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Research Article

Effects of photo-selective netting in Summer Beefsteak Tomato (*Solanum lycopersicum* L.) cultivation on the environmental conditions under nets as well as growth and yield

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Abstract

Located in a subtropical zone, Taiwan has intense summer sunlight that affects beefsteak tomato cultivation. In this study, beefsteak tomatoes were grown net-house under photo-selective netting of different colors to investigate netting performance. A significantly higher photosynthetic photon flux density (PPFD) was observed under the 24-mesh white (W24) and 24-mesh pink (H24) netting. A difference between the four net-house was only observed for wavelengths of 500–599nm. In 32-mesh blue (B32), the red to blue (R/B) and red to far-red (R/FR) ratios were significantly lower across canopies. The photosynthetic capacity of photosystem II of leaves in W24 was the lowest among the four treatments. In all four, fruit growth was relatively low under the impact of high temperatures, with the lowest single fruit weight and the smallest number of fruits per plant observed in W24. In H24 and 24-mesh pink (HH24), the yield per plant was significantly higher. Significantly fewer whiteflies were observed in the netting houses in H24, HH24, and B32 than in W24. However, the netting still failed to prevent high temperatures at noon. In H24 and HH24, the amount of light retained in the canopies was greater, the photosynthesis capacity was unchanged, the fruit yield was greater and the number of whiteflies in the netting houses was significantly lower. Therefore, pink netting is recommended for beefsteak tomato cultivation.

Introduction

Taiwan has hot and dry weather in the summer. Excessive sunlight and high ambient temperatures affect the photosynthetic ability of plants and plant growth. Photo-selective netting has emerged as a means to reduce sunlight intensity in facility-based horticulture. Colored shade netting absorbs different spectrums of light through light additives, thereby affecting light quality. Red, yellow, and white netting reduce UV light and enhance red and far-red light, whereas black netting reduces UV light but enhances red and far-red light [1]. For instance, under excessive solar radiation [2], colored shade netting was reported to help alleviate sunscald with bell peppers and tomatoes [3]. Sustained high ambient temperatures (35–40°C) can impair cell division and leaf development [4], and excessive light and high temperatures can also negatively affect the photosystem for photosynthesis.

Colored shade netting can enhance the ability of light to

penetrate the canopy by increasing scattering [5]. In addition, colored shade netting affects the spectral composition inside the netting. The red to the far-red ratio (R/FR) is substantially higher (close to 1) under red netting than under blue netting (~0.8). This ratio affects crops through phytochromes. A low R/FR ratio under shade reduces the activity of phytochromes, leading to stem elongation, root tip enhancement, and reduction of branches [6]. It also increases scattering and red and far-red light, thereby increasing the leaf area of bell pepper and tomato while increasing the plant height of the tomato [3]. By contrast, a high R/FR ratio increases the activity of phytochromes, limiting leaf expansion and inducing beneficial physiological responses, most notably reducing stem elongation and making plants firmer [7].

In addition to improving light quality, colored shade netting can prevent pests from accessing plants. A study by Yakir, et al. [8] on green peppers (*Capsicum annuum* L.) and tomatoes (*S. Lycopersicum* L) grown in net-houses in Israel revealed that

the infestation levels of aphids and whiteflies under yellow and white netting were 2–3 times lower than those under black or red netting.

This study investigated which color and mesh size of netting enhanced vegetable production. The study had two objectives: (1) to investigate the influence of photo-selective netting of different colors on the light conditions and ambient temperature and humidity inside netting houses in summer, and (2) to examine the effect of environmental conditions in different netting houses on beefsteak tomato vegetative and reproductive growth. The results can provide a reference to colored net manufacturers to produce nets that can increase crop yields.

Material and method

Study site

This research was conducted from August to October 2021 in the net house of the Department of Horticulture, National Chung Hsing University, Taiwan. The medium used in the experiment was a mixture of peat moss, perlite, and vermiculite at the ratio of 8:1:1 (v:v:v). Black baskets (60cm×40cm×25cm) were filled with the mixture and placed in net-houses (3.6m×4m×2.5m) built of different types of net.

Netting

The experiments were conducted using four types of netting: 1) white netting (W24, 1.06mm×1.06mm, Hun-Kun enterprise co., LTD, Taiwan). 2) pink netting (H24, 1.06mm×1.06mm, Hun-Kun enterprise co., LTD, Taiwan). 3) improved pink netting (HH24, 1.06mm×1.06mm, Hun-Kun enterprise co., LTD, Taiwan, and Industrial technology research institute, Taiwan). H24 and HH24 with different color additives in the process, which causes them to possess different photo-selective abilities. 4) blue netting (B32, 0.8mm×0.8mm, Hun-Kun enterprise co., LTD, Taiwan). In addition, another white netting (W32, 0.8mm×0.8mm, Jenn-Yeong biotech LTD, Taiwan) was added to analyze the light conditions without conducting the planting experiment.

Plant materials and growth survey

Tomato cultivar 'Chenfu 994' (All Lucky Seed CO., LTD, Taiwan.) was used in the experiment. The tomato seedlings were transplanted when they had 3 to 4 leaves and 1 heart. Each black basket contained 4 tomato seedlings with a row spacing is 50cm×40cm and there were four baskets in each net-house. The plants were pruned single-stem and tied nylon rope fixed with clips so that the tomato stem would climb upward. The lateral buds were completely removed, and the lower leaves were appropriately removed as the plant grows. When the plant grows to the fourth inflorescence, leave three leaves above the inflorescence for topping.

Plant height, number of nodes, and stem diameter were investigated every two weeks after transplanting. Four weeks after transplant, internode length and leaf length of the first inflorescence were investigated. One month after transplant, leaf thickness was measured by Digital Thickness Gauge (547-

320S, Mitutoyo, Japan) and leaf relative chlorophyll content was measured by SPAD 502 plus chlorophyll meter (2900P, Spectrum Technologies, Taiwan).

Leaf gas exchange

Leaf evapotranspiration, net photosynthesis, intercellular CO₂ concentration, and stomatal conductance of the plants were investigated from 10:00 am to 12:00 pm by using LI-6800(LI-COR, United States).

Fruit survey

During the second week after flowering, the number of flowers and fruits in the second to fourth inflorescences was recorded to calculate the fruiting rate. After the fruit matured, fruit yield per plant and single fruit weight of the first to fourth inflorescences were measured.

Net-room interior light

From August to October, the light spectrum and intensity in the net-house were measured by Spectral Irradiance Meter (Ai 101, Apacer Technology Inc. Taiwan) on sunny days, and each measurement was performed at three random locations within the net-house. The light conditions at the top of the tomato plant stem, the third inflorescence, and the first inflorescence were measured by Ai 101.

Statistical analysis

The experiment adopted a completely randomized design (CRD), with three replicates for one treatment and three plants for one replicate. All data were represented as the mean value of replication. The statistical analysis was performed using the software SAS Enterprise Guide 9.4 (SAS. Institute, Cary NC), and the mean-variance of the data were analyzed using Fisher's least significant difference (LSD) test at a 0.05 probability level.

Results

Ambient temperature, humidity, and light in netting houses

Figure 1 reveals the daily variation of ambient temperature throughout August and September at the study site. In the

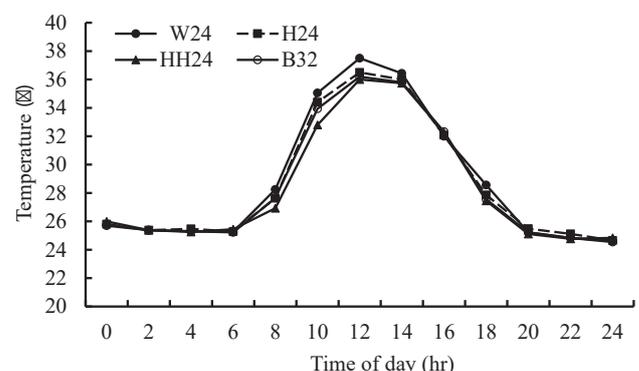


Figure 1: The average air temperature under different photo-selective netting during August and September.

four main treatments, high temperatures over 30°C were observed from 10:00 to 16:00. In treatment W24, the ambient temperatures were 35.0°C at 10:00, 37.5°C at 12:00, and 36.4°C at 14:00, all of which were the highest among the four treatments. In treatment HH24, the ambient temperatures were 32.8°C at 10:00 and 36.0°C at noon, both of which were the lowest among the four treatments. Of all the treatments, the lowest value of ambient humidity was observed at 14:00 (44%–47%; Figure 2).

Table 1 and Figure 3 present analyses of luminous intensity and quality in different netting houses at noon on a sunny day. The light intensities in treatment W24 (2268.14 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$), H24 (2072.75 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$), and H32 (2048.41 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$) were significantly higher than other treatment, followed by that in treatment HH24 (1719.46 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$). The light intensity in treatment B32 (1496.49 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$) was the lowest among the five treatments. The R/B and R/FR ratios of treatment B32 were significantly lower than those of the others. The spectral compositions of ambient light in the netting houses were compared. Among the five treatments, a significantly lower irradiance was observed only in the wavelength band of 500–599 nm in treatment HH24, and no significant difference was observed in other wavelength sections among the five treatments.

Tomatoes

A PPFD investigation was conducted of tomato plants with different canopy heights in the third inflorescence (Table 2). The PPFD measured in the upper, middle, and bottom layers of the plants in treatments W24, and H24 were significantly higher than those in treatments HH24 and B32. The R/B ratios of the upper, middle, and bottom layers in treatment B32 were the lowest by a significant margin among the four main

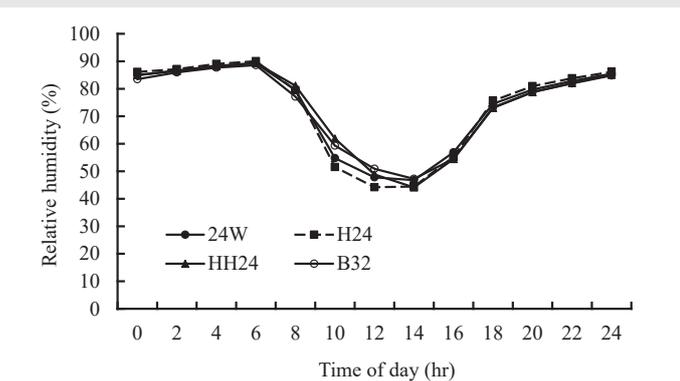


Figure 2: The average relative humidity under different photo-selective netting during August and September.

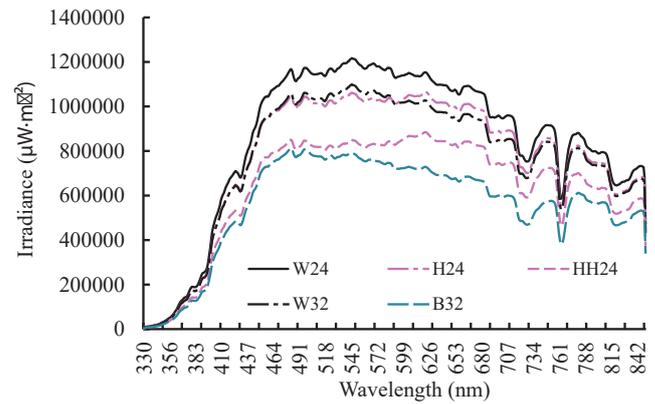


Figure 3: Irradiance measurement under different photo-selective netting at noon of sunny day.

treatments. The R/FR ratios of the middle and bottom layers of plants in treatment HH24 were significantly lower than those in treatments W24 and H24, and those of the layers of various heights in treatment B32 were all significantly lower than those of the other three treatments.

Table 3 presents the beefsteak tomato plant height measurements 4 weeks after transplanting. The plant heights in treatments HH24 (108.0cm) and B32 (106.5cm) were significantly higher than those in treatments W24 (84.1cm) and H24 (88.5cm). Significantly longer internode lengths were observed in treatments HH24 (6.33cm) and B32 (6.0cm) than in the other two treatments. The internode lengths in treatments W24 and H24 were 5.06 and 5.31cm, respectively. No significant difference was observed in the number of plant nodes among the four main treatments. The stem diameter in treatment W24 (6.03mm) was significantly smaller than that of the other treatments. Leaf traits were investigated (Table 4). The leaf lengths in treatments H24 (36.3cm) and B32 (34.3cm) were significantly longer than those in treatments W24 and HH24. However, the blade thicknesses in treatments W24 (0.41mm) and H24 (0.40mm) were significantly thicker than the others. No significant difference was observed in relative chlorophyll content among these four treatments.

The gas exchange capacity of beefsteak tomato leaves between 10:00 and 12:00 was investigated (Table 5). The net photosynthetic capacity of leaves in treatment H24 (12.36 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$) was significantly higher than that of leaves in treatment W24, which was the lowest among the four main treatments. No significant difference in intercellular CO₂ concentration was observed among these four treatments. The stomatal conductance of leaves in treatment HH24 (0.136 $\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$) was significantly higher among these four treatments. No

Table 1: Photosynthetic photon flux density and irradiance spectrum under different photo-selective net at noon of sunny day.

Treatment	PPFD ($\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$)	R/B	R/NIR	Irradiance (%)				
				330-399 nm	400-499 nm	500-599 nm	600-699 nm	700-850 nm
W24	2268.14 a ²	5.41 a	1.69 a	1.9 a	20.4 a	26.3 a	24.4 a	27.0 a
H24	2072.75 a	5.62 a	1.68 a	1.9 a	20.2 a	25.5 a	24.6 a	27.8 a
HH24	1719.46 ab	5.77 a	1.65 a	1.9 a	20.0 a	24.7 b	24.9 a	28.5 a
W32	2048.41 a	5.32 a	1.63 a	1.9 a	20.5 a	26.3 a	23.9 a	27.4 a
B32	1496.49 b	4.89 b	1.52 b	2.0 a	21.4 a	26.0 a	23.1 a	27.5 a

²Means within the same letters in column are not significantly different by Fisher's LSD test at 5% level

Table 2: Effects of different photo-selective netting on the PPFD, R/B and R/FR within the canopy of the tomato plant at noon of sunny day.

Treatment	Canopy	PPFD ($\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$)	R/B	R/FR
W24	Upper	1961.5 a ²	5.45 ab	1.72 a
	Middle	933.8 a	5.57 a	1.50 a
	Lower	623.1 a	5.79 a	1.01 a
H24	Upper	1989.3 a	5.90 a	1.71 a
	Middle	940.5 a	6.03 a	1.52 a
	Lower	582.1 a	6.06 a	0.97 a
HH24	Upper	1682.5 b	5.85 a	1.68 a
	Middle	761.5 ab	6.02 a	1.28 ab
	Lower	501.5 b	6.22 a	0.88 ab
B32	Upper	1669.6 b	4.89 b	1.59 b
	Middle	623.5 b	5.02 b	1.13 b
	Lower	465.5 b	5.11 b	0.87 b

²Means within the same letters in column are not significantly different by Fisher's LSD test at 5% level.

Table 3: Effects of different photo-selective netting on beef tomato plant height, node, internode length and stem diameter at 4 weeks after transplanting.

Treatment	Plant height	Node	Internode length	Stem diameter
	(cm)	(No.)	(cm)	(mm)
W 24	84.13 b ²	15.8 a	5.06 b	6.03 b
H 24	88.67 b	16.2 a	5.31 b	6.45 a
HH 24	108.00 a	17.2 a	6.33 a	6.32 a
B 32	106.50 a	16.0 a	6.03 a	6.23 a

²Means within the same letters in column are not significantly different by Fisher's LSD test at 5% level.

Table 4: Effects of different photo-selective netting on beef tomato leaf size and SPAD reading.

Treatment	Leaf length	Leaf thickness	SPAD
	(cm)	(mm)	
W 24	29.51 b ²	0.41 a	48.1 a
H 24	36.32 a	0.34 b	45.1 a
HH 24	31.23 b	0.40 a	49.8 a
B 32	34.32 a	0.32 b	50.1 a

²Means within the same letters in column are not significantly different by Fisher's LSD test at 5% level.

Table 5: Effects of different photo-selective netting on beef tomato leaf photo-synthetic character.

Treatment	E ²	P _n	C _i	g _{sw}	Fv/Fm
	(mmol m ⁻² s ⁻¹)	($\mu\text{mol m}^{-2}\text{ s}^{-1}$)	($\mu\text{mol mol}^{-1}$)	(mol m ⁻² s ⁻¹)	
W 24	2.06 a ²	10.95 b	326.5 a	0.124 b	0.73 b
H 24	1.90 a	12.36 a	306.4 a	0.124 b	0.79 a
HH 24	1.83 a	11.19 ab	310.2 a	0.136 a	0.79 a
B 32	1.81 a	11.41 ab	303.7 a	0.127 b	0.80 a

²E- evaporation rate. P_n - net photosynthetic rate. C_i - Leaf internal CO₂ concentration. g_{sw} - stomatal conductance. Fv/Fm- quantum yield of photosystem.

²Means within the same letters in column are not significantly different by Fisher's LSD test at 5% level.

Table 6: Effects of different photo-selective netting on the fruit mass, number of fruit per plant, yield per plant and the days to red maturity stage.

Treatment	Fruit mass	Fruit number per plant	Yield per plant	Days to red maturity stage
	(g)	(No./plt)	(g/plt)	(No.)
W 24	75.8 b ²	17.6 b	1327.6 b	42.3 b
H 24	88.4 a	19.8 a	1842.2 a	44.6 a
HH 24	82.6 ab	20.0 a	1774.0 a	44.1 a
B 32	79.1 b	18.2 ab	1459.6 b	45.0 a

²Means within the same letters in column are not significantly different by Fisher's LSD test at 5% level.

significant difference was observed in the evapotranspiration rate among the four treatments. Photosystem II of the leaves was investigated. According to the findings, the Fv/Fm ratio of treatment W24 (0.73) was the lowest among these four treatments.

The fruit characteristics in the first to fourth inflorescences were investigated (Table 6). The numbers of fruits in treatments H24 (19.8) and HH24 (20.0) were significantly greater than those in treatments W24 (17.6) and B32 (18.2). The single fruit weight in treatment H24 was the heaviest (88.4g), and that in treatment W24 (75.8g) was significantly lighter than that of H24 and HH24 treatments. In treatment W24, the tomato fruits needed significantly fewer days to ripen and, on average, the fruits could be harvested 42–43 days after flowering. The total yield was investigated. The yields per plant in treatment H24 (1842.2g) and HH24 (1774.0g) were significantly higher than the others, and that in treatment W24 (1327g) was the lowest among these four treatments.

The number of whiteflies in the four main treatments was investigated using sticky traps. The results are presented in Figure 4. The average number of whiteflies in treatment W24 (65) was the largest among the treatments, and the average numbers in treatments H24, HH24, and B32 were 25, 26.5, and 25.3, respectively. Whiteflies are pests that seriously damage beefsteak tomatoes. The results indicate that pink and blue photo-selective netting can effectively reduce the harm to whiteflies.

Discussion

Taiwan is located in a subtropical zone. The highly intense summer sun is often accompanied by high temperatures. In horticulture, shade is a common method of reducing the ambient luminous intensity and provides a cooling effect [5]. Diaz-Perez [6] grew bell peppers in shade and observed a highly negative correlation between luminous intensity, ambient temperature, and several sunburnt fruits with shading level (with a correlation coefficient up to 0.994), indicating that shade reduces the influence of excessive sunlight on yield. The experiment in this study was conducted in the summer months of August and September. In all the four main treatments, high temperatures over 30°C were observed from 10:00–16:00 (Figure 1), and temperatures of over 36°C were

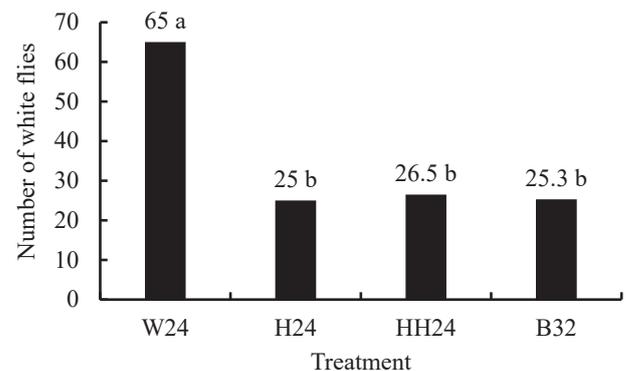


Figure 4: Influence of different photo-selective netting on white flies number.

recorded at noon. In treatment HH24, due to the reduced light penetration, the ambient temperature between 10:00–12:00 was the lowest and the relative humidity was the highest (Figure 2) among the four treatments, but the humidity under netting dropped substantially from 12:00 to 14:00. The shading effect of 32-mesh netting was stronger than that of 24-mesh netting. Tinyane, et al. [7] installed a photo-selective netting house (12m×12m×5m) in South Africa (latitude: 25°37' S), where the average ambient temperatures under pearl, red, and yellow netting were 42.18°C, 35.43°C, and 35.88°C, respectively, which were significantly higher than those under black netting (30.27°C). In Serbia (latitude: 43°30' N), Ilić, et al. [1]. Grew bell peppers under photo-selective netting. Compared with black netting, pearl, red, and blue netting retained greater amounts of light, and the ambient temperatures under the three types of netting during the day were also higher than those under the traditional black netting. It was inferred that the indoor wind speed in the netting house was weakened by more than 50%, and the weakening of airflow was the reason for the temperature rise.

The absorption of different wavelengths of light by photo-selective netting further alters luminous intensity and spectral composition and distribution in the netting house [11]. The present study investigated the luminous intensity and spectral composition in the environment at noon (Table 3 and Figure 1). Of the three types of 24-mesh photo-selective nettings used, the luminous intensity in the modified HH24 netting was significantly lower than that of white netting, whereas that under the 32-mesh blue netting was significantly lower. The experimental results were similar to those obtained by Ilić, et al. [1] from photo-selective netting houses installed outdoors. In the present study, at the same shading level, the luminous intensity under the blue netting was lower than that under the red and the white netting. Almost no significant difference was observed in the spectral composition of ambient light under the five types of netting. Only in the wavelength band of 500–599nm in treatment HH24 was a difference observed between the four main treatments, whereas the R/B and R/FR ratios under treatment B32 were significantly lower than those of the others. Shahak, et al. [11] investigated the spectral composition of photo-selective netting of different colors and obtained similar results. The B/R ratio under the blue netting was 1.26, which was higher than that under the red netting (0.63) and pearl netting (0.80).

Compared with traditional black netting, photo-selective netting increases the transmittance and scattering rate of light, allowing light to be scattered into the canopy ajapakse and Shahak, 2007 [12]. Kong, et al. [13]. Revealed relatively high transmittance and scattering with pearl netting in the photosynthetically effective band of 400–700 nm. In the summer and winter, the PPFDs of canopies in different nodes of bell pepper plants under pearl netting were relatively high. The present study compared different types of photo-selective netting (Table 2) and determined that the PPFDs measured in the upper, middle, and bottom layers in treatments W24 and H24 were significantly higher than those in treatments HH24 and B32. The R/FR ratios in the middle and bottom layers of

the plants with treatments HH24 and B32 were significantly lower than those of the others. Smith and Whitelam [6] observed stem elongation in the presence of low R/FR ratios, and Franklin [14] noted that a low R/FR ratio can promote shoot elongation. These findings are similar to those obtained in this experiment (Table 2 and Table 3), treatments HH24 and B32 has lower R/FR in the lower canopy which revealed greater internode lengths and heights of the beefsteak tomato plants in treatments HH24 and B32 were 6.33 and 6.03, respectively, longer than W24 and H24 were 5.06 and 5.31.

Kong, et al. [13]. Analyzed the photosynthetic and gas exchange capacities of bell pepper leaves under different types of photo-selective nettings. They observed significantly higher net photosynthetic rates and stomatal conductance under white and red netting than under yellow netting and presumed that these results were caused by the composition of the blue light reduced under the yellow regulation net. In the present study, the net photosynthetic rate of beefsteak tomato leaves in treatment H24 was the highest (Table 5), and the photosynthetic performance in treatment W24 was significantly lower than that in the other treatments, indicating that using colored netting was beneficial to plant growth. Camejo, et al. [15]. Cultivated both heat-tolerant and heat-sensitive tomato cultivars at high temperatures and observed a significant decrease in the Fv/Fm ratio of the latter. The beefsteak tomato variety used in the present experiment is heat-tolerant, but its photosystem II might be affected by high temperature from 10:00–14:00, thereby reducing its photosynthetic ability and decreasing its fruit weight. The stomatal conductance of treatment HH24 was revealed to be significantly higher without the stem diameter becoming thinner, indicating a positive effect of the environment on the plants' nutrient absorption and distribution to stems and leaves, which facilitates reproduction and growth while increasing yield.

Temperatures between 20°C and 25°C are suitable for tomato growth. Saeed, et al. [16]. Reported that the flower organs of heat-tolerant varieties could still develop normally in a high-temperature environment without affecting the *fruit set percentage*. In the four main treatments in this study, fruit setting still occurred in the heat-tolerant Chuanfu 994 variety used in the experiment, but the development of leaves and fruits were still affected by the heat. The fruit yield per plant was significantly higher in treatments H24 and HH24 than in the other treatments (Table 6). In treatment W24, the number of fruits per plant was significantly lower than in the others, and the stem diameter was the smallest among the four treatments. The significant reduction in fruit yield per plant was presumably due to the poor absorption and utilization of nutrients by the plants under high temperatures and white netting. Robert, et al. (2015) reported that tomato fruits grown at 28°C entered the reddening-ripening stage earlier, and the fruit weight was significantly lower than that of fruits grown at 21°C. Ilić, et al. [3] cultivated tomatoes (*Solanum lycopersicum* L. cv. Vedeta) under photo-selective netting. At a shading level of 40%, the yield was significantly higher under pearl and red netting than under blue and traditional black netting. Among all the types of netting used in this study, better yields were

observed under the H24 and HH24 netting. However, due to the high temperatures in summer, the fruits grown under the four types of netting failed to meet marketing standards. Although the pink H24 netting was modified to further reduce incoming light, under excessively high temperatures, HH24 photo-selective netting still failed to sufficiently lower the temperatures underneath the netting.

In this experiment, the number of silver leaf whiteflies in different photo-selective netting houses was monitored by replacing sticky insect traps weekly (Figure 4). Silverleaf whiteflies are among the main pests in beefsteak tomato cultivation. Legarrea, et al. [17]. Reported that photo-selective netting reduced the number of whiteflies able to reach the tomatoes, and UV-absorbing materials reduced the vitality of some pests. Yakir, et al. [18–20]. Observed that the silver leaf whiteflies caught by yellow netting significantly outnumbered those caught by blue and red netting. The results of the present study revealed that the number of whiteflies caught by the W24 netting was significantly larger than those caught by the H24, HH24, and B32 netting. If beefsteak tomatoes are cultivated in a netting greenhouse, pink netting is recommended to reduce Silverleaf whiteflies.

Conclusion

Intense sunlight, high temperatures, and uncontrollable pest damage in summer are unfavorable for beefsteak tomato cultivation. By growing tomatoes under photo-selective netting of different meshes and colors, the luminous intensity underneath the netting was reduced, but temperatures over 3°C were still observed from 10:00 to 16:00. With the high shading level for the canopies under the modified pink netting (HH24), the plant height was increased and the stomatal conductance was significantly higher. In addition, the leaves became smaller and thicker, but the stem diameter was not thinned, indicating the environmental influence on phytomorphology under netting. However, the yield per plant was significantly higher under the two types of 24-mesh pink netting, with no difference between them. Blue netting is not recommended because of the poor lighting environment under the netting. In the pink netting houses, the number of silverleaf whiteflies decreased significantly, thereby reducing the incidence of viral diseases as well as the necessity of insecticide use. Therefore cultivating beefsteak tomatoes in pink netting houses is recommended to generate higher profits.

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