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A STUDY ON THE PERFORMANCE OF VEGETATIVE CHARACTERS AND YIELD OF PAPAYA CV. RED LADY 786 UNDER OPEN AND PROTECTED CONDITIONS

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ABSTRACT

A study on the performance of papaya cv. Red Lady 786 under open and protected conditions was conducted in the Department of Horticulture, Khalsa college Amritsar during 2016-2017. The seedlings of papaya cv. Red Lady 786 were planted 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 the vegetative growth, flowering, fruiting and yield parameters of papaya with maximum height of plants (214.05 cm), number of leaves per plant (20.46), leaf area (876.5 cm^2), number of hermaphrodite flowers per plant (51.32), fruits per plant (49.52) and yield (45.39 kg/plant) respectively. Hence, the plants of papaya cv. Red Lady 786 showed an improved vegetative characters with increased yield 5 as compared to open field.

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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). It ranks fifth with regards to area and production among different fruit crops. Papaya has gained more importance owing to its high palatability, fruiting ability throughout the year, early fruiting, highest productivity per unit area and multifarious uses like food, medicine and industrial inputs (Parkash *et al* 2015). Papaya is a rich source of powerful antioxidants, vitamin A, C and E. It alsocontains minerals such as Fe, Na, Mg, K, panthothenic acid and riboflavin. In addition to all this, it contains a digestive enzyme papain, which helps in digestion of protein rich food (Vij and Parkash 2015). Red lady 786 is one such gynodioecious variety of papaya which can be grown successfully under protected conditions of poly net house (Singh and Parkash 2015).

It is cultivated for table as well as processing purpose as the fruits have excellent keeping quality. Under sub tropical conditions, papaya growth ceases at temperature below 11° C (Allan *et al* 2002). Therefore, protected cultivation of papaya in a sub tropical region may provide optimal environment for its growth and productivity. Protected conditions simultaneously provide both adequate temperature and exclusion of Ring spot virus. Leaf age and light intensity dramatically affect the leaf photosynthetic capacity of the developing canopy of the plant. The plants grown under greenhouse have more leaf area and more number of plants (Chang *et al* 2013).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.

A lot of research work has been done on the optimization of cultural practices performed in the cultivation of papaya, whereas as scanty information is available on the cultivation of papaya under protected conditions. So, present study was therefore proposed to investigate the performance of papaya plants under open and protected conditions

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. The height of five plants randomly selected was measured individually with a measuring scale from the crown level to the apex of primary leaf and results were expressed as average height in centimeters. The stem girth of plants was recorded from five randomly selected plants from both treatments and the results were expressed as average stem girth of plant. The number of leaves were recorded from five randomly selected plants of both the treatments and the results were expressed as average leaves per plant. The petiole length, length between leaf lamina and stem was measured with the help of thread and recorded with measuring scale. The leaf area was studied on a graph paper and average leaf area was expressed by counting squares in a cm^2. The total leaf area was worked out by multiplying number of leaves with an average leaf area. The days taken from transplanting to first day of flowering were recorded and the days were counted as flower initiation days. The number of flowers per plant, total number of flowers at 15 days intervals was recorded and an average number of flowers per plant was calculated. The number of fruits per plant, total number of fruits at 15 days interval were been recorded and average numbers of fruits per plant were calculated. The fruiting zone was recorded from the five randomly selected plants from both treatments and with the help of thread length of fruiting area from lower fruit to the top most fruit length was measured and length of thread was recorded with measuring scale. The total number of flowers per plant was counted and the number of fruit set in these plants was recorded after every 15 days. Percent fruit set per plant was worked out with a formula given by Westwood (1979). The total number of fruits picked per plant were counted and weighed. The yield (kg/tree) was calculated on the basis of product of average fruit weight and the total number of fruits per plant and expressed in kilogram.

RESULTS AND DISCUSSION

It was evident from the data that the plant height was affected by open and protected conditions. The results presented in Table 1 showed that the plant height was similar during the early growing period (March-April) in open and net house conditions but later on, it increased significantly in the plants of net house during the period of August-September with 214.05 cm as compared with open planting with (114.47 cm) as plant height. Similar results were observed by Galan and Rodriguez (2007) in papaya. The increase in plant height under net house with organic production system was also reported by Martelleto *et al* (2008), and Parkash *et al* (2015) in papaya fruits. The results of the data on stem girth presented in the Table 1 showed significant difference in the stem girth of papaya plants under protection and open conditions with (35.67 cm) in net house and (34.98 cm) stem girth in the plants under open conditions. This might be due to the congenial micro-climatic conditions under net house than open field. Also, good amount of photosynthesis led to the good vegetative characters. Similar results have been reported by Parkash *et al* (2015) under the same conditions in papaya cv. PusaNanha. The findings of Gunes and Gubbuk (2012) in papaya are also in line with the present findings. Number of leaves showed a significant difference in the plants grown in net house and open field. Maximum numbers of leaves (20.46) were observed in net house grown plants as compared to open field with (14.26) leaves respectively. The increase in leaf number might be due to the reason that the increase in hormonal metabolism, genetic makeup and production of more photosynthates in the plants planted under net house resulted in more number of leaves. The findings of Pomper *et al* (2002), Baiyeri (2006) and Parkash *et al* (2015) in papaya plants and Kadir *et al* (2006) and Kaur (2010) in strawberry are in line with the present research study.

Table 1. Performance of papaya cv. Red Lady 786 on vegetative growth under open and protected conditions

Treatments	Plant height at 11 months (cm)	Stem girth (cm)	No. of leaves per plant	Petiole length (cm)	Leaf area (cm^2)
Open field	114.47	34.98	14.26	64.59	625.4
Net house	214.05	35.67	20.46	72.26	876.5
C.D	6.07	0.89	0.34	4.65	2.06

The data presented in Table 1 showed that the petiole length differed significantly both in net house and open field conditions showing petiole length of (72.26 cm) in the plants under net house and (64.59 cm) under open conditions. The increase in petiole length might be attributed to the fact that increased hormonal metabolism, genetic make up and available of more photosynthates to the plants under net house resulting in more number of leaves with more petiole length than open field conditions. The results of the present studies are in support with the findings of Parkash *et al* (2015) in papaya cv. Pusa Nanha. Similar results has also been reported by Pomper *et al* (2002) and Baiyeri (2006) in papaya plants. The findings of Kadir *et al* (2006) and Kaur (2010) in strawberry cv. Chandler are also in agreement with the present results.

The data presented in Table 1 showed that the leaf area of the papaya plants under net house was more than open cultivated plants. More leaf area (876.5 cm^2) was recorded in the plants under net house as compared to the plants under open conditions with leaf area of (625.4 cm^2). This might be due to the fact that the favourable modified congenial conditions under net house resulted in better photosynthesis than the open conditions which promoted the leaf growth and enhanced the leaf area. Similar results were reported by Parkash *et al* (2015) in papaya cv. Pusa Nanha. The research findings of Baiyeri (2006) in Sunrise Solo papaya, Kaur (2010) in strawberry cv. Chandler and Sweet Charlie are also in accordance with the present results. Pomper *et al* (2002) also reported an increase in total leaf area of papaya plants under protected conditions which is in accordance with the present findings. The data pertaining to flower initiation presented in Table 2 clearly showed that the plant grown under net house took (66.76 days) for flower initiation while the plants under open field conditions took (89.94 days). Hence, it is clear from the data that the plants under net house started flowering earlier than the plants in open field.

This might be due to the fact that there was a difference of temperature and atmosphere conditions prevailing in the net house and in the open conditions which led to the better vegetative growth and better production of photosynthates in the plants of net house further accelerated the flower initiation earlier than the open field conditions. The research findings of Gunes and Gubbuk (2012) and Parkash (2015) in papaya plants are in support with the present results of the whole research. Reddy and Gowda (2014) also reported the same in papaya cv. Red Lady 786. The data on number of flowers depicted that the plants grown under net house generated significantly more flowers than open field plants. More hermaphrodite flowers (51.32) were obtained in the plants under net while the plants in open produced (38.31) flowers. Similarly number of pistillate flowers under net house were 15.58 while (9.90) were generated in the plants under open conditions. This might be due to the presence of favourable modified growing conditions under net house as compared to open field. The research study of Weerakkody and Peiris (2000) in tomato, Kadir *et al* (2006) in strawberry and Gunes and Gubbuk (2012) in papaya are in line with the present results. Reddy and Gowda (2014) and Parkash*et al* (2015) in papaya cvs. Red Lady 786 and Pusa Nanha also reported the same.

It is clear from the data on fruiting zone presented in Table 2 that the plants planted in the net house generated fruiting zone of 142.78 cm which was significantly larger than the open field plants of papaya cv. Red Lady 786 generating which produced fruiting zone of 80.15 cm. This might be due to the fact that the production of more fruits which ultimately formed a greater fruit zone. It resulted from the production of better photosynthates in the plants under net house as compared to open field. The research findings of Parkash *et al* (2015) in papaya cv. Pusa Nanha are in close conformity with the present results. The results of the study carried out by Reddy and Gowda (2014) are also in line with the present findings.

Table 2: Performance of papaya cv. Red Lady 786 on days taken for flowering and fruiting under open and protected conditions

Treatments	Days taken for flowering	Hermaphro dite flowers (%)	Pistillate flowers (%)	Fruiting zone (cm)
Open field	86.94	38.31	9.90	80.15
Net house	66.76	51.32	15.58	142.78
C.D	2.77	1.67	0.64	2.77

It is evident from the data in Table 3 that the number of fruits per plant of papaya cv. Red Lady 786 showed significant difference among both the conditions of cultivation. More number of fruits per plant (42.25) were registered in the plants under net house cultivation as compared to the open field plants with (24.72) fruits per plant. This might be due to the more flowers produced in the plants under net house conditions which in turn was due to the increased hormonal metabolism and photosynthesis in plants due to the presence of more favorable modified growing conditions under net house resulting in early flowering and more fruit number per plant. Similar effects have been reported by Parkash *et al* (2015) in papaya cv. Pusa Nanha. The findings of Manu *et al* (2015) in papaya cv. Red Lady 786 are also in close conformity with the present research. According to the data of fruit set per cent in Table the plants grown under net house generated higher fruit set percentage (63.12%) than the open field plants with (51.27%) respectively.

This might be due to the formation of more hermaphrodite and pistillate flowers which formed more fruits which resulted from the favourable conditions prevailing in the net house and formation of more photosynthates in the plants. Similar results were recorded by Parkash *et al* (2015) in papaya cv. Pusa Nanha. Kaur (2010) also stated more flowers in strawberry cv. Chandler under protected conditions. It is evident from the data presented in Table 3 that early fruit maturity (134.0 days) were observed in open field plants while the plants under net house took (145.2 days) for fruit maturation. Similar results were observed by Galan and Pastor (2007), Gunes and Gubbuk (2012) in papaya plants. The research findings of Parkash *et al* (2015) in papaya cv. Pusa Nanha are in line with the present results.

The perusal of data regarding the fruit yield of papaya cv. Red Lady 786 as affected by cultivation under net house and open field presented in Table 3 clearly indicated that significantly higher fruit yield was obtained from the plants under protected cultivation where minimum fruit yield (35.15 kg) per plant was from open field was (21.87 kg) per plant respectively. 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 3: Performance of papaya cv. Red Lady 786 fruiting and yield under open and protected conditions

Treatments	No. of fruits per plant	Fruit set (%)	Days taken for fruit maturity	Yield per plant (kg)
Open field	24.72	51.27	134.00	21.87
Net house	42.25	63.12	145.20	35.15
C.D	1.97	1.06	4.12	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 vegetative growth, profuse flowering, fruiting results in higher percentage of fruit set, high fruit yield.

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