Original Research Article

Effect of inorganic fertilizer and spacing on the plant growth of dragon fruit (*Hylocereus costaricencis*) under Tamil Nadu agro-climatic conditions

ABSTRACT

The present study was carried out to find the effect of fertilizer doses, spacings and interaction effect of both on plant growth of dragon fruit (*Hylocereus costaricencis*) at the Orchard, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore. during the year 2022. The design of the experiment was a split plot with four main plots *viz.* M_1 = 3.5 x 2.0 m^2, M_2 = 3.0 x 3.0 m^2, M_3 = 3.0 x 2.5 m^2, M_4 = 2.5 x 2.5 m^2 and six sub plots *viz.* $S_1 = N_{540}\ P_{420}\ K_{360,}$ $S_2 = N_{495}\ P_{385}\ K_{330,}$ $S_3 = N_{450}\ P_{350}\ K_{300,}$ $S_4 = N_{340}\ P_{260}\ K_{225,}$ $S_5 = N_{225}\ P_{175}\ K_{150,}$ $S_6 = N_0\ P_0\ K_0$ g per pillar was applied and replicate four times. A significant difference was observed in terms of vine length (m), cladode girth (cm), cladode length (cm) and cladode number when different doses of fertilizers were applied. The highest vine length (2.96), cladode girth (24.52), cladode length (67.21) and number of cladodes (67.48) were observed in S_3 ($N_{450}\ P_{350}\ K_{300}$). Similarly, the highest vine length (2.503) and cladode girth (19.78) were observed in M_4 (2.5 x 2.5 m^2). The highest cladode length (67.47) was observed in treatment combination M_2S_3. Hence, the application of fertilizer dose S_3 ($N_{450}\ P_{350}\ K_{300}$) and adoption of spacing M_4 (2.5 x 2.5 m^2) is good to enhance the vegetative growth characters of dragon fruit under Tamil Nadu conditions.

Keywords: Dragon fruit, NPK dose, spacing, vegetative growth, vine, cladode.

INTRODUCTION

The dragon fruit is a perennial climbing cactus in the family Cactaceae (2n=22), *Hylocereus costaricensis* (Web.) Britton and Rose. The Greek word 'hyle' (which means woody) and the Latin word 'cereus' (which means waxen) are combined to form the scientific name for dragon fruit. Dragon fruit is one of the most attractive and nutrient dense fruit crops in the world. It first originated from Mexico, Central and South America (Britton and Rose, 1963; Morton, 1987; and Mizrahi *et al.*, 1997). The cultivation of dragon fruit is expanding in India, where it was first introduced in the late 1990s (mostly in the Andaman and Nicobar

Islands, Andhra Pradesh, Gujarat, Karnataka, Kerala, Maharashtra, Orissa, Tamil Nadu, and West Bengal). The flower is too lovely, so people impersonate it as a noblewoman and the night's reigning queen.

Due to its abundance in phytochemicals, antioxidants, lipids, carbs, calcium, phosphorus, magnesium, potassium, phylocactin, hylocerenin, and betacyanin with 5-O- or 6-O-glycosides, dragon fruit provides several health benefits. In those with type 2 diabetes, dragon fruits reduce blood sugar levels. It helps with heart issues, carbohydrate metabolism, bone and tooth health, blood and tissue formation, respiratory tract infections, immune system strength, quicker wound and bruise healing, and even as a mixed laxative due to its high fibre content. It also helps prevent colon cancer, improve kidney function, and lengthen eye focal length. It has B group vitamins, which are crucial for good health (B1, B2, and B3). Due to its high antioxidant value, vitamins, and mineral content as well as its economic value and delightful red or pink colour has recently drawn much attention among Indian growers (Jaafar *et al*. 2009; Rebecca *et al*., 2010).

The areas with little rainfall, it is highly ideal to grow in most of India. The ideal temperature range for dragon fruit plants is a tropical climate with an average temperature of 20°C to 29°C, while they may survive brief periods of 38°C to 40°C and as low as 0°C (Karunakaran *et al.*, 2014). Locations with high rainfall are unsuitable for this crop since it leads to fruit and flower wilting (Karunakaran *et al.*, 2019). Dragon fruit may be grown on virtually any soil, however sandy loam soils that are rich in organic matter and have a slightly acidic character (pH 5.5 to 6.5) are the best.

Due to the no application of NPK fertilizer and improper spacing may cause poor growth and development of the plant. Since not much data is available on the effect of fertilizers and spacing on dragon fruit crop. Judicious application of fertilizers and planting at proper spacing may cause good growth and development of dragon fruit plants. It is necessary to know the optimum nutrient requirement, spacing and performance of the dragon fruit under Tamil Nadu conditions for commercial exploitation.

MATERIALS AND METHODS

The experiment was conducted in 2022 at dragon fruit Orchard, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore. To find out the effect of inorganic fertilizers and spacings on plant growth of dragon fruit (*Hylocereus costaricencis*) under Tamil Nadu conditions. The soil was sandy clay loam predominant plain soil, with a pH of 8.02 and EC 0.25 dsm^{-1}. The design of the experiment was a split plot design with four main plot treatments and six sub plot treatments including control replicated four times. Main plot treatments *viz.* M_1 = 3.5 x 2.0 m^2, M_2 = 3.0 x 3.0 m^2, M_3 = 3.0 x 2.5 m^2, M_4 = 2.5 x 2.5 m^2 and the sub plot treatments *viz.* S_1 = N_{540} P_{420} $K_{360,}$ S_2 = N_{495} P_{385} $K_{330,}$ S_3 = N_{450} P_{350} $K_{300,}$ S_4 = N_{340} P_{260} $K_{225,}$ S_5 = N_{225} P_{175} $K_{150,}$ S_6 = N_0 P_0 K_0 g per pole. For all the treatments 10 kg of FYM per pillar was applied. The fertilizers were applied in four split applications during the second to third week of February, March, April and June. The source of nitrogen, phosphorus and potassium was Urea, Di-ammonium phosphate (DAP) and Muriate of Potash (MOP) respectively. The vegetative growth parameters *viz.* cladode length (cm), cladode girth (cm), number of cladodes per pole and vine length (m) were recorded according to the standard method. Recorded data was statistically analyzed with the help of R studio, OPSTAT and MS Excel.

RESULTS AND DISCUSSION

Vine length (m)

It was observed that the vine length of dragon fruit differed significantly due to spacings. The highest vine length (2.503 m) was recorded in M_4 (2.5 x 2.5 m^2), which was significantly higher than the vine lengths which was recorded in M_1 (3.5 x 2.0 m^2), M_2 (3.0 x 3.0 m^2) and M_3 (3.0 x 2.5 m^2). The treatments M_1 and M_2 are on par with each other. The lowest vine length of (2.49 m) was observed in treatment M_3 (3.0 x 2.5 m^2). Similarly, it was disclosed that vine length differ significantly due to the different fertilizer doses. The highest vine length (2.96 m) was observed in S_3 (N_{450} P_{350} K_{300}) and was significantly higher than in other treatments. The treatments S_1 (N_{540} P_{420} K_{360}) and S_2 (N_{495} P_{385} K_{330}) are on par with each other. The lowest vine length (2.27 m) was observed in treatment S_6 (N_0 P_0 K_0). There was no significant difference due to spacing and fertilizer dose combinations in respect of vine length. The highest vine length (2.503 m) was observed in M_4 (2.5 x 2.5 m^2). Dragon fruit is shallow rooted crop and its roots are mostly confined up to 40 cm to 60 cm from the pole the distance of 2.5 m between two plants is sufficient for its growth and the intermingling of two plants' roots is also not done in this spacing this may be the reason for good vine growth. The highest vine length (2.96 m) was observed in S_3 (N_{450} P_{350} K_{300}) this may be due to the optimum dose of nitrogenous fertilizer. As the fertilizer dose goes increases or decreases the length of the vine also going decrease. When comparing S_4 (N_{340} P_{260} K_{225}), S_5 (N_{225} P_{175} K_{150}), and S_6 (N_0 P_0 K_0) fertilizer doses applied to plants the vine length goes decreasing this may be due to a decline in nitrogen level. The lowest vine length (2.27 m) was observed in treatment S_6 (N_0 P_0 K_0) this may be due to the no application of nitrogenous fertilizer. The aforementioned outcomes closely match those that were reported by Chakma *et al*., (2014), Sandeep Kumar *et al*., (2018), Sangeeta Shree *et al*., (2018), Shreenivas *et al*., (2017) and Lodhi *et al*., (2017).

Cladode girth (cm)

The highest value of cladode girth (19.78 cm) was observed in spacing M_4 (2.5 x 2.5 m^2). The other three spacings M_1, M_2, and M_3 are on par with each other. Similarly, it was observed that cladode girth differs significantly due to fertilizer doses. The highest value of cladode girth (24.52 cm) was observed in the treatment S_3 (N_{450} P_{350} K_{300}) followed by S_1 (N_{540} P_{420} K_{360}), S_2 (N_{495} P_{385} K_{330}), S_4 (N_{340} P_{260} K_{225}), S_5 (N_{225} P_{175} K_{150}), S_6 (N_0 P_0 K_0). The lowest cladode girth (14.43 cm) was observed in S_6 (N_0 P_0 K_0). There was no significant difference due to spacing and fertilizer dose combinations in respect of cladode girth. The highest cladode girth (19.78 cm) was observed in spacing M_4 (2.5 x 2.5 m^2) this may be due to the proper sunlight and shading to plants as compared to other spacings which support good plant growth. The highest cladode girth (24.52 cm) was observed in the treatment S_3 (N_{450} P_{350} K_{300}) this may be due to the optimum fertilizer dose, as the fertilizer dose goes increases or decreases the cladode girth decreases. When comparing S_4 (N_{340} P_{260} K_{225}), S_5 (N_{225} P_{175} K_{150}), and S_6 (N_0 P_0 K_0) fertilizer doses applied to plants the cladode girth goes decreasing this may be due to a decline in nitrogen level. Similar results regarding vegetative growth were reported by Chakma *et al*., (2014) and Tammana Perween and Hasan (2019).

Cladode length (cm)

It was observed that due to the fertilizer doses, cladode length differ significantly. The highest cladode length (67.21 cm) value was observed in S_3 (N_{450} P_{350} K_{300}) followed by S_1 (N_{540} P_{420} K_{360}), S_2 (N_{495} P_{385} K_{330}), S_4 (N_{340} P_{260} K_{225}), S_5 (N_{225} P_{175} K_{150}), S_6 (N_0 P_0 K_0). The lowest cladode length (55.68 cm) was observed in S_6 (N_0 P_0 K_0). There is no significant difference in cladode length due to spacings. The interaction effect between spacings and fertilizer doses was found to be significant in respect of cladode length. The highest cladode length (67.47 cm) was observed in M_2S_3 Followed by M_1S_3, M_4S_3 and M_3S_3 which were 67.38 cm, 67.12 cm and 66.90 cm respectively. The treatment combinations M_2S_3, M_1S_3, M_4S_3 and M_3S_3 are on par with each other. The lowest cladode length (55.45 cm) value was observed in treatment combination M_1S_6. The highest cladode length (67.21 cm) was observed in the treatment S_3 (N_{450} P_{350} K_{300}) this may be due to the optimum fertilizer dose, as the fertilizer dose goes increases or decreases the cladode length decreases. When comparing S_4 (N_{340} P_{260} K_{225}), S_5 (N_{225} P_{175} K_{150}), and S_6 (N_0 P_0 K_0) fertilizer doses applied to plants the cladode length goes decreasing this may be due to a decline in nitrogen level. The highest cladode length (67.47 cm) was observed in the treatment combination of M_2S_3. The treatment M_1S_3, M_2S_3, M_3S_3 and M_4S_3 are on par with each other this may be due to the application of the optimum dose of fertilizer. The above results are in close matches with those reported by Chakma *et al*., (2014). Correa *et al*., (2014) and Tammana Perween and Hasan (2019)

Cladode number (units)

There was no significant difference between cladode numbers due to spacings. It was observed that there is a significant difference between the cladode number due to fertilizer doses. The highest number of cladodes (47.48) was observed in S_3 (N_{450} P_{350} K_{300}) followed by S_2 (N_{495} P_{385} K_{330}), S_1 (N_{540} P_{420} K_{360}), S_4 (N_{340} P_{260} K_{225}), S_5 (N_{225} P_{175} K_{150}), S_6 (N_0 P_0 K_0) and that are 62.25, 59.50, 58.45, 56.15 and 51.18 respectively. The treatments S_1 and S_4 are on par with each other. There was no significant difference between cladode numbers due to spacings and fertilizer dose interaction effect. The highest cladode number (67.48) was observed in the treatment S_3 (N_{450} P_{350} K_{300}) this may be due to sprouting after getting the optimum dose of fertilizer. As the fertilizer dose goes increases as well as decreases the cladode number also decreases. The lowest cladode number (51.18) was observed in S_6 (N_0 P_0 K_0) this may be due to no application of fertilizers. The above findings are supported by Chakma *et al.*, (2014) and Kumar *et al*., (2018).

Table 1: Effect of spacing on vegetative growth parameters of dragon fruit

Treatments	Vine length	Cladode girth	Cladode length	Cladode number
M_1	2.493[ab]	19.05[b]	60.88[b]	59.43[a]
M_2	2.498[ab]	19.12[b]	61.37[ab]	59.07[a]
M_3	2.490[b]	18.89[b]	61.83[a]	58.76[a]
M_4	2.503[a]	19.78[a]	61.30[ab]	59.41[a]
SE d	0.004	0.231	0.363	0.494
CD (0.05)	0.010	0.522	0.821	1.117

Table 2 :Effect of inorganic fertilizer doses on vegetative growth parameters of dragon fruit

Treatments	Vine length	Cladode girth	Cladode length	Cladode number
S_1	2.46^{b}	21.96^{b}	64.54^{b}	59.50^{c}
S_2	2.45^{b}	21.24^{c}	62.23^{c}	62.25^{b}
S_3	2.96^{a}	24.52^{a}	67.21^{a}	67.48^{a}
S_4	2.43^{c}	16.97^{d}	60.27^{d}	58.45^{c}
S_5	2.40^{d}	16.18^{e}	58.14^{e}	56.15^{d}
S_6	2.27^{e}	14.43^{f}	55.68^{f}	51.18^{e}
SE d	0.006	0.339	0.591	0.735
CD (0.05)	0.012	0.679	1.182	1.470

Table 3 :Effect of interaction of spacing and inorganic fertilizer doses on vegetative growth parameters of dragon fruit

Treatments	Vine length	Cladode girth	Cladode length	Cladode number
M_1S_1	2.46^{cd}	21.36^{de}	64.35^{b}	60.46^{cde}
M_1S_2	2.45^{cde}	20.87^{e}	58.95^{cde}	61.82^{cd}
M_1S_3	2.97^{ab}	23.63^{bc}	67.38^{a}	68.36^{a}
M_1S_4	2.42^{fghi}	17.55^{f}	60.48^{c}	57.49^{fgh}
M_1S_5	2.39^{j}	16.48^{fg}	58.70^{cde}	57.52^{fgh}
M_1S_6	2.27^{k}	14.44^{ij}	55.45^{f}	50.91^{i}
M_2S_1	2.47^{c}	22.34^{cd}	64.45^{b}	59.46^{def}
M_2S_2	2.46^{cd}	21.50^{de}	63.35^{b}	63.20^{bc}
M_2S_3	2.95^{b}	24.40^{ab}	67.47^{a}	67.59^{a}

M_2S_4	2.44^{efg}	16.56^{fg}	59.57^{cd}	$57.64e^{fgh}$
M_2S_5	2.41^{hij}	16.37^{fgh}	57.33^{def}	55.63^{h}
M_2S_6	2.27^{k}	13.59^{j}	56.03^{f}	50.91^{i}
M_3S_1	2.45^{cde}	21.62^{de}	65.32^{ab}	59.31^{def}
M_3S_2	2.44^{def}	20.94^{e}	63.48_{b}	62.08^{cd}
M_3S_3	2.96^{ab}	24.55^{ab}	66.90^{a}	66.06^{ab}
M_3S_4	2.43^{efgh}	16.31^{fgh}	60.40^{c}	58.23^{efgh}
M_3S_5	2.40^{ij}	15.37^{ghi}	59.35^{cde}	55.35^{h}
M_3S_6	2.26^{k}	14.55^{ij}	55.56^{f}	51.53^{i}
M_4S_1	2.46^{cd}	22.50^{cd}	64.06^{b}	58.76^{efg}
M_4S_2	2.45^{cde}	21.64^{de}	63.14^{b}	61.91^{cd}
M_4S_3	2.97^{a}	25.49^{a}	67.12^{a}	67.89^{a}
M_4S_4	2.45^{cde}	17.47^{f}	60.63^{c}	60.46^{cde}
M_4S_5	2.41^{ghij}	16.49^{fg}	57.19^{ef}	56.09^{gh}
M_4S_6	2.27^{k}	15.12^{hi}	55.69^{f}	51.37^{i}
SE d	0.012	0.679	1.182	1.470
CD (0.05)	0.024	1.358	2.363	2.940

Fig 1 : Effect of treatment combinations on vine length (m)

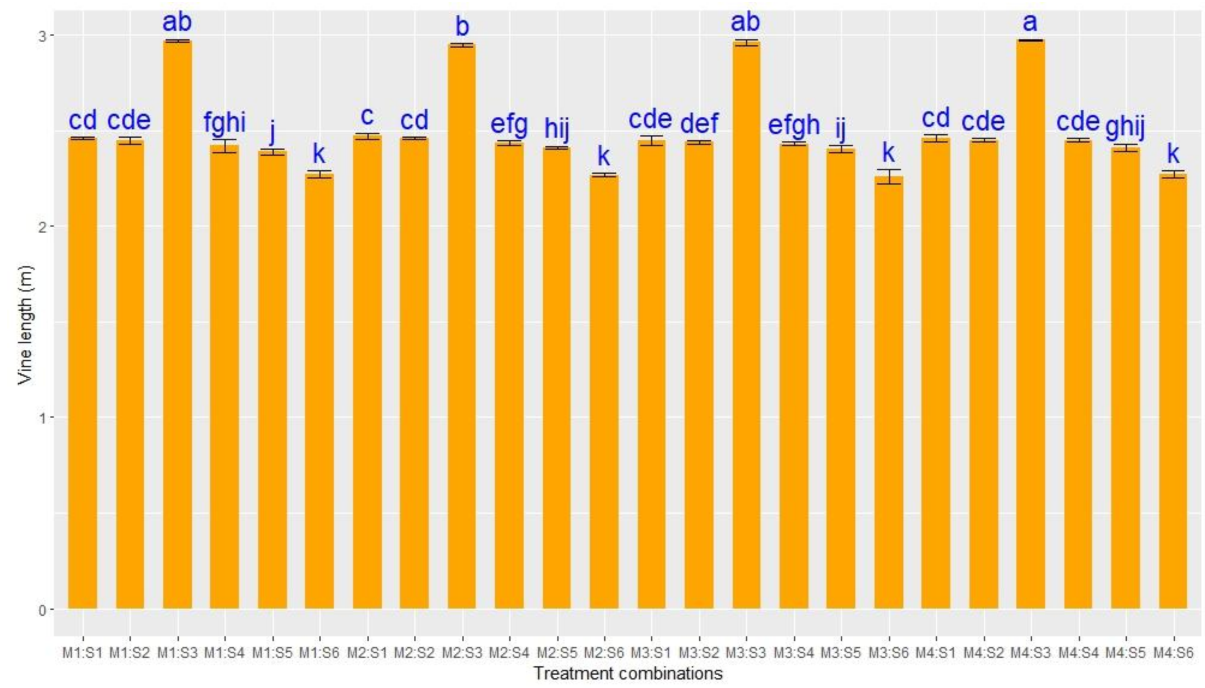


Fig 2 : Effect of treatment combinations on cladode girth (cm)

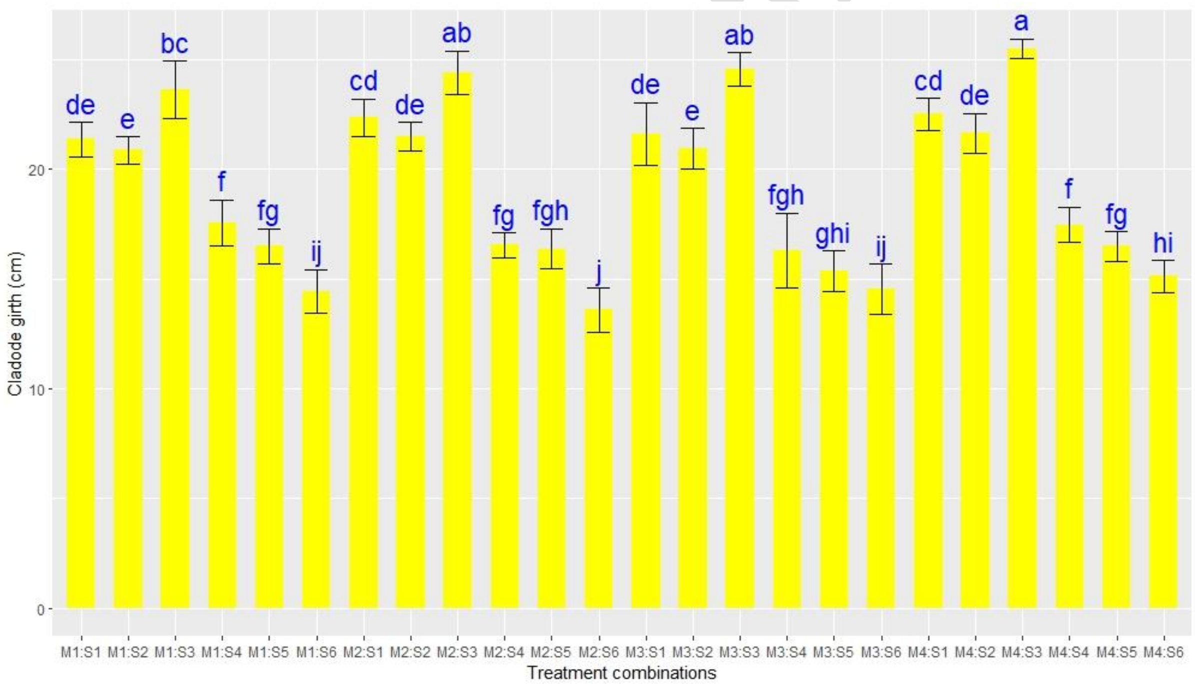


Fig 3 : Effect of treatment combinations on cladode length (cm)

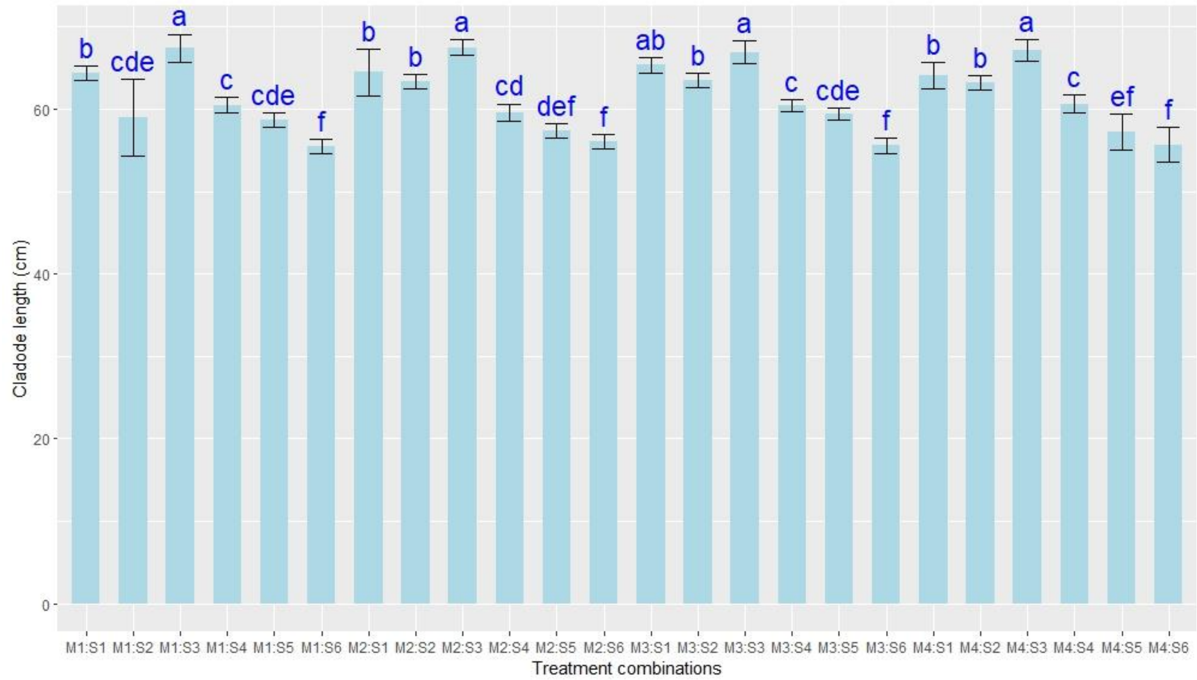
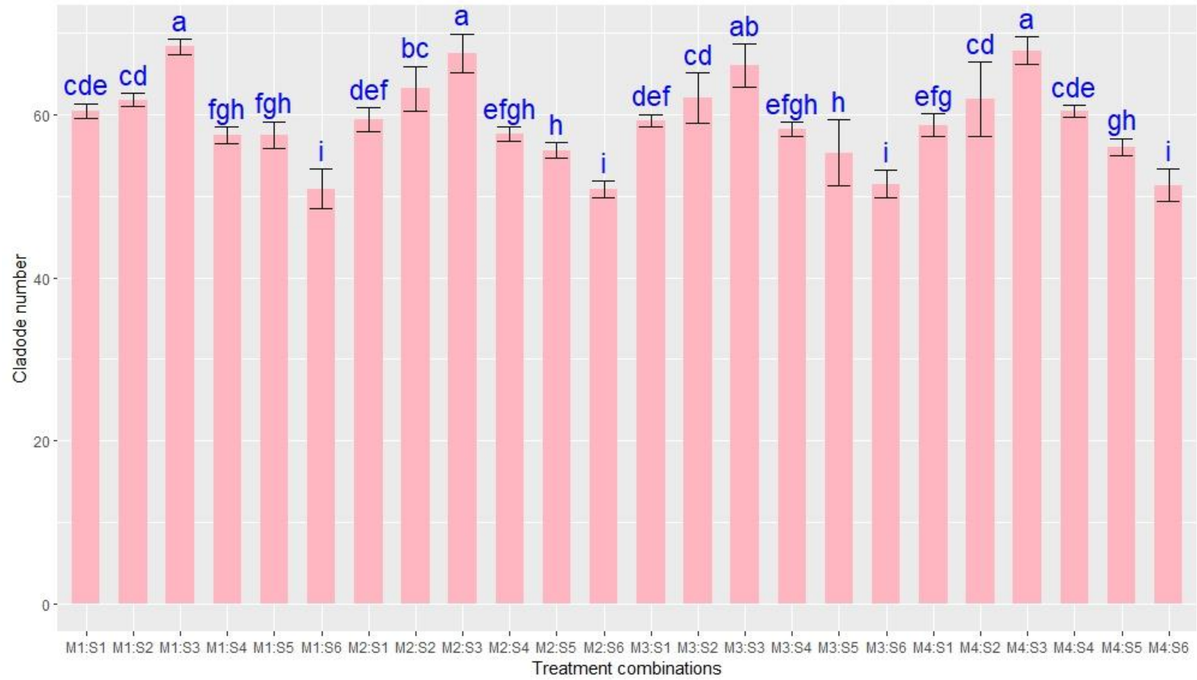


Fig 4 : Effect of treatment combinations on cladode number (units)



Conclusion

Dragon fruit is a shallow rooted fruit crop hence it requires judicious application of fertilizers and proper spacing for good vegetative growth. If there is good vegetative growth is responsible for getting good yield and quality fruits. The outcome from this experiment revealed that the adoption of spacing M_4 (2.5 x 2.5 m^2) and application of NPK dose S_3 (N_{450} P_{350} K_{300}) g/ pillar with 10 kg of FYM would be optimum for good vegetative growth of dragon fruit under Tamil Nadu condition.

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