International Journal of Plant & Soil Science

34(20): 209-216, 2022; Article no.IJPSS.88024
ISSN: 2320-7035

Performance Evaluation of Coccinia (*Coccinia grandis* L. Voigt) under Different Training Systems and Growing Environments

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJPSS/2022/v34i2031146

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/88024

Original Research Article

Received 05 April 2022
Accepted 09 June 2022
Published 14 June 2022

ABSTRACT

The present investigation was conducted during 2021-2022 at the Department of Vegetable Science, Horticultural College and Research institute, Tamil Nadu Agricultural University (TNAU) to examine the performance of coccinia in different growing environments and training systems. The experiment was laid out in Factorial randomized block design (FRBD) with three replications. The treatment combinations comprised of two growing environments *viz*, open field (G_1) and polyhouse (G_2) with four training systems *viz.*, Trellis system (T_1), Vertical system (T_2), Fish net (T_3) and Pandal system (T_4). Among these treatments, vertical training system and polyhouse cultivation was found to be superior for growth and yield attributing traits. In the vertical system of training the fruit yield was superior in polyhouse with the yield of 154.76 t/ha/year and 80.49 t/ha/year in open field. The interaction effect of polyhouse environment and vertical training (G_2T_2) was revealed by the highest number of fruits per vine (17.92), fruit yield/plant (5.15/kg), annual fruit yield (61.90 kg/plant) recorded in plants trained by vertical system. From the results it was concluded that, highest productivity in coccinia could be obtained from Polyhouse condition (G_2) with the adoption of vertical system of training (T_2).

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Keywords: Coccinia; growing environments; training systems; yield traits.

1. INTRODUCTION

Coccinia (*Coccinia grandis* L.Voigt) is a tropical, dioecious perennial herbaceous vine [1]. It has heteromorphic sex chromosome 2n=24 [2]. It is an underutilized cucurbitaceous crop with ample nutritive value. It has its origin in India and most popular in southern and central India [3]. It is cultivated throughout the year in south India. The temperature range of 20 – 32 ^{0}C is ideal for the growth and yield of coccinia. The fruits are dark green with white streaks in younger stages and become red or deep orange at maturity. These fruits are used for salad purpose in tender stages and the immature fruits are consumed for culinary purposes and are harvested 7-10 days after fruit setting [4].

In polyhouses the provision of optimum microclimate especially with respect to temperature and humidity will result in congenial environment and aid in the production of fruits with increased moisture content, superior quality and tenderness. In the current scenario, only the vegetables with high market value are grown under polyhouse condition. Coccinia is gaining popularity in the recent days as salad and culinary vegetable. This growing demand makes the production of coccinia inevitable. As of now, it is grown in pandal system under open condition.

Coccinia has aggressive climbing properties and spread easily in training systems [4]. Regulation of plant framework by appropriate training system is main key factor to get high yield in polyhouse [5]. The vertical supports was found to be effective for increasing the plant height, fruit quality and yield in watermelon [6].Therefore, keeping in view of exploiting all the prospects of training systems and growing environment, the present investigation was framed to study the performance of coccinia in different growing environments and training systems to ensure high productivity.

2. MATERIALS AND METHODS

The present investigation was carried out during 2021 – 2022 at the Department of Vegetable Science; Horticultural College and Research institute, Tamil Nadu Agricultural University which is located at latitude of N 11^{0}0'34.9596" and longitude E 76^{0}55'22122". The experimental material consisted of coccinia variety CO-1 which was clonal selection from Anaikatti type. The experiment was laid out in factorial randomized block design (FRBD) with three replications. The treatment combinations comprised of two growing environments *viz.,* open field (G_1) and polyhouse (G_2) with four training systems *viz.,* Trellis system (T_1), Vertical system (T_2), Fish net (T_3) and Pandal system (T_4). Semi hard wood cuttings of 20 to 30 cm length and 2 cm thick were prepared and planted in polybags of size 25 x 15 cm and filled with sand, soil and farmyard manure in 1:1:1 ratio. The cuttings were placed in shade nets for well establishment. After four to six true leaf stage rooted cuttings were transplanted to open field and polyhouse. The cuttings were planted at the spacing of 2 x 2 m in pits of size of 30 cm^3.

Based on Soil Test Crop Response studies (STCR), the fertilizer doses were applied in polyhouse and open field to ensure the uniformity in nutrients at the experimental plots.

Chart 1. Soil test values

	Initial soil test values (Kg/ha)		
	SN	**SP**	**SK**
Open field	179(L)	21.5(M)	656(H)
Polyhouse	224(L)	23(H)	771(H)

SN- Soil available Nitrogen ; SP- Soil available phosphorus; SK – Soil available potassium in (Kg /ha)

Recommendation as per TNAU CPG, 2020	**N**	**P**	**K**
	75	**40**	**75**
Nutrients applied to open field	75	40	60
Nutrients applied to Polyhouse	75	32	60

2.1 Training Systems Adopted

2.1.1 Trellis system (T_1)

The vertical posts of 2.0 m height were fixed on the ground by burial of 50 cm depth underground. These posts were spaced at a distance of 5 m apart. G.I wires of 15 gauge thickness were extended and coapted to these vertical post. Two rows of wires were tied in parallel rows of 30 cm apart and strongly tied to vertical posts. The main stem is allowed to reach the upper wire head. The lateral branches were trained horizontally on both sides from the lowest horizontal wire.

2.1.2 Vertical system (T_2)

The primary branches of the vine were trained vertically to reach the over head wire. Excess lateral branches were thinned periodically.

2.1.3 Fish net system (T_3)

Two supporting pillars of 1.8 m height were set on the ground with 30 cm below ground and the interspaced supporting pillars are netted by nylon wires.

2.1.4 Pandal system (T_4)

Pandal was erected and the vines were spread over the pandal. The height of the pandal is 1.5 m from the ground.

Observations were recorded for vegetative, flowering and yield attributes *viz.,* vine length (cm), number of primary branches, internodal length, node at which first female flower appears, days to first flowering, days to 50 % flowering, days to first picking, number of fruits/vine, fruit length (cm), fruit diameter (cm), fruit yield/vine (kg), fruit yield/plant/year (kg) and estimated fruit yield (t/ha). The data recorded were subjected to statistical analysis as per Panse and Sukhatme [7].

3. RESULTS AND DISCUSSION

The vegetative, flowering and fruit yield attributing traits were evaluated in different growing environments and training systems and the data obtained were analyzed and their level of significance were presented in table 1, 2, 3, 4 & 5. It is clearly evident from the results that the effect due to training system and growing environments on growth, flowering and yield parameters were highly significant and their interaction effect was also found to be significant for most of the important yield attributing parameters.

3.1 Growth Parameters

It is revealed that the highest vine length (433.98 cm) and number of primary branches (5.42) was observed in coccinia plants grown under polyhouse condition (G_2) and trained in vertical system (T_2). The increase in vine length and number of primary branches under polyhouse condition is due to the positive response of coccinia to favourable micro climate that prevailed under polyhouse condition which helps in better assimilation of carbohydrates. The food accumulation in the presence of high temperature led to increased plant height. Similar findings were reported by [8] in cucumber and [9] in capsicum. The highest vine length in vertical system of training is due to the restriction of flow of nutrients to the lateral branches which results in the diversification of plant nutrients to the flow towards the apical region there by increasing the vine length. This results were in line with the findings of [10] and [11]

Internodal length was found to be higher (7.43 cm) in trellis system under polyhouse condition and least (3.98 cm) was found in the vertical system of training under open field condition. The interaction effect of internodal length under different growing environments and training systems was statistically non-significant. The internodal length of the plants was found to be increased under shaded condition, so that the plants under polyhouse condition showed longest internodal length compared to open field. The similar findings were also recorded by Díaz-Pérez [12] in bell pepper.

3.2 Flowering Parameters

The number of days for first flowering was minimum (42.01) in open field conditions trained in vertical system of training which also reflected in minimum days to picking (48.3). But the days taken for first flowering and first picking was statistically found to be non significant and it was on par with pandal system of training. This findings were similar to [10] in cucumber. The days taken for 50 % flowering was found to be non significant for different growing environments and training systems. The similar results were also reported by [13] in capsicum and [14] in cucumber. The delay in flowering in polyhouses might be due to the conditions which favoured

more vegetative growth than reproductive growth. similar findings were reported by [15] for tomato in polyhouse and [16] in tomato.

The different growing environments and training systems showed non-significant influence on nodal position count of first female flower. Plants trained with vertical system produced first female flower at least node (5.27) in polyhouse conditions while the plant trained with trellis in open field condition showed flower at highest node (6.92).

Table 1. Effect of growing environments and training systems on vine length of coccinia

Treatment combinations	Vine length (cm)								
	30 DAYS			90 DAYS			180 DAYS		
	G1	G2		G1	G2		G1	G2	
T1	37.58	79.08		139.83	248.09		291.02	408.92	
T2	54.83	87.38		173.52	273.6		337.80	433.98	
T3	44.08	81.79		158.91	253.89		308.33	414.60	
T4	47.37	83.32		163.32	267.81		324.08	424.27	
S.Ed	G	T	G x T	G	T	G x T	G	T	G x T
	0.65	0.93	1.31	2.10	2.97	4.20	2.11	2.98	4.22
CD (0.05) - G x T	2.82			9.02			9.06		

G1 -Open field , G2-Polyhouse; T1-Trellis system, T2- Vertical system,T3-Fishnet system, T4-Pandal system

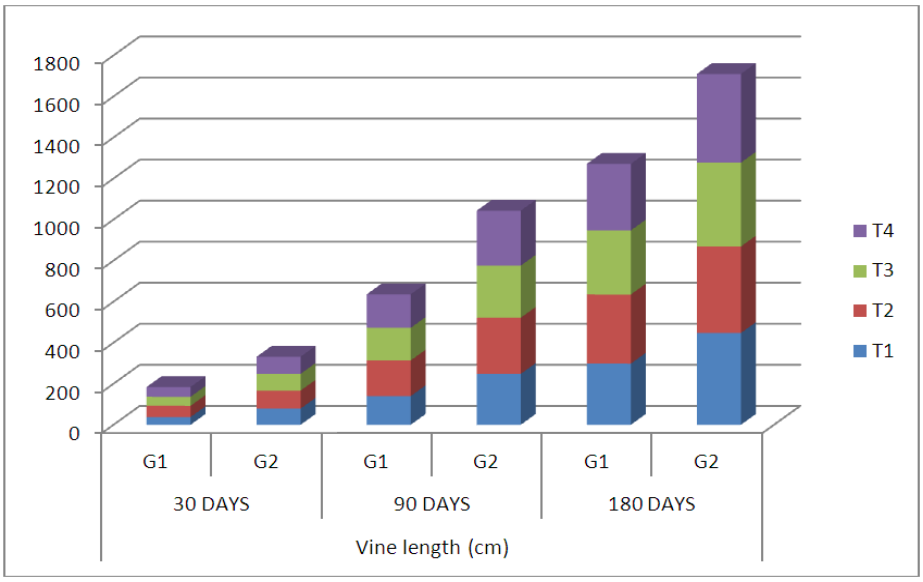

Fig. 1. Growth parameter – vine length of coccinia in different training systems and growing environments

Table 2. Effect of growing environments and training systems on number of primary branches and internodal length of coccinia

Treatment combinations	Number of primary branches			Internodal length (cm)		
	G1	G2		G1	G2	
T1	2.01	4.55		5.3	7.43	
T2	3.92	5.42		3.98	6.52	
T3	2.92	4.98		4.98	7.14	
T4	3.05	5.02		4.52	6.98	
S.Ed	G	T	G x T	G	T	G x T
	0.05	0.07	0.10	0.06	0.09	0.12
CD (0.05) - G x T	0.23			NS		

G1 -Open field , G2-Polyhouse; T1-Trellis system, T2- Vertical system,T3-Fishnet system, T4-Pandal system

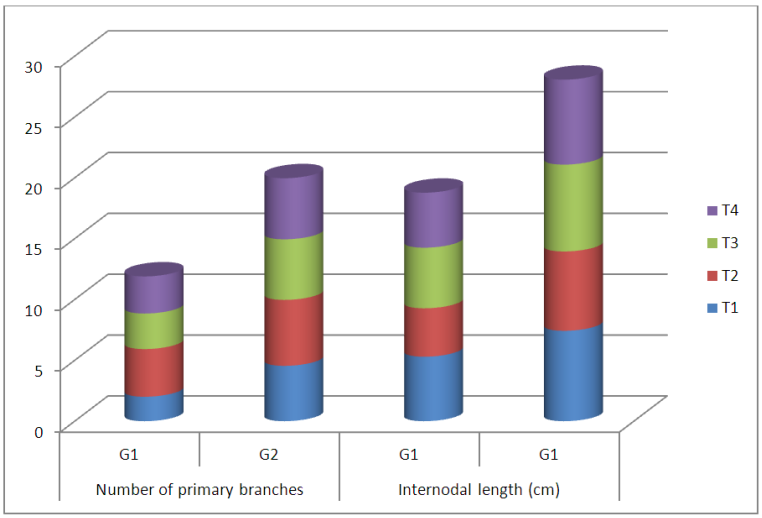

Fig. 2. Primary branches and internodal length of coccinia in different training systems and growing environments

Table 3. Interaction effect of growing environments and training systems on flowering attributes of coccinia

Treatment combinations	Node at which first female flower appears			Days to first flowering			Days to 50 % flowering		
	G1	G2		G1	G2		G1	G2	
T1	6.92	6.38		42.35	48.2		51.2	56.2	
T2	5.56	5.27		42.01	48.01		49.8	54.3	
T3	5.92	5.47		42.90	48.37		51	56.2	
T4	5.86	5.43		42.05	48.92		50.2	55.2	
S.Ed	G	T	G x T	G	T	G x T	G	T	G x T
	0.03	0.05	0.07	0.32	0.46	0.65	0.39	0.55	0.79
CD (0.05) - G x T	NS			NS			NS		

G1 -Open field , G2-Polyhouse; T1-Trellis system, T2- Vertical system,T3-Fishnet system, T4-Pandal system

3.3 Yield Parameters

Fruit length (8.92 cm) and fruit diameter (2.84 cm) was found to be highest in vertical system of training in polyhouse. The vertical system recorded 7.02 cm length and 2.25 cm fruit diameter in open field. Similar results to the findings of [14] in cucumber where the highest fruit length and diameter were recorded in vertical training system.

Vertical training system under polyhouse condition (G2T2) excelled with reference to highest number of fruits per vine (17.92), fruit yield/vine/month (1.49/kg), fruit yield/plant (5.15 kg), fruit yield/plant/year (61.90 kg/plant) and fruit yield /year (154.76 t /ha) and these characters were statistically found to be significant. Vertical system of training was found to be superior followed by pandal system. Lowest number of fruits per plant (6.87), fruit yield/vine (0.50/kg) fruit yield/plant/year (25.90 kg/plant) and fruit yield /year (64.76 t/ha) were observed in trellis system under open field condition.

The number of fruits per plant is directly proportional to fruit yield. Highest yield under protected condition is due to the favourable micro climate which helped in better photosynthesis and accumulation of food materials. The results obtained were similar to the findings of [17] in cucumber, [18] in bottle gourd. Vertical system of training recorded highest yield 154.76 t/ha/year in polyhouse and 80.49 t/ha/year in open field also. This is due to canopy structure which is highly suitable to absorb more solar energy and thus increasing photosynthesis. Similar results were recorded by [8] in cucumber, [19] in Tomato and [20] in rubber intercropping. [10] reported that vertical system of training exhibited highest yield due to the maintenance of canopy structure by training.

Table 4. Interaction effect of growing environments and training systems on fruit yield attributes of coccinia

Treatment combination	Days to first picking			Number of fruits/vine			Fruit length (cm)			Fruit diameter (cm)		
	G1		G2	G1		G2	G1		G2	G1		G2
T1	49.2		54.92	6.87		16.82	6.27		8.76	2.17		2.69
T2	48.3		53.3	8.96		17.92	7.02		8.92	2.25		2.84
T3	49		54.3	7.92		16.92	6.42		8.72	2.18		2.72
T4	48.6		53	7.96		17.52	6.56		8.87	2.21		2.81
S.Ed	G	T	G xT	G	T	G x T	G	T	G x T	G	T	G x T
	0.51	0.73	1.03	0.11	0.16	0.22	0.08	0.12	0.17	0.02	0.03	0.08
CD (0.05) - G x T	**NS**			**0.490**			**NS**			**NS**		

G1 -Open field, G2-Polyhouse; T1-Trellis system, T2- Vertical system,T3-Fishnet system, T4-Pandal system

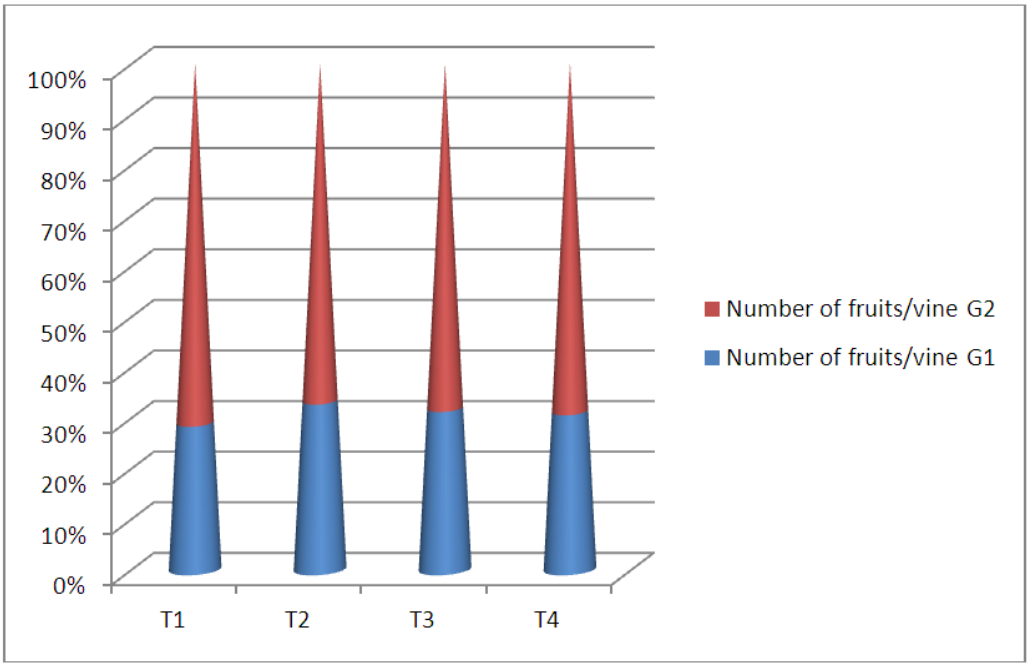

Fig. 3. Number of fruits/vine in different growing environments and training systems

Table 5. Interaction effect of growing environments and training systems on fruit yield attributes

Treatment combination	Fruit yield/vine/ month (kg)			Fruit yield/plant (kg)			Fruit yield /plant/ Year (kg)			Estimated fruit yield/year (t/ha)		
	G1		G2	G1	G2		G1		G2	G1		G2
T1	0.50		1.40	2.15	4.16		25.90		50.02	64.76		125.05
T2	0.74		1.49	2.68	5.15		32.19		61.90	80.47		154.76
T3	0.56		1.41	2.26	4.50		27.20		54.01	68.00		135.02
T4	0.64		1.42	2.53	4.79		30.43		57.54	76.08		143.85
S.Ed	G	T	G x T	G	T	G x T	G	T	G x T	G	T	G x T
	0.01	0.01	0.02	0.03	0.05	0.07	0.43	0.61	0.86	0.96	1.35	1.92
CD (0.05) - G x T	**0.048**			**0.171**			**1.859**			**4.119**		

G1 -Open field , G2-Polyhouse; T1-Trellis system, T2- Vertical system,T3-Fishnet system, T4-Pandal system

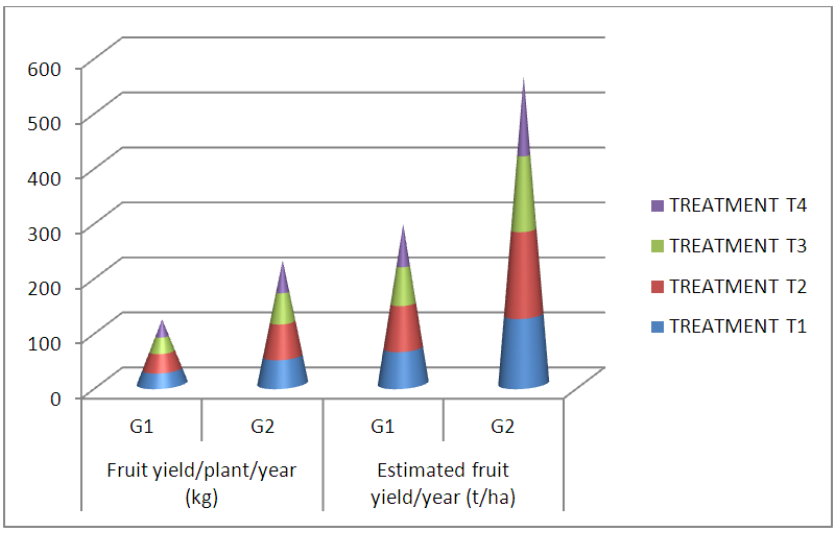

Fig. 4. Fruit yield/plant/year (kg) and estimated fruit yield/year (t/ha) in different training systems and growing environments

4. CONCLUSION

As evident from the result, it was concluded that the best performance of coccinia was found in polyhouse growing environment adopted with vertical system of training. The plant attributes *viz.*, vine length (433.98 cm), number of primary branches (5.42), number of fruits/vine (17.92) and fruit yield/plant/year (61.90 kg) were found to be superior in polyhouse condition trained with vertical system. In coccinia the fruit yield was superior in polyhouse with the yield of 154.76 t/ha/year and 80.49 t/ha/year in open field. So it could be concluded that growing environment and training system is vital to reap increased yield and productivity. Thus, highest productivity in coccinia could be obtained from polyhouse cultivation (G2) with the adoption of vertical system of training (T2).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Sharma P, Devi J, Sharma N. Cytomorphological studies on wild and cultivated vines of *Coccinia grandis* (L.) Voigt. Vegetos. 2022 :1-9.
2. Siddiqua S, Jyoti FH, Saffoon N, Miah P, Lasker S, Hossain H, Akter R, Ahmed MI, Alam MA. Ethanolic extract of *Coccinia grandis* prevented glucose intolerance, hyperlipidemia and oxidative stress in high fat diet fed rats. Phytomedicine Plus. 2021;1(4):100046.
3. Wasantwisut E, Viriyapanich T. Ivy gourd (*Coccinia grandis* Voigt, Coccinia cordifolia, Coccinia indica) in human nutrition and traditional applications. World review of nutrition and dietetics. 2003; 91:60-6.
4. BHARATHI L. 18 Ivy Gourd. Underutilized and Underexploited Horticultural Crops. 2007;1:275.
5. Premalatha MG, Wahundeniya KB, Weerakkody WA, Wicramathunga CK. Plant training and spatial arrangement for yield improvements in greenhouse cucumber (*Cucumis sativus* L.) varieties.
6. Gomes RF, Santos LS, Marin MV, Diniz GM, de Oliveira Rabelo H, Braz LT. Effect of spacing on mini watermelon hybrids grown in a protected environment. Australian Journal of Crop Science. 2017;11(5):522-7.
7. Panse VG, Sukhatme PV. Statistical methods for agricultural workers. Statistical methods for agricultural workers. 1954.
8. Sharma A, Kaushik RA, Sarolia DK, Sharma RP. Response of cultivars, plant geometry and methods of fertilizer application on parthenocarpic cucumber (*Cucumis sativus* L.) under zero energy polyhouse condition. Veg. Sci. 2011; 38(2):215-7.
9. Panigrahi HK, Tiwari SP, Agrawal N, Agrawal R, Sharma D. Comparative study of capsicum (capsicum annum l.) cv. california wonder under protected (green

house) and open field condition. international journal of agricultural and statistical sciences. 2010;6(2):659-62.
10. Dhillon NS, Sharma P, Kumar P, Singh H. Influence of Training on Vegetative Growth Characteristics and Yield of Polyhouse Grown Cucumber (*Cucumis sativus* L.); 2017.
11. Kumar S, Patel NB, Saravaiya SN. Response of parthenocarpic cucumber to fertilizers and training systems under NVPH in subtropical conditions. International Journal of Current Research. 2014;6(8):8051-7.
12. Díaz-Pérez JC. Bell pepper (*Capsicum annum* L.) crop as affected by shade level: Microenvironment, plant growth, leaf gas exchange, and leaf mineral nutrient concentration. HortScience. 2013;48(2): 175-82.
13. Thakur G, Singh AK, Patel P, Maurya P, Kumar U. Effect of training level on growth and yield of Capsicum (Capsicum annuum L) hybrid buffalo under natural ventilated polyhouse. Journal of Pharmacognosy and Phytochemistry, SP1. 2018:82-5.
14. Shivaraj D, Lakshminarayana D, Prasanth P, Ramesh T. Studies on the effect of pruning on cucumber cv. Malini grown under protected conditions. International Journal of Current Microbiology and Applied Sciences. 2018;7(3):2019-23.
15. Kumari P, Kumar M, Ojha RK, Job M. Phenological performance of tomato under microclimatic modification through mulching inside and outside the polyhouse. Progressive Horticulture. 2016;48(2): 181-5.
16. Gupta T, Thapa U, Kumar P. Assesment of Variety of Tomato for Growth Parameters under Cover and Open Field Conditon. Int. J. Pure App. Biosci. 2017;5(6):1238-45.
17. Rajalingam GV, Rajasree V, Arumugam T, Saraswathi T. Influence of different training systems in cucumber under naturally ventilated poly house. International Journal of Chemical Studies. 2017;5(6):1453-5.
18. Kalyanrao, B. T., & Singh, B. Influence of vertical trailing on seed yield and quality during seed production of bottlegourd (Legenaria siceraria) cv. Pusa hybrid-3. Seed Res 2012;40(2):139-144.
19. Rana N, Kumar M, Walia A, Sharma S. Tomato fruit quality under protected environment and open field conditions. International journal of bio-resource and stress management. 2014;5(3):422-6.
20. Swarna priya, R.. Assessment of the Growth and Yield Parameters of Fillers in Rubber Intercropping. Biological forum - International Journal. 2021;13:41-44.

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