

Final Project Report to the NYS IPM Program, Agricultural IPM 2000 – 2001

Title:

Evaluation of Pepper Cultivars for Tolerance to *Phytophthora capsici* and Impact of Messenger on Tolerance and Yield

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Type of grant:

Demonstration and Implementation: Pest Resistant Crops

Project location(s):

Tompkins, Schoharie, Niagara, Suffolk Counties

Abstract:

The goal of this project was to demonstrate and evaluate commercially available pepper cultivars for tolerance to *Phytophthora capsici* crown and fruit rot. Some of the cultivars were treated with a compound designed to enhance the ability of plants to resist diseases, to see if disease tolerance or yield could be improved. Of the tested cultivars, Paladin and Aristotle showed good tolerance to this disease, but disease pressure this year was light. Yields and earliness were generally similar across the 4 locations of testing, indicating that these varieties were fairly stable in their performance and may be good candidates for use in fields where the disease is problematic. Using Messenger, one crop stimulant, did not enhance yield or disease resistance of these peppers. The added labor and expense for application of this material could not be justified through these experiments.

Background and justification:

Phytophthora fruit and crown rot of peppers (*Phytophthora capsici*) is a major concern for many growers because an effective management program (including pesticides) has not been identified and severe disease losses have resulted. This disease has been increasing in importance in New York and elsewhere in the U.S. Within the past 20 years it has gone from being uncommon to a serious problem on Long Island, in the Capital District and in Western NY. Identifying effective management practices would benefit most vegetable growers because this pathogen affects peppers, tomatoes, eggplants and cucurbits.

Primary cultural practices suggested for the management of this disease have focused on rotation, water management and drainage. Growers in New Jersey and on Long Island produce peppers on tall raised beds (8-10 inches) with plastic mulch and drip irrigation. In addition, growers in New Jersey add soil to the planting hole to decrease water puddling around the plant crown that may increase disease incidence. Some commercially available cultivars have been shown to have tolerance to this devastating disease. Several of these tolerant cultivars, such as Palladin, Emerald Isle, Aristotle, and Conquest, also have been reported to have good

horticultural qualities in other parts of the country and on Long Island. The tolerance does not provide complete protection against the disease, but does allow for more harvests prior to plant death. Many growers and extension educators in NYS are not familiar with these cultivars and their tolerance, and expressed interest in trials and field days to evaluate these materials.

New research has indicated that chemical elicitors of systemic acquired resistance (SAR), such as Messenger (Eden Bioscience), may provide enhanced disease resistance to *Phytophthora* or improved yield in peppers. Integration of these biocontrol strategies- genetic tolerance and chemically induced SAR, with other cultural practices may further reduce losses to this disease compared to current fungicide and cultural practices.

Objectives:

1. Demonstrate and evaluate productivity and survival of 8-10 pepper lines (both commercial and breeding lines) with some tolerance to *Phytophthora capsici* in three commercial and one research station field with a history of disease incidence.
2. Test the efficacy of a compound that induces systemically acquired resistance to reduce disease incidence or increase yield in two tolerant and one susceptible cultivar of pepper.

Procedures:

CULTIVARS

Seed companies provided several lines with some level of *Phytophthora capsici* tolerance. Two standards were included: Boynton Bell, King Arthur and Paladin (Rogers)- a proven tolerant cultivar. Entries received included Conquest (Harris Moran), Aristotle (Petoseed), PR001 and PR004 (Pepper Research Inc.). Other cultivars that have been reported to have some tolerance (Emerald Isle and Reinger) were not included due to questionable tolerance or horticultural characteristics. All cultivars were evaluated on Long Island. All but the Pepper Research lines were evaluated in Western New York (2 grower fields), and only Aristotle and Paladin were evaluated in Freeville. In Freeville, Paladin and Boynton Bell were also treated with Messenger (Eden Bioscience) to determine effects on crop yield.

LONG ISLAND TRIAL

Plants were seeded on April 18 and transplanted June 8th, 2001. Fertilizer provided a total of 100 lb / A of N-P₂O₅- K₂O, preplant incorporated. Raised beds (30" across top) were formed with buried drip and black plastic over the bed. Plants were established using two rows per bed and a 15-inch plant spacing between and within rows, using a staggered configuration. Plots were 14 feet long, and the harvest area included 18 plants plus 2 buffer plants for the ends of each row. Plots were sprayed with Kocide (1.3 pt/A) + Maneb (2 lb/A) on 7/20, 8/2, 8/8, 8/17, 8/23, 8/31, and 9/7. Plots were scouted for *Phytophthora* crown and fruit rot on several dates (7/3, 7/9, 7/16, 9/7, 9/24, 10/10). Plants were harvested on three dates (23 August, 4 September, 19 September, 2001), and peppers were sorted by size as well as marketability.

WESTERN NEW YORK TRIALS

Two replicated plots were established in two grower fields. The experimental design used at each site was identical. Plants were seeded April 30 and transplanted June 14, 2001. Plants were spaced 12 inches apart in-row, using a double staggered row on raised beds covered with plastic and drip irrigation. Beds were spaced 5 feet apart. Each plot contained 6 plants plus one extra plant in each row, as a buffer on the ends of the plots. Each plot was maintained by the growers using their standard practices. Plots were harvested on 4 or 5 days, starting 3 August. Peppers were sorted based upon marketability.

FREEVILLE NEW YORK TRIALS

Four varieties (Boynton Bell, Paladin, Aristotle, King Arthur) were sown on April 18, 2001 in 72 cell plastic trays filled with peat-based medium. They were grown in the greenhouse with 85 F day temperature and 65 F night temperature. The plants were thinned 10 days later. They received weekly fertilizer applications after development of the first true leaves (Peter's water soluble 15-5-15). On May 24 the plants were removed from the greenhouse and placed outside in a cold frame.

For experiments with Messenger, Paladin (tolerant to *Phytophthora capsici*) and Boynton Bell were sown on April 18, and handled as described for the Freeville cultivar evaluation. One week prior to transplanting, these plants were evenly divided into two treatment groups. One group was sprayed with Messenger and the other with water (7 days before transplanting) using a SOLO backpack sprayer. The rate was 7.5 grams in 3 gallons of water (sprayed to run off).

A large portion of the fertilizer (460 lb per acre of 13-13-13) was broadcast and incorporated before planting. Raised beds were formed (6' apart on center, 4" high) and a single line of drip tape was buried (2" deep in center of bed). The bed was covered with black plastic (1.1 mil). Transplants were established on the beds using a double staggered row system with 15" in row spacing and 15" between row spacing on May 31. Starter fertilizer was added at this time. Irrigation was applied through the drip system. Additional fertilizer (Nitan and Peter's water soluble 20-20-20) was added through the drip system during the growing season (60 lbs. per acre). The total fertilizer applied during the season was 120 lb, 80 lb P₂O₅, and 80 lb K₂O.

For the Messenger treated plants, the material was applied to treated plots approximately every 14 days using a SOLO backpack sprayer, for a total of 5 applications. The rate was 0.25g in 1.5 quarts of water per plot.

Results and discussion:

OBJECTIVE 1.

In Riverhead, Long Island, no significant differences were detected for yield or earliness among any of lines tested (Table 1). The percent of marketable peppers was much lower at this sight (70% of total weight) compared to other locations (range 94-98%). Fruit were culled due to small size, blossom end rot, or poor shape. The tested cultivars did vary for the level of *Phytophthora* crown rot observed over the season (no fruit or leaf blight observed), despite the fairly low levels of infection this year (Table 1). Paladin, Aristotle and PR004 had no plants with symptoms at the end of the season.

In Western New York, results from two locations indicated that yields were twice as high in one location compared to the other, however there were no interactions between location and variety performance. Therefore, the data was pooled for analysis (Table 2). There were no differences in early or total marketable yield or number among the varieties. However, average fruit size Aristotle was significantly higher than that of Paladin, Boynton Bell or King Arthur in these two environments ($P < 0.05$).

In Freeville, New York, total and marketable yields were similar among the varieties tested (Table 3). King Arthur did have earlier production of fruit as well as more large fruit than the other cultivars, but overall yields were similar.

OBJECTIVE 2.

The Messenger treatment had no significant effect on early and total yield, yield per plant, and average length, width and wall thickness of either cultivar (Table 4). Wall thickness was dependent on the characteristics of the cultivar and Paladin had slightly thicker walls by about 7% ($P < 0.05$) compared to Boynton Bell. Messenger increased the percentage of the total number

of fruit (by weight and number) that were small by 5% compared to the control ($P < 0.05$). The control treatment produced 4% more large fruit (by weight and number) compared to the Messenger treatment ($P < 0.01$). This was also depended on the cultivar, with Paladin producing 10% more large peppers by weight ($P < 0.05$) than Boynton Bell. In a separate experiment not included in this research, Messenger had no effect on *Phytophthora* crown rot incidence in peppers (M. McGrath, personal communication). These results did not support the use of this type of compound to stimulate enhanced yield of peppers grown in central New York.

SUMMARY

All varieties performed well in all locations of our evaluation, and few differences in yield or quality were noted. This suggests that new cultivars displaying resistance to *Phytophthora capsici* could be grown in place of non-resistant cultivars in most locations of New York, with little loss in yield or quality compared to standard cultivars. Of the tested cultivars, Paladin and Aristotle showed good tolerance to this disease, but disease pressure this year was light. The new materials from Pepper Research Inc were also promising. Growers should feel confident to substitute a portion of their bell pepper varieties with these more resistant types, particularly in areas with history of the disease. New lines will be available for testing this year.

No differences in yield or quality were observed by application of Messenger. Messenger induces systemic acquired resistance as well has been shown to increase crop yields. Our results indicated that the use of this material may not be justified under New York climatic conditions. Labor as well as product costs increased the total costs of production, but no yield differences were observed to justify these expenses. Regions with longer seasons or higher total incident sunlight may be more conducive to yield improvements with these types of plant stimulants.

Table 1. Early and total yield of green bell peppers grown at Riverhead, NY.

Cultivar	Early Yield ¹		Total Yield ²		%Marketable ³		Marketable	%Large Fruit ⁴		% Plants with
	No.	Wt. (lb)	No.	Wt. (lb)	No.	Wt.	Yield T/A	No.	Wt.	<i>Phytophthora</i> ⁵
Aristotle	30	14.5	133	49.6	59	67.3	10	26	33	0.0
Boynton Bell	23	11.0	121	43.6	65	72.7	10	18	26	16.7
Conquest	48	22.1	124	48.0	63	72.5	11	40	50	1.4
Palladin	39	18.9	147	55.6	59	68.0	12	34	46	0.0
PR001	32	15.7	120	46.0	62	69.6	10	29	38	4.2
PR004	40	18.2	128	46.2	56	62.8	9	25	34	0.0

*Significance of Differences*⁵

Cultivar	ns	ns	ns	ns	ns	ns	ns	ns	ns	*
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¹ Early yield includes fruit harvested on August 23 from a plot.

² Total yield includes fruit harvested on August 32 and September 4 and 19.

³ Unmarketable fruit were small sized, diseased, or misshapen.

⁴ Large fruit were 0.5-0.75 lb each.

⁵ Cumulative total number of plants showing crown rot symptoms. No aerial symptoms (leaf or fruit rot) was observed.

⁶ ns = nonsignificant difference using the F test.

Table 2. Early and total marketable yield of five sweet green bell peppers grown in Western New York, 2001.

Cultivar	Early Yield ¹		Total Yield ²		Yield T/A	%Marketable		Average
	No.	wt. (lb)	No.	wt. (lb)		No.	wt.	Fruit Size (lb)
Aristotle	7	2.9	40	19.1	31.8	94	96	0.45
Conquest	6	2.2	44	20.8	34.6	88	91	0.43
Boynton Bell	7	2.6	40	16.7	27.8	90	93	0.39
King Arthur	6	2.3	39	16.2	27.0	93	94	0.40
Palladin	6	2.5	46	20.1	33.5	94	95	0.41

*Significance of Differences*³

Cultivar	ns	ns	ns	ns	ns	ns	ns	*
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¹ Early yield includes fruit harvested on August 8 or 9 from two locations.

² Total yield includes fruit harvested on August 15, 21, 28 and September 5.

³ ns = nonsignificant and * represents 0.05 level of significance using the F test.

Table 3. Early and total yield of four sweet green bell peppers grown in Freeville, NY.

Cultivar	Early Yield ¹		Total Yield ²		%Marketable ³		Marketable	%Large Fruit ³	
	No.	wt. (lb)	No.	wt. (lb)	No.	wt.	Yield T/A	No.	wt.
Aristotle	19	8.1	94	39.0	98	97.0	14.2	18	24
Boynton Bell	16	6.5	88	36.2	96	98.0	13.1	9	12
King Arthur	29	13.6	93	40.3	99	99.0	14.6	23	31
Palladin	19	8.5	86	35.8	89	98.0	13.0	19	24

*Significance of Differences*⁵

Cultivar	ns	*	ns	ns	ns	ns	ns	*	*
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¹ Early yield includes fruit harvested on August 15 from a plot.

² Total yield includes fruit harvested on August 15, 21, 28 and September 5.

³ Unmarketable fruit were small sized, diseased, or misshapen.

⁴ Large fruit were 0.5-0.75 lb each.

⁵ ns = nonsignificant and * represents 0.05 level of significance using the F test.

Table 4. Early and total yield, length and width and size distribution of two sweet pepper cultivars grown at Freeville, NY.

Factor	Total Yield ¹		Early yield ²		Yield per plant		Percent small ³		Percent medium		Percent large	
	No.	wt (lb)	No.	wt (lb)	No.	wt (lb)	No.	wt (lb)	No.	wt (lb)	No.	wt (lb)
Cultivar												
Palladin	95	40.1	66	27.7	6	2.5	0.13	0.09	0.69	0.67	0.18	0.23
Boynton Bell	108	44.4	65	25.5	7	2.8	0.18	0.13	0.72	0.74	0.10	0.13
Treatment												
Messenger	101	41.1	62	24.6	6	2.6	0.18	0.13	0.70	0.71	0.12	0.16
Control	103	43.4	69	28.6	6	2.7	0.13	0.10	0.71	0.70	0.16	0.20
Significance of Differences ⁴												
Treatment	ns	ns	ns	ns	ns	ns	*	*	ns	ns	**	**
Cultivar	ns	ns	ns	ns	ns	ns	ns	ns	ns	*	*	*
Treatment * cultivar	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns

¹ Total yield from a 10' by 2.5' plot.

² Early yield includes the harvests on 8/15 and 8/21.

³ Size classes were small (0.25-0.33 lb), medium (0.33-0.50 lb), large (0.50-0.75 lb) and jumbo (>0.75 lb).

⁴ ns, *, ** indicates nonsignificant or significant differences at the 0.05 or 0.01 level, respectively.

