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# EFFECT OF DIFFERENT TUNNEL COVERS ON GROWTH AND YIELD OF SWEET PEPPER

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## Abstract

A popular sweet pepper variety 'California Wonder' was evaluated under different protective structures in two consecutive seasons of 2008-09 and 2009-10 at the experimental field of Horticulture Research Center (HRC) of Bangladesh Agricultural Research Institute (BARI), Gazipur. Protective structures had remarkable and significant influence on plant growth and yield of the sweet pepper. The plants grown under tunnel cover with polythene and nylon net or tunnel cover with only nylon net had higher plant height compared to that of plants grown in open field. In both of the seasons the highest individual fruit weight (76.13g and 73.71g, respectively) was recorded from the plants grown under tunnel cover with polythene and nylon net while it was the lowest from open field grown plant (45.44g and 48.2g, respectively). The highest number of fruits per plant was recorded in both seasons from the plants grown under tunnel cover with polythene and nylon net and it was closely followed by tunnel cover with only nylon net. The maximum fruit yield per plant (550.1g) was recorded in 2009-10 from tunnel cover with polythene and nylon net which was followed by tunnel cover with only nylon net (439.58g). The lowest per plant fruit yield was obtained from the crop grown in open field (125.1g) indicating brighter scope for sweet pepper cultivation under protective structures.

***Key Words:*** Sweet pepper, protective structures, polythene, nylon net

## Introduction

Sweet pepper (*Capsicum annuum* L.) is one of the most important vegetable crops grown extensively throughout the world especially in the temperate countries. The crop is very sensitive to environmental factors (Bhatt *et al.* 1992). Owing to its sensitivity to biotic and abiotic stresses, its yield is affected significantly. Sweet pepper is the most important summer crop of temperate regions but now-a-days efforts are being made to grow sweet pepper in Bangladesh (Paul, 2009). Some advanced farmers grow sweet pepper sporadically to meet the demand of the periphery of Dhaka city (Saha and Salam, 2004). Its production in Bangladesh is largely affected by high infestation of mite, aphid and low night temperature (Anon, 2008). The optimum temperature requirement for sweet pepper growth ranged from 16-25 °C. High night temperature is more detrimental to fruit set than day temperature (Rylski and Spigelman, 1982). Again night temperature below 16 °C and day temperature above 32 °C also causes blossom dropping (Boswell, 1964). In Bangladesh, December to January night temperature gradually declined below 10 °C or less. Under this situation vegetative and reproductive growth stages of Capsicum plants become ceased or stunted and also, fruit and flower drops may occur. So for proper growth and yield of sweet pepper in winter at low temperature under netted poly tunnel or poly house may be an effective way to grow them because it protect the plants from pest infestation and from cold injury since night temperature inside poly covers raises higher than outside. There are reports that shading of plants or partial reduction in solar radiation increases the yield and yield contributing characters particularly number of fruits and fruit size (Bose and Som, 1986; Bose *et al.* 1993). However, information regarding use of protective structures for sweet pepper production in Bangladesh is very scanty. Therefore, the present investigation was undertaken to study the effect of protective structures on the growth and yield of sweet pepper.

## Materials and Methods

The study was conducted at Olericulture Division, HRC, BARI Gazipur, during Rabi season of two consecutive years of 2008-09 and 2009-10. The study was set up in RCB design with four replications. One popular commercial sweet pepper variety California Wonder was included in the study with three protective structures (tunnel covered with polythene and nylon net, tunnel covered with only nylon net and tunnel covered with only polythene; Fig. 1) and a control. The height of the structure was 1.0 meter above soil surface and the thickness of the polythene was

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0.5 mm while 120 mesh nylon net was used in this study. Seeds were sown in the seedbed on October 17 of 2008 and 2009. Seedlings of 2-3 leaf stage were transplanted in poly bags. Thirty five day old seedlings (4-5 true leaf stage) were transplanted in the experimental plots. The unit plot size was 4.0 m × 1.0 m and the plants were spaced 50 cm × 40 cm between plant-to-plant and row-to-row, respectively. The crop was fertilized with well decomposed cowdung, urea, TSP, MP, Gypsum and ZnO at the rate of 10 ton, 220 kg, 330 kg, 200 kg, 110 kg and 5 kg per hectare, respectively. Half of the quantity of cowdung was applied at final land preparation. The remaining cowdung, entire quantity of TSP, ZnO, Gypsum and one third each of urea and MP were applied during pit preparation. The rest of urea and MP were applied in two equal splits at 25 and 50 days after transplanting in the main field (Rashid *et al.* 2006). Irrigation, weeding and mulching were done as and when required. Data were recorded on yield and yield attributes and these were analysed using MSTAT software for interpretation of the results.

## Results and Discussion

Days to first flower, days to first harvest, plant height and number of fruits per plant are presented in Table 1. Days to first flower and days to first harvest were not significantly affected by the protective structures in both the years. However, days to first flower ranged from 58.0 to 62.0 days while days to first harvest varied from 97.0 to 103.0 days. Plant height was significantly influenced by the protective structures. The tallest plant was observed when grown under tunnel cover with polythene and nylon net while it was the lowest under open field condition. Low night temperature and other biotic and abiotic stresses in the open field were responsible for low plant growth. Boswell (1964) opined that low night temperature is very detrimental for growth of sweet pepper. In 2008-09 the highest number of fruits per plant was recorded from the plants grown under tunnel cover with polythene and nylon net (4.85) closely followed by tunnel cover with only nylon net (4.73) while it was the lowest from the plants grown in open field (2.55). Similar trend was also reflected in 2009-10 results where the highest number of fruits per plant was 7.52 when grown under tunnel covered with polythene and nylon net which was identical with that of tunnel covered with only nylon net (6.66). Individual fruit weight, fruit length and fruit diameter were also found the highest for those plants grown under tunnel covered with polythene and nylon net (Table 2). The heaviest individual fruit weight (76.13 g) was recorded from plants grown under tunnel covered with polythene and nylon net closely followed by tunnel cover with only nylon net (68.63g) in 2008-09 and 2009-10. The lowest individual fruit weight was recorded in both of the years (45.0 and 48.0g, respectively) when grown in open field condition. The highest fruit yield per plant (362.9 g and 550.1g, respectively) was obtained from the plants grown under tunnel covered with polythene and nylon net followed by those plants grown under tunnel covered with only nylon net (329.5 g and 439.58g, respectively) while it was the lowest from the plants grown in open field (138.1g and 125.1g, respectively).

**Table 1. Days to flower, days to harvest, plant height and number of fruits per plant of sweet pepper under different protective structures**

| Treatment | Days to flower | | Days to harvest | | Plant height (cm) | | Number of fruits plant$^{-1}$ | |
|---|---|---|---|---|---|---|---|---|
| | 2008-09 | 2009-10 | 2008-09 | 2009-10 | 2008-09 | 2009-10 | 2008-09 | 2009-10 |
| $T_1$ | 62.0 | 59.7 | 99.3 | 102.8a | 55.72a | 72.55a | 4.85a | 7.52a |
| $T_2$ | 61.0 | 59.0 | 98.0 | 101.5b | 49.28b | 65.90a | 4.73a | 6.66a |
| $T_3$ | 61.0 | 58.0 | 97.5 | 99.8c | 46.38b | 47.30b | 3.5b | 3.43b |
| $T_4$ | 61.5 | 61.2 | 97.5 | 98.5c | 43.95b | 46.34b | 2.55b | 2.81b |
| F-Test | ns | ns | ns | * | ** | ** | ** | ** |
| CV% | 2.56 | 2.57 | 1.35 | 1.49 | 5.8 | 5.87 | 14.84 | 12.93 |

*ns: not significant, *, **: significant at 5% and 1% level of probability, respectively*
*T1: Tunnel cover with polythene and nylon net, T2: Tunnel cover with only nylon net, T3: Tunnel cover with only polythene, T4: Control (open field)*

From the above discussion it is clear that protective structure is a prerequisite for successful sweet pepper production under Bangladesh condition. Protective structures provide favourable conditions and also protect the crops from pests. Structures were found more effective because at night sweet pepper plants covered with polythene sheet and nylon net are protected from cold injury, mites and aphids which might enhanced proper growth and development of the plants. It was also observed that the average minimum temperature under protective structures was 2-3 $^{\circ}$C higher than that of open field temperature (Table 3). Boswell (1964) reported that night temperature below 16 $^{\circ}$C and day temperature above 32 $^{\circ}$C caused blossom dropping. The increased temperature in protective structures compared to open field favours proper growth and development of the plant. The minimum temperature from 15 December to 15 January in the protective structure was around 14$^{o}$C while it was around 11$^{o}$C in the open field condition (Table 3). This variation in temperature might be the cause of yield variation between open field and protective structure.

Apart from that shade also improved yield of sweet pepper as suggested by El-Aidy *et al*. (1989). Wien *et al*. (1989) concluded that a little shade in the tropics might benefit pepper growth. Protective structures of the present study protect the plants from direct sun. Paul (2009) also opined that use of poly-shade and shade nets were very much effective for sweet pepper.

In conclusion sweet pepper production under Bangladesh condition is possible provided that the crop is protected from biotic and abiotic stresses by any means like protective structures of polythene and nylon net. Protection of plants from low night temperature during heavy cold, protection of the plants from mites and insects are the prerequisite for successful sweet pepper production in Bangladesh.

**Table 2. Yield and yield attributes of sweet pepper under different protective structures**

| Treatment | Individual fruit wt(g) | | Fruit length (cm) | | Fruit diameter (cm) | | Fruit yield plant$^{-1}$ (g) | |
|---|---|---|---|---|---|---|---|---|
| | 2008-09 | 2009-10 | 2008-09 | 2009-10 | 2008-09 | 2009-10 | 2008-09 | 2009-10 |
| $T_1$ | 76.13a | 73.71a | 7.11 | 8.97a | 5.98 | 6.26a | 362.9a | 550.1a |
| $T_2$ | 68.63a | 66.11ab | 6.81 | 7.04a | 5.62 | 5.36ab | 329.5a | 439.58b |
| $T_3$ | 53.63b | 53.23bc | 6.73 | 6.09b | 5.06 | 4.50bc | 187.1b | 183.96c |
| $T_4$ | 48.2b | 45.44c | 6.26 | 4.08c | 5.16 | 3.82c | 138.1b | 125.10c |
| F-Test | ** | ** | ns | * | ns | * | ** | ** |
| CV% | 6.51 | 11.51 | 13.05 | 11.33 | 12.78 | 9.65 | 10.29 | 12.93 |

*T1: Tunnel cover with polythene and nylon net, T2: Tunnel cover with only nylon net, T3: Tunnel cover with only polythene, T4: Control (open field); *,**= Significant at 5% and 1% level of probability, respectively, ns= not significant; Means followed by same letter(s) in a column do not differ significantly by LSD*

**Table 3. Maximum and minimum temperature and Relative humidity (RH) inside tunnel cover and open field from December 2008 to February 2009**

| Period | Maximum Temperature | | | | Minimum Temperature | | | | RH (%) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | T1 | T2 | T3 | T4 | T1 | T2 | T3 | T4 | Morning | Evening |
| 2008 | | | | | | | | | | |
| December 1-10 | 33.0 | 31.0 | 30.0 | 28.61 | 21.0 | 19.5 | 19.0 | 18.15 | 96.6 | 70.0 |
| December 11-20 | 30.0 | 30.0 | 28.0 | 23.87 | 18.0 | 17.0 | 17.0 | 16.2 | 96.7 | 78.6 |
| December 21-31 | 32.0 | 30.0 | 29.0 | 24.35 | 16.5 | 15.0 | 15.0 | 14.17 | 96.5 | 76.09 |
| 2009 | | | | | | | | | | |
| January 1-10 | 33.0 | 32.0 | 28.0 | 26.24 | 15.5 | 14.0 | 13.0 | 12.27 | 95.4 | 64.8 |
| January 11-20 | 32.0 | 31.0 | 27.5 | 25.85 | 16.0 | 15.5 | 14.5 | 13.07 | 96.6 | 69.4 |
| January 21-31 | 32.0 | 31.5 | 27.0 | 25.45 | 18.0 | 16.5 | 16.0 | 15.35 | 96.6 | 76.36 |
| February 1-10 | 35.0 | 35.0 | 29.0 | 27.99 | 14.0 | 13.0 | 13.0 | 12.84 | 94.9 | 50.0 |
| February 11-20 | 37.0 | 36.0 | 31.0 | 29.29 | 16.0 | 15.0 | 15.0 | 14.46 | 88.1 | 45.4 |
| February 21-28 | 37.5 | 36.0 | 33.0 | 31.44 | 20.0 | 19.5 | 19.0 | 18.8 | 88.7 | 43.5 |

*T1: Tunnel cover with polythene and nylon net, T2: Tunnel cover with only nylon net, T3: Tunnel cover with only polythene, T4: Control (open field)*


**Fig. 1. Sweet pepper under different protective structures**

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