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Standardization of production technology for hybrid coloured capsicum (*Capsicum annuum* var *grossum*) based on yield and economic benefit under different protected structures in plains of India

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ABSTRACT

The present experiment was conducted to evaluate the yield and economic gain in cultivation of coloured capsicum (*Capsicum annuum* var *grossum* (L.) Sendt) hybrids in different protected structures. Six hybrids of coloured capsicum, i.e. Indra, Natasha, Bomby in red coloured group and Orobelle, Swarna, Kanchan in yellow coloured group were tried in 3 different types of protected structures compared to open field (OF) conditions. It was found that protected technology significantly enhanced crop duration (300) days in fan-pad cum force ventilated polyhouse (FFVP), 265 days in naturally ventilated polyhouse (NVP),250 days in insect proof net house (IPNH) as compared to 200 days in open fields. FFVP technology registered maximum fruit weight and yield (1.98 kg/plant, 11.83 kg/m^2) followed by NVP(1.75 kg/plant, 10.42 kg/m^2), IPNH(1.11kg/plant, 6.68 kg/m^2) and OF (0.33 kg/plant, 1.98 kg/m^2), respectively. Economic analysis of different protected structures exhibited considerably higher net returns of ₹ 247.33/m^2 in FFVP, ₹ 309.67/m^2 in NVP, ₹ 86.43/m^2 in IPNH and ₹ 14.75/m^2 in OF condition. The benefit cost ratio was calculated as 1.73in FFVP, 2.47 in NVP, 1.48 in IPNH while the lowest value of 1.32 in OF condition. Disease incidence cum mortality of plant (2.43%) was minimum in all capsicum varieties grown under FFVP, while it was higher in NVP (6.52%) followed by IPNH (9.75%) with maximum in OF (43.65%). Whereas blossom end rot of fruits was minimum in FFVP (2.98%) followed by OF (3.28%). It is evident from the results that protected structures enhanced the production of coloured capsicum as compared to open field condition particularly during off-season in plains. Further, among different hybrid varieties evaluated, Indra in red group and Orobelle in yellow group are found more suitable for growing in these conditions while Bomby and Swarna were also performed at par under protected structure.

Key words: Capsicum hybrids, Disease incidence, Economics, Off-season, Protected structures, Yield

India is second largest vegetable producer in the world but still production and productivity is very low due to erratic climatic conditions, poor nutrient status in soil, marginal farmers, contour farming and scattered land. Consequently, even the recommended 300g/capita/day vegetable is not available to the population. Capsicum [*Capsicum annuum* L. var. *grossum* (L) Sendt] is one of the important vegetable crops required mild climates for growth and flowering. The fruits are harvested either at green, mature or coloring stage. It is rich in antioxidants vitamin A, C and other nutrients. Capsicum is having great export potential and also domestic demand in urban and peri-urban areas of the country and can fetch much higher price and more income to the farmers having small cultivation area.

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With changing weather and prevailing low night temperatures, high rainfall, hail fall, water-logging, higher relative humidity and cold wind are limiting factors for growing high value vegetables like colored capsicum under plain and hill condition of India during winter season. To make its cultivation successful in rainy and winter seasons, different protected structures like fan-pad cum force ventilated polyhouse (FFVP), naturally ventilated polyhouse (NVP) and insect proof net house (IPNH) are a valuable solution (Chandra *et al*. 2000, Savir and Singh 2013). Protected structures act as physical barrier and play a key role in IPM by arresting spread of insect pest and consequent plant diseases (Singh *et al*. 2003a, Singh and Tomar 2015). Furthermore, cultivation of hybrid varieties of vegetables have shown great production potential since it utilizes considerable amount of nutrients from soil for longer duration particularly in protected conditions (Singh *et al*. 2005 and Singh 2003a).

Farming of high value vegetable crops like capsicum has significant potential to improve small and marginal

farmers' livelihood. The information on growing vegetables particularly capsicum through protected technology under Indian condition is very scanty (Singh and Tomar 2015). Therefore, present study was conducted with the objectives to evaluate the economic feasibility of protected structures for growing capsicum and to identify suitable colored capsicum hybrids for maximum yield and economics along with minimum biotic and abiotic stress.

MATERIALS AND METHODS

Experiment was conducted during August to May months of 2012-13 and 2013-2014 at the CPCT farm in IARI, New Delhi, under protected and open field (unprotected) conditions. Six coloured capsicum hybrids namely Indra, Natasha, Bomby in red coloured groupand Orobelle, Swarna, Kanchan in yellow coloured group were evaluated in four protected structures, viz. fan-pad cum force ventilated polyhouse (FFVP), naturally ventilated polyhouse (NVP), insect proof net house (IPNH) and open field (OF) condition with three replications in factorial randomized block design during both the years.

The FFVP was a 1000 m^2 saw-tooth type, multi-span, gutter connected poly house with side and roof ventilation and fan-pad system for evaporative cooling inside the greenhouse. NVP was a 1000 m^2 arch type, two span, gutter connected structure with both side and roof ventilation. IPNH was a 1000 m^2 Quonset type, two-span structure with insect screen/net cover. FFVP and NVP were provided with thermal screen to reduce the radiation around the canopy during summer season. All the structures were having North-South orientation. All structures were made of GI pipe and having 1000 m^2 area. The polyhouses were covered with two-hundred micron thick UV stabilized transparent polyethylene sheet and 40 mesh per square inch insect proof net. The daily temperature (ºC) and relative humidity (%) inside the structure was monitored using Lutron (HT 305) sensor.

Farmyard manure was applied as basal @ 5 kg/m^2 in all treatments plots 20 days prior to transplanting. One-fourth amount of N and half amount of P and K fertilizer were applied as basal before transplanting in the form of urea, single super phosphate, potash in the ratio of 50:100:25 g/m^2 respectively just before transplanting of the crop.

The soil of experimental beds was sandy loam and having pH range 6.5-7.5. Nursery for experiment was raised under control protected condition using soilless media. In all polyhouses studied, curtains were kept open during day time and closed at night. One month old seedling was transplanted at 50cm × 30cm spacing during 1st week of August of the both years. Fertigation were provided in crops through pressurized drip system in all conditions. The round type 16mm size inline laterals were used for drip at appropriate spacing. Discharge capacities of drippers were 2 l/hr. Timely fertigation was provided by split regulator system. Recommended standard package of practices were followed to raise crop. The remaining fertilizers, calcium nitrate and micronutrient mixture were applied two times per month @ 100-200ppm through fertigation around root zone of plants.

Data on number of fruits/plant, fruit diameter (cm), weight of fruits (kg/plant) were recorded from randomly selected five tagged plants from each plot. Incidence of diseases, mortality (daily), and crop duration was also recorded. The yield (kg/m^2), cost of cultivation (₹/m^2), gross income/m^2, net return/m^2 and benefit cost ratio were compared for all protected structures along with control (open field). Pooled research results were statistically analyzed as per the standard procedure.

RESULTS AND DISCUSSION

Comparison of hybrid capsicum production performance under protected and open field conditions:

Fan-pad cum force ventilated polyhouse (FFVP) v/s naturally ventilated polyhouse (NVP): FFVP structure significantly enhanced the crop duration (13.21%), average fruit diameter (36.91%), number of fruits/plant (7.89%), average fruit weight (5.16%), fruit weight (kg/plant) (13.24%), yield (kg/m^2) (14.08%) and gross return (14.08%) over NVP (Table 2). Plants grown in FFVP experienced minimum incidence of plant mortality (-62.79%) and blossom end-rot in fruits (-43.35%) as compared to NVP during both the years. However, cost of cultivation under NVP was calculated as 64.64% lower than FFVP during both the year (Table 3). This may be due to the fact that FFVP is a closed structure which creates need based micro climate around the plants with the help of cooling, ventilation and exhaust devices. These devices could increase (winter) or decrease summer temperature (4-5^{0}C) and relative humidity (20-30%)and protects the plants from hot/cold air and other abiotic stresses during crop period. On the other hand, naturally ventilated polyhouse are simple structures without any devices to control the microclimate inside the structure which could be the reason for more infestation, decreased crop period and yield potential when compared to FFVP. The results are in congruence with Chandra *et al*. (2000), Singh *et al.* (2005) and Singh *et al*. (2004) who reported higher yield in FFVP condition than in NVP in vegetable crops.

Fan-pad cum force ventilated polyhouse v/s insect proof net house: Significant differences in growth, quality, yield and economics were noted between all capsicum hybrids grown in FFVP and IPNH (Table 1 and 3). As compared to IPNH, crop grown in poly-house was having longer crop duration (20.00%), better growth and economic attributes such as diameter (64.96%) number of fruits (24.24%), individual fruit weight (44.23%), fruits weight (kg/plant) (78.85%), yield (77.85%), gross income (122.59%), net return (186.16%) and benefit cost ratio (BCR) (16.82%), while decreased incidences of infestation and diseases observed in FFVP which resulted in minimum plant mortality (-75.13%) and blossom end-rot (-38.49%) as compared to IPNH during both years. The cost of cultivation recorded

91.97% less in the IPNH than in FFVP (Table 3). The higher yield, economics along with minimum disease and mortality under FFVP could be attributed due to its complete protective structure against abiotic stresses, which creates need based micro climate around the plants. These devices protect the plants from hot/cold air and other abiotic stresses inside of crop which reduces the effect of the rain fall, water logging, hail fall and provide controlled environment. However, IPNH was not controlling abiotic stresses except insect vector. The similar result has also been reported by Singh *et al*. (2003a) and Singh *et al*. (2003b).

Fan-pad cum force ventilated polyhouse v/s open field condition: Fan-pad cum force ventilated polyhouse (FFVP)

Table 1 Performance of coloured capsicum hybrids under different protected structures and open field condition

Treatment	Pooled data during 2012 - 2014 Observations											
	Total crop period (days)	Fruit diameter (cm)	Number of fruits/ plant	Fruit weight (g)	Weight of fruits kg/plant	Yield kg/m^2	Mortality % through all kind of Stress	Incidence of blossom-end rot in fruits (%)	#Cost of cultivation ₹/m^2	Gross income ₹/m^2**	Net returns ₹/m^2	BCR
Protected structure												
*Varieties**	*Fan-pad cum forced ventilation polyhouse (FFVP)*											
Indra (R)	300	7.40	16	143.75	2.30	13.80	2.10	2.50	346	690.00	344.00	1.99
Natasha (R)	300	7.50	14	128.57	1.80	10.80	3.10	3.50	347	540.00	193.00	1.56
Bomby (R)	300	7.80	12	160.00	1.92	11.50	2.10	3.30	346	575.00	229.00	1.66
Orobelle (Y)	300	7.30	15	142.00	2.13	12.80	3.00	2.50	348	640.00	292.00	1.84
Swarna (Y)	300	7.70	13	151.54	1.97	11.80	2.10	3.60	347	590.00	243.00	1.77
Kanchan (Y)	300	7.50	12	147.50	1.77	10.60	2.15	2.50	347	530.00	183.00	1.53
Mean	300	7.53	13.67	145.56	1.98	11.88	2.43	2.98	346.83	594.17	247.33	1.73
CD (P=0.05)	NS	0.75	1.05	1.31	0.92	1.12	1.0	1.32				
Naturally ventilated polyhouse (NVP)												
Indara (R)	265	5.40	14	137.85	1.93	11.60	7.50	4.00	210	580.00	370.00	2.76
Natasha (R)	265	5.50	13	123.07	1.60	09.50	6.50	6.50	211	475.00	264.00	2.25
Bomby (R)	265	5.60	12	147.50	1.77	10.20	6.20	4.50	210	510.00	300.00	2.42
Orobelle (Y)	265	5.35	14	137.14	1.92	11.50	5.50	4.50	212	575.00	360.00	2.71
Swarna (Y)	265	5.60	12	145.83	1.75	10.50	5.80	6.50	211	525.00	314.00	2.49
Kanchan (Y)	265	5.55	11	139.10	1.53	09.20	7.60	5.60	210	460.00	250.00	2.19
Mean	265	5.50	12.67	138.42	1.75	10.42	6.52	5.27	210.67	520.83	309.67	2.47
CD (P=0.05)	NS	0.68	1.07	1.30	0.83	1.08	1.32	1.41				
Insect proof-net-house (IPNH)												
Indra (R)	250	4.50	12	105.83	1.27	7.65	9.70	3.60	180	306.00	126.00	1.70
Natasha (R)	250	4.65	11	95.45	1.05	6.35	10.30	5.70	181	252.00	72.00	1.39
Bomby (R)	250	4.70	10	100.00	1.00	5.95	9.40	4.80	180	238.00	58.00	1.32
Orobelle (Y)	250	4.45	12	103.33	1.24	7.44	8.60	4.50	182	297.60	115.60	1.63
Swarna (Y)	250	4.60	11	100.90	1.11	6.65	9.80	5.70	181	266.00	85.00	1.47
Kanchan (Y)	250	4.50	10	100.00	1.00	6.05	10.70	4.80	180	242.00	62.00	1.35
Mean	250	4.57	11.00	100.92	1.11	6.68	9.75	4.85	180.67	266.93	86.43	1.48
CD (P=0.05)	NS	0.56	1.10	1.28	0.62	1.13	1.21	1.39				
Open field condition												
Indra (R)	150	3.50	9	50.60	0.455	2.73	40.50	2.50	45.50	81.90	36.40	1.80
Natasha (R)	150	2.50	7	40.50	0.284	1.70	43.50	3.70	46.50	51.00	04.50	1.10
Bomby (R)	150	2.75	7	43.60	0.298	1.79	45.50	3.60	45.50	53.70	08.20	1.18
Orobelle (Y)	150	3.25	8	46.70	0.374	2.24	40.50	2.50	47.50	75.00	27.50	1.58
Swarna (Y)	150	3.30	7	41.55	0.291	1.74	44.40	3.60	46.50	52.20	05.70	1.12
Kanchan (Y)	150	2.50	7	40.25	0.282	1.69	47.50	3.80	44.50	50.70	06.20	1.14
Mean	150	2.97	7.50	43.87	0.33	1.98	43.65	3.28	46.00	60.75	14.75	1.32
CD (P=0.05)	1.23	0.70	1.22	1.31	0.63	1.15	1.23	1.41				

* (R)=Red colour and (Y) = Yellow colour, ** Average sale price of Coloured capsicum of polyhouse= ₹.50/kg, net- house ₹ 40/kg and open ₹ 30/kg during 2012-2014 and number of plants/m^2 =6, # Cost of cultivation is inclusive of cost of structure plus agricultural inputs like fertilizers, manpower, electricity etc.

Table 2 Comparison between protected structures v/s open field condition on production of coloured capsicum hybrids

Structure	Pooled data during 2012–2014											
	Observations											
	Total crop period (days)	Fruit diameter (cm)	Number of fruits/plant	Fruit weight (g)	Weight of fruits (kg/plant)	Marketable yield (kg/m^2)	Mortality (%) through all kind of stress	Incidence of blossom-end rot in fruits (%)	#Cost of cultivation (₹/m^2)	Gross income (₹/m^2)	Net returns (₹/m^2)	BCR
FFVP	300	7.53	13.67	145.56	1.98	11.88	2.43	2.98	346.83	594.17	247.33	1.73
NVP	265	5.50	12.67	138.42	1.75	10.42	6.52	5.27	210.67	520.83	309.67	2.47
IPNH	250	4.57	11.00	100.92	1.11	6.68	9.75	4.85	180.67	266.93	86.43	1.48
Mean	272	5.87	12.45	128.30	1.61	9.66	6.23	4.37	246.06	460.64	214.48	1.89
Open field	200	2.97	7.50	43.87	0.33	1.98	43.65	3.28	46.00	60.75	14.75	1.32
CD (P=0.05)	26.43	0.87	2.23	0.77	0.48	2.16	11.73	1.33				

Cost of cultivation is inclusive of cost of structure plus agricultural inputs like fertilizers, manpower, electricity etc.

Table 3 Percentage increase in parameters between different protected structures v/s open fields for coloured capsicum production

Treatment	Pooled data during 2012 - 2014											
	Total crop period (days)	Fruit diameter (cm)	Number of fruits/ plant	Fruit weight (g)	Weight of fruits (kg/plant)	Yield (kg/m^2)	Mortality (%) through all kind of Stress	Incidence of blossom-end rot in fruits (%)	#Cost of cultivation (₹/m^2)	Gross income (₹/m^2**)	Net returns (₹/m^2)	BCR
Percent Increase of FFVP as compared to NVP	13.21	36.91	7.89	5.16	13.24	14.08	-62.79	-43.35	64.64	14.08	-20.13	-30.16
Percent Increase of FFVP as compared to IPNH	20.00	64.96	24.24	44.24	78.28	77.85	-75.13	-38.49	91.97	122.59	186.16	16.82
Percent Increase of FFVP as compared to OF	50.00	153.93	82.22	231.82	499.29	499.66	-94.44	-9.14	653.98	878.05	1576.81	30.68
Percent Increase of NVP as compared to IPNH	25.00	53.93	46.67	103.06	236.19	237.17	-77.66	47.72	292.75	339.40	485.99	11.87
Percent Increase of NVP as compared to OF	32.50	85.39	68.89	215.52	429.23	425.65	-85.06	60.41	357.98	757.33	1999.46	87.12
Percent Increase of IPNH as compared to OF	25.00	53.93	46.67	130.04	236.19	237.17	-77.66	47.72	292.76	339.40	485.97	11.87
Percent Increase of all protected structure as compared to Open field	35.83	97.75	65.93	192.45	388.24	387.50	-85.73	33.99	434.91	658.26	1354.10	43.22

Cost of cultivation is inclusive of cost of structure plus agricultural inputs like fertilizers, manpower, electricity etc. OF = Open field.

significantly increased percentage of crop duration (50%), average diameter (153.93%), number of fruits (82%), individual fruit weight (231.82%), fruit weight (kg/plant) (499.29%), yield (500%), gross income (878%), net income (1577%), cost benefit ratio (31%) and recorded minimum plant mortality (-94%) and blossom end rot in fruits (-9%)

as compared to open field condition. The performance of capsicum was bad in open field (OF) as compared to FFVP. All the parameters of crop and economic gain were many fold increased in case of FFVP and significantly better as compared to OF condition. The cost of cultivation under open field condition was 654% lower as compared to FFVP during both the year (Table 1 and 3). This could be due to fact that FFVP is a protective structure against abiotic stresses, which creates need based better micro climate inside of crop with the help of different devices. These devices are regulating temperature, humidity and abiotic stresses which reduces the effect of the rainfall, waterlogging, hail fall and extreme weather. FFVP structure improved winter night temperature and provide controlled environment protection against erratic climatic stresses during night which increased plant growth, fruiting and consequently, higher yield and net return was obtained from the crop. Vidhyadhar *et al.* (2015), Singh *et al*. (2004) and Chandra *et al*. (2000) have also reported higher productivity of cherry tomato, summer squash, tomato and capsicum in term of growth, yield and economics in protected cultivation.

Naturally ventilated polyhouse v/s insect proof net-house: Naturally ventilated polyhouse (NVP) significantly improved the crop performance in terms of growth, quality, yield and economics when compared to IPNH (Table 1 and 3). As compared to IPNH, crop grown in NVP improved crop duration (25%), and produced better performance and economic gain attributes such as fruit diameter (54%) number of fruits (47%), fruit weight (103%), fruit weight (kg/plant) (236%), yield (237%), gross income (339%), net return (486%) and BCR (12%) while decreased plant mortality (-78%) and blossom end-rot (48%) as compared to Insect proof net house during both the years. The cost of cultivation recorded 17% lesser in IPNH than the NVP (Table 3). The higher yield, economic and minimum disease and mortality recorded under FFVP could be due to its complete protective structure against abiotic stresses and better microclimate with the help of four side openings, roof ventilation and thermal screen. It is here stated that roof and side ventilation was closed during winter and thermal screen was opened during night which caused a difference of 2-3ºC temperature and 15-20% relative humidity between inside NVP and outside conditions. Apart from these polyhouse structure also protected the plants from hot/cold air and other abiotic stresses. On the other hand, IPNH was unable to control the effects of rain fall, water logging and hail except insect vector. Our results are very well supported with the findings of Singh *et al*. (2003a) and Singh *et al*. (2003b) wherein higher capsicum yield and economics was derived under NVP conditions due to improved microclimate and better protection from biotic stresses.

Naturally ventilated polyhouse v/s open field: From the data presented in Table 1, 2 and 3 it is evident that naturally ventilated polyhouse technology significantly increased percentage of crop period (32.50%), diameter (85.39%), number of fruits/plants (69%), fruit weight (215.52%), weight of fruits/ plant (429%), yield (426%), gross income (757%), net income (2000%) and BCR (87%) along with lower disease incidence like mortality (-85.06%) and blossom end rot (60.41%) as compared with open field conditions in both the years. On the other hand, cost of cultivation was lower by 358% in open field condition compared to NVP (Table 1 and 3). Naturally ventilated polyhouse technology protected plants from rainfall, hail fall, cloudy weather cold wind which created suitable microclimate inside and protected the plants against abiotic stress and disease incidences during rainy season (Singh *et al*. 2004, Singh *et al*. 2005).

Insect proof net-house (IPNH) v/s open field: A significant increase in diameter (53.93%), number of fruits/ plant (46.67%), individual fruit weight (130.04%), weight of fruits/plant (236.19%), yield (237.17%), gross income (339.39%), net income (485.97%), CBR (11.87%) led by higher crop duration (25%) and lower incidences of plant mortality(-77.66%) and blossom end-rot (-47.72%) in IPNH as compared to OF condition was reduced during both the years (Table 2 and 3). Although the cost of cultivation was 292.76% lower in open field condition than IPNH during both the years but higher yield and net return was recorded in IPNH to the tune of 237.17% and 485.97%, respectively. These results are very well corroborated with the results obtained by Singh *et al*. (2003a and 2005) and Chandra *et al*. (2003 and 2000).

Protected cultivation v/s open field: The average crop duration (272 days), fruit diameter (5.87cm), number of fruits/ plant (12.45), individual fruit weight (128.30g), fruits weight of (kg/plant) (1.61) (9.66 kg/m^2), gross return (₹ 460.64/m^2), net return (₹ 214.48/m^2) and BCR (1.89) were significantly higher under protected cultivation than open field condition (Table 1 and 3). Such results were ascribed due to lower plant mortality (6.23%) and blossom end rot in fruits (4.37%) under protected condition as compared to open field condition. Further these results clearly reveals that protected structures improved the crop growth and yield attributes by providing optimum microclimate around the plant and reducing the insect pest incidence. The similar findings were also reported by Vidyadhar *et al.* (2015), Singh *et al*. (2003b and 2005), Chandra *et al*. (2000), Singh *et al*. (2004) and Singh (1998). A non significant difference in physical quality of fruit was noticed under both the cultivation practices.

Effect on hybrid capsicum varieties on growth, yield, insect pest incidence and economics

Growth, yield and economics: Significant differences were observed in growth, yield and economics among all six hybrid varieties of coloured capsicum (Table 1). The red coloured hybrid Bomby and yellow coloured hybrid Swarna recorded maximum fruit diameter irrespective of the cultivation conditions. Individual fruit weight in hybrid Bomby and Swarna were on par with all hybrids of capsicum under both protected and open field conditions. However,

number of fruits per plant, fruit weight (kg/plant), total yield (kg/m^2), gross income (₹/m^2), net income (₹/m^2) and BCR were maximum in red hybrid Indra followed by yellow hybrid Orobelle as compared to other hybrids under all protected structures and in open field condition during both the years (Table 1). The performance of red hybrid Bomby and yellow hybrid Swarna were on par with Indra and Orobelle hybrids in both conditions. Although the cost of cultivation for growing coloured capsicum was minimum under open field condition as compared to protected structures. However, protected structure, which involves high initial cost in creating the structures, but due to 2-3 times higher marketable yields, early harvesting, best quality, longer crop length and better price protected agriculture fetch more viability under protected structure. The results are in close confirmation with the findings of Chandra *et al*. (2000), Singh (1998) and Singh *et al*. (2005 and 2003a). Based on the present observations these hybrids of colored capsicum can be recommended for cultivation in plains of India only under protected conditions and particularly during off-seasons.

Insect pest incidences: The higher loss of yield and economic was found in open field condition among all hybrids varieties of coloured capsicum as compared to different protected structures (Table 1 and 2). This could be due to the fact that the crops in open field were not having any protection against heavy rainfall, hail fall, cold wind, low night temperature and high humidity etc. These abiotic stresses also promotes higher incidence of diseases in plants and fruits especially wilt which is very serious plant disease in capsicum under harsh climatic conditions and causes high mortality (Table 1). Similarly blossom end rot was found more in infected fruits and plants. Similar effect on disease incidence was noted by earlier researchers (Vidyadhar *et al* (2015), Singh (1998), Singh *et al*. (2003b and Singh *et al*. (2005)). The results infer that protected structures would be a viable proposition for maximizing productivity of capsicum using hybrids Bomby, Indra, Orobelle and Swarna with low use of plant protection measures.

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