CC-14-1 and CC-18-2 Progenies of Chinese Cabbage Derived from Somatic Hybridization for Resistance to Bacterial Soft Rot

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Bacterial soft rot, caused by *Erwinia carotovora* subsp. *carotovora*, is a serious disease in Chinese cabbage (*Brassica rapa* L., Pekinensis Group). No effective control methods are available. Phytosanitary and cultural practices are the usual means for reducing the disease infection. Variation of susceptibility among genotypes of *B. rapa* has been reported (Ren et al., 2001b; Shimizu et al., 1958). It has also been observed that some crucifer species are more resistant to bacterial soft rot than others, and *Brassica oleracea* L. is generally more resistant than *B. rapa* (Ren et al., 2001b). By repeated backcrosses to Chinese cabbage after interspecific hybridization between Chinese cabbage and cabbage (*B. oleracea* L., Capitata Group), a relatively resistant cultivar of Chinese cabbage, 'Hiratsuka No. 1', was developed by Shimizu et al. (1962). Genes for resistance to soft rot were also introduced from a nontuber-bearing wild potato into a cultivated potato through protoplast fusion (Austin et al., 1988). Relatively resistant materials of Chinese cabbage and broccoli (*B. oleracea* L., Italica Group) were identified and selected in previous work (Ren et al., 2000). The materials described herein originated from protoplast fusion between these materials followed by two generations of backcrossing to Chinese cabbage. They showed higher resistance than their fusion parents and likely contain resistance genes from both parents.

Origin

Chinese cabbage CC-14-1 and CC-18-2 were derived from interspecific somatic hybridization between Chinese cabbage (G30449) and broccoli ('Shogun', Sakata America). G30449 was obtained from the

U.S. Dept. of Agriculture–Agricultural Research Station (USDA–ARS), Plant Genetic Resources Unit, Geneva, N.Y. C3-28, a Chinese cabbage breeding line, derived from recurrent selection (Ren et al., 2001a), served as the recurrent parent in backcrosses. G30449, C3-28, and 'Shogun' were identified as more resistant to bacterial soft rot than other tested materials. The breeding scheme is illustrated in Fig. 1.

Somatic hybrids (Ren et al., 2000) were evaluated for resistance to soft rot disease by seedling mist-chamber and detached leaf assays (Ren et al., 2001b). Following two generations of backcross using C3-28 as a pollinator with the most resistant somatic hybrids and BC₁ plants, seven BC₂ lines were obtained. CC-14-1 and CC-18-2 are two BC₂ plants having the highest resistance as well as the leaf morphology of Chinese cabbage.

Their pedigree and disease ratings are given in Table 1. Detailed information about the somatic hybrids and the BC₁ generation was previously reported by Ren et al. (2000).

Description and performance

Seven BC₂ lines, three parental lines, and a susceptible check CC25 (*B. rapa* L., Chinensis Group) were evaluated by a seedling mist-chamber assay with four replications and six plants per line per replication. Statistical analysis of mean disease severity ratings (MDSR) showed no significant differences among the lines except for CC25, which was significantly more susceptible than the others (Table 1). There was a large plant to plant variation in the morphology and resistance of BC₂ lines. Individual BC₂ plants with low disease severity ratings and leaf morphology most like Chinese cabbage and plants from the parents were selected and re-evaluated twice by detached leaf assays 2 and 3 months later. In each assay, two or three leaves from each plant were inoculated, and disease lesions were measured 3 d later.

The results from the two detached leaf assays were similar (Table 1). The selected BC₂ plants CC-14-1 and CC-18-2 had much less disease (0.4- to 0.8-cm lesions) than Chinese cabbage C3-28 and G30449 (1.7- to 14.0-cm lesions). The nuclear DNA content of CC-14-1 and CC-18-2 measured by flow cytometry (Arumuganathan and Earle, 1991) was the same as that of regular Chinese cabbage (1.00 pg/2c). The plants also showed leaf morphology similar to Chinese cabbage.

Fig. 1. Breeding scheme used to select for bacterial soft rot resistance in Chinese cabbage.

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Table 1. The pedigree and disease ratings of the selected BC₂ and their parents.

Material and pedigree	Seedling mist-chamber assay	Selected plant	Detached leaf assay lesion length (cm) $\pm$ SE ^y	
	MDSR ^z		1 st	2 nd
BC ₂				
14 [(S + C4)-8 $\times$ C3-28] $\times$ C3-28}	4.8	CC-14-1	0.4 $\pm$ 0.2	0.8 $\pm$ 0.8
18 [(S + C4)-1 $\times$ C3-28] $\times$ C3-28}	5.0	CC-18-2	0.4 $\pm$ 0.2	0.8 $\pm$ 0.8
Parents				
<i>B. rapa</i>				
G30449 (C4)	3.8	C4-1	4.4 $\pm$ 1.9	14.0 $\pm$ 4.0
C3-28	3.6	C3-28-1	1.7 $\pm$ 0.1	2.2 $\pm$ 1.1
<i>B. oleracea</i>				
Shogun (S)	5.6	S-1	1.1 $\pm$ 0.8	1.0 $\pm$ 0.5
Susceptible check				
<i>B. rapa</i>				
CC25	8.0	---	---	---
LSD _{0.05} ^x	2.0	---	---	---

^xMean disease severity rating averaged from individual plants on a 0–9 scale, where 0 = no disease and 9 = plant dead (Ren et al., 2000b).

^yAverage lesion length from two to three leaves per plant.

^zMinimum significant difference of MDSR based on Fisher multiple comparison.

Availability

Seeds from self-pollination of plants CC-14-1 and CC-18-2 can be obtained from Elizabeth D. Earle, Dept. of Plant Breeding, Cornell Univ., Ithaca, NY 14853-1901.

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