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Papaya performance under various growing conditions cv. Red Lady 786

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ABSTRACT

The present investigation a was conducted in the Department of Horticulture, Khalsa college, Guru Nanak Dev University in sub tropical climate of Amritsar during 2016-2017. The seedlings of papaya cv. Red Lady 786 were transplanted in the second week of August with a spacing of 1.6 x 1.6 m in net house and open field at the same time. The investigation was laid out in CRD with two treatment combinations replicated thrice. Results of the study revealed that the plants under net house showed an increase in fruit length (22.68 cm),breadth (11,93 cm), weight (874.32 g) and fruit volume (895.16 cc). Among bio- chemical characters maximum TSS (11.13^0 Brix), minimum peel weight (539.42g) and organoleptic rating(8.90) were also observed under net house conditions while maximum juice percentage (83.36 %), and pulp weight(184.13g) were registered in the plants of open field. Plants under net house showed an increase in the yield (45.39 kg/plant) as compared to the plants under open conditions.. Hence plants of papaya cv. Red Lady 786 can be successfully cultivated under protection of net house with good yield and fruit quality respectively.

Key words: Brix., CRD, Net house, Organoleptic rating, Papaya, Pulp, Quality, Red Lady 786, TSS.

INTRODUCTION

Papaya (*Carica papaya*) also known as papaw or pawpaw is the fruit of the plant *Carica papaya*, the only species in the genus Carica of the plant family Caricaceae with chromosome number 18 (Martelleto *et al* 2008). In Australia yellow fleshed cultivars of *Carica papaya* are known as pawpaw, and the red fleshed and pink fleshed cultivars are known as papaya. In India plant is commonly known as papaya (Dhillon 2013). It is native to tropical America. Papaya is one of the most important cash crops in the tropics and sub-tropics (Reddy and Gowda 2014). Although it is a tropical fruit but it can also be grown under sub-tropical conditions (Allan 2002, Galan and Rodriguez 2007). Presently, papaya is grown extensively in Australia, Hawaii, India, Sri Lanka, Malaya, Myanmar, South Africa and Kenya. Papaya is a short-lived perennial fruit crop growing upto 30 ft high. The stem is hollow and soft wooded usually unbranched. The leaves are palm-like with long stalk. The shape of fruit from pistillate flower is ovoid-oblong. The fruit is fleshy berry. The skin of papaya is smooth, colour is green but turns yellowish or orange when ripe. Flesh is orange or reddish-orange, central cavity is 5 angled. The seeds are spherical in shape, black or greyish, wrinkled enclosed in gelatinous sarcotesta formed from outer integument (Kumar *et al* 2013). Papaya is dioecious but hermaphrodite forms also occur. It is a popular crop among farmers with regular demand of fruits in the market. It is a highly remunerative crop producing good cost benefit ratio (Sharma and Zote 2010). Under sub tropical conditions, papaya growth ceases at temperature below 11º C (Allan *et al* 2002). Therefore, protected cultivation of papaya in a sub tropical region may provide optimal environment for its growth and productivity. Growth and flowering benefits from the climate within the protected chambers results in improved yields, both in fruit quality and quantity with the critical additional benefits of the exclusion of Ring spot virus (Galan and Rodriguez 2007). Therefore, it is extremely important to determine yield and quality features of papaya under protected cultivation.

MATERIALS AND METHODS

The present study was conducted during 2016-2017 in the experimental plot of the nursery of Department of Horticulture, Khalsa College, Amritsar. An ultra-dwarf gynodioecious variety of papaya cv. Red Lady 786 was selected for evaluation under open and protected conditions of net house. Ten fruits from each treatment were taken randomly and their length and diameter were measured from the centre with the help of thread and length of thread was measured with scale in centimeters. To evaluate the fruit firmness of papaya fruits 10 fruits of each size at random from the sample were selected. Fruit firmness was measured on three sides of the fruit using a penetrometer with a 1.5 cm diameter tip depressed 2 mm into the fruit after harvest. Downward pressure was applied steadily until the plunger penetrated the flesh of the fruit up to the depth mark on the plunger. The readings was noted from the watch of the penetrometer and expressed as kg cm^{-2}. To ascertain the fruit weight, ten fruits from each treatment were randomly selected

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and weighed on Top-pan electrical balance and the average weight of fruit was calculated and expressed in kilogram per fruit. Volume of the fruits was calculated by water displacement method and expressed in cubic centimeters. Specific gravity of the fruits was calculated by dividing the fruit weight with its volume and expressed in whole number. The shape of papaya fruit was observed as visual appearance and noted as per shapes of fruits. Skin colour of the fruit was recorded with the help of horticultural colour chart (Wilson, 1963) according to which codes of colour were taken accordingly in which VRO depicted vivid red orange, SO (Sunset orange) and SOY refered to Sunset orange yellow. The average pulp weight of ten randomly selected fruits in each replication was determined by weighing the pulp of the fruit on the pan balance and average pulp weight was calculated in grams. The average peel weight of ten randomly selected fruits in each replication was determined by weighing the peel of the fruit on the pan balance and average peel weight was calculated in grams. To determine the number of seeds per fruit, total number of seeds per fruit was recorded and average number of seeds per fruit was calculated. The papaya fruits were evaluated for the organoleptic tests by a panel of the five judges on a scorecard (maximum score: 10 points) based on general appearance, taste and flavor and were awarded scores. The fruits were given rating as excellent (8.0-10.0), good (6.5-8.0), fair (5.0-6.5) and poor (below 5.0). Juice of the weighed fruits was extracted and weighed. For calculating juice percentage weight of juice was divided by the weight of fruits and expressed as percentage. 2kg fruit from each treatment was taken randomly and juice was extracted by electric juicer. The total soluble solids (TSS) of the berry juice was determined with the help of Erma hand refractrometer by taking average of the no. of readings taken. The values were corrected at 20ºC with the help of a temperature correction chart (AOAC 1990).

RESULTS AND DISCUSSION

The data on the fruit size of papaya plants depicted that the plants under open conditions produced fruits with more length (22.68 cm) and breadth (11.93 cm) as compared to the length (18.33 cm) and breadth (9.31 cm) in plants under net house conditions. The decrease in fruit size under net house might be due to the large number of fruits which led to reduction in fruit size. These findings are corroborated with the reports of Reddy and Gowda (2014), Allan (2007) with Honey Gold papaya from South Africa. Increase in fruit size of papaya in open conditions has also been reported by Parkash *et al* (2015) in papaya cv. Pusa Nanha. The research work of Singh *et al* (2010) in pumpkin and Gunes and Gubbuk (2012) in papaya also support the present studies.

Table 1(a): Performance of papaya cv. Red Lady 786 on fruit characters under open and protected conditions.

Treatments	Fruit size (l×b)		Fruit firmness
	Length (cm)	Breadth (cm)	(kg/cm^2)
Open	18.33	9.31	1.92
Net house	22.68	11.93	1.94
CD at 5% Level	**1.74**	**1.14**	**0.02**

The data in Table 1 pertaining to the fruit firmness revealed that the fruit firmness showed slight differences in the plants under net house as compared to the plants grown in open field conditions. The fruit firmness under net house was (1.94 kg/cm^2) whereas the fruit firmness of the fruits in open field had (1.92 kg/cm^2) respectively (Table 1a). This might be due to the congenial micro-climatic conditions maintained in net house, which influenced the production of more photosynthates resulting in more fruit firmness. The findings are similar to the reports of Gunes and Gubbuk (2012) in papaya plants. The present results are also in conformation with the earlier findings of Parkash (2015) and Singh *et al* (2010) in papaya plants respectively. The findings of Kim *et al* (2011) in blue berries cv. Northland also corroborates the present results.

The data regarding the fruit weight of papaya plants under net house and open conditions revealed that the plants under net house and open condition showed significant difference among each other. It is also evident from the data that the protected cultivation produced significantly heavier fruits than open field. The maximum fruit weight (874.32g) was observed from the plants cultivated under open field whereas fruits obtained from plants under protected cultivation showed less fruit weight (679.32g) respectively. This might be due to the fact that there were more number of fruits under net house and the compactness of the fruits did not allow each other to acquire proper fruit size which also led to decrease in fruit weight. The present results are in confirmation with the earlier findings of Parkash *et al* (2015) in papaya cv. Pusa Nanha, Singh *et al* (2010) and Gunes and Gubbuk (2012) in papaya cultivars. Manu *et al* (2015) also reported the same in papaya cv. Red Lady 786.

It is evident from the data that the volume of the fruits of papaya cv. Red Lady 786 was affected by growing plants under net house and open conditions. The fruit volume of plants under net house was (895.16cc) where as the fruits under open field showed fruit volume of (759.87cc) respectively. Similar results were observed by Parkash *et al* (2015) and Kim *et al* (2011) in papaya. This might be due to

Table 1(b): Performance of papaya cv. Red Lady 786 on fruit characters under open and protected conditions.

Treatments	Fruit weight (g)	Fruit volume (cc)	Specific gravity g/cc	Fruit shape
Open	679.32	759.87	1.20	Oblong
Net house	874.32	895.16	1.11	Ovoid and oblong
CD at 5% Level	**14.99**	**15.84**	**0.03**	

the metabolic changes of the papaya plant and the fruits under net house had large number of fruits per plant which ultimately reduced the fruit size and volume. The research findings of Gunes and Gubbuk (2012) are also in support with the present results.

The data pertaining to specific gravity of the papaya fruits cv. Red Lady 786 as affected by cultivation under net house and open field depicted that the specific gravity of plants showed statistically significant differences between plants under both the conditions. The data showed that specific gravity (1.11 g/cc) under protected condition was more as compared with the fruits obtained from open field with (1.20 g/cc) specific gravity respectively (Table 2b). This might be due to the more fruit volume in open field which resulted in more specific gravity than the fruits in net house. These results are in line with the findings of Parkash (2015) in papaya cv. Pusa Nanha and Similar trend has also been indicated by Cheema *et al* (2013) in tomato, Kadir *et al* (2006) and Kaur (2010) in strawberry cvs. Chandler and Sweet Charlie.

The data pertaining to the fruit shape was observed as visual appearance from the shapes of the fruits. The fruits of net house were ovoid and oblong in shape whereas a fruit under open field conditions were with oblong shape. Similar results were observed by Manu *at al* (2015) in papaya cv. Red Lady 786.

The data of different treatments on fruit colour of papaya cv. Red Lady 786 stated that the best pulp colour of fruits coded as 32A (VRO) generating values of (L 76.32, a 27.03, b 56.65) and peel colour 24B (SOY) generating values of (L 56.98, a 54.53, b 48.68) was found in the fruits obtained from the net house. Minimum pulp colour developed was noticed as 33B (VRO) generating values of (L 73.65, a 34.25, b 60.04) and peel colour recorded was 25B (SO) generating values of (L 56.50, a 51.01,b 45.22) in fruits obtained from open field Table 2. This might be due to the congenial micro-climatic conditions maintained in net house, which influenced the production of more photosynthates resulting in proper colour formation. The findings are similar to the report of Manu *et al* (2015).

Minimum peel weight (539.42g) was reported from the plants grown under net house. Parkash *et al* (2015) also reported the same in papaya cv. Pusa Nanha. The data pertaining to pulp weight registered more pulp weight (666.04 g) in the plants under open conditions as compared to the plants grown under net house conditions with pulp weight of (539.42 g) respectively (Table 3). This might be due to the large sized fruits with more pulp in the fruits of open field than the plants under net house. The results are in close conformity with the findings of Parkash *et al* (2015) who also reported the same in cv. Pusa Nanha.

The data pertaining to number of seeds per fruit registered lesser number of seeds(39.98) in the plants grown under net house (Table 3). This might be due to the more weight of fruit with more number of seeds per fruit from plants of open field than the plants under net house. The results are in close conformity of Manu *et al* (2015) who also in reported the same in cv. Red Lady 786. The findings of Parkash *et al* (2015) are also n line with the present results.

Data regarding the organoleptic rating that the maximum organoleptic scores 8.9 were awarded to the papaya fruits from the plants under net house and 7.6 was observed under open field fruits respectively. Results of the study revealed that the better rating of papaya fruits obtained from net house might be due to the high sugars present in fruit and more edible portion of the fruit. Results of these findings are confirmed by Manu *et al* (2015) in papaya cv. Red Lady 786.

It is evident from the data that the juice percentage of papaya cv. Red Lady 786 showed significant differences among the plants grown under open field and protected conditions. The juice percentage of fruits (83.36%) cultivated from plants in open condition was more than the juice percentage of fruits obtained from the plants cultivated in net house with (78.54%) juice percentage respectively. This might be due to the fact that the fruit size and weight were more in open conditions which resulted in more juice percentage in the fruits of the plants planted in open conditions than the plants planted in net house. The results of the study conducted by Parkash *et al* (2015) are also in support with the present findings.

Maximum TSS (11.13ºBrix) were recorded in the fruits obtained from the plants under net house condition with whereas minimum TSS (8.49ºBrix) was recorded from the plants cultivated in open conditions respectively (Table 3). The present results are in confirmation with the earlier findings of Parkash *et al* (2015) in papaya cv. Pusa Nanha, Singh *et al* (2010) and Gunes and Gubbuk (2012) in papaya cultivars. Similar results are also observed by Cheema *et al* (2013) in tomato, Kaur (2010) and Kadir *et al* (2006) in strawberry. This might be due to the congenial micro-climatic conditions maintained in poly house which influenced the

Table 2 : Performance of papaya cv. Red Lady 786 on peel/pulp colour under open and protected conditions.

TREATMENTS	Peel colour				Pulp colour			
	code	L	a	b	code	L	a	b
Open	25B	56.50	51.01	45.22	33B	73.65	34.25	60.04
Net house	24B	56.98	54.35	48.68	32A	76.32	27.03	56.65
C.D		**0.18**	**1.23**	**1.98**		**1.56**	**2.01**	**1.35**

L- green shade, a- red shade,* b- yellow shade

Table 3: Performance of papaya cv. Red Lady 786 on fruit internal characters under open and protected conditions.

Treatments	Peel weight perfruit (g)	Pulp weight per fruit (g)	Number of seeds per fruit	Organoleptic rating	Juice per cent	TSS ^{O} Brix
Open	666.04	184.13	41.85	7.60	83.36	8.49
Net house	539.42	115.36	39.98	8.90	78.54	11.13
C.D	**2.22**	**1.34**	**0.89**	**1.20**	**1.67**	0.74

production of more photosynthates that might resulted in sweeter fruits with maximum TSS. These finding are also in line with the results of Reddy and Gowda (2014) in papaya cv. Red Lady 786.

The perusal of data regarding the fruit yield of papaya cv. Red Lady 786 as affected by cultivation under net house and open field clearly indicated that significantly higher fruit yield was obtained from the plants under protected cultivation (35.15) where minimum fruit yield per plant was from open field was (21.87 kg) per plant respectively (Table 4). In net house, the increased yield recorded might be due to the extent incidence of papaya ring spot virus (PRSV), continuous and healthy growth, and high number of fruits and enhanced fruiting zone. These findings are corroborated with the reports of Sauco and Pastor (2007), Reddy and Gowda (2014) and Allan (2007) with 'Honey Gold' papaya from South Africa. Similar results were also observed by Parkash *et al* (2015) in papaya cv. Pusa Nanha, Singh *et al* (2004) in pepper and Sheen *et al* (2008) in HA6-1 of papaya respectively. The findings of Baiyeri (2006) on papaya cv. Sunrise Solo are also in line with the present research.

Table 4: Performance of papaya cv. Red Lady 786 on yield (kg) under open and protected conditions.

Treatments	Yield per plant (kg)
Open	21.87
Net house	35.15
Mean	28.51
C.D	**4.97**

CONCLUSION

From the present study, it is to be concluded that papaya cv. Red Lady 786 can be grown successfully under net house with improved fruit weight, size, colour, yield and fruit quality.

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