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Effect of Protected Environment on Off-Season Seedling Raising of Papaya

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ABSTRACT

To evaluate the effect of different types of structure on off-season papaya seedling raising, two year experiment was laid out in February month of the year 2015 and 2016. Different types of structures like poly-cum-shade net house covered with 200µ UVS plastic on top and sides are covered with 50% white shadenet, naturally ventilated walk-in-type tunnel covered with 200µ UVS plastic, black shadenet house covered with the 50% black shade net were constructed. An open field was selected as control. Proportion of soil, sand and FYM was kept as 1:1:1 for preparation of the root media. Climatic parameter like temperature, relative humidity and light was recorded highest in walk in type tunnel followed by poly-cum-shadenet house, open and black shadenet house. Optimum climatic condition influenced the morphology parameter of offseason seedling raising of papaya. Seedling height (34.8 cm), collar diameter (5.5 mm), number of leaves per plant (13.6), tap root length (21.1 cm), germination percentage (93.9 %), vigour index (3266) and sturdiness (83.5) of papaya seedlings were observed highest in poly-cum-shadenet house. Benefit cost ratio for papaya seedling raising in different types of the structures was range from 4.13 to 4.84.

Keywords Off season papaya seedling raising, Protected structures, Crop parameter, Economic feasibility.

INTRODUCTION

Papaya is one of the important fruit crop in Gujarat state. In India, papaya occupies an area about 1.43 lakh ha with its production of 5980 million ton (Anonymous 2020). Maximum area under papaya is in Andhra Pradesh followed by Gujarat (NHB 2015). In Saurashtra region, awareness of papaya cultivation is gaining good momentum but cultivators have little knowledge about effect of protected environmental on papaya seedling for higher production and good quality of papaya seedling. Seedlings quality is essential for good growth and performance of crops in main field which increases the farmer income (Ramakkrushnan and Vijayan 2013). Major difficulty of raising papaya seedling is mortality of seedling (Bhardwaj 2013) which is a very serious problem. Therefore, protected cultivation technology is used

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to raise the papaya seedling (Sengar and Kothari 2009). It is difficult to seed germination and pollen germination in below 10°C (Santosh *et al.* 2017b). Saran *et al*. (2016) conducted experiment on effect of temperature on germination of seedling raising of papaya and reported highest average seed germination per cent was observed in the month of July and August while lower was found in the month of January causes of low temperature. Therefore, it is to be close relationship between mean temperature and pollen germination. Rosbakh and Poschlod (2016) concluded that the restriction of pollen germination and growth by low temperatures is an important contributor to the climatic restriction of plant species distributions. Papaya is a tropical crop which requires high temperatures to produce good quality fruits all year round (Galan Sauco *et al.* 2005). Summer season is the favorable climatic condition to grow papaya in Saurashtra region of Gujarat state of India. It required to raising the seedling in winter or off season to summer papaya cultivation. It is difficult to raising of papaya seedling in off season in law temperature in winter season (Sengar and Kothari 2009). Protected cultivation structures like green house, poly house, shadenet house and low tunnel house provide favorable environment for crop growth thereby achieving greater yield and high quality produce (Santosh *et al.* 2017b). Sengar and Kothari (2009) reported that seedling raising of papaya in off season required high temperature as compared to ambientcondition during off season. Hence green house and shade net house are supposed to be a better option for region like Saurashtra. Generally black shed net of 75% is used for fruit seedling raising purpose. Many scientist have worked the raising of seedling of papaya in chemicals and bio-Inoculants (Dayeswari *et al*. 2018), media on seed generation and plant growth regulator (Bhardwaj 2013, Anjanawe *et al*. 2013) and shade net house and green house (Sengar and Kothari 2009, Baiyeri 2006). Protected cultivation technology provides better climate for better growth of seedling raising (Santosh *et al.* 2017a). Among abiotic factors of environment like unfavorable microclimate, especially temperature restricts raising off-season nursery under open field condition. Mostly the farmers are raising papaya seedling during their normal growing season by sowing of seeds and when such seedling are sold for marketing, the markets are flooded with these seedlings and sometime growers are not getting back their cost of production. But the same seedling are fetching very high price during off-season. Present article is articulated to study the effect of protectedstructures on morphology parameters and cost economics of papaya seedlings raising.

MATERIALS AND METHODS

Two years experiment was laid out during February 2015 and February 2016 to evaluate the effect of different types of structure on off-season papaya seedling raising. It was raising in poly-cum-shadenet house, walk-in-type tunnel, shadenet house and open field. The poly-cum-shade net house is modified poly house by top covering of 200 µm thickness plastic and sides are covered with 50% white shade net house (Satasiya *et al.* 2014, Santosh, *et al.* 2017b) with floor area of 9 m × 5 m and height is 3.96 m. Sakthivel (2009) have used insect net of 40 mesh instead of shade net to cover four side while top is covered with UV stabilized high density polyethylene film (HDPE) material. Walk in tunnel structure are covered with 200 µm UVS diffused light polythene to all side of tunnel (Maughan *et al.* 2014) with floor area of 6 m × 3 m and height is 2.44 m. Manually operated roll up side vents along the length of low tunnel with insect net are provided for ventilation (Sethi *et al.* 2009). Shadenet house is covered with 50% black shadenet with floor area of 3 m × 3 m with height of 2.44 m. A plot having an area of 3 m × 3 m was selected for an open field as control. Clay, sand and FYM were used for the root media preparation and its proportion was kept as 1:1:1 (Anjanawe *et al.* 2013, Bhardwaj 2013, Athulya 2016, Joshi and Chauhan 2016). Root media is filled up in black soft polythene bag of 40µ thickness having dimension of 5 cm × 20 cm (Athulya 2016). Irrigation was applied manually through the garden shower. Climatic parameters like temperature, relative humidity and light intensity were recorded at 3 h interval (9:00, 12:00, 15:00 and 18:00). Germination percentage, seedling height, collar diameter, number of leaves and tap root length were measured and vigour index and sturdiness are calculated during the experiment (Athulya 2016, Sakthivel 2009, Joshi and Chauhan 2016). Experiment was replicated for three times and result was analyzed with stastical Complete Randomize Design (CRD). Cost economics

Table 1. Effect of different types of the structures and open field on germination percentage and seedling height of papaya seedlings.

Treatments	Germination percentage			Seedling height, cm		
	2015	2016	Pooled	2015	2016	Pooled
Poly-cum-shadenet house	93.0	94.8	93.9	35.8	33.8	34.8
Walk-in-type tunnel	87.5	88.0	87.8	26.5	27.2	26.8
Black shade nethouse	91.0	82.5	86.8	34.2	26.6	30.4
Open field	41.5	36.5	39.0	12.9	11.4	12.1
SEm.±	2.4	2.0	1.6	1.5	1.5	1.1
CD at 5%	7.4	6.1	4.5	4.6	4.6	3.1
CV%	6.2	5.2	5.7	11.0	12.1	11.5

for different structures was also worked out (Sengar and Kothari 2008, Sengar and Kothari 2009, Satasiya *et al.* 2014, Joshi and Chauhan 2016).

RESULTS AND DISCUSSION

Performance of structures on morphology of papaya seedling

Germination percentage

Germination percentage of papaya seed in poly-cum-shadenet house (93.9 %) was found significantly higher than open field during the year 2015, 2016 and pooled result while it was at par with walk-in-type tunnel (87.8) and black shadenet house (86.8%). Micro climatic parameter like temperature inside the poly house and walk in type tunnel was recorded 29.7ºC and 32.5ºC respectively which might be responsible good germination. It is also clear from the Table 1 that maximum germination percentage of papaya seed was observed in poly-cum-shadenet house (Joshi and Chauhan 2016) but it was recorded minimum in open field condition (Sakthivel 2009). There was low germination percentage recorded in open field due to low temperature and cold wave at germination stage. Temperature was recorded lower in black shadenet house than the open field even though germination percentage was at par with poly-cum-shadenet house that might be due to black shadenet structure reduce the effect of cold wave at germination stage.

Seedling height

Seedling height in poly-cum-shadenet house was found significantly higher than open field during the year 2015, 2016 and pooled result while it was at par with black shadenet house during the year 2015. Seedling height is affected by temperature (Rajasekar *et al.* 2013, Saran 2016). It is also clear from the Table 1 that maximum seedling height (34.8 cm) was observed in poly-cum-shadenet house which is line with Sakthivel (2009). Minimum seedling height (12.1 cm) was recorded in open field condition which is also supported by Kakade *et al.* (2018) and Sakthivel (2009). The mean light intensity observed higher in open field followed by walk in type tunnel and Poly-cum-shadenet house and temperature was recorded higher walk in type tunnel and poly-cum-shadenet house. Temperature and light intensity simultaneously prompt the plant height which was favored inside the poly-cum-shadenet house.

Table 2. Effect of different types of the structures and open field on Collar diameter, Number of leaves per plant and Tap root length of papaya seedlings.

Treatments	Collar diameter, mm			Number of leaves per plant			Tap root length, cm		
	2015	2016	Pooled	2015	2016	Pooled	2015	2016	Pooled
Poly-cum-shadenet house	5	6	6	15	13	14	20.4	21.8	21.1
Walk-in-type tunnel	4	5	5	9	10	10	14.2	14.7	14.4
Black shade nethouse	4	4	4	10	9	9	14.8	12.0	13.4
Open field	3	3	3	5	6	5	9.8	8.8	9.3
SEm±	0.2	0.2	0.1	0.5	0.7	0.4	0.6	0.8	0.9
CD at 5%	0.6	0.7	0.4	1.7	2.2	1.3	1.9	2.5	4.1
CV%	9.4	10.4	10.0	11.3	15.5	13.5	8.4	11.3	9.9

Table 3. Effect of different structures and open field on morphological parameters of papaya seedlings.

Treatments	Vigour index			Sturdiness		
	2015	2016	Pooled	2015	2016	Pooled
Poly-cum-shadenet house	3330.2	3201.9	3266.0	70.7	52.9	61.8
Walk-in-type tunnel	2317.3	2390.7	2354.0	54.0	54.4	54.2
Black shade nethouse	3107.9	2199.8	2653.8	107.0	60.1	83.5
Open field	542.7	422.9	482.8	48.2	40.2	44.2
SEm±	137.4	136.2	217.5	2.5	4.8	10.3
CD at 5%	423.3	419.7	978.9	7.8	NS	NS
CV%	11.8	13.3	12.5	7.3	18.4	12.5

Collar diameter

Collar diameter of papaya seedling in poly-cum-shadenet house was found significantly higher than all other treatments during the year 2015, 2016 and pooled result. It is also clear from the Table 2 that maximum collar diameter of papaya seedling was observed in poly-cum-shadenet house (6) followed by walk-in-type tunnel (5) and black shadenet house (4) and open field (3) condition which is in line with Sakthivel (2009). Optimum climatic parameter like temperature, humidity and light inside the structures promotes morphology parameter of seedling.

Numbers of leaves per plant

Numbers of leaves per plant of papaya seedlings in poly-cum-shadenet house was found significantly higher than all other treatments during the year 2015, 2016 and pooled result. It is also clear from the Table 2 that maximum numbers of leaves per plant of papaya seedlings (14) was observed in poly-cum-shadenet house whereas minimum recorded open field (5) condition which is in line with Sakthivel (2009).

Tap root length

Tap root length of papaya seedlings in poly-cum-shadenet house was found significantly higher than all other treatments during the year 2015, 2016 and pooled result. It is also clear from the Table 2 that maximum tap root length of papaya seedlings 21.1 cm was observed in poly-cum-shadenet house where as minimum was measured in open field (9.3 cm) which is also supported by Sakthivel (2009).

Vigour index

Vigour index of the papaya seedlings for the poly-cum-shadenet house was found significantly higher than open field during the year 2015-2016 and pooled result. During the year 2015, vigour index was at par with black shade nethouse and in pooled result, it was at par with black shade nethouse and walk-in-type tunnel (Sakthivel 2009). It is also clear from the Table 3 that vigour index was found 3266, 2654, 2354 and 483 for poly-cum-shadenet house, black shade nethouse, walk-in-type tunnel and open field respectively which is also supported by Satasiya *et al.* (2014), Joshi and Chauhan (2016) and Sakthivel (2009). The optimum desirable climatic parameters like temperature, relative humidity and light intensity produce better vigour of the seedling (Lingaiah *et al*. 2000).

Sturdiness

Sturdiness of the papaya seedlings for the black shade nethouse was found significantly higher than open field during the year 2015 and it was non-significant during the year 2016 and pooled result. It is also clear from the Table 3 that maximum sturdiness was observed in black shade nethouse which is in line with Joshi and Chauhan (2016) whereas it was recorded minimum in open field condition.

Cost economics

Cost calculation for papaya seedling raising in differ-

Table 4. Economics of papaya seedling raising in different types of the structures and open field condition.

Sl. No.	Structure	Gross income (Rs /m^2)	Total cost (Rs /m^2)	Net profit (Rs/ m^2)	BCR
1	Poly-cum-shade net house	1175	213	962	4.50
2	Walk-in-type tunnel	1100	214	886	4.13
3	50% Black shade net house	1185	203	982	4.84
4	Open field	490	203	288	1.42

ent types of the structures and open field was worked out and presented in Table 4. Net profit per m^2 for poly-cum-shade net house, walk-in-type tunnel and 50% black shade net house were Rs 962, Rs 886 and Rs 982 respectively. It is also shown from the Table 4 that benefit cost ratio for papaya seedling raising in different types of the structures ranged 4.13 to 4.84 which is also supported by Satasiya *et al.* (2014), Joshi and Chauhan (2016), Sengar and Kothari (2009) and Sengar and Kothari (2008) while it was minimum recorded in open field due to low revenue generate cause of less germination percentage.

CONCLUSION

Seedling height, collar diameter, number of leaves per plant, tap root length and germination percentage are related to micro climatic condition inside the structures. Temperature, relative humidity and light level can be modified in the structures which influence morphology of the papaya seedling. Poly-cum-shadenet house and walk in type tunnel structure provide optimum micro climatic condition for improved morphology of off season papaya seedling raising. It was observed that poly-cum-shadenet house is best to off season papaya seedling rasing followed by walk-in-type tunnel. Vigour index and sturdiness were observed highest in poly-cum-shadenet house and black shadenet house respectively. Benefit cost ratio for papaya seedling raising in different types of the structures was ranged to 4.13 to 4.84 while it was recorded minimum in control. It is recommended to papaya cultivator to use poly-cum-shadenet house to raise the off season papaya seedling.

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