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# Effect of Mulching on Growth of Dragon Fruit [*Hylocereus costaricencis* (Web.) Britton and Rose] in Sub Tropical Climate

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***Abstract***: The experiment on mulching practices for the better use of soil moisture for the growth of dragon fruit which is a hardy Cactaceae family was conducted at sub-tropical climate of Lucknow region. There were 8 treatments (mulching with sugarcane trash, paddy straw, wheat straw, dry leaves, saw dust, black polyethylene and transparent polyethylene). Mulching was done round the base of plants on 60 cm radius. The mulching with transparent polyethylene showed better growth in terms of plant length, number of segment, distance between areole, number of new branches as well as chlorophyll content. However, among the organic mulches saw dust, dry leaves and wheat straw beneficial for improving vegetative growth of dragon fruit.

***Keywords***: Dragon fruit, *Hylocereus costaricencis* (Web.), Organic mulching

In India, dragon (*Hylocereus spp.)* fruit was introduced during the late 1990s (Arivalgan et al., 2019). Between 2005 and 2024, the cultivation of dragon fruit saw a gradual expansion, with the cultivation area increasing from 4 to 4000 hectares. Although, India has not a significant mark in global export market, the ongoing expansion of dragon fruit cultivation in the country presents promising opportunities for the future. *Hylocereus costaricensis* Syn. *selenicereus costaricensis* has a purple red flesh having more phyto-nutrients and high market demand (Mori et al., 2023, Maji 2019). In India around 95% of market demand is fulfilled by importing in India and mostly are white fleshed.

Mulching is well-known and recommended practice for conserving soil and water as well as weed control (Pabin et al., 2003, Becher 2005, Prasad et al., 2017, Maji et al., 2021). Mulched crops approach also increases soil organic matter and microbial biomass in long term (Sun et al., 2021). It further improves nutrient retention and N-uptake efficiency. The other profits of mulching are favourable changes in microclimate within fields and reduction soil temperature variations (Sharratt 2002). The use of surface mulch can result in storing more precipitation water in soil by reducing runoff, increasing infiltration and decreasing evaporation (Ji and Unger 2001). Organic mulching like wheat straw mulching could increase soil C sequestration and microbial biomass (Wang et al., 2018). Comparative study on use of organic and inorganic mulching materials specially on dragon fruit is lacking. Thus, there is a scope to explore the present study to effective utilization of available resources like wheat straw, rice straw, saw dust, grass clippings, leaf debris, sugarcane trashes etc. which can also address the issue of stubble burning. It is not only cost-effective but also helps conserve water, soil temperature, reduce waste and improve soil health. Mulch around the base of dragon fruit plants can create a more favourable environment for dragon fruit growth.

## MATERIAL AND METHODS

The present investigation was carried out at Babasaheb Bhimrao Ambedkar University, Lucknow, Uttar Pradesh, India (26°55′N latitudes and 80°54′E, 123 m above MSL) situated under the subtropical climate of central Uttar Pradesh during 2023-24. Lucknow exhibits distinct seasonal variations, including hot, dry summers and cold winters. The soil of experimental site was sandy loam with uniform topography having slightly alkaline soil with pH 8.2. The experiment consisted of 8 treatments having mulching with sugarcane trash, paddy straw, wheat straw, dry leaves, saw dust, black polythene and transparent polythene in randomised block design with 3 replication having 96 plants (4 years old).

Sugarcane trash was obtained from the nearest sugarcane juice corner, underwent treatment with insecticide and was subsequently dried in the sun before being applied. Rice straw and wheat straw were acquired from a farmer field. Dry leaves were collected from the campus area. Additionally, black and transparent (white) polythene mulch, each with a thickness of 15 microns, was purchased from market. Mulches were applied at root zone around the pole each having 4 plants was completely covered by these mulching materials along 60 cm radius leaving sufficient space at the crown area for excess heat to dissipate into the environment.

Observations were recorded for its vegetative growth parameters like plant height (cm), stem circumference (cm), stem thickness (cm), number of segments per plant, number of primary branches, distance between areoles (cm), number of new primary branches per plant, dry weight of stem (g), moisture content (g), moisture percentage of the stem (%) and chlorophyll content (mg/100g) using standard methods of biochemical analysis (Thimmaiah 2009). The observed data were analyzed by OPSTAT software (Sheoran et al., 1998).

## RESULTS AND DISCUSSION

**Plant height:** The maximum plant height (12.99 cm) was in $T_8$ (transparent polythene) with 6.75% increase from 0 to 90 DAT followed by $T_3$ (paddy straw), $T_5$ (dry leaves) and $T_6$ (saw dust) with non-significant difference in $T_3$, $T_5$, $T_6$ and $T_7$. Deb et al. (2014) also reported that transparent polythene mulch comparable to black polythene mulch, indicating its effectiveness in promoting plant growth.

**Stem circumference:** The maximum increase (1.60 cm) in stem circumference was in $T_6$ (saw dust) followed by $T_2$ (sugarcane trash) while, minimum increase of 4.18% was recorded (0.63 cm) in $T_5$ mulching.

**Stem thickness:** $T_5$ caused maximum increase in stem thickness (0.96 cm, 22.59 %) followed by $T_2$ and $T_7$ (black plastic mulch) but were statistically at par. Minimum stem thickness (0.40cm) was in $T_8$. Sharma et al. (2023) rice husk was more effective in increasing stem diameter, even better than black plastic followed by straw and sawdust treatments in tomato.

**Number of stem segment per plant:** The highest increase (23.13%) in number of stem segment per plant from 0 to 90 DAT was in treatment $T_8$ which was significantly higher from $T_5$ (12.49%). Control ($T_1$) was at par with $T_2$ and $T_3$. Puri et al. (2022) concluded that plastic mulch gave best result in increasing number of leaves in okra. Besides plastic mulch, rice straw and rice husk mulch were effective.

**Distance between areoles:** Maximum increase (0.64 cm, 25.71 %) of distance between areole was in $T_8$ mulch followed $T_5$ and $T_3$ while, minimum increase (0.10 cm, 3.30 %.) was in $T_2$. Increase in areole distance was most probably due to effect of mulch as it also resulted in the increase of plant height.

**Number of primary branches:** The highest increase in number of primary branches (14.00) was in $T_8$ and was significantly different from minimum increase (4.67) in $T_1$. Rajbir et al. (2006) suggested that thick, matted surface covering capacity of polythene mulches helps to better water retention and nutrient availability to the plant leading to increased vegetative growth.

**Stem dry weight and moisture content:** The dry weight of the stem was significantly influenced by the application of mulches. The maximum stem dry weight (6.83 g) was in $T_4$. However, highest moisture content (45.50 g) was observed in $T_6$ followed by $T_7$ which was statistically *at par* with $T_1$. Kazemi and Jozay (2020) also reported that the fresh and dry weights of the plants under mulch treatments had significant difference might be due to less evaporation from soil. The water vapours that evaporate from the soil surface further trapped in the plastic and dropped again into the upper soil surface which increases soil moisture content in the root zone. Khan and Singh (2005) reported similar observation in tomato crop.

**Chlorophyll content:** Highest Chlorophyll-A was 10.51 mg/100g) in $T_8$ followed by $T_6$ (saw dust) and least was in $T_1$ (1.50 mg/100g. Similarly, Chlorophyll-B as well as total chlorophyll was also maximum (9.64 and 12.07 mg/100g, respectively) in $T_8$ followed by $T_6$ (8.64 and 10.63 mg/100g). Kazemi and Jozay (2020) reported that mulch type significantly affect chlorophyll levels in *Gaillardia* sp.

**Table 1.** Influence of mulching on plant height, stem circumference and stem thickness of dragon fruit

| Treatments | Plant height (cm) | | | | Stem circumference (cm) | | | | Stem thickness (cm) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | At 0 DAT | At 90 DAT | Total increase | Per cent increase | At 0 DAT | At 90 DAT | Total increase | Per cent increase | At 0 DAT | At 90 DAT | Total increase | Per cent increase |
| $T_1$ | 222.50 | 228.19 | 5.66 | 2.56 | 15.60 | 16.76 | 1.16 | 7.59 | 4.92 | 5.51 | 0.59 | 12.03 |
| $T_2$ | 268.22 | 274.25 | 6.02 | 2.24 | 15.66 | 17.05 | 1.39 | 8.93 | 4.58 | 5.43 | 0.84 | 18.78 |
| $T_3$ | 231.64 | 240.44 | 8.80 | 3.80 | 13.97 | 14.65 | 0.68 | 4.91 | 3.92 | 4.61 | 0.70 | 17.91 |
| $T_4$ | 237.74 | 243.40 | 5.69 | 2.39 | 13.38 | 14.56 | 1.19 | 8.92 | 4.07 | 4.55 | 0.47 | 11.60 |
| $T_5$ | 212.71 | 221.20 | 8.49 | 4.00 | 15.24 | 15.87 | 0.63 | 4.18 | 4.27 | 5.23 | 0.96 | 22.59 |
| $T_6$ | 228.60 | 236.63 | 8.04 | 3.52 | 16.93 | 18.53 | 1.60 | 9.44 | 5.30 | 5.88 | 0.58 | 10.95 |
| $T_7$ | 234.85 | 242.81 | 7.96 | 3.39 | 12.52 | 13.61 | 1.09 | 8.76 | 3.36 | 4.08 | 0.73 | 22.59 |
| $T_8$ | 193.04 | 206.03 | 12.99 | 6.75 | 12.36 | 13.70 | 1.34 | 10.88 | 3.80 | 4.20 | 0.40 | 10.52 |
| CD (p=0.5) | | | 1.55 | 0.86 | | | 0.39 | 3.33 | | | 0.16 | 6.92 |

$T_1$-Control (no mulch), $T_2$-Sugarcane trash, $T_3$-Paddy straw, $T_4$-Wheat straw, $T_5$-Dry leaves, $T_6$-Saw dust, $T_7$-Black polythene, $T_8$-White polythene

**Table 2.** Influence of mulching on change of number of segments, distance between areoles and number of primary branches of dragon fruit

| Treatments | Number of stem segment/plant | | | | Distance between areoles | | | | Number of primary branches | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | At 0 DAT | At 90 DAT | Total increase | Per cent increase | At 0 DAT | At 90 DAT | Total increase | Per cent increase | At 0 DAT | At 90 DAT | Total increase | Per cent increase |
| $T_1$ | 6.00 | 6.37 | 0.37 | 6.22 | 2.71 | 2.92 | 0.21 | 7.83 | 0.00 | 4.67 | 4.67 | |
| $T_2$ | 5.67 | 5.95 | 0.28 | 6.81 | 3.04 | 3.14 | 0.10 | 3.30 | 0.00 | 6.00 | 6.00 | |
| $T_3$ | 5.67 | 6.00 | 0.34 | 6.79 | 2.47 | 2.86 | 0.39 | 15.71 | 0.00 | 12.00 | 12.00 | |
| $T_4$ | 5.67 | 6.49 | 0.82 | 20.89 | 2.87 | 3.06 | 0.19 | 6.50 | 0.00 | 7.00 | 7.00 | |
| $T_5$ | 5.00 | 5.06 | 0.06 | 1.13 | 2.89 | 3.36 | 0.47 | 16.49 | 0.00 | 9.33 | 9.33 | |
| $T_6$ | 4.00 | 4.64 | 0.64 | 22.81 | 3.00 | 3.29 | 0.29 | 9.78 | 0.00 | 9.00 | 9.00 | |
| $T_7$ | 5.67 | 6.33 | 0.66 | 12.49 | 3.04 | 3.28 | 0.24 | 8.01 | 0.00 | 6.67 | 6.67 | |
| $T_8$ | 5.00 | 6.03 | 1.03 | 23.13 | 2.48 | 3.12 | 0.64 | 25.71 | 0.00 | 14.00 | 14.00 | |
| CD (p=0.05) | | | 0.20 | 0.03 | | | 0.05 | 2.96 | | | 3.34 | |

**Table 3.** Effect of different mulches on stem dry weight, moisture content and chlorophyll content

| Treatments | Dry weight of stem (g)* | Moisture content (g) | Moisture percentage (%) | Chlorophyll A | Chlorophyll B | Total chlorophyll |
|---|---|---|---|---|---|---|
| $T_1$ | 5.54 | 44.46 | 88.91 | 1.50 | 2.49 | 2.81 |
| $T_2$ | 6.04 | 43.46 | 87.91 | 4.99 | 5.03 | 5.47 |
| $T_3$ | 6.11 | 43.89 | 87.79 | 6.85 | 6.17 | 8.18 |
| $T_4$ | 6.83 | 43.17 | 86.33 | 5.98 | 6.94 | 9.18 |
| $T_5$ | 5.62 | 44.38 | 88.76 | 4.75 | 5.15 | 6.53 |
| $T_6$ | 4.50 | 45.50 | 91.00 | 10.06 | 8.64 | 10.63 |
| $T_7$ | 5.23 | 44.77 | 89.54 | 8.49 | 7.96 | 10.42 |
| $T_8$ | 6.06 | 43.94 | 87.88 | 10.51 | 9.64 | 12.07 |
| CD (p=0.05) | 1.05 | 1.05 | 2.10 | 0.40 | 0.56 | 0.20 |

* Dry weight was estimated on the basis of 50 g fresh weight

## CONCLUSION

Application of organic and inorganic mulches both are beneficial for dragon fruit cultivation. The transparent polythene mulch under inorganic category while dry leaves and saw dust under organic mulching category may be recommended for better growth of dragon fruit in Lucknow region having maximum vegetative growth in terms of stem length, stem thickness, higher plant branches, dry weight, moisture content and chlorophyll content.

## AUTHOR'S CONTRIBUTION

This is a part of the M.Sc. Thesis of first author Kanak Lata. She executed most part of the field experiment. Sutanu Maji planned this investigation. Manya Kumari, Tannu Kumari, Tanay Anand and Ashish Kumar Murmur are the coworkers who have assisted her in field as well as for laboratory works.

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