

**Carolina Wonder and Charleston Belle:  
New, Southern Root-knot Nematode Resistant  
Bell Pepper Cultivars for South Carolina**

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### **Introduction**

The southern root-knot nematode (*Meloidogyne incognita*) is a major pest of bell peppers, and the principal control method at present is soil fumigation with methyl bromide. The southern root-knot nematode is one of the major reasons why peppers account for almost 12% of the preplant methyl bromide use in the United States. The ideal solution to this bell pepper pest problem would be to develop and use resistant cultivars, but heretofore none of the bell pepper cultivars available to commercial growers and home gardeners exhibited an adequate level of resistance. We recognized the need for resistant bell pepper cultivars in the early 1980's, and initiated a breeding program to make them a reality. Our efforts were brought to a successful conclusion in early 1997 with the release of two cultivars, Carolina Wonder and Charleston Belle.

### **Origin**

'Carolina Wonder' and 'Charleston Belle' were developed at the U. S. Vegetable Laboratory, Charleston, SC. They are the products of conventional recurrent backcrossing procedures to transfer the dominant *N* gene for root-knot nematode resistance from 'Mississippi Nemaheart' into 'Yolo Wonder B' and 'Keystone Resistant Giant'. 'Carolina Belle' and 'Carolina Wonder' originated from bulked F<sub>3</sub> populations that were derived after the completion of the sixth backcross.

### **Description**

'Carolina Wonder' and 'Charleston Belle' are similar in appearance and maturity to 'Yolo Wonder B' and 'Keystone Resistant Giant', respectively. The two new cultivars have many common characteristics. The plants have compact growth habits, and the period from transplanting to first harvest ranges from 63 to 70 days. The results of two sets of replicated field experiments conducted at Charleston, SC, in 1996 indicated that the plant habit, fruit, and yield characteristics of 'Carolina Wonder' and 'Charleston Belle' are virtually identical to those of respective recurrent parents 'Yolo Wonder B' and 'Keystone Resistant Giant' (Tables 1, 2, and 3). Premium grade fruits (U.S. Fancy and U.S. No. 1) are large, blocky, and bell shaped. The fruit walls are thick. Harvest-stage, mature-green fruits are dark green; the fruits mature to become bright red. The fruits are sweet, and have three or four locules.

'Carolina Wonder' and 'Charleston Belle' are homozygous for the *N* gene that conditions resistance to the southern root-knot nematode. The new cultivars have exhibited high levels of resistance in all greenhouse and field tests; the numbers of galls and egg masses on the roots have always been minimal. The results of 1996 tests (Table 4) conducted in greenhouse soil benches infested with *M. incognita* race 3 showed that 'Carolina Wonder' and 'Charleston Belle' yielded 95% and 93% respectively fewer *M. incognita* eggs per gram of root than did their recurrent parents 'Yolo Wonder B' and 'Keystone Resistant Giant'. The resistance exhibited by 'Carolina Wonder' is equal to that exhibited by the resistant cultivar Carolina Cayenne. The resistance exhibited by 'Charleston Belle' is equal to that exhibited by the donor of the *N* gene, 'Mississippi Nemaheart'.

**Table 1.** Plant height, plant width, and yield and weight per fruit of U.S. No. 1 and total marketable fruit for ‘Carolina Wonder’ vs. ‘Yolo Wonder B’ and ‘Charleston Belle’ vs. ‘Keystone Resistant Giant’ plots grown at Charleston, SC (Field Experiments IA and IB)<sup>Z</sup>.

Cultivar	Plant height (cm)	Plant width (cm)	US No. 1 fruit <sup>y</sup>		Total marketable fruit <sup>x</sup>	
			Yield (g/plant)	Wt./fruit (g)	Yield (g/plant)	Wt./fruit (g)
<i>Field Experiment IA</i>						
Carolina Wonder	43.0	61.6	831	134.6	980	124.6
Yolo Wonder B	41.2	56.0	731	138.0	809	128.5
F ratio	4.62 <sup>NS</sup>	2.68 <sup>NS</sup>	0.89 <sup>NS</sup>	2.26 <sup>NS</sup>	2.52 <sup>NS</sup>	2.56 <sup>NS</sup>
<i>Field Experiment IB</i>						
Charleston Belle	45.1	65.9	404	118.7	596	98.3
Keystone Resistant Giant	41.8	63.8	486	114.7	645	98.4
F ratio	2.25 <sup>NS</sup>	1.32 <sup>NS</sup>	0.71 <sup>NS</sup>	0.33 <sup>NS</sup>	0.22 <sup>NS</sup>	0.28 <sup>NS</sup>

<sup>Z</sup>Data from randomized complete block experiments with six replications (single-row plots; 10 plants per plot; intrarow spacing: 76 cm; inter-row spacing: 102 cm). Yields are a total of five harvests.

<sup>y</sup>Includes U. S. Fancy grade.

<sup>x</sup>Includes U. S. Fancy, U. S. No. 1, and U. S. No. 2 grades.

<sup>NS</sup>Nonsignificant at  $P \leq 0.05$ .

**Table 2.** Yield and weight per fruit of U. S. No. 1 and total marketable fruit for ‘Carolina Wonder’ vs. ‘Yolo Wonder B’ and ‘Charleston Belle’ vs. ‘Keystone Resistant Giant’ plots grown at Charleston, SC (Field Experiments IIA and IIB).<sup>Z</sup>

Cultivar	US No. 1 fruit <sup>y</sup>		Total marketable fruit <sup>x</sup>	
	Yield (g/plant)	Mass/fruit (g)	Yield (g/plant)	Wt./fruit (g)
<i>Field Experiment IIA</i>				
Carolina Wonder	556	116.0	1,030	89.4
Yolo Wonder B	526	116.3	973	85.1
F ratio	0.18 <sup>NS</sup>	0.05 <sup>NS</sup>	0.18 <sup>NS</sup>	1.65 <sup>NS</sup>
<i>Field Experiment IIB</i>				
Charleston Belle	550	119.1	1,076	89.5
Keystone Resistant Giant	571	119.1	1,015	87.6
F ratio	0.10 <sup>NS</sup>	0.00 <sup>NS</sup>	0.35 <sup>NS</sup>	0.25 <sup>NS</sup>

<sup>Z</sup>Data from randomized complete block experiments with 10 replications (single-row plots; five plants/plot; intra-row spacing: 30 cm; interrow spacing: 102 cm). Yields are a total of six harvests.

<sup>y</sup>Includes U. S. Fancy grade.

<sup>x</sup>Includes U. S. Fancy, U. S. No. 1, and U. S. No. 2 grades.

<sup>NS</sup>Nonsignificant at  $P \leq 0.05$ .

**Table 3.** Comparison of fruit characteristics of the southern root-knot resistant 'Carolina Wonder' and 'Charleston Belle' and their respective susceptible recurrent parents 'Yolo Wonder B' and 'Keystone Resistant Giant' (Field Experiments IA and IB).

Cultivar	Fruit Characteristic <sup>Z</sup>			
	Width (cm)	Length (cm)	Wall Thickness (mm)	Locules (no.)
<i>Field Experiment IA</i>				
Carolina Wonder	7.7 ± 0.1 <sup>y</sup>	8.4 ± 0.2	5.12 ± 0.09	3.65 ± 0.11
Yolo Wonder B	8.0 ± 0.1	8.7 ± 0.3	5.00 ± 0.13	3.45 ± 0.15
<i>Field Experiment IB</i>				
Charleston Belle	8.2 ± 0.1	7.8 ± 0.2	5.66 ± 0.10	3.60 ± 0.13
Keystone Resistant Giant	8.0 ± 0.1	7.9 ± 0.3	5.24 ± 0.09	3.45 ± 0.14

<sup>Z</sup> Means of the 20 largest fruits from the bulked second and third harvests of randomized complete block experiments.

<sup>y</sup> Å S.E.

**Table 4.** Average root gall index, average egg mass index, and average number of eggs per gram fresh root tissue for 'Carolina Wonder' vs. 'Yolo Wonder B' and 'Charleston Belle' vs. 'Keystone Resistant Giant' plants grown in soil inoculated with the southern root-knot nematode, *Meloidogyne* race 3 (Greenhouse Experiments IA and IB).<sup>Z</sup>

Cultivar	Gall index <sup>y</sup>	Egg mass index <sup>x</sup>	No. eggs/g fresh root tissue
<i>Greenhouse Experiment IA</i>			
Carolina Wonder	1.08	1.20	946
Yolo Wonder B	3.98	3.60	17,743
Carolina Cayenne <sup>w</sup>	1.05	1.15	534
LSD (0.05)	0.21	0.37	3,906
<i>Greenhouse Experiment IB</i>			
Charleston Belle	1.25	1.30	1,652
Keystone Resistant Giant	3.95	3.95	25,119
Mississippi Nemaheart <sup>w</sup>	1.15	1.12	1,194
California Wonder <sup>v</sup>	3.90	3.58	22,960
LSD (0.05)	0.33	0.75	8,509

<sup>Z</sup>Randomized complete block experiments with four replications (five plants per plot; seeds planted on 13 Mar. 1996; seedlings transplanted into a steam-pasteurized mixture of soil, sand, and peat moss on 30 Apr. 1996; each seedling inoculated with 3,200 *M. incognita* race 3 eggs on 8 May 1996; roots of all plants evaluated for galling and egg masses on 20 Aug. 1996).

<sup>y</sup>Rated on a scale of 1 to 5; 1 = no galls and 5 = galls covering Å 80% of root system.

<sup>x</sup>Rated on a scale of 1 to 5; 1 = no egg masses and 5 = egg masses covering Å 80% of root system.

<sup>w</sup>Resistant control.

<sup>v</sup>Susceptible control.

## **Recommendations**

The southern root-knot nematode resistant ‘Carolina Wonder’ and ‘Charleston Belle’ are recommended for use by home gardeners and commercial growers. These cultivars are recommended particularly as home garden cultivars because home gardeners do not have easy access to alternative production sites or the needed nematicides. ‘Carolina Wonder’ and ‘Charleston Belle’ should perform well in all areas where their recurrent parents, ‘Yolo Wonder B’ or ‘Keystone Resistant Giant,’ have been grown successfully.

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