.,* (2023)** in dragon fruit.

**Stem circumference**

The maximum increase in stem circumference (1.34 cm) was obtained under treatment T9-Vermicompost (0.5kg/plant) + *Azotobacter*(50g/plant) + *Azospirillum*(50g/plant) followed by 1.27 cm (T11), while minimum (0.84 cm) T1 (control) (Fig. 7). It might be attributed to the increased biological nitrogen fixation, better organic nitrogen utilization, better development of root system with the combined application of vermicompost and biofertilizers, helping in the promotion of stem circumference. The results conform with the studies of **Siddiqua *et al.,* (2021),Siddiqua *et al.,* (2022),Singh*et al.,* (2022), Maurya*et al.,* (2023), Rawat*et al.,* (2023) and Samant *et al.,* (2023)** in Dragon fruit.

**Number of new sprouts per plant**

From the perusal of data, it found that the maximum increase number of new sprouts per plant (3.97) was obtained under treatment T9-Vermicompost (0.5kg/plant) + *Azotobacter* (50g/plant) + *Azospirillum*(50g/plant) followed by 3.71 (T11), while minimum (2.56) was recorded under treatment T1 (control) (Fig. 8).

This might be because the presence of vermicompost around the root zone of plants throughout growth, which is a source of humus, *Azotobacter,* and *Azospirillum* act as N-fixers and making nutrients available to plants, this might have resulted in the higher values concerning several new sprouts per plant. The results are in agreement with the findings of **Kumar *et al.,* (2019), Siddiqua *et al.,* (2021), Prajapati *et al.,* (2021), Siddiqua *et al.,* (2022), Prasad *et al.,* (2022)**in Dragon fruit.

**Number of fruits per pillar**

 The relevant data are presented in Table 1 shows that maximum number of fruits per pillar (12.64) was recorded in treatment T11-Vermicompost (0.5kg/plant) + *Azospirillium* (50g/plant) + PSB (50g/plant) followed by treatment T10 (10.51). The least number of fruits per pillar (5.23) was recorded in treatment T₁ (Control). It might be due to better metabolic activities in the plant which might have ultimately increased protein and carbohydrate levels which might have enhanced the yield. These observations are in conformity with the findings of **Pandey *et al.,* (2023)** in dragon fruit, **Singh and Tripathi(2020b)** in papaya, **Kumarand Tripathi(2020)** in strawberry.

**Fruit yield kg/pillar**

 The maximum fruit yield (2.60 kg pillar-1) was recorded in treatment T11 (Vermicompost (0.5kg/plant) + *Azospirillum*(50g/plant) + PSB (50g/plant)), followed by treatment T10 (2.09 kg pillar-1), while the least fruit yield (0.55 kg pillar-1) was recorded in treatment T1 (Control). This is due to an increase in various endogenous hormonal levels in the plant tissues due to applied vermicompost along with bio-fertilizers which may enhance pollen germination and pollen tube growth, ultimately increases the fruit set as well as number of fruits per plant, which might have the directly influenced the fruit yield. These results are in line with the observation made by**Pandey *et al.,* (2023)** in dragon fruit, **Mishra and Tripathi (2011)** in strawberry **Singh and Tripathi(2020a)**in papaya.

**CONCLUSION**

The results of this study reveal our routes towards prescribed organic manure and biofertilizer for better growth, yield and benefit-cost ratio of dragon fruit. Among all the treatments, T9-Vermicompost (0.5kg/plant) + *Azotobacter* (50g/plant) + *Azospirillum* (50g/plant) was best for vegetative growth and T11- Vermicompost (0.5kg/plant) + *Azospirillum* (50g/plant) + PSB (50g/plant) was best in respect of fruit yield and economic feasibility of dragon fruit.

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**Table: 1-**Yield parameters of Dragon Fruit as influenced by different organic manures and bio-fertilizers

|  |  |  |
| --- | --- | --- |
| **Treatments** | **Number of fruits per pillar** | **Fruit yield (kg/pillar)** |
| T1 | 5.23 | 0.55 |
| T2 | 5.73 | 0.78 |
| T3 | 6.23 | 0.92 |
| T4 | 6.48 | 1.06 |
| T5 | 5.84 | 0.87 |
| T6 | 7.52 | 1.29 |
| T7 | 8.34 | 1.51 |
| T8 | 7.23 | 1.20 |
| T9 | 9.58 | 1.79 |
| T10 | 10.51 | 2.09 |
| T11 | 12.64 | 2.60 |
| **SE (m)±** | 0.11 | 0.02 |
| **C.D. at 5% level** | 0.31 | 0.05 |

**Fig.1:** Influence of Vermicompost and Biofertilizers on increase in plant length of Dragon plant

**Fig.2:** Influence of Vermicompost and Biofertilizers on increase in number of segments per plant

**Fig.3:** Influence of Vermicompost and Biofertilizers on increase in number of areoles per segment

**Fig. 4:** Influence of Vermicompost and Biofertilizers on increase in number of spines per areole

**Fig. 5:** Influence of Vermicompost and Biofertilizers on increase in distance between areoles

**Fig. 6:** Influence of Vermicompost and Biofertilizers on increase in stem thickness

**Fig. 7:** Influence of Vermicompost and Biofertilizers on increase in stem circumference

**Fig. 8:** Influence of Vermicompost and Biofertilizers on umber of new sprouts per plant