Tomato pollination and how to increase it in high tunnels

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Solutions in your community
Research in the eastern United States has demonstrated that the yield per plant from a HT tomato should be between 20 and 30 lbs per plant.

My yields averaged 19.6 lbs/plant.
My nutrient levels according to leaf tissue analysis were in the sufficient to good range in most of my samples.
But I still had many flowers abort because of poor pollination/fertilization.
At times many flowers would abort on plants.
Tomato flowers are a bit odd in the plant world. They are self-pollinated and fertilized.
Typical flower

- Stigma
- Pistil
- Style
- Anther
- Filament
- Petal
- Ovary
- Stamen
- Sepal
- Ovule
- Receptacle
- Stalk
Tomato flowers have their female parts surrounded by the male (pollen) parts.
Tomato pollen is heavy and sticky and needs to be dislodged from the anthers of the flower in order to fall onto the stigma for fertilization to take place.
The final size and weight of fruit are largely determined by the number of seeds set, which is ultimately due to the quality of pollination and fertilization.
Temperatures above 88°F may cause abnormal style elongation. High rain fall will cause pollen to clump and be less available for pollination.

The optimum temperature for pollen tube growth is 70°F. Above or below this temperature reduces the germination and growth of the pollen tube. Temperatures above 90°F negatively affect the viability of ovules and pollen.
Bumble bees are good at ‘buzz pollination’ which causes the pollen to be shed inside the tomato flower. Either bumble bees do this or wind—bees are better, but wind is usually sufficient.
Tomato flower that was not visited by bumble bees

Tomato flower visited by bumble bees. Bees grab flower with mouth parts and cause scar on outside of flower.
These flowers have all been visited by bumble bees several times.
Poor pollination causes flower/fruit abortion
Study was conducted for 2 years. The first year of the study only one HT was used while in the 2\textsuperscript{nd} year 2 HTs were used. One HT was on the eastern shore while the other was on the western shore.

Four different cultivars of tomatoes were used in both HTs, 2 hybrids (*Mt Fresh+* and *Crista*) and 2 heirlooms (*Cherokee Purple* and *Brandywine*).

I used a Craftsman 235/150 mph electric blower to sonicate (buzz pollinate).
An ‘enhanced pollination treatment’ consisted of taking the leaf blower and placing it on low (150 mph) with the end of the blower 2-3 ft from a plant moving it back and forth and up and down concentrating the movement in the area of the flowers.

Plants were treated either 0, 2, or 4+ times a week and for either 0, 5, 10, or 20 seconds per plant with the blower. Treatments started 5-days after the first flower cluster appeared and were treated for 4 weeks. There were 4 replications of each treatment, 5 plants per rep.
One concern I had about the technique is that if fruit set was increased and plants were supporting more fruit:

1. Would plants be able to size those tomatoes and
2. Would the tomatoes have good quality?
Results
Non treated areas with the usual flower/fruit abortion
Where treated there were many more fruit on plants
Yield (lbs)
1st harvest/plot

None | Four + | Two | Two | Four+
-----|--------|-----|-----|------
0    | 5      | 5   | 10  | 10
Culls (lbs.)
1st harvest/plot

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Length of time pollination enhancement occurred

Yield (lbs)
1st harvest/plot

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Yield:
- None: a
- Five: b
- Ten: b
Yield (lbs) of total harvest

Per plant

None
Five
Ten

None
Five
Ten

15
17
19
21
23
25
27
29
31

None
Five
Ten

None
Five
Ten

a
b
b
Yield (lbs) per plant

Frequency of pollination enhancement per week

total harvest, HT-A

Four +  Two  None

a     ab     b
Wt (lbs) per plant

total harvest, HT-B

a                      b                     c
none       two       four+
Mean Weight (oz.) of 1 fruit

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Treated 4 times a week for 5 secs
Non treated control
Overall yields were good in these two HTs compared with previous seasons. Normally I would have expected 19.6 lbs/plant in these HTs, but instead got 21.8 lbs per control plant.
The average yield per plant increased to as much as 33.7 lbs with the pollination enhancement technique.

By enhancing pollination I was able to increase my yields by as much as 55%.

The pollination enhancement technique also improved fruit quality by reducing the percentage of culls and increasing the average size of fruit.
One concern I had about the technique is that if fruit set was increased and plants were supporting more fruit:

1. Would plants be able to size those tomatoes and
2. Would the tomatoes have good quality?

The answer appears to be yes to both questions. We did not add any extra nutrients to either HT compared with how we normally fertilize.

This technique did appear to work better on the first 6-8 fruit clusters the plant produced vs using the technique on later fruit clusters.
This technique is not for everyone, but it could be utilized very easily in a HT and be carried out by just about anyone who can hold and point a leaf blower.

The plants would need to be treated for 5-10 seconds at least 4 times a week for there to be a good possibility of yield and quality enhancement.
Treating the plants longer than 20 seconds ended up decreasing yields compared with doing nothing (data from year 1).

Plants could undergo this enhancement technique in the early part of the season when the HT sides are often down.
CAUTION

This technique should not be used if your HT tomatoes are usually low in any nutrient at the first harvest or you have fruit ripening problems with later harvests. Heirloom cultivars responded less consistently than hybrid cultivars
Questions

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http://extension.umd.edu/mdvegetables