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Narrow Rainshelters for Trellised Tomatoes in the Tropics

B.A. Kratky, Horticulturist[1]
University of Hawaii
461 W. Lanikaula
Hilo, Hawaii 96720

and

Y.C. Roan, Associate Crop Management Specialist
Asian Vegetable Research and Development Center
P.O.Box 42 Shanhua, Tainan 74199
Taiwan, R.O.C.

Abstract. A large fruited (90 grams) and a small fruited (30 grams) tomato cultivar produced 0.96 and 0.51 kg/plant more grade 1 fruit, respectively, when trellised vines were protected by 1.75 m high x 0.8 m wide plastic covered rainshelters during the hot, rainy summer season in Taiwan. Air temperatures under the rainshelters were similar to ambient temperatures when the spacing between shelters was 0.7 m and the wind speed was 11 km/hr.

[1]This study was conducted at AVRDC while the senior author was on sabbatical leave.

Hot and rainy weather conditions are commonplace in the tropics. Yield and quality of vegetables suffer because diseases and physiological imbalances proliferate under rainy conditions. Plastic covered rainshelters can greatly improve this situation but the greenhouse effect causes heat buildup in many of these structures (1). Tomato fruit set is greatly reduced by high temperature (3) such that temperatures above the ambient summer temperatures in Taiwan (mean maximum and minimum = 32 and 24°C, respectively) would be increasingly detrimental. Differences between indoor and outdoor temperatures are negligible when the ventilated area of a greenhouse exceeds 45 percent of the floor area (2). Thus, a series of tall, open sided narrow rainshelters should act much like a large rainshelter with considerable ventilation.

The objective of this study was to determine the effects of 1.75 m high x 0.8 m wide rainshelters on the yield and quality of two tropically bred tomato cultivars.

Materials and Methods

Tomato plants were grown in conventional soil beds, 30 cm high and 80 cm wide at the top with a center to center distance between beds of 1.5 m. Spacing between plants was 30 cm.

Plants were either unprotected as is the normal practice or protected with a plastic covered rainshelter. Rainshelters consisted of bamboo frames, 1.75 m high, supporting a gable type roof covered with 1 m wide vinyl plastic over which plastic coated chicken wire was placed to provide for a reliable attachment of the plastic roof. The effective width of the rainshelter roof was 0.8 m; thus, each rainshelter covered only one row and was separated from adjacent rainshelters by a spacing of 0.7 m. Rainshelters were 9 m long and adjacent rainshelters were connected to each other by horizontal bamboo poles for added support.

Two AVRDC heat tolerant cultivars, CL 5915-206-2-2-0 (large fruited) and CL 5915-553-D4-3-0 (small fruited), were seeded on May 14, transplanted on June 18 and harvested weekly from August 12 to November 6. Plants were pruned twice in the first 6 weeks after transplanting but were allowed to grow freely thereafter. They were held upright by a trellis.

Total rainfall during the growing period was 89 cm of which 26 cm occurred within 2 weeks after transplanting (including a storm of 14 cm) and 51 cm occurred within 40 days after first harvest (including 8 daily rainfalls ranging between 29 and 84 cm). Since the weather was otherwise fairly dry, the soil beds were furrow irrigated when rainfall was insufficient. There were 10 applications of a foliar fertilizer (20-19-19 + micronutrients) in addition to the soil fertilizer applications and there were 9 insecticide and 7 fungicide applications.

There were 6 plants per plot and the experiment was arranged as a randomized complete block with 4 replications. For the large fruited cultivar, fruits of good shape and appearance and larger than 5 cm in diameter were designated grade 1; those smaller were designated grade 2; offshaped, slight cracking or poor appearance resulted in a salable offgrade rating. The small fruited cultivar was graded similarly except the demarcation line between grade 1 and 2 was a diameter of 3 cm.

Results and Discussion

The narrow 0.8 m width of the rainshelters alternated with a large vent area (0.7 m) between rainshelters resulted in air temperatures under the shelters which were similar to ambient air temperatures when the wind speed was 11 km/hr (Table 1). However, the restricted air movement immediately under the gable roof caused air temperatures there to rise 2.3°C higher than ambient.

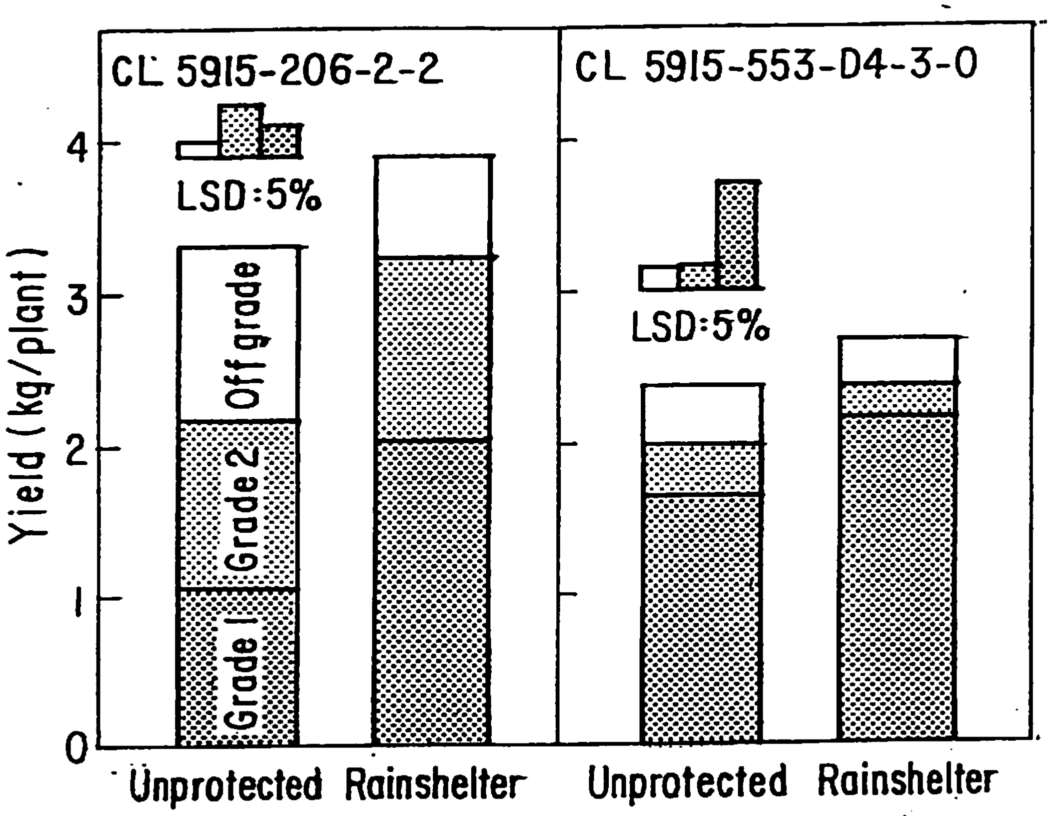
Salable yields are shown in Figure 1. The highest yield and quality for both cultivars were obtained in the rainshelter treatment. The large fruited cultivar, CL 5915-206-2-2-0, yielded 0.96 and 0.58 kg/plant more grade 1 and total salable fruit, respectively, in the rainshelter treatment than in the unprotected soil bed treatment. Thus, tomato plants protected by the rainshelter produced more high quality fruit as well as more

Table 1. Ambient and rainshelter air temperatures.*

Height (m)	Temperature (^oC)	
	Ambient	Rainshelter
0.5	28.5	29.1
1.0	27.9	27.7
1.5	28.3	28.2
1.7	27.6	29.9

*At 4 heights in/over a row of trellised tomato plants, 1.3 m high, on a sunny day with a wind speed of 11 km/hr.

Figure 1. Salable yields of a large and a small fruited tomato cultivar which were protected or not protected by a rainshelter.



total salable fruit. The small fruited cultivar, CL 5915-553-D4-3-0, tolerated rainy conditions much better. Nevertheless, plants protected by rainshelters yielded 0.51 kg/plant more grade 1 and 0.29 kg/plant more total salable weight than unprotected plants.

The early establishment of transplanted seedlings protected by rainshelters was superior to the unprotected seedlings. The heavy rainfall in the first 2 weeks after transplanting caused the unprotected plants to exhibit a yellowish appearance and also leaf rolling.

Fruit cracking was a serious problem with the unprotected, large fruited cultivar of which 0.31 kg fruit/plant was unsalable and other fruit with minor cracking was downgraded to salable offgrade (Table 2). Most of the fruit cracking occurred in the first 6 weeks of harvest which was also a period of heavy rainfall. Thus, fruit cracking was influenced by both cultivar type and high soil moisture.

Insect damage was negligible, but it was greater in the unprotected treatments; presumably, this could have been due to the washing off of insecticides by rainfall.

Unsalable 'other' yields were also higher in the unsheltered treatments for the large fruited cultivar but not for the small fruited cultivar. The primary maladies for this category were sunburn, blossom-end rot, disease, small size and offshape of fruit.

Table 2. Yields of two tomato cultivars which were protected or unprotected by rainshelters.

Yield Parameter	Cv. 5915-206-2-2-0 Rainshelter	Cv. 5915-206-2-2-0 Unprotected	Cv. 5915-206-2-2-0 LSD 5%	Cv. 5915-533-D4-3-0 Rainshelter	Cv. 5915-533-D4-3-0 Unprotected	Cv. 5915-533-D4-3-0 LSD 5%
	per plant					
Grade 1 fruits (no.)	22.9	12.5	3.0	67.4	57.7	ns
Grades 1+2 fruits (no.)	48.1	36.5	10.4	81.9	79.3	ns
Grades 1+2+salable offgrade (no.)	59.4	54.8	ns	92.0	94.0	ns
Cracked (no.)	0.4	3.8	2.6	0.7	2.0	0.8
Insect damage (no.)	0.7	2.0	1.1	2.0	4.7	ns
Unsalable other[1] (no.)	3.9	9.4	4.5	9.0	8.1	ns
Total unsalable (no.)	5.0	15.2	4.7	11.7	14.8	ns
Cracked (grams)	26.0	310.0	196.0	22.0	51.0	13.5
Insect damage (grams)	19.0	87.0	68.0	45.0	76.0	ns
Unsalable other[1] (grams)	152.0	337.0	157.0	190.0	157.0	ns
Total unsalable (grams)	197.0	734.0	257.0	257.0	284.0	ns

[1]Includes sunburn, blossom end rot, disease, small size and offshape of fruits.

The total unsalable yield of the large fruited cultivar was 0.73 kg/plant for the unprotected treatment compared with only 0.20 kg/plant for the rainshelter protected treatment. However, total unsalable yields were similar for both treatments with the small fruited cultivar, primarily due to the low cracking incidence of this cultivar.

The results of this study suggest that narrow rainshelters have potential use for hot, rainy tropical areas particularly when genetic resistances are not sufficient to overcome the negative effects caused by these unfavorable environmental conditions. The use of narrow rainshelters for tropical conditions should be investigated furthur.

Literature Cited

1) Bowen, J.E. and B.A. Kratky. 1982. Greenhouses for the tropics. World Farming 24:6.

2) Mastalerz, J.W.. 1977. The Greenhouse Environment. John Wiley and Sons, New York.

3) Villareal R.L. 1979. Tomato production in the tropics - problems and progress. In Proc. of the 1st International Symposium on Tropical Tomato, 6-21. AVRDC, Shanhua, Taiwan.