

Bell Pepper Cultivar Evaluation Under High *Phytophthora capsici* Incidence

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Introduction

Phytophthora capsici causes Phytophthora blight, which is a devastating disease of bell peppers and many other vegetables grown in the Midwest. Recently, the incidence of this rapidly spreading disease has dramatically increased in Illinois and has caused yield losses of up to 100% in bell pepper fields. This trial was established to determine the impact of *P. capsici* on yield and farm-gate revenues of susceptible, tolerant, and resistant bell pepper cultivars.

Materials and Methods

Nine bell pepper cultivars (Alliance, Aristotle X3R, Cal. Wonder, Commandment, King Arthur, Legionnaire, Paladin, Red Knight X3R, and Revolution) were evaluated during 2005 and 2006 in a commercial field infested with *P. capsici* near Shawneetown, Illinois. 'Paladin' is resistant to *P. capsici*, while 'Alliance,' 'Aristotle X3R,' and 'Revolution' are tolerant. All other cultivars evaluated are highly susceptible. The experiment was set up as a randomized complete block design with three replications. Raised beds were formed on 7-foot centers and covered with 1.25-mil black plastic mulch with drip irrigation. Six-week-old bell pepper seedlings were transplanted on double rows spaced 1.5 feet apart. Plots were 7.5 feet long with five plants per row. Each plot had 10 plants. About 120 lbs./A N was applied over the growing season. No insecticides or fungicides were used.

Phytophthora blight disease incidence was rated 4, 8, 12, and 16 weeks after transplanting (WAT). Visible symptoms included wilting of plants, crown rot, stem lesions, and fruit rot. Farm-gate revenues were calculated using a \$10 per 28-pound box conversion factor, based on average St. Louis, Missouri produce terminal market prices for 2005 and 2006. Harvests began on July 25, 2005 and July 6, 2006, and ended on October 7, 2005 and September 6, 2006, with a total of six harvests. Fruit were weighed and graded into marketable (Fancy, No. 1, and No. 2) and cull (misshapen or decaying fruit) based on USDA standards. Bell pepper plants showing symptoms of Phytophthora blight were collected both years. *Phytophthora capsici* was isolated and 'Cal. Wonder' seedlings were inoculated in a greenhouse with the isolated pathogen. In all cases, Phytophthora blight disease symptoms developed and *P. capsici* was again re-isolated.

Data were subjected to analysis of variance procedures appropriate for a randomized complete block design using SAS (SAS Institute, Cary, N.C.). Fisher's least significant difference (LSD) tests were used to separate differences among bell pepper cultivar means at $P \leq 0.05$.

Results

Phytophthora blight incidence data were combined over the 2005 and 2006 growing seasons since no year by cultivar interactions ($P > 0.05$) were observed. However, a year by cultivar

interaction ($P \leq 0.05$) was observed for bell pepper yields and farm-gate revenues indicating that cultivar performance for these variables depended on year. The two years provided different growing seasons primarily due to more rainfall during July and August of 2005 compared to 2006, resulting in higher soil moisture amounts with water often standing between rows. Therefore, yield and farm-gate revenue results will be presented by year.

Only 7% *Phytophthora* blight disease incidence was detected on *P. capsici*-resistant ‘Paladin’ at 16 WAT (Table 1). The tolerant cultivars (Aristotle X3R, Revolution, and Alliance) had lower *Phytophthora* blight disease incidence at 16 WAT (52%, 53%, and 65% in plots, respectively) compared to most of the susceptible cultivars. At 98%, ‘Cal. Wonder’ had the highest *Phytophthora* blight disease incidence rating of all bell pepper cultivars evaluated at 16 WAT.

Table 1. *Phytophthora capsici* incidence on nine bell pepper cultivars combined over the 2005 and 2006 growing seasons in a *P. capsici*-infested field in Shawneetown, Ill.

Cultivar ^z	% <i>Phytophthora</i> Blight Incidence (Weeks After Transplanting — WAT)			
	4	8	12	16
Paladin ^y	0 a	2 a	3 a	7 a
Aristotle X3R ^x	7 a	20 ab	33 a-c	52 b
Revolution ^x	2 a	17 ab	32 ab	53 bc
Alliance ^x	10 a	18 ab	42 b-d	65 b-d
Red Knight X3R	8 a	28 b	65 b-d	73 b-e
King Arthur	10 a	25 ab	58 b-d	78 b-e
Commandment	8 a	18 ab	53 b-d	85 c-e
Legionnaire	17 a	35 b	73 d	92 de
Cal. Wonder	14 a	30 b	46 b-d	98 e

^zCultivars are ranked according to least percentage of *Phytophthora* blight incidence at 16 WAT. Symptoms included wilting of plants, crown rot and stem lesions, and fruit rot. Means followed by the same letter within each column are not significantly different at $P \leq 0.05$.

^y*Phytophthora capsici*-resistant.

^x*Phytophthora capsici*-tolerant.

2005

Early-season marketable yields and farm-gate revenues were similar among most bell pepper cultivars (Table 2). ‘Paladin’ had greater marketable weights (7,100 pounds per acre) and farm-gate revenues (\$5,600 per acre) during the late-season harvests compared to all cultivars except ‘Alliance.’ ‘Paladin,’ ‘Aristotle X3R,’ and ‘Alliance’ had the highest total-season marketable weights ($\geq 6,000$ pounds per acre) and farm-gate revenues ($\geq \$4,800$ per acre) compared to all other cultivars. In contrast to ‘Paladin,’ ‘Alliance’ and ‘Aristotle X3R’ did not differ from most other lower-yielding cultivars; however, ‘Cal. Wonder’ and ‘Legionnaire’ generated lower total-season yields and farm-gate revenues than ‘Paladin,’ ‘Alliance,’ and ‘Aristotle X3R.’

2006

‘Paladin,’ ‘Revolution,’ ‘Alliance,’ and ‘Aristotle X3R’ produced high early- and late-season marketable yields ($\geq 15,000$ and $10,900$ pounds per acre, respectively) and early- and late-season farm-gate revenues ($\geq \$11,900$ and $\$8,700$ per acre, respectively) compared to the five susceptible cultivars (Table 3). However, ‘Paladin’ generated greater marketable yields and farm-gate revenues compared to all cultivars for both late- and total-season harvests. Yields and farm-gate revenues of *P. capsici*-tolerant ‘Revolution,’ ‘Alliance,’ and ‘Aristotle X3R’ did not differ for early-, late-, or total-season harvests. Overall, *P. capsici*-resistant or tolerant ‘Paladin,’ ‘Revolution,’ ‘Alliance,’ and ‘Aristotle X3R’ and susceptible ‘King Arthur’ generally produced the highest total-season yields and farm-gate revenues. In contrast, ‘Cal. Wonder’ and ‘Legionnaire’ produced the lowest total-season yields and farm-gate revenues.

Table 2. Impact of *Phytophthora capsici* on marketable weights and farm-gate revenues during the 2005 growing season for nine bell pepper cultivars at Shawneetown, Ill.

Cultivar ^y	Early-season ^z (x 1,000)		Late-season ^z (x 1,000)		Total-season ^z (x 1,000)	
	MW (lbs./acre)	FGR (\$/acre)	MW (lbs./acre)	FGR (\$/acre)	MW (lbs./acre)	FGR (\$/acre)
Paladin ^x	2.5 ab	2.0 ab	7.1 a	5.6 a	9.6 a	7.6 a
Aristotle X3R ^w	4.2 a	3.3 a	2.5 b	2.0 b	6.6 ab	5.3 ab
Alliance ^w	2.4 ab	1.9 ab	3.6 ab	2.9 ab	6.0 a-c	4.8 a-c
Red Knight X3R	2.6 ab	2.1 ab	1.3 b	1.1 b	3.9 b-d	3.1 b-d
King Arthur	2.2 ab	1.8 ab	1.3 b	1.0 b	3.5 b-d	2.8 b-d
Commandment	2.5 ab	2.0 ab	0.7 b	0.5 b	3.2 b-d	2.5 b-d
Revolution ^w	1.0 b	0.8 b	2.0 b	1.6 b	3.0 b-d	2.4 b-d
Legionnaire	1.5 b	1.2 b	0.2 b	0.1 b	1.7 d	1.3 d
Cal. Wonder	0.2 b	0.1 b	0.4 b	0.3 b	0.6 d	0.5 d

^zEarly-season = first 3 harvests, late-season = harvests 4 to 6, and total-season = all 6 harvests. MW = marketable weights. FGR = farm-gate revenues based on St. Louis, MO produce terminal market prices during 2005. Means followed by the same letter within each column are not significantly different at $P \leq 0.05$.

^yCultivars are ranked according to total-season marketable yields.

^x*Phytophthora capsici*-resistant.

^w*Phytophthora capsici*-tolerant.

Table 3. Effect of *Phytophthora capsici* on marketable weights and farm-gate revenues during the 2006 growing season for nine bell pepper cultivars at Shawneetown, Ill.

Cultivar ^y	Early-season ^z (x 1,000)		Late-season ^z (x 1,000)		Total-season ^z (x 1,000)	
	MW (lbs./acre)	FGR (\$/acre)	MW (lbs./acre)	FGR (\$/acre)	MW (lbs./acre)	FGR (\$/acre)
Paladin ^x	20.8 a	16.6 a	26.8 a	21.3 a	47.6 a	37.9 a
Revolution ^w	15.7 a-c	12.5 a-c	16.0 b	12.7 b	31.7 b	25.2 b
Alliance ^w	17.6 ab	14.0 ab	13.7 bc	10.9 bc	31.3 bc	25.0 bc
Aristotle X3R ^w	15.0 a-d	11.9 a-d	10.9 bc	8.7 bc	25.9 b-d	20.6 b-d
King Arthur	14.5 b-e	11.5 b-e	9.9 bc	7.9 bc	24.4 b-e	19.4 b-e
Red Knight X3R	13.0 b-f	10.4 b-f	8.4 bc	6.7 bc	21.4 d-f	17.1 d-f
Commandment	9.2 d-g	7.3 d-g	9.5 bc	7.5 bc	18.7 d-f	15.0 d-f
Cal. Wonder	4.6 g	3.6 g	9.2 bc	7.3 bc	13.8 f	11.0 f
Legionnaire	8.2 fg	6.6 fg	5.2 c	4.1 c	13.4 f	10.7 f

^zEarly-season = first 3 harvests, late-season = harvests 4 to 6, and total-season = all 6 harvests. MW = marketable weights. FGR = farm-gate revenues based on St. Louis, MO produce terminal market prices during 2006. Means followed by the same letter within each column are not significantly different at $P \leq 0.05$.

^yCultivars are ranked according to total-season marketable yields.

^x*Phytophthora capsici*-resistant.

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