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*Original Article*

# Effect of Branch Pruning on the Flowering, Fruiting and Insect-Pest Infestation of Dragon Fruit Varieties (*Hylocereus* sp.)

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**A B S T R A C T**

Dragon fruit (*Hylocereus* sp.) is one of the most popular and nutritious fruits of Cactaceae family. Present research was done at the Germplasm Centre of Bangladesh Agricultural University, Mymensingh to assess the performance of branch pruning on flowering, fruiting, fruit quality assessment and the intensity of insect-pest infestation of *Hylocereus* sp. plant. A two-factor investigation was carried out in randomized complete block design (RCBD) consisting of two varieties viz., BAU Dragon-1 (White flesh) and BAU Dragon-2 (Red flesh) with two conditions viz. under branch pruning and without pruning maintaining five replications. Results of this experiment showed that branch pruning significantly improved the number of flowering/plant, fruit number/plant, individual fruit weight, higher the flesh weight, improved fruit quality in size and flesh and lowered insect-pest infestation compared to un-pruned condition. In case of pruned BAU Dragon-1 variety, the highest number of flowering per plant was 22.33, fruiting number 26.33, individual fruit fresh weight 0.442-0.685 Kg, insect-infestation per plant was 0-0.67 whereas in BAU Dragon-2 variety, the highest number of flowering per plant was 28.33, fruiting number 12.67, individual fruit fresh mass 0.345-0. 605 Kg, insect-infestation per plant was 0-2. This study showed that branch pruning might be one of the best intercultural operations to increase the yield, fruit excellency and quantity and to lower the insect-pest infestation of dragon fruit. Further study is suggested to understand how pruning will develop the quality of dragon fruit and how long the beneficial properties of pruning may exist.



## Introduction

Dragon fruit (*Hylocereus* sp.) is considered as one of the most nutritious fruits of Cactaceae family with its light red skin stubbed with green scales and white, pink in addition to red flesh with tiny black seeds (Patwary *et al.*, 2013). Dragon plant was known as ornamental plant and later as a fruit plant that is a vine of terrestrial cactus (Pet'ko and Skorokhod, 2019). The flower of this plant is beautiful considered as Nobel women which is Queen of the night or the Moonflower (Hossain, 2020). Due to its nutritional values, Dragon fruit is grouped as a vital profitable plant species globally (Rifat *et al.*, 2019). It is now commercially cultivated in many tropical and subtropical countries such as Australia, Bangladesh, Bermuda, China, Colombia, Indonesia, India, Israel, Japan, Myanmar, Malaysia, Mexico, Nicaragua, Philippines, Sri Lanka, Taiwan, Thailand, Vietnam, the West Indies etc. (Mercado-Silva, 2018). Dragon fruit is considered as a medicinal plant, used in herbal medicine which is increased food digestion and has the ability to control health problems such as obesity, cancer, diabetes, high cholesterol as well as high blood pressure (Sofowora *et al.*, 2013). The pulp and the peels of fruits having high water contents, rich in fibres and contain several nutrient components such as high amount of vitamins, minerals, and antioxidants (Juliastuti *et al.*, 2020; Suastuti *et al.*, 2018; Perween *et al.*, 2018; Ismail *et al.*, 2017; Rodriguez *et al.*, 2016).

This fruit can be grown efficiently in Mediterranean regions due to lesser requirement of water and higher adaptation to high temperatures (Trivellini *et al.*, 2020). Although dragon

fruit is a vine crop, its flowering, fruiting, individual weight of fruit and infestation of insect pest can be enhanced by cultivar, season, climatic condition, several cultural practices, irrigations, transport, handling and storage conditions (Janick and Paull, 2008). Previous scientific studies revealed the impact of intercultural operations in improving morphological and physiological growth in many fruiting plants (Anolisa *et al.,* 2020; Ranjan *et al.,* 2017; Singh *et al.,* 2010). Among the intercultural practices-fertilization, watering, branch pruning, bagging etc. are well known as effective approaches in enlarging flowering, fruiting and reducing stress impacts (Hossain, 2020; Zamora-Re *et al.,* 2020; Wiedenfeld, 1995). Dragon fruit is attracted by insect-pest like ants, beetles and fruit flies (Hossain et al., 2021). These insect-pests can drastically hinder the yield of this fruit. Due to numerous fungi, insect-pest attack, excess flowering and fruit bearing, fruit size along with best quality (skin color) is not possible to get suitably thus lowered the quality of fruits unable to attract consumers thus not usually sold in the market (Hossain *et al.,* 2021).

Branch pruning is one of the most vital agro-technical measures during cultivation frequently applied to numerous fruiting plants, which not only develops their physical quality by promoting color, size, shape and falling the occurrence of fruit cracking and rusting, but also alter the micro environment for fruit improvement, which indirectly have numerous effects on center fruit quality (Younis et al., 2013). As an eco-friendly management approaches, this cultural practices are applying in numerous plant in Bangladesh such as tomato (Lamptey and Koomson, 2021), guava (Paikra and Sahu, 2021), walnut (Yakup *et al.,* 2021), lemon (Mahesha and Singh, 2018) etc. and improve plant growth, yield and fruit quality. Focusing on its advantageous effects, branch pruning has become a vital part for diverse fruits farming in various countries of the world. However, very inadequate data is available regarding the effect of branch pruning on dragon fruit production, quality improvement and controlling insect-pest in an eco-friendly way in Bangladesh. Therefore, our research experiment was aimed to assess the effects of branch pruning on flowering, fruiting, fruit quality assessment and infestation of insect-pest under pruned and without pruned condition considering two varieties viz. BAU Dragon fruit-1 having white flesh and reddish flesh containing BAU Dragon fruit-2.

## Materials and Methods

### The experimental site and planting materials

This experiment was accompanied at the Germplasm Centre of Bangladesh Agricultural University (BAU-GPC), Mymensingh during the period from December 2019 to August 2021. The experimental field was situated between 24.46°N latitude and 90.24°E longitude and having altitude of 18m from sea level. The soil was sandy loam type within the experimental field going to AEZ 9 the old Brahmaputra Flood Plain Alluvial Tract having non-calcareous dark grey flood plain soil. The studied area was under medium high land, well drained, fertile and slightly acidic with pH ranges from 6.0 to 6.8. During the study period the average maximum temperature was 35.20 $^{0}$C, minimum maximum temperature was 22.50 °C and relative humidity 86.45%. The selected planting materials were plated 5-6 years before and fully in production stage for last two years. BAU Dragon 1 (White flesh) and BAU Dragon 2 (Red flesh) were taken under consideration for this experiment.

### Experimental design and treatments

A two-factor experiment was carried out in randomized complete block design (RCBD) comprised of two varieties viz., BAU Dragon fruit-1 (White flesh) and BAU Dragon fruit-2 (Red flesh) with two conditions viz. under branch pruning and without pruning maintaining five replications. Ten (10) plants from each variety were selected for the study those having similar planting time and maintaining others intercultural practices within the same field condition. One year before of the fruiting period (harvesting), selected plants were pruned. Matured fruits were harvested and data were recorded from the next year considering 10 days interval during harvesting period for six times. Six fruits were randomly selected from each replication and analyzed to determine average dragon weight (kg), average fruit number per plant, average flower number per plant length, average number of insect pest per plant and fruit quality.

### Data collection and Data analysis

Parameters measured were number of flowers per plant, fruits per plant, weight of fruits per plant and infestation by insect-pest under branch pruning and without branch pruning condition. Data were collected at ten (10) days interval for six (06) times following parameters from the sampled plants during the experiment at period. Six plants were randomly selected from each plot to record data. The collected data were evaluated by analysis of variance (ANOVA table). A statistical computer package MSTAT-C was applied for analyzing data. The analysis was performed F- test and significance of the difference between pairs of lines means evaluated by the Least Significance Difference (LSD) test at 1% level of probability (Gomez and Gomez, 1984). Few data were then subjected to analysis using Microsoft excel version 10.0 for generating graph.

## Results and Discussion

### Effects of pruning on flowering

Results of present study revealed statistically significant variance in the number of flowers in two varieties (Figure 1). The plants, which were branch pruned, produced maximum number of flowers in the studied varieties. The higher number of flowers 28.33 was obtained from BAU Dragon fruit-2 while BAU dragon fruit-1 produced the lower flowers 22.33 (Figure 1). Numbers of flower were significantly influenced by pruning. Both the varieties gave highest results every times when these are pruned. On the other hand, control (without pruning) condition showed lowest flower bearing in the studied varieties (Figure 1). This may be due to decline in vigor, lower functioning of growth regulators and lesser metabolites level which can be attenuated by pruning thus physiological modification within the plants due to pruning might be facilitated higher flowering and fruiting in plants (Adhikari and Kandel, 2015). Present study explored that pruning of old branches stimulated the growth of fresh inflorescence, buds and shoots to obtain new flowering. So the numbers of flowers were more in pruned crops for example compared to without-pruned.

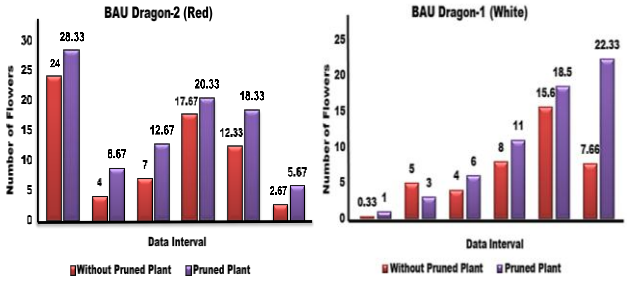



**Figure 1. Effects of branch pruning in flowering**

## Effects of pruning on fruiting

### Fruit Number

Statistically significant difference was observed in the fruiting parameters such as the number of fruit, fruit weight, fruit length and diameter, weight and thickness of Peel (Figure 2 and Figure 3, Table 1) due to pruning. It was perceived that higher number of fruits 26.33 was found from BAU Dragon fruit-1 when the plants were pruned while BAU dragon fruit-2 produced the lower fruits 22.33 (Figure 2) under pruning condition. Results also revealed that, within the varities, pruning may have significant influence on fruit bearing. In case of the studied varieties, all the time pruned plants gave highest results compared to un-pruned plant. For instance, pruned BAU Dragon-1 had 26.33 fruits/plant than un-pruned plants which had 17.33 fruits/plants. Similarly, in the circumstance of the pruned BAU Dragon-2, it had 12.67 fruits/plant than un-pruned plants which had 10.33 fruits/plants. Similar findings were revealed in *Moringa oleifera* where the number of fruits was increased after pruning (du Toit *et al.*, 2020). Bhagawati *et al.* (2015) also supported similar idea where they found pruning enhanced fruit number in guava.

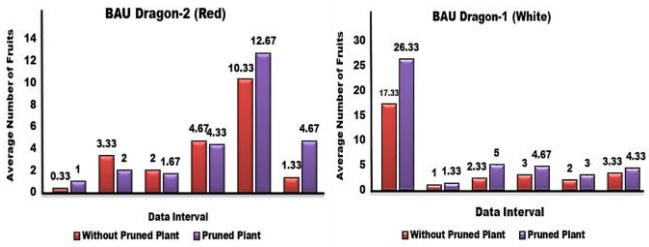



**Figure 2. Effects of branch pruning in fruit number**

### Fruit Size

Fruit length and diameter also significantly affected by pruning within the two varieties (Table 1). The higher fruit length 12.53 cm was obtained from BAU Dragon fruit-1 when it was pruned and lowest from un-pruned plants 10.31. Similarly, BAU dragon fruit-2 produced the highest fruit length 9.95 cm compared to control 9.16 cm (Table 1). This trend was resumed in case of fruit diameter where maximum results were acquired from pruned plants (Table 1). It was perceived that the relationship between variety and pruning had a significant influence on fruit diameter. The highest fruit diameter 8.82 cm was found when BAU dragon fruit-1 was pruned followed by BAU Dragon fruit-2, 7.62 cm. The lowermost fruit diameter 7.2 cm was attained from the BAU dragon fruit-2 un-pruned condition (Table 1). The current finding was also supported by many scientists by their findings. The largest sized fruits can be found from pruning due to enhancing growth, nutrient management, and maintaining hormonal balance within the plants (Adhikari and Kandel, 2015; Ara *et al.*, 2007). According to Adhikari and Kandel, (2015), pruning can change the micro-environment and the altered environment can stimulate fruit development and hormonal synthesis (Adhikari and Kandel, 2015).

**Table 1. Combined effects of variety and branch pruning on the fruiting parameters of dragon fruit.**

| Treatment Combination | Fruit length (cm) | Diameter (cm) | Fruit fresh weight (g) | Flesh weight (g) | Peel weight (g) | Thickness of peel (cm) |
|---|---|---|---|---|---|---|
| $V_1P_0$ | 10.31 | 7.80 | 360.26 | 303.42 | 56.67 | 0.17 |
| $V_1P_1$ | 12.53 | 8.82 | 593.26 | 543.54 | 49.56 | 0.16 |
| $V_2P_0$ | 9.16 | 7.2 | 242.32 | 180.45 | 61.66 | 0.21 |
| $V_2P_1$ | 9.95 | 7.62 | 295.50 | 238.05 | 57.26 | 0.19 |
| Level of significance | ** | ** | ** | ** | ** | ** |

$V_1$ = BAU Dragon-1, $V_2$ = BAU Dragon-2, $P_0$ = Without Pruning (Control), $P_1$ = Pruning
** = Significant at 1% level of probability

### Fruit weight

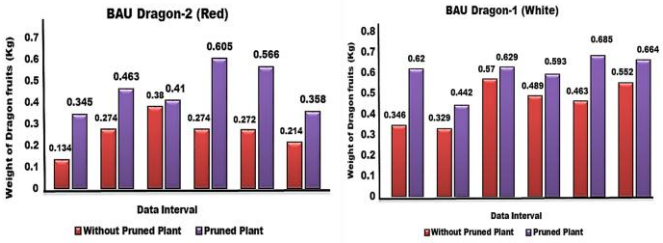



**Figure 3. Effects of branch pruning in fruit weight (Kg)**

There was a significant variation found in terms of average individual fruit weight and fresh weight of two varieties of Dragon fruit (Figure 3 and Table 1). The highest individual fruit weight was observed from pruned plant of BAU Dragon-1 (0.685 kg) and from BAU Dragon-2 (0.605 kg). Fruit subjected to pruning treatments exhibited major difference in fruit fresh weight throughout the period. In every cases, average fruit weight was found higher in pruned plant compared to un-pruned plants (Figure 3). For instance, the time pruned BAU Dragon-1 had 0.593 kg weight all at once un-pruned plant had 0.489 kg weight (Figure 3). This similar trend was observed in case of BAU Dragon-2 as well. Related increase in fruit fresh weight because of pruning of Pear reported by Goke *et al.* (2020), guava reported by Adhikari and Kandel, (2015), olive tree reported by Albarracín *et al.* (2017). They explained that pruning may increase cell division and cell growth boosted addition of photosynthates thus improved fruit weight.

### Fruit flesh weight

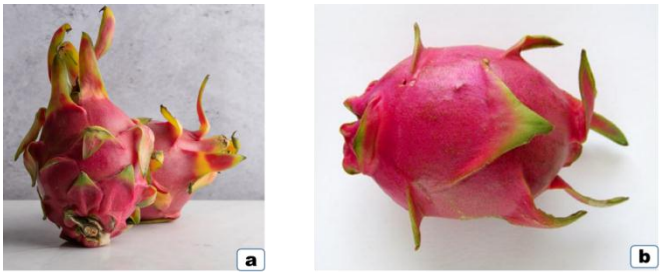
Diversified results were achieved from fruit flesh weight measurement between two varieties and pruning condition of dragon fruit (Table 1). The average fruit flesh weight from un-pruned BAU Dragon-1, 303.42 g was higher as compared to BAU Dragon-2, 180.45 g. Pruning expressively influenced the fruit flesh weight the highest flesh weight 543.54 g was found from pruned BAU Dragon-1 and flesh weight from pruned BAU Dragon-2 was 238.05 g (Table 1).

## Peel weight and thickness

Fruit peel weight and peel thickness was also varied significantly between two varieties due to pruning with the lowermost peel weight 49.56 g and lowest peel thickness 0.16 cm from BAU Dragon-1. The uppermost peel weight 61.66 g and highest peel thickness 0.21 from BAU Dragon-2 (Table 1). According to Ding *et al.* (2004), the result exhibited important impact of pruning on peel weight and thickness of dragon fruit, which might be because of the varietal dissimilarity in the both varieties to get developed at identical period. Pruning considerably reduced the peel weight and thickness of dragon fruit. The lower peel weight 49.56 g and thickness 0.16 cm was found from pruned plant whereas higher peel weight 56.67 g and thickness 0.17 cm was recorded from un-pruned from BAU Dragon-1 plants. Similarly, the lower peel weight 57.26 g and thickness 0.19 cm was found from pruned plant whereas higher peel weight 61.66 g and thickness 0.21 cm was recorded from un-pruned from BAU Dragon-2 plants. Umara *et al.* (2017) explained that pruning considerably reduces peel weight and thickness of dragon fruit, may be due to the diversified varietal character and pruning help the fruit rapid growth and promoted cell division.

## Effects of pruning on fruit quality

Fruit color, size and weight cumulatively represent fruit quality. The surface color of fruit was also examined by visual observation (Figure 4). The investigation exposed that fruits that were harvested from pruned plants had attractive orange red color and large in shape, while fruits from un-pruned plants had light green orange yellow and yellow green color and considerably lower in size and shape. Singh *et al.* (2004), were supported this similar findings and reported that because of pruning sunlight might enhances the color development in fruit.




**(a) Fruit from without pruned plant (b) Fruit from pruned plant**

**Figure 4. Effects of branch pruning in fruit quality**

## Effects of pruning on insect-pest infestation

The insect-pest infestation in Dragon fruit was lowest in pruning condition whereas without pruning condition showed lower to severe pest infestation. Results of this experiment showed a significant variance in terms of insect-pest infestation between two varieties of Dragon fruit (Figure 5). The lowest number of insect-pest infestations were observed in pruned BAU Dragon-1 plant had 0.67 insect/plant and from BAU Dragon-2 had 2.0 insect/plant. Plants subjected to pruning treatments exhibited noteworthy difference in insect-pest infestations throughout the period. In every cases, the number of insect-pest infestations were found higher in un-pruned plant compared to pruned plants (Figure 5). For example, the time pruned BAU Dragon-1 had 0.67 insect/plant at the same time un-pruned plant had 5.67 insect/plant (Figure 5). This similar trend was observed in case of BAU Dragon-2 as well. Pruning eradicates the destructive insect-pests like fruit borer, ant, caterpillar, larvae, birds etc. Pruning modifies the microclimate, which sequentially influence insect-pest infestation. Modification of shelter from environment and destruction of eggs, larvae because of pruning might be influenced in contributing lesser pest number (Schöneberg *et al.*, 2020). Therefore, insects can't lay egg on the leaves surface and consequently the larvae unable to damage the leaves or shoot of plant.

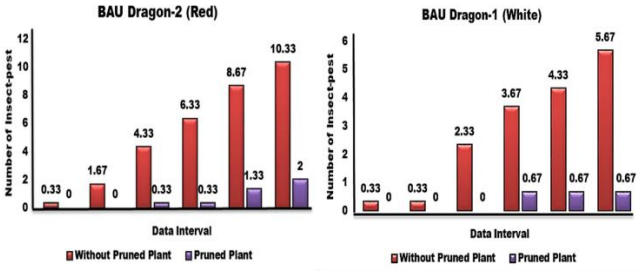



**Figure 5. Effects of branch pruning in insect-pest infestation**

## Conclusion

This research study was expected to analyze the impacts of pruning on dragon fruit production considering the food and economic values. Because of its nutritional and health value, dragon fruit has wide acceptability and becoming popular globally. It can be summarized that both the varieties of dragon fruit exhibited superior performances in respect of most of the parameters studied after pruning. Pruning enhanced flower number, fruit number, fruit length and diameter, improved fruit flesh weight, lowered peel thickness, higher quality of fruit color and lessen insect-pest infestation. Further study is recommended to investigate how pruning progresses the quality of dragon fruit and how long the beneficial effects of pruning can exist.

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## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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