University of Kentucky College of Agriculture
New Crop Opportunities Center

Bell and Specialty Pepper Evaluations for Bacterial Spot Resistance, Yield, and Quality

Brent Rowell, R. T. Jones, W. Nesmith, A. Satanek, W. Turner, and J.C. Snyder
Department of Horticulture

Introduction

After completing a three-year (1995-97) evaluation of bell pepper cultivars under induced bacterial spot (*Xanthomonas campestris* pv. *vesicatoria* or *Xcv*) and bacterial spot-free environments, we began a new series of trials in 2000 to compare new cultivars with previously recommended cultivars that were either highly resistant ('Boynton Bell') and/or that had very attractive fruits ('X3R Wizard'). While spot resistant pepper cultivars with the *Bs2* gene (resistance to *Xcv* races 1, 2, and 3) gained widespread acceptance in the state, a number of new resistant cultivars had been released since 1997. In addition to bells, we also wanted to screen a large number of hot and specialty peppers, some of which also carry the *Bs2* gene. Out-of-state buyers have expressed a strong interest in sourcing hot and specialty peppers from Kentucky. Bell varieties were tested again in replicated trials at two locations again in 2001 while hot and specialty peppers were observed for a second year in non-replicated 'RACE' trials at the same locations.

Materials and Methods

Near-duplicate trials were planted at the Horticultural Crops Research Station in Lexington (LEX) and at an isolated location in eastern Kentucky at the Robinson Experiment Station in Quicksand (QSND). Sixteen bell and 46 hot and speciality pepper cultivars were seeded in the greenhouse at LEX on 26 March. Seedlings were grown in 72-cell plastic trays and transplanted to the field on 16 May (LEX). Fourteen of the same bell cultivars and all of the same hot/specialty cultivars were transplanted at QSND on 29-30 May. Each LEX trial received 62 lb N/acre prior to planting supplemented by an additional 38 lb N/acre divided into 3 weekly fertigations from 27 June to 12 July (100 lb N/acre season total). Trials at QSND received preplant applications of 50 lb N/acre supplemented by 60 lb N/acre divided into 4 fertigations applied from 13 June to 20 July (110 lb N/acre season total). Phosphorus and potassium were applied prior to planting at both locations according to soil test recommendations.

Plots at both locations consisted of 16 plants in double rows with four replications in a randomized complete block design for bells and in single plots for hot and specialty peppers. All were planted on raised beds with black plastic mulch and drip irrigation. Plants of all cultivars were spaced 12 in. apart in the row with 15 in. between the two rows on each bed. Beds were 6 ft apart from center to center. A tank mix of maneb+fixed copper was applied weekly for bacterial spot (BLS) protection at Lexington.

No preventive fungicide treatments were applied at QSND in order to encourage the development of a natural BLS epidemic. No insecticides were required in the field at LEX or QSND. A pheromone trap for adult male European corn borers was placed adjacent to the trial field at LEX.

Thirteen new bell cultivars with the *Bs2* gene were compared with resistant controls 'Boynton Bell' and 'X3R Wizard' and with a susceptible control, 'King Arthur' (*Bs1* only, Table 1). The thirteen

new cultivars included seven from the 2000 trial and six which were tested for the first time in 2001. Mature green fruits were harvested four times in LEX and twice at QSND.

Marketable fruits were graded and weighed according to size class (U.S. No. 1 extra large, large, medium). We also weighed misshapen fruits which could be marketed to foodservice as 'choppers' (LEX only). Yields in each size class were multiplied by their respective wholesale market prices to determine gross returns ('income') for each cultivar. The income variable has been a good indicator of a cultivar's overall performance, taking into account yields of the different size classes and their price differentials. Prices from 2000 were also used for the 2001 trials.

Hot and specialty peppers included a group of 13 jalapeño cultivars of which two had the *Bs2* resistance gene ('X3R Ixtapa' and 'El Rey'= SAX 7603) and others claiming multiple virus resistance (Table 3). These were compared with 'Mitla'. Other pepper types included were three serrano cultivars, six anaheim cultivars, seven poblano/ancho cultivars (entry SVR 35-4845-7 has the *Bs2* gene), four Italian/cubanelle cultivars, four hot banana/wax cultivars (X3R Hot Spot and SVR 35-4846-7 with *Bs2* gene), six sweet banana/wax cultivars ('Pageant', 'Sweet Spot', and PX 35-4360-7 with *Bs2* gene), two fresno cultivars, and two pepperoncini cultivars (Tables 4 and 5).

Fruit appearance ratings. All bell pepper fruits harvested from all replications at the second harvest (July 19) at LEX were laid out in the field for careful examination and quality ratings. All fruits from single plots of hot and specialty pepper cultivars were evaluated in the same way at LEX on July 30. Bell pepper fruits from two replications were evaluated at QSND (August 9, first harvest). Overall appearance ratings took several things into account including, in order of importance: overall attractiveness, shape, smoothness, degree of "flattening" (bell cultivars only), color, and uniformity of shape.

Plant support requirements. Some of the hot and specialty pepper cultivars required staking and tying in these trials which used close spacings, double rows, and plastic mulch with drip irrigation. All specialty cultivars at LEX were inspected at maximum fruit load to determine if staking and tying were needed; those requiring support are indicated in Tables 4 and 5. Tomato stakes (shorter stakes could also have been used) were driven into the ground at the four corners of individual plots; plants were 'fenced in' by running a string (tomato twine) around these four stakes. A single stringing was adequate for some cultivars while others required two or three successive stringings.

Inoculation and disease assessment

As in previous years, LEX plots were sprayed weekly with copper+maneb to help protect against bacterial spot while QSND plots were left unsprayed in order to encourage the development of a natural epidemic. June weather conditions in QSND were very favorable for BLS epidemic development and a natural epidemic did occur early in the season. Bell and specialty cultivars were assessed only once at QSND for BLS symptoms on June 28. Symptoms were extensive and severe on some cultivars in the hot and specialty trial by that date. BLS symptoms were scored as follows: 0 = no symptoms, 1 = very few (trace) symptoms visible, 2 = symptoms obvious but not extensive, and 4 = extensive symptoms (plants severely affected). These observations were made prior to the inoculation attempt described below.

In order to encourage a more uniform BLS epidemic within the trial, an attempt was made to

inoculate all bell cultivars with inoculum collected from the hot pepper trial: About 300 leaves with typical symptoms were collected at random from various susceptible cultivars within the hot pepper trial plot on 27 June. These were placed in a plastic bucket with sufficient distilled water to cover the leaves. The mixture was stirred for about 10 minutes with a wooden stick to enhance extraction of the bacteria, making an effort to crush some leaves on the side of the bucket. The mixture was then poured through a cotton bag to remove leaf debris and squeezed by hand. Two gallons of this mixture were diluted further with water to make a total volume of 4 gallons. This mixture was applied uniformly to all plants in the bell pepper trial using a hand-operated sprayer. The inoculation attempt was made in late afternoon, within 15 minutes of the extraction. Heavy rains had preceded the inoculation attempt–the ground and foliage were wet during the inoculation and remained wet until mid-morning the following day. We considered this procedure to be a relatively simple means of ensuring more uniform epidemics using only races of the bacterium already found within the trial; we have successfully used this method in trials with other crops in the past.

About three hours after the inoculations, some of the mixture remaining in the sprayer was applied to pepper seedlings growing in a greenhouse on the Lexington campus. These seedlings developed extensive BLS symptoms within 10 days.

Results and Discussion

As in previous years, we wanted to encourage disease and evaluate resistance at QSND while keeping the LEX trial free of bacterial spot. No bacterial spot symptoms were observed in the bell or hot/specialty trials in LEX.

Bell cultivars. Total marketable yields, gross incomes, and fruit quality characteristics for bell cultivars grown without bacterial spot at LEX are shown in Table 1. Although yields were somewhat lower than in 2000, most of the cultivars were high yielding (20-25 tons/acre) at LEX with 9 that were not significantly different from the top yielding cultivar 'X3R Aristotle' (Table 1). 'Aristotle', 'King Arthur' (bacterial spot susceptible), '4 Star', 'Boynton Bell', and 'Lexington' were also in this category in the 2000 LEX trial.

Yields, income, and fruit quality characteristics for most of the same cultivars grown at QSND are shown in Table 2. While an early bacterial spot epidemic did occur in the trial at this location, it had ended abruptly and inexplicably by the second week in July. No new bacterial spot lesions developed in the field at QSND after the inoculation attempt. In fact, all bacterial spot activity suddenly stopped in both the inoculated trial and the adjacent hot pepper trial which had not been inoculated. The reasons for this failure are not understood, but may be the result of environmental factors. Night temperatures below 61EF are known to suppress bacterial spot development regardless of daytime temperatures. Nights were unusually cool from 12-17 July (57EF was the average night temperature for that period). In addition, although the plots were still soaked from heavy rains prior to inoculation, rainfall did not occur again until 8 days after the inoculation.

There were no statistically significant differences among cultivars for total marketable yields or gross incomes at QSND. Marketable yields ranged from 13 to18 tons per acre (Table 2). Some of the highest yielding cultivars at QSND were also in the highest yielding group of varieties tested at LEX: '4

Star', 'X3R Aristotle', 'X3R Red Knight'. Yields appeared to have been affected by the early bacterial spot epidemic. 'King Arthur' and 'X3R Wizard' were among the lowest yielding cultivars at this location; these cultivars have been among the most susceptible in previous trials exposed to natural and induced BLS epidemics at QSND.

Scores for BLS symptom development from the 28 June assessment were extremely variable (c.v. = 116%) and no statistically significant differences were detected among cultivars (data not shown). This single assessment did not provide enough information to make valid comparisons for BLS resistance among cultivars. 'Conquest', a cultivar with the *Bs2* gene, had the highest average score for BLS symptoms at this first and only assessment date.

While BLS symptoms had nearly disappeared by the third week in July, leaf spots caused by *Phyllosticta* sp. were evident on many of the bell and specialty cultivars by July 11.

Fruit quality characteristics for bell cultivars are also shown in Tables 1 and 2. 'Aristotle' and Defiance' received the highest fruit appearance ratings at LEX which were better than ratings for 'X3R Wizard'. 'Aristotle', 'Lexington', 'Defiance', and 'X3R Wizard' had the darkest green fruits in the LEX trial. 'Defiance', 'X3R Wizard', and 'X3R Red Knight' received the best appearance scores at QSND. Many other cultivars received acceptable appearance ratings (6 or above at LEX or 5 and above at QSND) while 'King Arthur', 'Boynton Bell', 'X3R Red Knight', 'Conquest', and PR99Y-3 were rated lower than the others at LEX. 'X3R Aristotle' scored lower in overall appearance at QSND than at LEX. 'King Arthur' had the lowest score at QSND. 'King Arthur' has had consistently low fruit appearance scores in a number of trials; we consider it and similar cultivars better suited to foodservice markets.

Cultivars that were the highest yielding *and* which had acceptable or better fruit quality ratings at both locations included 'X3R Aristotle', '4 Star', and 'Orion'. A possible disadvantage of a cultivar like '4 Star' was its light to medium green-colored fruits (also light green in the 2000 trial); it may be difficult to market these lighter colored cultivars when buyers are have become accustomed to receiving those with darker fruits like 'X3R Wizard'.

Jalapeños. Yields and fruit characteristics of the 13 jalapeño pepper cultivars grown in single plots at LEX and QSND are shown in Table 3. Two of these cultivars carried the *Bs2* gene for bacterial spot resistance. Most jalapeño cultivars had high marketable yields at LEX ranging from 14 to 27 tons per acre with three cultivars exceeding 'Mitla' (Table 3). Among these 'Coyame', 'Summer Heat 6000', and RPP 7042-VP had the most attractive fruits.

Cultivars were exposed to a natural bacterial spot epidemic early in the season at QSND; however, the epidemic had nearly disappeared by mid-July and only a single assessment for symptoms was obtained. Unlike results from the 2000 jalapeño trial, the two cultivars with the *Bs2* gene and 'Jalandro' appeared to be most affected by this short-lived epidemic (Table 3).

Serranos. Marketable yields for the three serrano cultivars at LEX ranged from 15 to 22 tons per acre with 'Tuxtlas' and 'Serrano del Sol' having the highest yields and most attractive fruits (Table 4). 'Tuxtlas' was also the highest yielding and most attractive serrano in 2000.

Anaheims. Yields of the six anaheim cultivars ranged from 15 to 31 tons per acre at LEX; 'Navojoa' was the highest yielding while PX-35-4606-7 and 'Anaheim TMR 23' had the most attractive fruits

(Table 4). 'Navojoa' was also highest yielding at QSND in spite of severe BLS symptoms early in the season (Table 4).

Poblano/anchos. Yields among the seven poblano cultivars at LEX ranged from 4 to 21 tons per acre. 'Ancho Villa' was again (as in 2000) the highest yielding with the largest fruit size (Table 4); fruits of this cultivar, however, were lighter colored which could possibly be a disadvantage in some markets. The only entry with the *Bs2* gene for resistance to bacterial spot (SVR 35-4845-7) was high yielding and had the highest appearance rating at LEX. Most poblano/ancho cultivars are quite susceptible to bacterial spot and yields at QSND may have been affected by the early epidemic at this location (Table 4). 'Mulato Isleno' had very low yields at both locations.

Italian/cubanelles. Yields for the four Italian/cubanelle or frying peppers ranged from 17 to 28 tons per acre at LEX (Table 4). 'Aruba' had the highest yield and largest fruit size followed by 'ACX 500'. As in 2000, 'Corno di Toro' was considered to have the most attractive fruits although they were light to medium green in color instead of the typical light green or pale yellow. 'Key West', a new cultivar with the resistance to bacterial spot, appeared to be unaffected by the early epidemic at QSND (Table 4).

Hot banana/wax. Two hot banana cultivars and 'Santa Fe Grande' were tested. 'X3R Hot Spot' (with the *Bs2* gene) had the highest marketable yield and good appearance ratings at LEX (26 tons/acre, Table 5). Both 'Inferno' and 'Santa Fe Grande' had severe symptoms of bacterial spot associated with the early epidemic at QSND.

Sweet banana/wax. The six sweet banana or sweet wax cultivars included two with the *Bs2* gene ('Pageant' and PX 35-4360-7); yields at LEX ranged from 21 to 32 tons per acre (Table 5). PX 35-4360-7 was the highest yielding entry at both locations and had the most attractive fruits. Most cultivars had many 'C'- or apostrophe-shaped fruits. 'Market Sweet' was high yielding at LEX but exhibited severe BLS symptoms during the brief epidemic at QSND.

Fresno and pepperoncini. Two fresno cultivars–one with upright fruits and one with pendant fruits--were included in the trials. Marketable yield was higher and fruit size larger for the upright type (Table 5). 'Pepperoncini' from Rupp Seed Co. was the highest yielding of the two pepperoncini types tested at LEX. PX 17494 had more attractive fruits at LEX and had higher yields at QSND. The authors are not familiar with market requirements for pepperoncini types; these are usually brined and sold with pizza. Perhaps 'c'-shaped pepperoncini fruits could be as desirable as straight fruits.

Pepper types, cultivars, and bacterial spot risk. Kentucky pepper growers experienced periodic devastating bacterial spot epidemics prior to the widespread planting of resistant cultivars after 1995. There is growing interest in Kentucky and other states in growing hot and specialty pepper cultivars, many of which do not carry any major resistance genes. While there is a significant risk of bacterial spot epidemics associated with the production of some of these cultivars, others can be grown with less likelihood of disaster, especially with a sound spray regimen. Relative bacterial spot risks for various pepper types and cultivars were estimated after the 2000 trials and are shown in Table 6. Our recommendation remains that growers use resistant cultivars whenever possible *in conjunction with* copper+maneb preventive spray programs.

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Table 1. Yields, gross returns, and appearance of bell pepper cultivars under bacterial spot-free conditions in Lexington, KY; yield and returns data are means of four replications.

Cultivar	Seed source	Tot. mkt. yield[z] (tons/A)	% XL +Large[y]	Income[x] ($/acre)	Shape unif.[w]	Overall appear.[v]	No. lobes[u]	Fruit color	Comments
X3R Aristotle	S	25.0	89	10180	4	7	3	dk. green	most fruits longer than wide
King Arthur	S	22.5	88	9079	3	5	4	light-med green	deep blossom-end cavities
4 Star	RG	22.2	86	9111	3.5	6	4	light-med green	
Boynton Bell	HM	21.7	92	9003	3	5	3	med-dk. green	~15% of fruits 2-lobed (pointed)
Corvette	S	20.6	88	8407	3	6	3&4	med-dk green	~10% elongated (2-lobed)
X3R Red Knight	S	20.5	90	8428	3	5	4	med-dk. green	
SP 6112	SW	20.2	78	8087	4	6	3	med green	
Conquest	HM	20.0	85	8021	2	5	3&4	light-med green	deep stem-end cavities, many misshapes
Orion	EZ	20.0	93	8219	4	6	4	med-dk green	
Lexington	S	19.8	87	8022	3.5	6	3	dk. green	
PR99Y-3	PR	19.5	87	7947	3	5	3&4	med green	many misshapen fruits
Defiance	S	18.7	87	7568	4	7	3&4	dk. green	
X3R Ironsides	S	18.4	92	7585	4	6	3	med green	~5% w/ deep stem-end cavities
X3R Wizard	S	18.0	92	7447	3	6	3&4	dk. green	
RPP 9430	RG	17.3	89	7029	3	6	4	med-dk green;	~10% of fruits elongated
ACX 209	AC	17.2	89	7035	3.5	6	3	med green	
Waller-Duncan LSD (P<0.05)		5.2	7	2133					

[z]Total marketable yield included yields of U.S. Fancy and No. 1 fruits of medium (>2.5 in. diameter) size and larger plus misshapen but sound fruit which could be sold as 'choppers' to foodservice buyers.
[y]Percentage of total yield that was extra-large (>3.5 in. diameter) and large (>3 in. diameter but # 3.5 in. diam.).
[x]Income = gross returns per acre; average 2000 season local wholesale prices were multiplied by yields from different size/grade categories: $0.21/lb for extra-large and large, $0.16/lb for mediums, and $0.13/lb for 'choppers', i.e. misshapen fruits.
[w]Average visual uniformity of fruit shape where 1=least uniform, 5=completely uniform.
[v]Visual fruit appearance rating where 1=worst, 9=best, taking into account overall attractiveness, shape, smoothness, degree of flattening, color, and shape uniformity; all fruits from all 4 replications observed at the second harvest (July 19).
[u]3&4 = about half and half 3 and 4-lobed; 3 = mostly 3-lobed; 4 = mostly 4-lobed.

Table 2. Yields, gross returns, and appearance of bell pepper cultivars at Quicksand, KY; yield and returns data are means of four replications. All cultivars except King Arthur have the Bs2 gene for resistance to bacterial spot races 1, 2, and 3.

Cultivar	Seed source	Tot. mkt. yield[z] (tons/A)	% XL +Large[y]	Income[x] ($/acre)	Shape unif.[w]	Overall appear.[v]	No. lobes[u]	Fruit color	Comments
4 Star	RG	18.4	86	7496	--	--	--	--	--
X3R Red Knight	S	18.0	90	7344	3	6	3	med green	earlier maturing; some red fruits
Defiance	S	17.8	87	7256	3.5	7	3	med-dk. green	nice blocky fruits
X3R Aristotle	S	17.4	90	7164	3	5	3	med-dk. green	some 2-lobed fruits
RPP 9430	RG	17.3	88	7105	--	--	--	--	--
X3R Ironsides	S	16.7	83	6794	2	5	3	light-med	some 2-lobed
PR99Y-3	PR	16.0	86	6508	3	5	3	light-med	deep stem end; some 2-lobed
Conquest	HM	15.9	91	6560	3	5	3	med green	slightly elongated; some red fruits
Orion	EZ	15.8	86	6486	3	5	3	med green	
SP 6112	SW	15.5	81	6290	3	5	3	med-dk. green	many small fruits
Corvette	S	15.1	86	6194	3.5	5	3	med green	some 2-lobed
Boynton Bell	HM	14.9	77	5978	3	5	3	med green	
ACX 209	AC	14.7	82	5994	3	5	2,	med green	many 2&3-lobed fruits; elongated
King Arthur	S	14.3	77	5746	2	4	3	med green	
Lexington	S	13.6	82	5520	3	5	3	dk. green	many small and flattened fruits
X3R Wizard	S	12.8	90	5289	4	6	3	dk. green	nice; slightly elongated
Waller-Duncan LSD (P<0.05)		ns	12.2	ns					

[z]Total marketable yield included yields of U.S. Fancy and No. 1 fruits of medium (>2.5 in. diameter) size and larger.
[y]Percentage of total yield that was extra-large (>3.5 in. diameter) and large (>3 in. diameter but # 3.5 in. diam.).
[x]Income = gross returns per acre; average 2000 season local wholesale prices were multiplied by yields from different size/grade categories: $0.21/lb for extra-large and large, $0.16/lb for mediums.
[w]Average visual uniformity of fruit shape where 1=least uniform, 5=completely uniform.
[v]Visual fruit appearance rating where 1=worst, 9=best, taking into account overall attractiveness, shape, smoothness, degree of flattening, color, and shape uniformity; all fruits from 2 replications observed at the first harvest (Aug 9).
[u]3&4 = about half and half 3 and 4-lobed; 3 = mostly 3-lobed; 4 = mostly 4-lobed.

Table 3. Yields from single plots of jalapeno pepper cultivars at Lexington and Quicksand with fruit characteristics from Lexington, KY, 2001.

		Mkt. yield			Fruit characteristics						
Cultivar (resistance gene)	Seed source	LEX --- (tons/acre)----	QSND	BLS[z]	Crack-ing[y]	Average[x] Ln(in.)	Diam (in.)	Wt (g)	Appear. rating[w]	Color[v]	Comments
Coyame	S	27.4	--[u]	2	3	3.2	1.3	34	7	mg-dg	~10-20% slightly crescent-shaped
X3R Ixtapa (Bs2)	S	26.1	10.4	2	3	3.2	1.3	28	6	mg-dg	Some stubby, misshapen (~2%); ~10% purpling
RPP 7042-VP	RG	24.9	19.2	2	4	3.3	1.1	25	7	mg	
Summer Heat 6000	AC	23.6	19.8	2	3	3.4	1.3	34	7	mg-dg	Nice; ~50% very slightly curved
Mitla	S	23.4	20.1		3	2.9	1.1	24	7	mg-dg	Nice
El Rey (Bs2)	SK/SW	23.1	12.9	1	3	3.1	1.3	35	5	mg	Taper not always smooth
Torreon	S	22.9	20.7	2	3	3.3	1.2	27	6	mg-dg	
Ballpark	S	21.7	16.2	2	2	3.6	1.0	28	6	mg-dg	Some crescent-shaped (~10-15%)
Grande	S	21.4	18.0	4	3	3.2	1.2	30	6	mg	~5% with anthocyanin purpling??
HMX 3677	HM	21.3	16.1	2	4	3.0	1.3	26	7	dg	
Hybrid No. 7	RU	21.2	22.3	2	2	3.3	1.3	31	6	mg	~10% crescent-shaped
Jalandro	UG	20.8	12.2		1	3.3	1.6	40	4	mg	
HMX 3676	HM	13.9	16.1	2	3	2.7	1.2	31	7	mg-dg	Nice; some frts. very lightly curved.

[u]data not available from Quicksand for this cultivar.

[z]Bacterial spot symptoms were observed in some plots at QSND and may have affected yields of those cultivars: '1' = plots with mild infection, '2' = plots with mild to moderate infections, '4' = plots that had severe infections. A blank in this column indicates that no symptoms were observed; blanks or numbers do *not* imply resistance or tolerance.

[y]Extent of cracking in jalapeno fruits where 0 = none; 5 = very extensive, over entire fruit surface (Lexington trial); some cracking may be a desirable trait in hispanic markets.

[x]Average of a sample of 10 fruits (length and width); avg. fruit weight = marketable yields divided by number of fruits (entire season, Lexington).

[w]Visual fruit appearance ratings where 1 = worst, 9 = best, taking into account overall attractiveness, shape, color, and uniformity (Lexington).

[v]mg = medium green; dg = dark green (Lexington trial).

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Table 4. Yields from single plots of specialty pepper cultivars at Lexington and Quicksand with fruit characteristics from Lexington, KY, 2001.

		Mkt. yield			Fruit characteristics						
type	Seed	LEX	QSND	Bac.	Average[x]			Appear.	Plant		
Cultivar	source	----(tons/acre)----		spot[y]	Ln(in.)	Diam (in.)	Wt (g)	rating[w]	Color[v]	support[u]	Comments
serrano											
Tuxtlas	S	22.4	--[z]		2.9	0.8	12	7	mg	req'd.	~20% slightly crescent-shaped
Serrano del Sol	S	21.0	17.4		3.1	0.8	11	7	mg	req'd.	Nice, slightly crescent-shaped
Tampico Fiesta	HN/AS	15.3	13.7	2	2.9	0.6	7	6	lg-mg	req'd.	~50% slightly crscent-shaped
anaheim											
Navojoa	S	31.0	23.3	4	8	1.7	65	5	lg-mg	ben.	~30% 'C'-shaped
Garden Salsa	S	24.6	13.7	2	6.9	1.5	48	6	mg	req'd.	~30% 'C'-shaped, many culls from blossom-end decay
Sahuaro	S	18.7	12.4		6.7	2.1	73	5	lg	req'd.	10-20% 'C'-shaped, many culls from blossom-end decay
PX-35-4606-7	S	18.3	19.6		7.3	2.0	69	7	mg	ben.	Nice
Anaheim TMR 23	S	17.7	11.7	2	7.0	1.9	59	6	lg	req'd.	~20% 'C'-shaped, some blossom end decay
Joe E. Parker	R	14.8	21.3		6.3	1.7	59	4	lg	req'd.	~40% 'C'-shaped
poblano/ancho											
Ancho Villa	RG	21.0	12.3	2	5.4	3.0	133	6	lg-mg	req'd.	Lighter colored than most
SVR 35-4845-7 (Bs2)	S	17.2	10.7	4	4.9	2.8	94	7	dg	req'd.	Very nice
Ancho Ranchero	RG	14.6	11.6	2	5.1	2.9	99	4	lg-dg	req'd.	Highly variable
Ancho San Martin	SW	11.4	11.4		4.7	2.7	70	6	mg-dg	req'd.	Many culls from blossom-end decay
Mulato Costeno	S?	10.3	10.6		3.9	2.4	67	6	dg	req'd.	Small fruit size
PS 13194	S	9.7	10.2	1	4.5	2.6	90	6	mg-dg	req'd.	variable sizes; many culls from blossom-end decay
Mulato Isleno	S	3.9	3.9		4.3	2.3	54	5	dg	req'd.	Small fruit size; very low yield
Italian/cubanelle											
Aruba	RG	28.3	15.6	1	7.5	3.0	137	5	lg-py	ben.	~20% apostrophe-shaped
ACX 500	AC	24.2	9.4	2	7.5	2.8	115	5	py	req'd.	~40% apostrophe-shaped; nice color
Corno Di Toro	RU	18.4	16.5	4	6.6	2.3	107	6	lg-mg	ben.	~10% apostrophe-shaped
Key West (Bs2)	S	16.7	22.0	1	7.1	2.9	116	4	lg	ben.	~40% apostrophe-shaped

[z]Data not available from Quicksand for this cultivar.
[y]Bacterial spot symptoms were observed in some plots at QSND and may have affected yields of those cultivars: '1' = plots with mild infection, '2' = plots with mild to moderate infections, '4' = plots that had severe infections. A blank in this column indicates that no symptoms were observed; blanks or numbers do*not* imply resistance or tolerance.
[x]Average of a sample of 10 fruits (length and width); avg. fruit weight based on marketable yields divided by number of fruits (entire season, Lexington).
[w]Visual fruit appearance ratings where 1 = worst, 9 = best, taking into account overall attractiveness, shape, color, and uniformity (Lexington).
[v]Lg = light green; mg = medium green; dg = dark green; vdg = very dark green; gy = greenish yellow; py = pale yellow; ly = lemon yellow.
[u]Staking with one or more strings may be required using double rows on plastic with drip as indicated by 'req'd.' = cultivars requiring staking/support; 'ben.' = cultivars that may benefit from staking.

Table 5. Yields from single plots of specialty pepper cultivars at Lexington and Quicksand with fruit characteristics from Lexington, KY, 2001.

		Mkt. yield			Fruit characteristics						
type	Seed	LEX	QSND		Average[y]			Appear.		Plant	
Cultivar	source	---(tons/acre)----		BLS[z]	Ln (in.)	Diam (in.)	Wt (g)	rating[x]	Color[w]	support[v]	Comments
hot banana/wax											
X3R Hot Spot (Bs2)	S	26.2	23.5		6.3	1.6	54	6	py	ben.	
Inferno	S	25.6	17.7	4	7.0	1.6	64	4	py	ben.	Over 50% short and apostrophe-shaped
Santa Fe Grande	S	16.8	14.5	4	2.9	1.1	19	7	py	poss.	Very nice; jalapeno size and shape
sweet banana/wax											
PX 35-4360-7 (Bs2)	S	32.5	26.8	2	6.5	1.6	58	7	py	req'd.	~50% 'C'/apostrophe-shaped; many w/ blossom end decay
Market Sweet	RU	28.7	15.9	4	6.8	1.8	65	4	py-lg	poss.	Over 50% short and 'C'/apostrophe-shaped
Sweet Spot	S	24.5	17.6	2	6.9	1.8	58	5	py	ben.	Many culls
Pageant (Bs2)	RG	23.6	18.3		6.2	1.7	70	4	py	poss.	Over 50% short and 'C'/apostrophe-shaped
Banana Supreme	RU	23.5	14.9	2	6.2	1.8	65	5	py	poss.	~50% short and 'C'/apostrophe-shaped
Bounty	S	21.3	20.1	2	7.1	1.6	76	5	py	ben.	~50% short and 'C'/apostrophe-shaped
fresno											
Grande (upright)	PG	7.2	15.0				22			poss.	
Supreme (pendant)	PG	4.7	3.9	2			19			req'd.	
pepperoncini											
Pepperoncini	RU	17.6	11.5	2	3.9	1.5	39	6	lg-mg	req'd.	~40% 'C'-shaped
PX 17494	S	12.5	14.8	1	3.3	1.3	18	7	lg	req'd.	Mostly straight, more uniform

[z]Bacterial spot symptoms were observed in some plots at QSND and may have affected yields of those cultivars: '1' = plots with mild infection, '2' = plots with mild to moderate infections, '4' = plots that had severe infections. A blank in this column indicates that no symptoms were observed; blanks or numbers do *not* imply resistance or tolerance.
[y]Average from a sample of 10 fruits (length and width); avg. fruit weight based on marketable yields divided by number of fruits (entire season, Lexington).
[x]Visual fruit appearance ratings where 1 = worst, 9 = best, taking into account overall attractiveness, shape, color, and uniformity (Lexington).
[w]Lg = light green; mg = medium green; dg = dark green; vdg = very dark green; gy = greenish yellow; py = pale yellow; ly = lemon yellow.
[V]Staking with one or more strings may be required using double rows on plastic with drip as indicated by 'req'd.' = cultivars requiring staking/support; 'ben.' = cultivars that may benefit from staking; 'poss.' = cultivars that possibly need staking under windy conditions or with heavy fruit loads.

Table 6. Tentative ranking of pepper types and cultivars by their relative susceptibility to bacterial spot (based on results from trials at Quicksand, KY in 2000).

BLS risk	Group[z]	Resistance gene(s)	% BLS[y]	Cultivars[x]
Lowest	resistant Jalapeños	Bs2	3-22	X3R Ixtapa, El Rey
	tolerant Serranos	--	3-10	Tampico Fiesta, Serrano Chili
	most resistant Bells[w]	Bs2	8-13	X3R Ironsides, Peninsula, X3R Chalice, X3R Aristotle, X3R Red Knight
	resistant Hot banana	Bs2	17	X3R Hot Spot
	tolerant Habanero	--	22	Habanero (Hollar Seed Co.)
	tolerant Cubanelle	--	40	Aruba
	tolerant Hot bananas/wax.	--	40-52	Hungarian Yellow Wax, ACX 400, Romanian Hot Hybrid
	tolerant Cayenne (Misc.)	--	62	Mesilla
	tolerant Poblanos/anchos	--	62-67	Ancho San Martin, Ancho Villa
	less resistant Bells[w]	Bs2, --	63-71	X3R Wizard, Bennington
	tolerant Sweet bananas/wax	Bs2, --	62-75	Pageant, Market Sweet, Sweet Banana
	susceptible Cubanelles	--	67-77	Biscayne, ACX 500, Giant Aconcagua, Corno di Toro
	susceptible Hot bananas/wax	--	65-80	Hungarian Heat, Inferno
	susceptible Anaheims	--	72-80	Mexiheim, Garden Salsa, Anaheim TMR 23
	susceptible Bells	--, Bs1, Bs3[v]	80-82	King Arthur, Merlin, Consul, Vivaldi, Guardian, Sentinel
	susceptible Jalapeños	--	80-87	Mitla, Tam Jalapeño No.1, Delicias, Perfecto, Summer Heat 5000
highest	susceptible Poblanos/anchos	--	72-85	Ancho Ranchero

[z]Cultivars within types (Bells, Jalapeños, or hot/specialty types in Tables 4 and 5) grouped as: 1)"resistant" = having *Bs2* gene and high yielding with fewer symptoms and defoliation overall than 2)"tolerant" = having no major resistance gene but with considerably fewer symptoms and yielding more marketable fruits than 3)"susceptible" = little to no marketable yield with extensive foliar symptoms and defoliation.

[y]% BLS = range of the avg. percentages of leaves with bacterial spot symptoms under severe epidemic conditions at QSND in 2000; data were from 2 assessment dates and one or more cultivars.

[x]Not all cultivars tested are listed; others may be equally resistant, tolerant, or susceptible.

[w]Bell cultivars that were the "most resistant" with highest yields and gross returns. "Less resistant Bells" are those cultivars (with or without *Bs2*) that had relatively high AUDPC values, %BLS, and defoliation in 2000.

[v]Cultivars having *Bs1*, *Bs3*, or both were as susceptible as those with no major resistance genes in 1995 trials.