Effect of different protected structures on yield and economics of sweet pepper at farmers' field level

BALVIR KAUR and KULDEEP SINGH

ICAR- Krishi Vigyan Kendra (PAU), Jalandhar 144039 Punjab, India
Email for correspondence: usha29@pau.edu

 Received: 05.06.2020/Accepted: 18.06.2020

ABSTRACT

Farmers in Punjab use different types of material for protecting crops from adverse weather condition under low-tunnel technology of solanaceous and cucurbitaceous crops to fetch better profit margin according to cost of protecting material. Study was conducted to evaluate the effect of different types of protected structures on yield and economics of sweet pepper in three adopted villages of Krishi Vighan Kendra, Jalandhar, Punjab in Numahal block of the district during 2017-18 and 2018-19. The pooled data collected on various parameters under study viz days to first fruit harvest, number of fruits per plant, fruit weight, early yield, harvesting span and total yield during two years showed significant differences amongst treatments under study. The early as well as total yield was recorded maximum in the treatment use of polythene sheet (50 micron) followed by use of frost protection sheet (degradable) and use of polythene sheet (20 micron). The maximum B-C ratio was also recorded in the treatment use of polythene sheet (50 micron) (3.37) and use of frost protection sheet (degradable) (3.34) which were statistically at par with each other. But cost of cultivation was less in the latter as compared to the former treatment. From overall performance of the treatments used, use of protection sheet (degradable) is suggested to be feasible treatment at farmers' level.

Keywords: Capsicum; yield; earliness; protection; economics

INTRODUCTION

In the present scenario of perpetual demand for better quality vegetables and continuously shrinking landholdings protected cultivation is the best choice for quality produce and efficient use of land and other resources. In Punjab, extreme weather conditions under the open field condition are the major limiting factor in achieving higher yield and better quality of vegetables. Introduction of protected cultivation technologies (polynethouse and low-tunnel) bring about the major changes in the growth, quality and yield of the crops in prevailing adverse conditions and give high return to the farmers in solanaceous and cucurbitaceous crops. In addition these enhance vegetative growth and increase productivity which may improve the sustainability of vegetable production operations (Arancibia 2018). Low-tunnel technology which is cheaper than polynethouse to raise early crop for better profit margin has been widely adopted by majority of vegetable growers having small and medium landholding under Punjab conditions. Therefore to enhance income and to ensure nutritional security of small and marginal farmers, off-season nursery as well as vegetables cultivation under low-cost polyhouses is found to be economical and profitable enterprise (Yadav et al 2014).

Sweet pepper or Shimla mirch (*Capsicum annuum* L var *grossum*) is generally transplanted during February in open field condition in Punjab where extreme low temperature in winter season touches 0°C and as high as 45°C in summer thereby limiting the harvesting span of the crop. This situation suggests to modify microclimate which will not only increase the availability span of vegetables but also early and total yield. Low-tunnel technology includes cultivation of crops under protection using various types of materials during severe cold weather condition during December to February months. This leads to production of high quality early yield and increased harvesting span which help the farmers to get better profit margin which is not possible under open field condition. Farmers of

district Jalandhar, Punjab grow sweet pepper under low-tunnel technology in which temperature and moisture are controlled for specific period to get early yield so that they can get better profit margin in market. This technology also helps to modify microclimate which increases availability span of vegetables and thus farmers can capture the market early in the season to get good return of the produce (Lamarrel et al 1996). Demonstrations and practical trainings on low-tunnel technology of various vegetable crops are conducted under technology park at KVK farm and on farmers fields to convince the farmers to adopt these technologies for getting early crop which can fetch better price in the market. Farmers are using different types of protection materials in relation to cost of these materials which directly affects the early production.

The present study was conducted to evaluate the effect of different types of protection materials on yield contributing characters and economics of use of these technologies in sweet pepper on farmers' fields.

METHODOLOGY

The study was conducted by Krishi Vigyan Kendra, Nurmahal, Jalandhar, Punjab in three adopted village viz Dalla, Kot Badal Khan and Shadipur of Numahal block, Jalandhar district to find out the effect of different types of protected low-tunnels on yield and economics of sweet pepper at farmers' fields during the year 2017-18 and 2018-19. The climate of the region is extremely hot during the summer and cold during winter. Each location of the study under selected villages was considered as one replication.

The study consisted of six treatments viz T_1: Use of polythene sheet (50 micron), T_2: Use of polythene sheet (20 micron), T_3: Use of frost protection sheet (degradable), T_4: Use of paddy straw, T_5: Open crop and T_6: Feb transplanted crop. Nursery of sweet pepper was sown in mid-October under net tunnel to avoid the whitefly attack and transplanted in third week of November in treatments T_1, T_2, T_3, T_4 and T_5 while nursery of T_6 treatment was sown in the first week of November and transplanted in the second week of February after frost period was over. The transplanting was done on both the sides of raised beds at a distance of 120 and 30 cm between rows and plants respectively to maintain uniform plant population in all the treatments. The protecting sheets in case of treatments T_1, T_2 and T_3 were removed during last week of February when there was no risk of frost. All the cultural practices were applied as per package of practices for open cultivation recommended by Punjab Agricultural University, Ludhiana, Punjab.

The data were recorded on days to first fruit harvest, number of fruits per plant, fruit weight, early yield, harvesting span and total yield. Benefit-cost ratio, cost of cultivation and net return were also calculated for the crop. The pooled data collected on various parameters under study during two years were statistically analyzed and comparisons were made at five per cent level of significance.

RESULTS and DISCUSSION

It has been observed that yield and yield contributing characters responded significantly in all the tested treatments at each location (Table 1). For calculating days to first fruit harvest the number of days from transplanting to first fruit harvest was taken into account. It is index of earliness used under protected weather condition as early crop in market gets better price rather than main season crop when there is glut in the market. Number of days from transplanting to harvest is very important from economic point of view. The number of days to first fruit harvest varied from 85.7 to 150.3 with average value of 123.7. Minimum number of days was recorded in February-transplanted crop which was not useful for the vegetable growers as there was glut production of sweet pepper at that time. Under protected condition, treatment T_1 took minimum days (120.2) followed by T_3 (121.0) and T_4 (124.5) while maximum days were recorded in open field crop that was T_5 (150.3) followed by T_4 (140.5) where paddy straw was used as protecting material. This may be due to accumulation of maximum photosynthates favouring fast growth which triggered early initiation of flowers in capsicum (Rui et al 1989). Arin and Ankara (2001) also reported that days to first harvest were less for tunneled treatment compared to plants growing without tunnel in tomato.

Number of fruits per plant was calculated by taking average weight of 20 fruits from randomly selected 10 plants from each location ie each replication. Number of fruits is directly correlated with yield. Data showed significant difference in number of fruits per plant with average value of 14.4. Highest number of fruits was recorded in T_1 (19.4) followed by T_2 (18.9) and T_3 (18.5) which were statistically at par with one another. Minimum number of fruits per plant was recorded in T_6 followed by T_5 and T_4 which exhibited

average value of 8.6, 9.7 and 11.5 respectively. Minimum number of fruits in these treatments may be due to prevalence of unfavorable condition for crop. Bell pepper grown under plastic tunnel might have got favorable conditions for maximum growth, flowering and fruiting in comparison to other treatments resulting in more number of fruits per plant. The results are in consonance with the findings of Thakur et al (2017).

Weight of 20 randomly selected fruits from 10 selected plants was taken. Data revealed significant differences in fruit weight which varied from 34.8 to 46.3 g with average mean weight of 41.1 g. Treatment T_1 exhibited highest fruit weight (46.3 g) followed by T_3 and T_1 with average fruit weight of 44.9 and 45.9 g respectively all the three being at par. Minimum fruit weight was recorded in T_4 (34.8 g) followed by T_5 (36.4 g) and T_6 (38.5 g) the three treatments being at par.

Early yield of a particular crop is very important from economic point of view as it fetches better profit margin in the market than main season crop. Early yield varied significantly in all the treatments. In treatment T_6 wherein the crop was transplanted during main season (February) did not produce early yield. This character varied from 30 to 192.5 q/ha. Maximum early yield was recorded in T_1 with average value of 192.5 q/ha followed by T_3 and T_2 which exhibited average yield of 185.7 q and 166.2 q/ha respectively. Minimum early yield was recorded in T_5 (30.0 q/ha) followed by T_4 (59.2 q/ha). It could be due to the reason that there was continuous growth of the plants due to high temperature in the tunnel which resulted in the escape of crop from frost damage during December and January. The uncovered plants were severely affected by frost and these regained their growth during February when the frost period was over. At that time flowering started in protected crop which lead to production of early yield. Gerber et al (1988) in their study also observed similar results and reported that the pepper crop development increases with the increase in soil temperature due to low tunnel effect.

Table 1. Effect of different treatments on yield contributing characters in sweet pepper (2 years pooled data)

Treatment	Days to first fruit harvest	Number of fruits/plant	Fruit weight (g)	Early yield (q/ha)	Harvesting span (days)	Total yield (q/ha)
T_1	120.2	19.4	46.3	192.5	96.2	226.2
T_2	124.5	18.9	45.9	166.2	95.8	196.2
T_3	121.0	18.5	44.9	185.7	96.0	213.0
T_4	140.5	11.5	34.8	59.2	69.2	164.0
T_5	150.3	9.7	36.4	30.0	64.2	139.5
T_6	85.7	8.6	38.5	-	50.7	175.5
Mean	123.7	14.4	41.1	126.7	78.6	185.7
$CD_{0.05}$	4.5	1.8	3.8	5.9	4.6	2.1

T_1: Use of polythene sheet (50 micron), T_2: Use of polythene sheet (20 micron), T_3: Use of frost protection sheet (degradable), T_4: Use of paddy straw, T_5: Open crop and T_6: Feb transplanted crop

Table 2. Effect of different treatments on economics of capsicum (2 years pooled data)

Treatment	Gross return (Rs '000/ha)	Total variable cost (Rs '000/ha)	Return over variable cost (Rs '000/ha)	B:C
T_1	1018.1	301.6	716.4	3.37
T_2	881.3	273.7	609.3	3.21
T_3	958.5	281.8	659.8	3.34
T_4	410.0	201.9	209.0	2.03
T_5	209.2	163.7	45.50	1.27
T_6	263.2	168.3	94.9	1.56

T_1: Use of polythene sheet (50 micron), T_2: Use of polythene sheet (20 micron), T_3: Use of frost protection sheet (degradable), T_4: Use of paddy straw, T_5: Open crop and T_6: Feb transplanted crop

Harvesting span was calculated by number days from first fruit harvest to last fruit harvest. Harvesting span of crop under protected condition was higher than open as well as February-transplanted crop. The higher harvesting span was recorded in T_1 (96.2 days) which was statistically at par with T_3 (96.0 days) followed by T_2 (95.8 days). The minimum harvesting span was recorded in T_6 (50.7 days) followed by T_5 (64.2 days) and T_4 (69.2 days).

Total yield is an indicator of early and main season yield which varied from 139.5 to 226.2 q/ha with average mean yield of 185.7 q/ha. The total yield differed significantly in all the treatments. Yield was significantly higher in protected crop than the crop in open condition. T_1 recorded highest total yield (226.2 q/ha) followed by T_3 and T_2 with average yield of 213.0 and 196.2 q/ha respectively. Although yield recorded in T_6 was 175.5 q/ha but this was of main season which did not fetch better price in the market than early crop. The minimum yield was recorded in T_5 (139.5 q/ha) followed by T_4 (164.0 q/ha). This might be due to the fact that the crop got the maximum favorable time for its growth, flowering and fruiting under protected condition than open and February-transplanted crop.

Singh et al (2006) reported that use of plastic tunnel resulted in significantly higher plant spread, dry matter accumulation and yield attributing characters compared to control. Further the plastic tunnel enhanced earliness by 16 days besides 19 per cent higher yield over control in strawberry. Similar results were recorded by Singh et al (2013) in which they reported higher early and total yield under protected condition then February-transplanted crop.

Benefit-cost ratio was calculated to know the economics of each treatment by calculating gross income, net return and variable cost (Table 2). The highest gross return of Rs 10,18,125/ha was obtained in T_1 with B-C ratio of 3.37 while T_3 and T_2 had gross return of Rs 9,58,500 and Rs 8,81,325 with B-C ratio of 3.34 and 3.21 respectively. Results indicated that though the B-C ratio was at par in T_1 and T_3 but cost of cultivation was lesser in T_3 (Rs 2,81,875) as compared to T_1 (Rs 3,01,687). Minimum gross return was obtained in T_4 (Rs 4,10,000) with B-C ratio of 2.03 followed by T_6 (Rs 2,63,250) and T_5 (Rs 2,09,250) with B-C ratio of 1.56 and 1.27 respectively. Shukla et al (2019) reported that structure covered with 200 µ LDPE polythene and natural ventilation through shade net was found best wrt yield, physiological yield, physiological parameters, maximum net income (Rs 13,813 per structure ie Rs 215.83/m^2 area) and B-C ratio of 1.87 in sweet pepper.

CONCLUSION

The study revealed that use of different types of protecting materials under low tunnel technology of capsicum caused a significant variation in yield, yield contributing characters and economics of capsicum. Use of polythene sheet (50 micron) recorded maximum early and total yield followed by use of frost protection sheet (degradable) and use of polythene sheet (20 micron) which was major character of interest from farmers' point of view to get early as well as high yield for fetching better price in the market than main season crop. The maximum B-C ratio of 3.37 was recorded in the treatment use of polythene sheet (50 micron) and use of frost protection sheet (degradable) (3.34) which were statistically at par with each other. But cost of cultivation was less in the latter treatment. Thus the farmers were suggested to go for treatment use of frost protection sheet (degradable) keeping in view the less variable cost. The frost protection sheet is also easily degradable which is environment-friendly. It was also observed that open as well as February-transplanted crop did not get better price in the market. These technologies may help the vegetable growers to raise off-season crop of capsicum for fetching high price in the market.

REFERENCES

Arancibia RA 2018. Low tunnels in vegetable crops: beyond season extension. Publication HORT 291, Virginia Cooperative Extension, Virginia Tech.

Arin L and Ankara S 2001. Effect of low-tunnel, mulch and pruning on the yield and earliness of tomato in unheated glasshouse. Journal Applied Horticulture **3(1):** 23-27.

Gerber JM , Mohd-Khir I and Splittstoesser WE 1988. Row tunnel effects on growth, yield and fruit quality of bell pepper. Scientia Horticulturae **26(3-4):**191-197.

Lamarrel M, Larean MJ, Payette S and Fortin C 1996. Influence of nitrogen fertilization, row covers and cultivars on the production of day neutral strawberry. Canadian Journal Soil Sciences **76:** 29-36.

Rui RL, Nie YQ and Tong HY 1989. Protective effect of plastic film coverage on photosynthesis of capsicum in summer. Jiangsu Agriculture Science **8:** 30-31.

Shukla C, Acharya SK, Bhakar SR and Jamrey PK 2019. Effect of different micro-climate on the physiological parameters and yield of capsicum. Horticulture International Journal **3(2):** 61-65.

Singh K, Singh R, Khurana DS and Singh J 2013. Effect of low poly-tunnel on the growth, yield and harvesting span of sweet pepper. HortFlora Research Spectrum **2(1):** 45-49.

Singh R, Asrey R and Kumar S 2006. Effect of plastic tunnel and mulching on growth and yield of strawberry. Indian Journal Horticulture **63(1):** 18-20.

Thakur S, Thakur R and Mehta DK 2017. Evaluation of genotypes of bell pepper (*Capsicum annuum* L) in cold desert zone of Tabo valley of Spiti district of Himachal Pradesh. International Journal of Agricultural Sciences **13(1):** 30-33.

Yadav RK, Kalia P, Choudhary H, Husain Z and Dev B 2014. Low-cost polyhouse technologies for higher income and nutritional security. International Journal of Agriculture and Food Science Technology **5(3):** 191-196