High Tunnel Greenhouse Cucumber Variety Trial, 2011

Cornell Vegetable Program

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Introduction

The unheated greenhouse, or high tunnel, offers a vertical production environment suitable for crops such as indeterminate tomatoes and cucumbers. As it is a soil based system however, and passively heated, greenhouse cucumbers must be transplanted later in the spring than tomatoes, due to their intolerance for low root zone temperatures. However, cucumbers can provide good returns when grown in a high tunnel, given consistent pest control and matching variety performance with market demand. A variety trial of four greenhouse cucumbers was established in a cooperating high tunnel in the spring of 2011.

Materials and Methods

Cucumber varieties Celsius, Presidio, Tamazula and Trinindad were seeded in a heated greenhouse on March 16, 2011 into 50 count trays. These were transplanted into the high tunnel soil, a Lima Silt Loam, on April 15. After 7 days in the soil the majority of these plants wilted and died. We attribute this to cold soils, and likely some low levels of Damping-off (Pythium and Phytothphora spp.). A new seeding took place in the greenhouse on April 26 and was transplanted into the high tunnel soil on May 13. Replanting of several cucumber plants, of all varieties (except Tamazula), due to continued Damping-off was necessary. All cucumbers were also treated with Ridomil Gold SL (mefenoxam) at a label rate of 2 pints/acre. The high tunnel, fabricated on farm, is a 30 by 120 foot galvanized steel structure, covered with Tuff Lite IV 6 mil polyethylene. No supplemental heat was used in growing the crop post-transplant. The trial was arranged as a randomized in-row block design with four replications. Each replicate consisted of six plants, transplanted into black plastic mulch with 12-inch single row drip irrigation. The grower cooperator maintained the trial site for fertilization, irrigation and weed control to their standards (see appendix 1). No pesticides were applied. Cucumbers were harvested from June 17 to September 5 (for Celsius and Trinidad) and October 11 (for Presidio and Tamazula). Celsius and Trinidad were removed early due to disease and low production. The weight and number of marketable fruit was recorded at each harvest date. Mean yield (lbs) per plant, mean fruit per plant and mean fruit weight were calculated (table 1). Disease ratings of Powdery Mildew (*Podosphaera xanthii*) were taken on July 12, August 27 and September 5, using a 0-9 ordinal scale, with 0 representing no infection and 9 plant death. Level of Two Spotted Spider Mite (*Tetranychus urticae*) was also recorded using the same ordinal scale on August 27 and September 5 (table 2). Data was analyzed using statistical software Analysis of Variance (ANOVA) procedure, and treatment means were separated using Fishers Protected Least Significant Difference Test ($p<0.05$).

Results

Yield as measured by pounds of fruit per plant were significantly different among the four varieties. Tamazula was the highest yielding as measured by pounds and number of fruit per plant, although in the

same statistical grouping as Presidio (Table 1). Celsius and Trinidad were also together in a statistically separate grouping for pounds per plant. Fruit weights were significantly different, again, with Presidio and Tamazula separate from Celsius and Trinidad. Trinidad was the only variety significantly susceptible to Powdery Mildew, from the apparently resistant grouping of Celcius, Presidio and Tamazula (Chart 2). Trinindad also exhibited the highest susceptibility to Two Spotted Spider Mites, with significant differences detected on the final rating of September 5.

Discussion

Presidio and Tamazula fruit were shorter varieties than Celcius and Trindidad (Figures 1-4). These fruit were able to hold their shape more consistently than the longer varieties, and additionally they yielded more fruit per plant. Considering resistance to mites and Powdery Mildew, Tamazula is the grower preferred variety in this trial.

The trial experienced minor levels of Downy Mildew (*Psuedoperonospora cubensis*) in October. It should be noted that this disease has become nearly unmanageable in field grown cucumbers without the application of multiple systemic fungicides in late summer and early fall. With the low moisture environment of the tunnel we were able to harvest from June until October without the use of any foliar fungicides.

As high tunnels are passively ventilated there is considerably more wind and pollinator visitation than in controlled environment greenhouses. These factors lead to misshapen fruit in greenhouse cucumbers, particularly in the longer seedless varieties. For this reason we strongly recommend shorter fruited cucumbers for high tunnel production.

Conclusions

Cucumbers are a remarkable crop for high tunnel production, given their quick maturity and heavy yields. However, cucumbers in our experience are more likely to suffer from pests such as mites and thrips, which increases input costs for control measures. Labor on cucumbers is also higher than that of tomatoes. Given a receptive market however, the higher yielding varieties in this trial would provide solid returns. High tunnels should also be considered as an alternative management approach for Downy Mildew.

The Cornell Vegetable Program and cooperating grower express gratitude to MGS Horticultural Inc. and Syngenta Seed (Rogers) for their collaboration in this project.

Table 1. Cucumber Yields

	Plant Yield (lbs)	Number of Fruit per Plant	Average Fruit Weight (lbs)
Celcius	21.2 b	19.8 b	1.08 a
Presidio	28.4 a	43.3 a	0.66 c
Tamazula	30.7 a	43.5 a	0.71 bc
Trinidad	20.5 b	22.4 b	0.92 ab
p-value	***0.0108***	***0.0000***	***0.0054***

Table 2. Cucumber Pests and Diseases. Powdery Mildew and Two-Spotted Spider Mites were evaluated using a 0-9 ordinal scale, with 0 representing no infection and 9 plant death

	Powdery Mildew			Spider Mites	
	July 12	**Aug 27**	**Sept 5**	**Aug 27**	**Sept 5**
Celsius	0.14 b	0.00 b	0.50 b	3.75	3.25 ab
Presidio	0.00 b	0.00 b	0.00 b	1.75	1.50 bc
Tamazula	0.00 b	0.00 b	0.00 b	1.50	1.00 c
Trinidad	2.75 a	5.75 a	6.50 a	3.75	4.25 a
p-value	***0.0008***	***0.0003***	***0.0000***	***NS***	***0.0165***

Figures 1-4. Fruit at Harvest: Tamazula, Presidio, Celcius, and Trinidad.

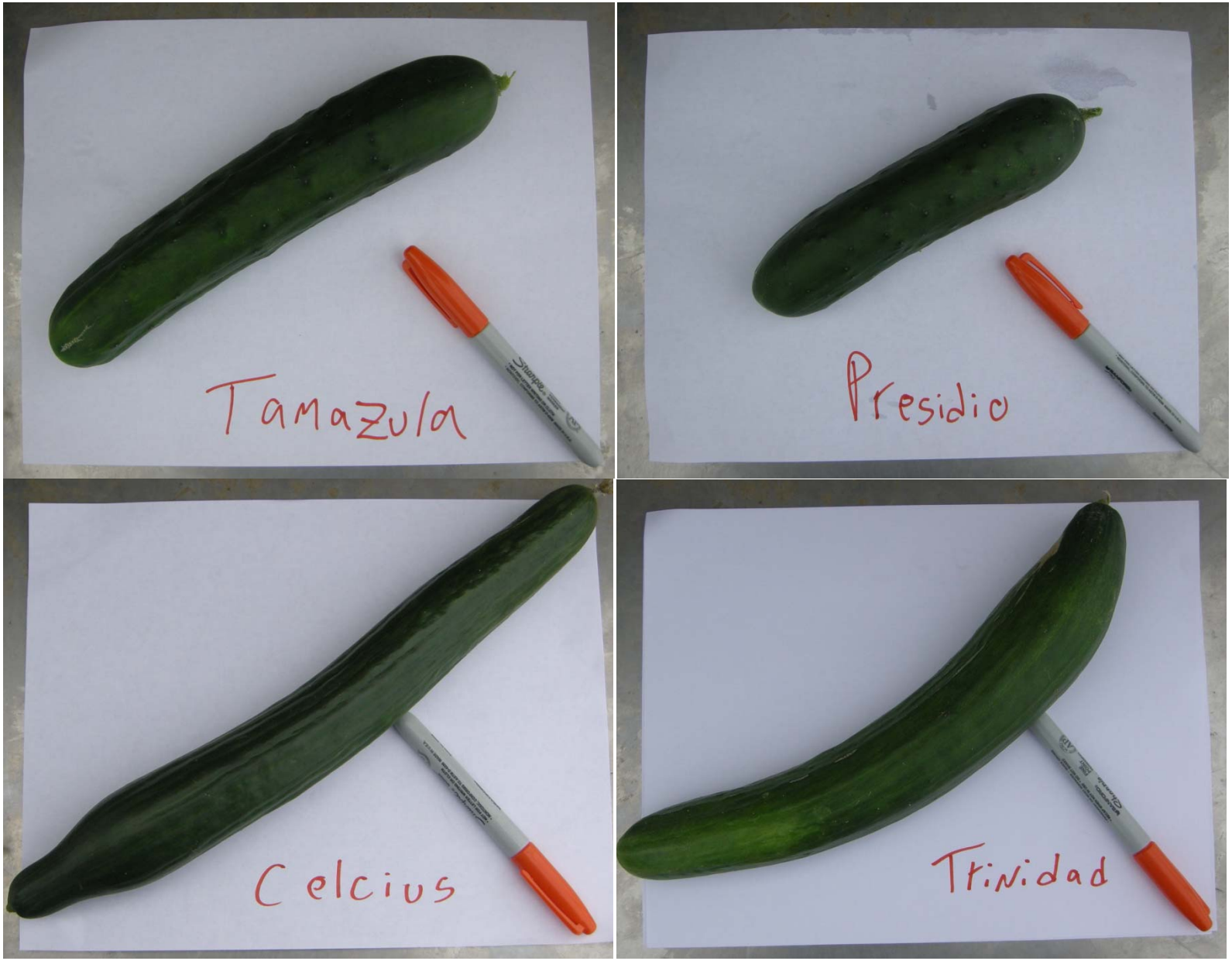

Figure 5. High Tunnel Cucumber Trial

Figure 6. Spider Mites Damage on Cucumber Plants

Figure 7. Powdery Mildew on Cucumber Plants

Appendix 1. High Tunnel Cucumber Fertilizer Schedule.

21-May	20-20-20	0.30	
1-Jun	20-20-20	0.31	
4-Jun	20-20-20	0.36	plus 0.02 fluid oz. 66% sulfuric acid
8-Jun	20-20-20	0.39	
9-Jun	Epsom salt (magnesium sulfate)	0.39	
10-Jun	Epsom salt (magnesium sulfate)	1.04	Foliar application
15-Jun	Epsom salt (magnesium sulfate)	0.24	
16-Jun	9-15-30	0.27	
17-Jun	9-15-30	0.42	
18-Jun	Epsom salt (magnesium sulfate)	0.28	
18-Jun	Epsom salt (magnesium sulfate)	1.56	Foliar application
21-Jun	9-15-30	0.42	
22-Jun	9-15-30	0.27	
23-Jun	Epsom salt (magnesium sulfate)	0.28	
24-Jun	9-15-30	0.42	plus 0.03 fluid oz. 66% sulfuric acid
25-Jun	Epsom salt (magnesium sulfate)	0.06	
27-Jun	9-15-30	0.45	
28-Jun	9-15-30	0.21	
30-Jun	Epsom salt (magnesium sulfate)	0.30	
1-Jul	9-15-30	0.30	
5-Jul	Epsom salt (magnesium sulfate)	0.18	
6-Jul	9-15-30	0.24	
7-Jul	9-15-30	0.18	
9-Jul	9-15-30	0.39	
12-Jul	9-15-30 to 4 tunnels	0.51	
13-Jul	Epsom salt (magnesium sulfate)	0.15	
14-Jul	9-15-30	0.21	
16-Jul	9-15-30	0.24	
19-Jul	9-15-30	0.15	
20-Jul	9-15-30	0.09	
21-Jul	20-20-20	0.42	
22-Jul	20-20-20	0.36	
23-Jul	20-20-20	0.12	
26-Jul	9-15-30	0.30	
28-Jul	9-15-30	0.24	
29-Jul	9-15-30	0.37	
30-Jul	9-15-30	0.30	
5-Aug	20-20-20	0.24	
8-Aug	9-15-30	0.37	
11-Aug	9-15-30	0.22	
13-Aug	9-15-30	0.15	
27-Aug	9-15-30	0.18	
29-Aug	9-15-30	0.12	
	*Miller's Greenhouse Grade 20-20-20 (N-P-K) plus micronutrients In irrigation water sufficient to moisten the rootzone.		
	**Miller's Greenhouse Grade 9-15-30 (N-P-K) plus micronutrients In irrigation water sufficient to moisten the rootzone.		