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Effect of severity of pruning on plant growth, flowering, fruit yield and quality of dragon fruit (*Hylocereus undatus*)

Priyanka G More and UA Raut

Abstract
A field experiment on "Effect of severity of pruning on plant growth, flowering, fruit yield and quality of dragon fruit" was conducted at an Experimental farm, Department of Fruit Science, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during the year 2021-22 with objectives to study the effect of different severity of pruning on vegetative growth, flowering, fruit yield and quality of dragon fruit under Akola condition. To find out the optimum severity of pruning for better vegetative growth, flowering, fruit yield and quality of dragon fruit under Akola condition. The experiment was laid out in Randomized Block Design (RBD) with five treatments which were replicated four times. The observations in respect of before pruning, after pruning and chemical evaluation, were recorded of dragon fruit. The results obtained during the course of the investigation are summarized in the following paragraphs. The result reveals that the level of pruning at canopy pruned 50% cladodes remove / pole at 90, 180 and 270 days of dragon fruit was found significantly superior for the number of new shoots formed/post (7.28), length of cladodes (34.7cm), the girth of main stem segment (4.92 cm), the average circumference of cladodes (18.12), plant canopy of mop top north to south (52.65 cm), plant canopy of mop top east to west (58.81 cm), total floral bub/post (14.40), the total number of fruit/post (12.96), yield/post (2.95 kg). Quality parameters recorded after harvesting of dragon fruits canopy pruned 40% cladodes removed from/pole was found significantly superior for fruit weight (229 g), pulp weight (146.56 g), skin weight (82.44 g), fruit length (25.60 cm), fruit breadth (26.00 cm), fruit volume (155cm^3), pulp recovery ratio (66.85%). Chemical parameters recorded during studies and observed that TSS (15.21^{0}Brix), reducing sugar (4.72%), non-reducing sugar (3.94%), total sugar (8.25%), ascorbic acid (2.4mg/100g) canopy pruned 20%, 40% cladodes remove from/pole was found significantly superior for successful pruning in dragon fruit.

Keywords: Dragon fruit, severity, cladodes, pruning, pole, quality

Introduction

Dragon fruit is also known as Pitaya (*Hylocereus undatus)* is a climbing fast growing perennial cactus species which is originated in Mexico, Central and South America and belongs to the family Cactaceae. It is one of the newly introduced exotic fruit crops in India during the 90s. Dragon fruit is a native American cactus of varied habitats, widely distributed in many nations and territories such as Mexico, Colombia, Costa Rica, Israel, Taiwan, Thailand, Philippines, Sri Lanka, Malaysia, China, etc. In Vietnam, dragon fruit is considered one of the most important tropical fruits. It is commonly called Pitaya, Strawberry pear, Night blooming cereus, Queen of night, Jesus in the cradle and Belle of the night. It has received worldwide recognition, as an ornamental plant and as a fruit crop (Mizrahi and Nerd,1997) [23]. Dragon fruit plant has night blooming, yellowish-green flowers that are about 1 foot long and 9 inches wide, bell-shaped, and very fragrant; they open during the early evening and wilt by daybreak, these flowers are nicknamed "Noble Woman" or "Queen of the night". Pitaya fruit has red or pink thornless skins, while its juicy flesh can range from white to magenta. The skin is covered with bracts or scales. The small seeds are consumed with the fruit. Usually, Pitaya fruit is propagated sexually by seed and asexually by grafting and stem cutting. The easiest, cheapest, and most convenient method of propagating dragon fruit is by stem cutting (Gunasen *et al*. 2006) [14]. This experiment was carried out to study the effect of severity of pruning as this crop possess a heavy branching structure so, it requires pruning at different significant level by cutting or removing the side shoots from the main stem and allowing the main stem to grow efficiently which become helpful to produce the new stems or cladodes at initial stage to attain a proper height to reach the level of the ring, flowering branches and to produce the fruits of better quality. Pruning improves not only the fruit quality but is also required at an early stage to build up a strong framework in order to increase the fruit-bearing area of the tree becomes weak and both fruit size and quality impaired. Thus, regular annual pruning at the bearing stage may help to induce good healthy shoots which will provide maximum fruit-bearing area and good quality fruits (Bajpai *et al*., 1973) [4]. Pruning is essential to develop a good crown and better yields over a long period of time. Without pruning, the plants become bushy, and their bearing efficiency comes down. Hence, the timely removal of misplaced limbs is necessary to build a strong framework. Selective and mild pruning of deadwood and very old branches is necessary to avoid congestion and encourage well-spaced branching. Yellowing of leaves starts as the harvesting season of fruits ends. The leaves begin to drop with the onset of winter and fresh growth occurs in spring. Therefore, considering the bottleneck in the cultivation of dragon fruit, it is very necessary to standardize the pruning levels and time of operation to develop for increasing the pollen viability, fruit set, yield and yield contributing characters and quality traits in dragon fruit under prevailing climatic conditions of Maharashtra.

Materials and Methods

The experiment was laid out in Randomized Block Design (RBD) with five treatments T_1 (canopy pruned (20% cladodes remove from cladodes/pole), T_2 (canopy pruned 30% cladodes remove from cladodes/pole), T_3 (canopy pruned 40% cladodes remove from cladodes/pole), T_4 (canopy pruned 50% cladodes remove from cladodes/pole), T_5 control (unpruned) which replicated four times. Five treatments of canopy pruning were tested on three-year-old white flesh dragon fruit plants as mentioned below. For each treatment, the canopy was pruned after harvesting (main season). The priority was to remove old (unproductive) and cladodes particularly. The number of cladodes before and after pruning was counted for all treatments. The data was collected from various observations, while the investigation was statistically analysed by Randomized Block Design (RBD) as suggested by Panse and Sukhatme (1967) [26].

Results and Discussion

The result obtained from the present investigation as well as relevant discussion have been summarized under the following subheadings given in Table 1, 2 (a), (b), 3 (a), (b).

Initial growth observations before pruning

From the data presented in Table 1, it is revealed that initially the height of the main stem segment was measured and recorded in treatment T_1 canopy pruned (20% cladodes remove from cladodes/pole) is 134.45 cm, T_2 canopy pruned (30% cladodes remove from cladodes/pole)137.82 cm, T_3 canopy pruned (40% cladodes remove from cladodes/pole) 141.34 cm, T_4 canopy pruned (50% cladodes remove from cladodes/pole) 145.35 cm, T_5 control (unpruned) 130.45 cm respectively.

Table 1: Initial growth observations before pruning

Treatment	Height of main stem segment (cm)	Number of cladodes remain before pruning (cladodes/pole)	Number of cladodes remain after pruning (cladodes/pole)
T_1: Canopy pruned (20% cladodes remove from cladodes/pole)	134.45	120	24
T_2: Canopy pruned (30% cladodes remove from cladodes/pole)	137.82	130	39
T_3: Canopy pruned (40% cladodes remove from cladodes/pole)	141.35	100	40
T_4: Canopy pruned (50% cladodes remove from cladodes/pole)	145.29	92	46
T_5: Control (unpruned)	130.45	135	135

Pruning was done after completion of the harvesting in the second fortnight of November, the cladodes were removed from the main stem, and the older stems were selectively removed from the underneath (cut branches back to the node) which were lying on the ground or spreading in between the cultural operational space, the tertiary and quarterly branches were cut back to the original stem, the primary branches were allowed on the pillar having at least 1-2 sub-branches and immediately after pruning cut ends of stems were sprayed with copper fungicide. Newly developing cladodes could be competitive sinks for resource allocation during the growth stage of the fruits in cactus pear (Inglese *et al*.1994) [15]. The cut portions of cladode were removed from the field to avoid contamination. Gunasena *et al.* (2006) [14] reported a well-grown plant can produce 130 branches or more in the fourth year and therefore pruning is necessary to avoid interference with cultural operations and harvesting.

The number of cladodes remaining after pruning in treatment T_4 canopy pruned (50% cladodes remove from cladodes/pole) is (46), (20% cladodes removed from cladodes/pole (24) and maximum cladodes are present as it is in treatment T_5 control (unpruned) i.e. (135) cladodes. The results of the present findings are in agreement with the findings of Nguyen Thanh Hieu *et al.* (2011) [25]. Forty numbers of poles were randomly selected and tagged for each treatment per replication for the record of observations on different growth parameters.

Observation recorded after pruning

Data related to the effect of the severity of pruning on a number of new shoots formed/posted are presented in Table 2 (a). The number of new shoots formed/post after 270 days after pruning (DAP) was recorded maximum in treatment T_4 (7.28) i.e., canopy pruned (50% cladodes remove from cladodes/pole) which was found at par with treatment T_5 (6.4) i.e., control (unpruned) and treatment T_3 (6.3) while the minimum number of new shoots formed/post was observed in treatment T_1 (4.2) i.e. canopy pruned (20% cladodes remove from cladodes/pole). This might be due to the shoot emergence being found earliest in severely pruned plants followed by lightly pruned and late in unpruned plants. The pruned plants started new vegetative growth earlier after pruning with stored carbohydrates that provided a sufficient boost for growth as there was less sink as compared to the unpruned pillars where there were lots of growing points with a limited amount of stored carbohydrate. (Alam and Hasan, 2022) [2].

The data pertaining to effect of severity of pruning on length of cladodes (cm) was presented in Table 2 (a). After 270 days of pruning the length of cladodes was recorded maximum in treatment T_3 (34.7 cm) i.e. canopy pruned (40% cladodes remove from cladodes/pole) which was found at par with T_4 (33.7 cm) i.e. canopy pruned (50% cladodes remove from cladodes/pole), T_2 (33.55 cm) and T_1 (31.96 cm) while minimum length of cladodes was recorded in treatment T_5 (30.29 cm) i.e. control (unpruned). Because of the huge numbers of growing points (cladodes) in control, there was more competition for nutrients among the existing cladodes which might have resulted in the lowest average growth in cladode length. Inglese *et al.* (1994) [15] conducted similar experiment in cactus pear (*Opuntia ficus indica* (L.) Miller) and found that, the primary and secondary one-year old terminal cladodes accounted for most of the yield while thicker and older cladodes were less fruitful. The data related to the effect of severity of pruning on girth of main stem segment (cm) is presented in Table 2 (a). The girth of main stem segment after 270 days after pruning (DAP) was recorded maximum in treatment T_4 (4.92 cm) i.e., canopy pruned (50% cladodes remove from cladodes/pole) which was found to be at par with treatment T_3 (4.87 cm) i.e. canopy pruned (40% cladodes remove from cladodes/pole) and followed by T_1 (4.64 cm), T_2 (4.56 cm) while minimum girth of main stem segment was recorded in treatment T_5 (4.45 cm) i.e. control (unpruned). These results are in line with that of (Bisla *et al.*1990) [7] who reported that the girth of new shoots is more in the case of pruned trees as compared to unpruned trees in ber. It might be because light-pruned trees stored more reserved food compared to severely pruned trees which provide more vegetative growth. In severely pruned trees, a part of the energy is always lost for healing wounds and bearing the pruning setback. Awasthy and Shakila (2017) [3] also recorded that, the maximum girth of shoots/ cladodes on light and medium-pruned trees as compared to unpruned trees in guava. The average circumference of cladodes after 270 days after pruning (DAP) is presented in Table 2 (a). The data regarding the average circumference of cladodes was recorded maximum in treatment T_4 (18.12 cm) i.e., canopy pruned (50% cladodes remove from cladodes/pole) which was statistically at par with treatment T_3 (17.10 cm) i.e. canopy pruned (40% cladodes remove from cladodes/pole) and treatment T_2 (16.20 cm) while the minimum average circumference of cladodes was recorded in treatment T_1 (14.23 cm) i.e. canopy pruned (20% cladodes remove from cladodes/pole. This may be due to the shift of metabolites from flowering sites to new vegetative growth sites influencing the increase in the cladode/ stem circumference of the plant. A similar kind of observation was also reported by Meena *et al.* (2016) [21] in relation to the pruning experiment on guava.

Table 2a: Observations recorded after pruning

Treatment	Number of new shoots formed/post			Length of cladodes (cm)			Girth of main stem segment (cm)			Average circumference of cladodes (cm)		
	90 Days	180 Days	270 Days	90 Days	180 Days	270 Days	90 Days	180 Days	270 Days	90 Days	180 Days	270 Days
T_1: Canopy pruned (20% cladodes remove from cladodes/pole)	2.43	3.4	4.2	14.28	23.66	31.96	3.46	4.22	4.64	12.52	13.2	14.23
T_2: Canopy pruned (30% cladodes remove from cladodes/pole)	3.56	3.9	5.1	16.37	25.27	33.55	3.49	4.21	4.56	14.75	15.35	16.2
T_3: Canopy pruned (40% cladodes remove from cladodes/pole)	4.82	5.8	6.3	17.11	26.81	34.7	3.56	4.3	4.87	15.75	16.12	17.1
T_4: Canopy pruned (50% cladodes remove from cladodes/pole)	5.84	6.2	7.28	16.03	25.34	33.7	3.87	4.52	4.92	16.05	17.2	18.12
T_5: Control (unpruned)	4.2	5.52	6.4	18.24	27.65	30.29	3.75	4.35	4.45	13.34	14.2	15.11
'F' test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
Mean	4.17	4.97	5.85	16.38	25.72	32.94	3.61	4.31	4.66	14.32	15.20	16.26
SE(m) ±	0.017	0.021	0.0247	0.371	0.138	0.213	0.021	0.027	0.013	0.454	0.180	0.225
CD @ 5%	0.053	0.066	0.0764	1.140	0.425	0.841	0.067	0.085	0.041	1.399	0.557	0.694

From the data presented in Table 2 (b), it is revealed that plant canopy north to south was considerably influenced by different severity of pruning levels at different intervals i.e., at 180, and 270 days after pruning. In respect of the plant canopy of the mop-top north to south at 270 days after pruning (DAP), the maximum plant canopy of the mop-top north to south was observed (52.60 cm) by the treatment T_4 i. e. canopy pruned (50% cladodes remove from cladodes/pole), which was found at par with treatment T_3 (47.84 cm), i.e. canopy pruned (40% cladodes remove from cladodes/pole) while minimum plant canopy of mop top north to south was observed in treatment T_1 (41.50 cm) i.e. canopy pruned (20% cladodes remove from cladodes/pole respectively. This might be due to more vigorous growth in primary and secondary branch pruned plants might be due to a lower number of growing points as compared to unpruned trees (Sahoo *et al.* 2017) [30].

The data pertaining to the plant canopy of the mop-top East to West (cm) is presented in Table 2 (b) After 270 days plant canopy of the mop-top east to west was found significantly highest in treatment the maximum (58.81 cm) T_4 i. e. canopy pruned (50% cladodes remove from cladodes/pole) which was found to be at par with treatment T_3 (48.52 cm), i.e. canopy pruned (40% cladodes remove from cladodes/pole) while minimum plant canopy of mop top east to west was recorded in treatment T_5 (38.01 cm) i.e. control (unpruned). This might be due to huge numbers of growing points in unpruned trees, there is more competition for nutrients among existing shoots, which resulted in the lowest average growth in shoot length. Lal and Mishra (2009) [19] reported a similar pattern of tree spread in the mango tree.

Dragon fruit floral bubs are unopened flowers surrounded by layers of fleshy sepals growing along vining cactus stems. When plants reach the post top, they each produce multiple cladodes. From the data presented in Table 2 (b), it is revealed that the total floral bub/post was considerably influenced by various severity of pruning levels at intervals i.e., at 270 days after pruning. The total floral bub/post at 270 days after pruning was recorded as maximum (14.40) by treatment T_4 i.e. canopy pruned (50% cladodes remove from cladodes/pole) which was found at par with treatment T_3 (14.34) i.e. canopy pruned (40% cladodes remove from cladodes/pole and followed by treatment T_1 (12.57) and T_2 (13.20) while minimum total floral bub/post was observed in treatment T_5 (11.45) i.e. control (unpruned). It might be due to plants remaining physiologically more active to build up sufficient food stock for the developing flowers and fruit production, ultimately resulting in a flower set. The above results were in agreement with those of Chaudhari *et al. (*2016) [9] on custard apples.

From the data presented in Table 2 (b), it is revealed that the total number of fruit /posts was considerably influenced by various severity of pruning levels at intervals i.e., at 270 days after pruning. The total number of fruit/post at 270 days after pruning was recorded as maximum (12.96) by treatment T_4 i.e. canopy pruned (50% cladodes remove from cladodes/pole), which was followed by treatment T_3 (12.90) i.e. canopy pruned (40% cladodes remove from cladodes/pole and T_2 canopy pruned (30% cladodes remove from cladodes/post) while minimum total fruit/post was observed in treatment T_5 (10.30) i.e. control (unpruned). Pruning restores the balance between the vegetative and reproductive growth of the plant. Thereby decreases in competition among the flower for nutrients and plant hormones and increases the auxin content in the flowering shoot of the first and second-order pruned tree may be the probable reason for the total number of fruit/posts. This finding is well supported by Salem *et al*. (2008) [31] in the mandarin tree and Shaban A.E.A. (2009) [32] in the guava plant.

Table 2b: Observations recorded after pruning

Treatment	Plant canopy of mop top North to South (cm)		Plant canopy of mop top East to West (cm)		Total floral bub/post	Total no. of fruit /post	Average yield /post
	180 Days	270 Days	180 Days	270 Days	270 Days	270 Days	270 Days
T_1: Canopy pruned (20% cladodes remove from cladodes/pole)	37.81	41.5	35.31	38.08	12.57	12.3	1.964
T_2: Canopy pruned (30% cladodes remove from cladodes/pole)	40.97	43.56	36.45	39.73	13.2	14.12	2.115
T_3: Canopy pruned (40% cladodes remove from cladodes/pole)	42.59	47.84	37.19	48	14.34	14.28	2.954
T_4: Canopy pruned (40% cladodes remove from cladodes/pole)	44.94	52.6	39.56	58.81	14.4	15.2	2.488
T_5: Control (unpruned)	41.59	42.2	36.1	38.01	11.45	11.15	1.563
'F' test	Sig	Sig	Sig	Sig	Sig	Sig	Sig
Mean	40.45	44.98	36.69	44.34	13.18	13.32	2.216
SE(m) ±	0.822	0.443	0.733	0.322	0.019	0.396	0.0060
CD @ 5%	2.533	1.366	2.261	0.992	0.061	1.222	0.0186

From the data presented in Table 2 (b), it is revealed that the average yield /post (kg) was considerably influenced by various severity of pruning levels at intervals i.e.at 270 days after pruning. The average yield/post (kg) at 270 days after pruning was recorded as maximum (2.954 kg) by treatment T_4 i.e. canopy pruned (50% cladodes remove from cladodes/pole) which was followed by treatment T_3 (2.488 kg) and T_2 (2.115 kg) while the minimum average yield /post was observed in treatment T_5 (1.5263 kg) i.e. control (unpruned). This might be due to pruning is forced trees into investing more of their energy into the manufacture of fructose instead of cellulose. Pruning increases the ability to take water, carbon dioxide and sunlight to make carbohydrates or sugars which ultimately encourage the tree to produce a higher yield. These findings are following the results obtained by Masalkar and Joshi (2009) [20] in pomegranates, Sheikh and Rao (2002) [34] in pomegranates, Ghum (2011) [12] in custard apples and Sharma (2014) [33] in apples.

Dragon fruit quality parameters

(a) Physical parameters (after harvest)

Pruning significantly influences fruit size and weight. Fruit weight was increased with an increase in the level of pruning intensity. (Prakash *et al*. 2012) [27] opined that fruit size has a direct correlation with the number of fruits borne on the trees. Owing to the high leaf-to-fruit ratio and availability of more photosynthates due to the removal of current season growth, the fruits gained larger size and weight compared to those from unpruned trees. The highest fruit weight (229.00 g) was observed in treatment T_4 followed by T_3 (192.00 g) which was presented in Table 3 (a). As the pruning intensity increases the number of fruits per plant increases. So developing fruit gets ample nutrient and plant hormone that increases fruit size. This may be the reason for the highest fruit weight observed in T_4 followed by treatments T_1 (173.34 g), T_2 (178.11 g), and T_3 (192.00 g) However the minimum fruit weight was recorded (151.83 g) in treatment T_5 control (unpruned).

The present data revealed that average pulp weight was significantly affected due to various treatments presented in Table 3 (a). It is evident that treatment T_4 (canopy pruned 50% cladodes remove from cladodes/pole) average pulp weight (146.56 g) which was followed by treatments T_3 (122.88 g), T_2 (115.49 g) and T_1 (11.25 g). However minimum pulp weight was found in treatment T_5 (97.13 g) respectively. The increase in pulp weight may be due to stimulating cell division and increased volume in newly developed cells (Metraux, 1988) [22] or maybe enhance uptake of water and accumulation of sugar and other food reserves in a greater amount as well as increased volume of intracellular spaces in the pulp of the fruit. Moreover, higher pulp content may be due to higher accumulation and translocation of the extra metabolite from other parts of the tree towards developing fruits (Barkule *et al*. 2018) [5].

The present data in table 3 (a) it is revealed that average skin weight was significantly maximum treatment T_4 (canopy pruned 50% cladodes remove from cladodes/pole (82.44 g) followed by T_3 (canopy pruned 40% cladodes remove from cladodes/pole) having skin weight (69.12 g) T_2 canopy pruned (64.11 g) and T_1 (62.5 g) while minimum skin weight was recorded in treatment T_5 (54.65 g). This may be attributed to the reduction in crop load on the severely pruned tree which resulted in the diversion of more translocate to the remaining fruits thereby increasing physical fruit attributes like skin weight (Ghatul *et al*. 2019) [11].

The data presented in Table 3 (a) significant maximum fruit length recorded in treatment T_4 (25.6 cm) followed by treatments T_1 (21.5 cm), T_2 (22.8 cm) and T_3 (24.0 cm) while the minimum length of fruit (20.7cm) was observed in T_5 control (unpruned). The results of the present findings are in agreement with the findings of Jadhav *et al*. (2002) [16] in guava, Mohamed *et al*. (2010) [24] in custard apple, and Shiva *et al*. (2015) [35] in guava.

The data presented in Table 3 (a) indicated that the effects of severity of pruning on fruit breadth were found significant in the maximum fruit breadth recorded in treatment T_3 (26.00 cm) which was found at par with treatment T_2 (24.9 cm) and T_4 (22.52 cm) while minimum fruit breadth was recorded in treatment (20.7 cm) T_5 control (unpruned). This might be due to more nutrient supply (food) to a lesser number of fruits in case of severe pruning. Lesser number of fruit reduces the competition for resources between fruit allowing individual fruit to has a greater share of resources which allows the size of the cell and cell elongation, resulting in maximum accumulation of the food materials in the developing fruits, therefore improving the fruit size in litchi.

Table 3a: Physical parameters (after harvest)

Treatments	Fruit weight (g)	Pulp weight (g)	skin weight (g)	Fruit length (cm)	Fruit breadth (cm)	Fruit volume (cm^3)	Pulp recovery ratio (%)
T_1: Canopy pruned (20% cladodes remove from cladodes/pole)	173.34	111.25	62.5	21.5	22.9	145	64.54
T_2: Canopy pruned (30% cladodes remove from cladodes/pole)	178.11	115.49	64.11	22.8	24.9	130	64.94
T_3: Canopy pruned (40% cladodes remove from cladodes/pole)	192.00	122.88	69.12	24	26	155	60.25
T_4: Canopy pruned (50% cladodes remove from cladodes/pole)	229.00	146.56	82.44	25.6	21.52	150	66.85
T_5: Control (unpruned)	151.83	97.17	54.65	20.7	20.7	135.5	66.06
'F' test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
Mean	184.85	118.67	66.56	23.26	23.38	141.6	64.63
SE(m) ±	5.104	0.6813	0.385	0.303	0.279	1.460	0.392
CD @ 5%	15.72	2.099	1.186	0.934	0.860	4.500	1.210

The size of mango fruit was improved with the severity of pruning treatments under high-density planting (Pratap *et al*. 2009) [28]. The results of the present findings are in agreement with the findings of Mohamed *et al*. (2010) [24] in custard apples.

From the data depicted in Table 3 (a), it is observed that the volume of fruit was significantly influenced by the severity of pruning. The maximum fruit volume (155.00 cm^3) was observed in treatment T_3 (canopy pruned 40% cladodes remove from cladodes/pole) which was found at par with treatment (150.00 cm^3) T_4 (canopy pruned 50% cladodes remove from cladodes/pole) and followed by treatment T_1(145.00 cm^3) and T_5 (135.00 cm^3). However, the minimum volume of fruit (130.00 cm^3) was recorded by treatment T_2 (canopy pruned 30% cladodes remove from cladodes/pole). The increase in the volume of fruit might be attributed to the better source-sink relationship and lesser competition for assimilates among fruits in the pruned tree. These results follow that of Gill and Bal (2006) [13].

The data regarding the pulp recovery ratio is recorded in Table 3 (a) indicating that, the pulp recovery ratio was significantly increased by different pruning treatments. The maximum pulp recovery (66.85%) was observed in treatment T_4 canopy pruned 50% cladodes remove from cladodes/pole at par with treatments, T_1 canopy pruned 20% cladodes remove from cladodes/pole (64.54%), T_5 (control- unpruned) (66.06%), T_2 canopy pruned 30% cladodes remove from cladodes/pole (64.94%) while minimum pulp recovery was recorded (60.25%) in treatment T_3 canopy pruned 40% cladodes remove cladodes/pole. The slight variations in the values obtained may be attributed to differences in peel/skin morphology and variations in the atmospheric storage conditions. As the fruit ripens, the increase in sugar content of the pulp results in a change in osmotic pressure which causes the movement of moisture from the skin into the pulp. The peel loses more moisture also by transpiration. The percentage of the pulp with the total weight of the fruit at each ripe stage increases with ripening time. The increase in the pulp weight and pulp-to-peel/skin ratio and the decrease in peel weight over the ripening periods. The results are similar to the findings of Saeed *et al*. (2006) [29] in kinnow fruit.

(b) Chemical parameters

Pruning enhanced the fruit quality measured in terms of increased total soluble solids (^{0}Brix) presented in table 3 (b). The data revealed that the total soluble solids content was significantly increased by different pruning treatments. The maximum TSS observed in treatment T_4 canopy pruned 50% cladodes remove from cladodes/pole (15.21 ^{0}Brix) and at par with T_1 canopy pruned 20% cladodes remove from cladodes/pole (14.52 ^{0}Brix), T_2 canopy pruned 30% cladodes remove from cladodes/pole (14.42 ^{0}Brix), T_3 canopy pruned 40% cladodes remove from cladodes/pole (14.67 ^{0}Brix) whereas lowest TSS (13.05 ^{0}Brix) was recorded in treatment T_5 control (unpruned). The increased rate of photosynthesis due to more penetration of sunlight into the interior tree canopy increased the TSS content in the fruit harvested from pruned trees. Bhagawati R. *et al*. (2015) [8] observed the highest TSS (10 ^{0}B) in severely pruned guava plants as compared to moderate and light pruning in guava under the mid-hill condition of the Eastern Himalayas. The results are similar to the findings of Sheikh and Rao (2002) [34] in guava, and Dahapute *et al*. (2018) [10] in custard apple.

Table 3b: Chemical parameters

Treatments	TSS (^{0}Brix)	Reducing sugars (%)	Non-reducing sugars (%)	Total sugars (%)	Ascorbic acid (mg/100g)
T_1: Canopy pruned (20% cladodes remove from cladodes/pole)	14.52	4.65	3.51	8.16	2.4
T_2: Canopy pruned (30% cladodes remove from cladodes/pole)	14.42	4.69	3.52	8.21	2.35
T_3: Canopy pruned (40% cladodes remove from cladodes/pole)	14.67	4.72	3.46	8.18	2.1
T_4: Canopy pruned (50% cladodes remove from cladodes/pole)	15.21	4.65	3.5	8.25	1.85
T_5: Control (unpruned)	13.05	4.21	3.94	8.15	1.75
'F' test	Sig.	Sig.	Sig.	Sig.	Sig.
Mean	14.06	4.618	3.584	8.196	2
SE(m) ±	0.343	0.050	0.069	0.016	0.147
CD @ 5%	1.057	0.155	0.215	0.051	0.454

The data regarding the reducing sugars were significantly increased by different pruning treatments presented in Table 3 (b). The maximum reducing sugars (4.72%) were observed in treatment T_3 (canopy pruned 40% cladodes remove from cladodes/pole) at par with treatments, T_1 (4.62%) canopy pruned 20% cladodes remove from cladodes/pole, T_2 (4.69%) canopy pruned 30% cladodes remove from cladodes/pole, T_4 (4.65%) canopy pruned 50% cladodes remove from cladodes/pole while minimum reducing sugars (4.21%) were recorded in treatment T_5 control (unpruned). This might be due to increasing nutrient uptake by the trees and consequently more synthesis of carbohydrates and other metabolites and their translocation to the fruits. These results conform with the findings of Sheikh and Rao (2002) [34] in pomegranates and Kadam *et al*. (2018) [17] in custard apples.

The non-reducing sugar content is indirectly related to the amount of reducing sugars. The increase in reduced sugar leads to a decrease in the non-reducing sugar level in fruit. The data pursued is recorded in Table 3 (b). It is indicated that the non-reducing sugar of dragon fruit was maximum (3.94%) noticed in treatment T_5 control (unpruned) which was followed by treatment T_1 (3.51%) canopy pruned (20% cladodes remove from cladodes/pole), T_2 (3.52%) canopy pruned (30% cladodes remove from cladodes/pole), T_4 (3.50%) canopy pruned (40% cladodes remove from cladodes/pole). However, the minimum non-reducing sugars (3.46%) were recorded under treatment T_3 canopy pruned (40% cladodes remove from cladodes/pole). The reason for the increase in the content of non-reducing sugars might also be due to the delayed ripening of fruit and provided a long period of fruits remaining on the tree, during which they accumulated more carbohydrates within them. These results conform with the findings of Bisen *et al*. (2014) [6] in guava.

The total sugar was significantly increased by different pruning treatments are presented in Table 3 (b). The maximum total sugars (8.25%) were observed in treatment T_4 canopy pruned (50% cladodes remove from cladodes/pole) which was found at par with treatment T_2 (8.21%) followed by treatments T_1 (8.16%) and T_3 (8.18%) while minimum total sugar content was found in treatment T_5 (8.15%). This might be due to increasing nutrient uptake by the trees and consequently more synthesis of carbohydrates and other metabolites and their translocation to the fruits. These results conform with the findings of Kadam *et al*. (2018) [17] on custard apples.

The data revealed that there was a significant increase in the ascorbic acid content of fruits with the enhanced severity of pruning treatments have been presented in Table 3 (b). The maximum ascorbic content (2.40 mg/100g) was observed in treatment T_1 canopy pruned 20% cladodes remove from cladodes/pole) which was followed by treatments, T_2 canopy pruned 20% cladodes remove from cladodes/pole (2.35 mg/100g), T_3 canopy pruned 40% cladodes remove from cladodes/pole (2.10 mg/100g), T_4 canopy pruned (50% cladodes remove from cladodes/pole (1.85 mg/100 g). The minimum ascorbic acid was recorded (1.75 mg/100 g) in treatment T_5 control (unpruned). The decrease in ascorbic acid may be attributed to its destruction due to oxidation or heat. The enzyme ascorbic acid oxidase found in fruits easily oxidises it to dehydro-I-ascorbic acid (Abdul rahman *et al*. 2016) [1]. The ascorbic acid content in ripe fruits decreased as the number of days required to reach the ripe stage increased with decreasing storage temperature (Vishnu Prasanna *et al*. 2000) [36]. The results are similar to the findings of Lal and Das (2017) [18] in guava.

Conclusion

From the findings of an experiment conducted to study the "Effect of severity of pruning on plant growth, flowering, fruit yield and quality of dragon fruit (*Hylocereus undatus*)" it will be concluded that, among the five severity of pruning levels evaluated under Akola condition the following conclusion will be drawn: Based on findings reported in the present investigation the effect of severity of pruning on plant growth, flowering, fruit yield and quality of dragon fruit (*Hylocereus undatus*) significant results were recorded as per treatments. In respect of different severity of pruning levels, better performance of severity of pruning was observed in treatment T_4 canopy pruned 50% cladodes remove from cladodes/pole for all growth parameters *viz*., number of new shoots formed/post, length of cladodes (cm), a girth of main stem segment (cm), the average circumference of cladodes (cm), plant canopy of mop top (North-South), plant canopy of mop top (East-West). The effect of severity of pruning was successfully observed under Akola conditions with 50% severity of pruning in suitable flowering parameters like total floral bub/post and the total number of fruit/post and average fruit yield/post (kg) in dragon fruit. Based on quality attributes, canopy pruned with 40% and 50% was found significantly superior in regards to physical parameters like fruit weight (g), pulp weight (g), skin weight (g), fruit length (cm), fruit breadth (cm), fruit volume (cm^3), pulp recovery ratio (%) while chemical parameters like TSS (^{0}B), reducing sugars (%), non-reducing sugars (%), total sugars (%) and ascorbic acid (mg/100g).

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