UMASS EXTENSION

VEGETABLE IPM MESSAGE

MARCH 23, 2002 VOLUME 13, NUMBER 1

GREETINGS FOR THE 2002 SEASON!

We begin the 2002 growing season with the usual unpredictable, variable "normal" weather of New England. One of the biggest snowstorms of the season came on the first day of spring, and the temperatures are bouncing all over the place. It is true that the long-term drought throughout the Northeast is more severe than anyone has seen for a long time, and could give us serious problems this season. The good news is that we've been getting regular rain and snow in the past several weeks, and if this continues there's hope for alleviation of the drought conditions. However, growers need to be thinking ahead about what a very dry summer could mean, and how to be as prepared as possible. The next issue of *Vegetable Notes* will focus on water and irrigation.

Why a special early edition of the IPM Newsletter? Every year at this time I think back to the widespread problems of bacterial diseases in tomato and pepper that growers had the previous year. I think about how disease management starts right now, before you even plant your seed. So this issue provides suggestions on what you can do now to prevent bacterial problems in the field. Also, we received an excellent report from Jeremy Barker-Plotkin and Don Franczyk who conducted on-farm research on heirloom tomato varieties for the field and greenhouse. We think that tomato growers who are interested in heirloom tomatoes will appreciate this information.

--R Hazzard, Editor

2001 HEIRLOOM VARIETY TRIALS

by Jeremy Barker-Plotkin, Simple Gifts Farm, and Don Franczyk, Big Red Barn Farm

INTRODUCTION AND METHODS

Heirloom tomatoes are currently enjoying a huge surge in popularity. The wide range of colors and flavors make them extremely appealing for restaurant chefs and for fresh-market customers. Their special handling requirements make them an ideal niche crop for small, direct-market oriented farmers. However, the thousands of varieties available and the wide variability make for some difficult choices for farmers. This project evaluated 38 varieties for yield and quality under typical organic market farm management.

We were looking for varieties within each of several color classes, which had high yields of marketable fruits and good flavor. Yellow/orange, black/purple, and bi-color (yellow with red stripes) tomatoes were evaluated at **Simple Gifts Farm (SGF)** in Belchertown, MA, and yellow/green, black/purple, and pink tomatoes were evaluated at the **Big Red Barn (BRB)** in Winchendon, MA. The black/purple color class was grown at both farms to compare site differences. In addition, 10 varieties in several color classes were evaluated in a high tunnel at SGF.

The sites differed considerably in conditions. Though less than 50 miles apart geographically, BRB is at a higher elevation, and experienced cooler conditions. First field harvest was on August 1st at SGF and on August 12th at BRB. Localized rainfall and a heavy soil provided adequate moisture at SGF, while BRB had drought conditions for much of the summer. Tomatoes at BRB were grown at a 3-foot spacing, with 2 plants per plot; at SGF,

plants were at a 2-foot spacing, with 2 plants per plot. Both sites were set up in a randomized complete block design to compensate for variations within the field. Weight harvested, number of tomatoes per harvest, and average weight per fruit was measured at BRB. Only marketable fruits were weighed, so yield figures are marketable yield only. At SGF, number of fruits was not measured, so average weight was not calculated. However, both first-quality and cull fruits were weighed, so cull rates are presented. In all of the following tables, numbers within the same column followed by the same letter are not significantly different. Columns without letters indicate no significant differences. The field trials at SGF exhibited very high levels of variation, which eliminated statistically significant differences in many of the categories. Early yield indicates yield within the first three weeks of harvest.

TOTAL MARKETABLE			
Black Tomato	**Early Yield SGF**	**Yield SGF**	**% Marketable**
Variety	**(lbs/100 row ft.)**	**(lbs/100 row ft.)**	**Yield SGF**
Black Brandywine	11.4	133.7	55.2%
Black	30.0	111.5	40.8%
Russian Black	37.9	103.2	41.2%
Black Prince	27.3	93.9	48.6%
Black Krim	33.2	88.9	49.8%
Black from Tula	29.1	74.3	35.3%
Marizol Purple	21.1	68.6	60.1%
Cherokee Purple	20.0	44.0	39.4%
Black Early	13.2	37.6	26.2%

BLACK TOMATOES

Black tomatoes were grown on both farms. The black tomatoes performed very well at BRB, and very poorly at SGF. BRB found that the black tomatoes had the strongest yields and best flavor of any of the tomatoes. At SGF, the usually strong performance of the black tomatoes was not observed in 2001. Most of the black tomatoes had lower yields, paler color and less remarkable flavor than SGF usually observes for the same varieties in other seasons. There must have been some site condition that disadvantaged the black tomatoes at SGF this year (note that yields were higher at SGF in general due to the longer season; black tomato yields were higher at SGF than at BRB, but low relative to other tomatoes at SGF. Cherokee Purple and Black Prince were noted at BRB for their good flavor and uniformity. Black Plum and Russian Black both had high yields but small fruits and unremarkable flavor.

TOTAL MARKETABLE			
Black Tomato	**Early Yield BRB**	**Yield BRB**	**Average Weight**
Variety	**(lbs/100 row ft.)**	**(lbs/100 row ft.)**	**Per Fruit (lbs.)**
Russian Black	63.9	104.2A	1.73BC
Black Brandywine	56.9	98.6AB	2.82A
Cherokee Purple	50.0	86.1ABC	1.68BC
Black Plum	52.8	83.3BC	0.85C
Black from Tula	52.8	69.4C	1.85B
Black Prince	33.3	43.1D	1.07BC

YELLOW/GREEN TOMATOES

Yellow to green tomatoes were grown at BRB. Green Pineapple was the most surprising variety, with beautiful fruit, great flavor, and high yields. Tasty Evergreen and Green Zebra are dependable and flavorful. Garden Peach and Plum Lemon are distinctive in appearance even though their flavor is not the best. Yellow Brandywine and Aunt Ruby's Green were particularly low-yielding and inconsistent in appearance.

Yellow/Green Total Marketable			
Tomato	**Early Yield**	**Yield**	**Average Weight**
Variety	**(lbs/100 row ft.)**	**(lbs/100 row ft.)**	**Per Fruit (lbs.)**
Garden Peach	41.7ab	111.1a	1.04
Green Pineapple	45.8a	106.9ab	1.40
Plum Lemon	27.8abc	90.3abc	1.42
Tasty Evergreen	22.2bcd	73.6abcd	2.83
Yellow Brandywine	0.0e	41.7bcd	1.72
Green Zebra	2.8de	38.9cd	1.06
Aunt Ruby's	13.9cde	20.8d	1.25

YELLOW/ORANGE TOMATOES

Yellow/Orange tomatoes were grown at SGF. This class did especially well, with many of the varieties exhibiting very good uniformity, yield and flavor. Nebraska Wedding, Moonglow, Russian Persimmon, and Amana Orange were all quite similar in appearance, being relatively round, defect free, and a nice bright orange color. Golden Sunray was disappointing – a strange off-orange color, and inconsistent shape. Elberta Girl was supposed to be a striped tomato, but came out practically identical to Garden Peach—pale yellow, small and fuzzy, with pleasant but not dramatic flavor.

Yellow/Orange Total Marketable			
Tomato Variety	**Early Yield (lbs/100 row ft.)**	**Yield (lbs/100 row ft.)**	**% Marketable Yield**
Nebraska Wedding	65.0a	221.3	78.4%
Goldie	27.1ab	219.3	48.0%
Amana Orange	72.4a	195.5	55.9%
Golden Sunray	41.5ab	176.5	76.0%
Moonglow	38.6ab	146.6	68.2%
Russian Persimmon	21.2ab	137.8	70.8%
Elberta Girl	10.4b	102.5	78.0%
Azoychka	31.6ab	85.7	68.4%

HOOPHOUSE TOMATOES

Tomatoes from several color classes were grown in the high tunnel at SGF. First harvest was 3 weeks earlier than the field tomatoes, and the early harvests were heavier than the earliest field harvests. Fruit quality was higher, and cull rates lower, than in the field. Most culls came later in the season, due to a hornworm infestation. Hybrid tomatoes were also grown in the high tunnel—while they were not included in the trial, yields were higher than the heirlooms, but not so much higher that the heirlooms were unprofitable. In our marketplace, unheated high tunnels do not produce the earliest tomatoes, so the colorful heirlooms help to differentiate our product from the earlier greenhouse tomatoes. Cherokee Purple and Black from Tula were lower-yielding than they had been in previous seasons, as were most of the black tomatoes in the field at SGF in 2001. Tigerella had decent yields, but was uninteresting in appearance and flavor. All of the other varieties had great results in the hoophouse.

PINK TOMATOES

Pink Tomatoes were grown at BRB. This category seemed to be affected by the drought more than the other two categories. Eva's Purple Ball was the best variety in this trial, with good flavor and yield and extraordinarily consistent. Caspian Pink was also very free of defects, and had the highest yield, but had less flavor. The beefsteak varieties all performed poorly in one category or another. Pruden's Purple was the best of the pink beefsteaks but the pinks should be re-tested under more favorable conditions.

Pink Total Marketable			
Tomato Variety	**Early Yield (lbs/100 row ft.)**	**Yield (lbs/100 row ft.)**	**Average Weight Per Fruit (lbs.)**
Caspian Pink	68.1	108.3	2.49
Eva's Purple Ball	36.1	98.6	2.51
Brandywine	26.4	97.2	3.68
Crnkovic	31.9	95.8	3.43
Pruden's Purple	40.3	88.9	3.33
Marizol Purple	25.0	55.6	2.17

Hoophouse Total Marketable			
Tomato Variety	**Early Yield (lbs/100 sq. ft.)**	**Yield (lbs/100 sq. ft.)**	**% Marketable Yield**
Persimmon	31.2a	134.6a	97.1%a
Marizol Gold	0.0c	119.3a	78.5%ab
Black Plum	13.7bc	113.1a	95.0%a
Nebraska Wedding	8.6bc	110.8a	95.8%a
Green Zebra	5.4c	99.9ab	77.8%ab
Tigerella	20.5ab	93.6ab	90.5%a
Moonglow	11.4bc	93.6ab	97.4%a
Gold Medal	13.6bc	78.8ab	85.3%
Cherokee Purple	13.9bc	50.1b	55.7%b
Black from Tula	10.6bc	47.9b	77.9%ab

Striped Total Marketable			
Tomato Variety	**Early Yield (lbs/100 row ft.)**	**Yield (lbs/100 row ft.)**	**% Marketable Yield**
Marizol Gold	62.0	326.9	53.0%
Gold Medal	13.2	305.6	60.7%
Striped German	31.0	219.8	59.3%
Northern Lights	47.0	207.4	67.3%
Hillbilly	13.8	168.2	50.6%
Georgia Streak	28.5	153.1	61.6%
Pineapple	3.3	115.0	44.5%

STRIPED TOMATOES

Striped tomatoes were grown at SGF. These were the highest yielding tomatoes due to their large fruits. The large fruits can be somewhat hard to sell at a premium retail price. The varieties were fairly similar in flavor and appearance, with the exception of Georgia Streak, which turned to be an orange tomato with no stripes and very inconsistent appearance. Gold Medal had slightly less distinct stripes than the other varieties, but had a very uniform appearance.

Acknowledgements:

Funding for this project was provided by the NESARE Program, with support from NOFA/ Massachusetts.

MANAGING BACTERIAL CANKER IN TOMATO: KEY STRATEGIES

by Ruth Hazzard, Dept. of Entomology, and Robert Wick Dept. of Microbiology, University of Massachusetts

Bacterial canker (*Clavibacter michiganensis pv. michiganensis*) is one of the most destructive and puzzling tomato diseases in Massachusetts. One grower sets out a vigorous crop of transplants that grows into healthy-looking plants full of green fruit, only to see "marginal scorch" appear throughout the field and his yields decline despite regular copper sprays. Another has never had it on the farm before, and finds an outbreak that starts in one cultivar and spreads throughout the field. Another has had it for years, and can't seem to escape it no matter how many different strategies he tries.

Everyone would like a simple answer to the canker problem. There isn't one. However, there are a number of strategies that can make a big difference.

Three key principles for preventing losses to bacterial canker can be summed up as follows:

1. Use disease-free seed.

2. Control bacterial populations that may be present on the leaf surface of transplants in the greenhouse.

3. Plant into a clean field.

Each of these protects your plants at a different stage of growth - and all are important.

SEEDS AS A SOURCE

The bacterial canker pathogen can be seed-borne, both on the surface of the seed and under the seed coat. One infected seed variety can introduce bacteria into the greenhouse, where it can spread to other varieties. Do your best to ensure that all of the seed you start in your greenhouse is clean - *including the plants that are destined to be sold as bedding plants.* See the next article on hot-water treatment of seeds.

Greenhouses: what you cannot see is what you get. It is important to realize that the ***Clavibacter*** bacteria can live on the surface of a tomato leaf for a period of time, before they enter the plant and cause symptoms. So the bacteria can be present and moving around in the greenhouse without visible symptoms on the plants. Then, they can enter through wounds or natural openings, eventually causing "marginal scorch" or systemic infections. Once the bacteria enters the plant -- which could occur in the greenhouse or in the field - it can take anywhere from 7 to 84 days for symptoms to appear.

Research by Mary Hausbeck at the Michigan State University has shown that: 1) the pathogen can move readily from infected plants onto clean plants in the course of regular greenhouse activities, and 2) carryover in the greenhouse from one season to the next may not be as important as was once thought.

In one experiment, seedlings that carried systemic infections with bacterial canker were placed in known locations in a grid of transplants in the greenhouse. Watering was from hand-held sprinklers; no special precautions were taken to prevent disease spread. Plants nearest the infected plants developed bacterial canker symptoms (wilting) and died in the greenhouse. Many other plants showed no symptoms in the greenhouse, but the bacteria could be found residing on the surface of their leaves. When these healthy-looking plants were set out in the field they developed symptoms during the season and the yield losses were serious. This type of infection - bacteria that enter from the surface of the leaf through natural leaf openings or wounds - causes the "marginal scorch" symptoms that are so common in Massachusetts.

The second part of that Michigan experiment was to leave the weeds and residue in that greenhouse over the winter, and put new, clean transplants into the house the following year. These plants did not develop symptoms either in the house or the field, and the bacteria was not found on the plants. Does this mean you should stop your greenhouse sanitation practices? No! It is important to use all standard sanitary precautions, such as disinfecting benches, trays, hoses, etc, and keeping watering devices off the floor.

If infected plants are present, bacteria move readily from one plant to another during normal watering, handling, and ventilating activities. Controlling the bacteria at this stage can prevent yield losses. Bacteria on the surface of transplants can be controlled with sprays of copper hydroxide or streptomycin in the greenhouse. Kocide (101, 2000, DF), Agri-Strep and Agri-mycin 17, are labeled for greenhouse use on tomato transplants. Do not exceed label rates: excessive rates of copper can result in phytotoxicity.

In another greenhouse experiment at Michigan State, tomato seedlings were inoculated with *Clavibacter*. Kocide 40DF, alone or mixed with Dithane F-45, or Agri-Mycin 17 was applied on a five-day schedule from the first true leaf stage until transplanting. Bacteria on leaf surfaces were effectively suppressed. After plants were set out in the field, no further sprays were applied. Yields of sprayed, inoculated transplants were equal to clean, non-inoculated plants that were grown in a separate greenhouse. Unsprayed, inoculated plants had lower yields. In a similar experiment conducted at University of Massachusetts in 1994, weekly sprays of streptomycin on greenhouse - inoculated plants eliminated all bacteria on the leaves of sprayed plants until mid July. It is possible that a less intensive spray schedule would have similar results, but this was not tested.

Using bactericide in the greenhouse saves a lot of chemicals, expense and time, compared to multiple copper applications in the field. Check the label carefully for required REI and personal protective equipment.

There are a number of novel pesticides that are labeled for use against bacterial diseases of tomato. These include Actigard which stimulates the plant defense against pathogens and is labeled for use against bacterial speck and spot in tomato. Serenade *(Bacillus subtillus)* is labeled for suppression bacterial spot of tomato and is a biological control agent.

Rotate your tomatoes to a different field. Setting clean transplants into a field where canker-infected tomato was grown the previous year will result in early infection with canker and reduced yields. This has been documented by research, and by grower experience in Massachusetts.

Bacterial canker survives in the field as long as there is any infected crop debris. It lasts longer in debris on the surface than it does in buried debris. We have cultured active bacteria from dried-up tomato leaves that sat on the soil surface all winter in a field that was infected with bacterial canker the previous season. Plowing after harvest will help to speed up the decomposition. Keep each field out of tomato (and related crops such as potato and eggplant) for two to three years.

We have seen outbreaks of canker where tomatoes are planted in rotated ground that is adjacent to last year's tomato ground. New fields should, as much as is possible, be located at a distance from last year's fields - as far as possible given the choices available on your farm.

PREVENTION IS COST-EFFECTIVE

All of these tactics focus on prevention - ensuring that disease-free plants go out into a "clean" environment. Bacterial canker outbreaks in the field require regular (weekly) sprays with a copper or copper/maneb mix, with limited success. Prevention strategies are both the least expensive and the most effective way to "beat bacterial canker".

USING HOT-WATER SEED TREATMENT TO PREVENT BACTERIAL DISEASES

by Jude Boucher and Gianna Nixon, University of Connecticut Cooperative Extension System and Ruth Hazzard and Robert Wick, University of Massachusetts

Bacterial disease of vegetable crops, such as **bacterial leaf spot** (BLS) of peppers caused by *Xanthomonas campestris pv. vesicatori*a, **bacterial canker** of tomatoes (*Clavibacter michiganensis pv. michiganensis*) and **black rot** on cole crops (*Xanthomonas campestris pv. capestris*), have become all too common in recent years. Before the arrival of BLS-resistant pepper varieties, over 90% of the Connecticut pepper plantings inspected were infected with bacterial leaf spot, sometimes resulting in complete crop failure, but always drastically reducing profits. Resistant varieties have helped reduce this problem, but for many specialty peppers no resistant varieties are available. If you are selecting resistant varieties, make sure to choose those with resistance to BLS Races 1, 2 and 3.

Similarly, bacterial canker has caused significant losses in tomato plantings throughout Massachusetts. When present, these diseases can cause extensive crop destruction, due to the speed with which they spread and because chemical control often provides disappointing results.

These three disease-causing organisms can arrive on farms in infected seed and transplants or survive one or two winters on crop residues, or for longer periods on weeds in the same botanical families as the host crop. Companies that produce seed take many steps, from inspecting seed production fields to testing seed in lots of 10 to 30,000, to try to ensure that it is free of bacterium. Many companies use chemical treatment such as sodium hypochlorite, which sterilize the surface of the seed; however, chemicals do not reach infections within the seed. Research has shown that hot-water treatment can penetrate the seed sufficiently to eradicate bacterial infections inside the seed.

There are only a few seed companies that routinely hot-water test cole crop and tomato seed (not peppers, which are considered more fragile) or may do it on request. Their reluctance is understandable, since there is risk that germination will be reduced if the water gets too hot or if the seed crop was grown under stressful environmental conditions. Thus, some varieties or lots are more vulnerable to heat treatment than others. One seed company reports, however, that they often see an “increase” in germination rates after hot-water treatment, because other microbes that attack the seed during germination are killed.

If possible, buy hot-water treated seed**.** If the varieties you prefer are not available from a company that offers this service, treat the seed yourself. Hot-water treatment is easier, cheaper and more effective than trying to combat bacterial diseases in the field with chemicals.

Once **you** hot-water treat, the seed company’s liability and guarantees are null and void, therefore the following precautions and recommendations should be observed. It is important that the water be maintained at a uniform temperature throughout the vessel, that the recommended temperature of 122 degrees Fahrenheit not be exceeded and that the seed be treated no longer than the time interval specified.

- Treat tomato seed at 122 °F for 25 minutes.
- Treat pepper, cabbage or Brussels sprouts at 122 F for 25 minutes.
- Treat cauliflower and broccoli at 122 F for 20 minutes.

1. Due to the expense of hybrid seed, it is recommended to treat a 100-seed sample and conduct a germination test in the greenhouse before exposing the whole lot to the high temperature bath. Treat a 100-seed sample of each lot number and variety, and plant it alongside an equal number of untreated seed in the same growing media that you plan to use for your transplant production.

2. It is **essential** to use an accurate laboratory thermometer to ensure that the water bath is at the correct temperature. We recommend using a stirring hot plate to provide continuous agitation and uniform water temperature, but continuous manual stirring may suffice.

Bring the bath up to the recommended temperature. Suspend the thermometer in the center of the water bath. Wrap the seed loosely in a cloth or in cheesecloth with a metal bolt or sinker to keep the seed submerged, or place it in a large tea ball, and proceed to soak it for the recommended interval. Check the temperature constantly. It helps to have a separate container of room temperature water or ice cubes close by to add, if necessary, to prevent overheating. Remove the seed after 20 to 25 minutes, cool the seed under tap water and air dry at 70 to 75 F by spreading the seed on paper towels.

3. If the test treatment gives acceptable germination rates, treat as much seed as you expect to plant this year, carefully using the same procedure.

WE TRIED IT!

In the spring of 1995, germination tests were conducted on five new lots (varieties) of pepper seed and one lot, which was a year old. The hot-water treated seeds had an average germination rate of 95% (range of 89% to 99% across varieties) compared to 94% (range of 88% to 99%) for the untreated seeds. Ten weeks after the hot-water treatment, a second planting was made and again, there was no reduction in germination for treated seed. For additional information contact Jude Boucher at UConn's Vernon Cooperative Extension Center, 860-875-3331.

Experiments conducted at UMass in the winter of 1994 showed that hot-water treatment at 125 F for 30 minutes caused a reduction in germination ranging form 0.5% to 59% among seven different tomato varieties. The average reduction was 20%. Seed was planted at two-week intervals following the hot-water treatment, and there was no further reduction in germination rate for up to 10 weeks following treatment. Thus, it should be possible to store seed for later plantings after treatment without reduced germination. Note that our recommended temperature for tomato is 122 °F, slightly lower than the temperature used in this test.

In the case of vegetable bacterial diseases, an ounce of prevention (hot-water treatment) may be worth more than hundreds of pounds of chemical cure!

You can order the necessary equipment from Fisher Scientific, 1-800-766-7000. The recommended products are:

-- Thermometer (Total immersion type , 0-230 °F scale, accurate to 2 degrees F, Cat. #14-983-15B), priced around $11.75 each.)

-- Stirring Hot Plate, 9"x9" surface 1995 cat. #11-498-7SH, priced around $310.

Another supplier is Cole Palmer (1-800-323-4340).

-- Thermometer (Total immersion type , 0-230 °F scale, Cat # SR-08118-54) $11.30

The information in this material is for educational purposes. The recommendations contained are based on the best available knowledge at the time of printing. Any reference to commercial products, trade or brand names is for information only, and no endorsement or approval is intended. Mass Extension does not guarantee or warrant the standard of any product referenced or imply approval of the product to the exclusion of other which also may be available. The user of this information assumes all risks for personal injury or property damage.

VERRILL FARM SEEKS FARM MANAGER FOR 2002 SEASON

Verrill Farm in Concord, Massachusetts is looking for a farm manager, who will have full responsibility for 150 acres of premium vegetables. For more information or to apply, call Steve Verrill at 978-835-5227.

Vegetable IPM Newsletter, Ruth Hazzard, editor. Stephanie DeGray, Assistant Editor. The Vegetable IPM Newsletter is published weekly from May to September and includes contributions from the UMass Extension Vegetable Program faculty and staff, Extension programs from other states, growers, and private IPM consultants.