The Susceptibility of Fodder Beet and Wild Species of *Beta* to an *Erwinia* sp. from Sugar Beet

E. D. WHITNEY, Research Plant Pathologist, USDA, ARS, Western Region, Salinas, CA 93915

ABSTRACT

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In greenhouse experiments, all fodder beet and fodder beet × sugar beet cultivars tested were susceptible to an *Erwinia* sp. that causes vascular necrosis and rot of sugar beet. Of the six wild species tested, collections from *Beta maritima, B. macrocarpa,* and *B. corolliflora* were found to be susceptible to the sugar beet *Erwinia* sp.; *B. patellaris, B. procumbens,* and *B. webbiana* were highly resistant. These data demonstrate the need for a comprehensive survey and a selection program for *Erwinia* resistance if these wild beets are to be used in a breeding program to improve quality and disease resistance in sugar beet.

In 1972, a bacterium of the genus *Erwinia* (4) was reported to cause a new disease of beet characterized by vascular necrosis and root rot. Most cultivars of sugar beet (*Beta vulgaris*) were shown to be susceptible (5), but genetic variation was shown to be sufficient to select for resistance (3,6).

Interest has increased in recent years in alternative sources of energy and in disease control by interspecific hybridization to reduce the need for chemical control. Fodder beet (*B. vulgaris*) has been suggested as a potential crop for the production of alcohol. In addition, wild *Beta* species have many characters that might increase yield and disease resistance (1). However, susceptibility to the sugar beet *Erwinia* sp. could restrict the areas in which fodder beets could be successfully grown or the use of wild *Beta* species in hybridization programs without intensive testing and reselection. This pilot study was initiated to determine the susceptibility of these beets to the sugar beet *Erwinia* sp.

MATERIALS AND METHODS

Three sugar beet cultivars, four fodder beet cultivars, eight fodder beet × sugar beet cultivars, and six wild *Beta* species were tested in the greenhouse (Table 1). Seed was germinated, and three seedlings each were transplanted to a pot of soil 15 cm in diameter. Seed germination was variable; therefore, the number of plants per test and replication varied. Four tests were conducted.

MR-1, a moderately aggressive isolate of the pathogen, as determined in cultivar-isolate tests, was used for inoculations. The isolate was maintained in sterile tap water at room temperature. It was cultured for 24 hr on King's medium B (2), washed from the culture with tap water, and standardized with a Klett-Summerson colorimeter to about 3.5×10^7 cells per milliliter.

Four petioles or branches of a 6-wk-old plant were pierced with a dissecting needle usually about 1 cm from the crown. About 0.25 ml of inoculum was sprayed onto each injury. Plants were harvested and roots were cut 2 mo after inoculation. Plants were rated on a scale of 0 to 2: 0, no infection; 1, plant infected; and 2, plant dead. Uninoculated, uninjured sugar beet and fodder beet plants and uninoculated, injured wild species served as checks. A disease index, percentage of infected plants, and percentage of dead plants were calculated. The disease index was calculated as the sum of readings divided by twice the number of plants, times 100. Tests I and II and tests III and IV were conducted simultaneously during late summer (July–October).

Table 1. The susceptibility of fodder beet and wild beet to an *Erwinia* sp. from sugar beet

Section Cultivar or species	Disease index[a,b]	Plants infected[a] (%)	Plants dead[a] (%)	Total no. plants
Vulgaris section				
Beta vulgaris				
Fodder beet				
Monara	26.4	36.1	13.9	36
Yellow Daeno	33.3	46.6	20.0	30
Eckdobarres	43.3	56.7	16.7	30
Oscar	60.0	40.0	20.0	33
Fodder beet × sugar beet				
Barsein	19.4	33.3	5.5	36
Monorosa	23.6	36.1	11.1	36
Monosrover	24.2	42.4	6.0	33
Monovigor	24.2	39.4	9.1	33
Beta Rose Sugar	25.8	42.4	9.1	33
Monriac	34.8	48.5	12.1	33
Kyros	42.4	69.7	15.2	33
Monoblanc	42.4	54.5	30.3	33
Sugar beet				
C36	4.2	8.3	0.0	36
C13	68.8	93.7	59.4	32
E840	94.4	97.2	91.7	36
LSD[c] (0.05)	9.6	6.0	5.0	
Wild species				
B. maritima	...	37.5	12.5	24
B. macrocarpa	...	60.0[d]	0.0	20
Corollinae section				
B. corolliflora	...	25.0[d]	0.0	20
Patellaris section				
B. patellaris	...	0.0	0.0	19
B. procumbens	...	0.0	0.0	30
B. webbiana	...	0.0	0.0	11

[a] Mean of four tests.
[b] The disease index was calculated as the sum of readings divided by twice the number of plants, times 100.
[c] Least significant difference.
[d] Crown rot.

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RESULTS

The sugar beet check cultivars that were tested reacted as expected: C36 was resistant, C13 was intermediately susceptible, and E840 was highly susceptible (Table 1). All the fodder beet and fodder beet × sugar beet cultivars were susceptible to some degree; their disease indexes varied from 19.4 to 60.0 (Table 1).

The collection of wild *Beta* species samples varied from highly resistant to intermediately susceptible. *B. maritima* reacted as do many sugar beet cultivars, varying from susceptible (dead) to resistant, with some becoming infected but remaining alive. Although *B. macrocarpa* became infected with a crown rot, secondary buds were initiated that did not become infected systemically. *B. corolliflora* reacted similarly to *B. macrocarpa* but was less susceptible (Table 1). The three samples from species of the *patellaris* section of *Beta* were highly resistant. In a few cases, injured, inoculated seed stocks died prematurely, but the bacterium did not spread. Infected wild species showed symptoms typical of *Erwinia* infection (vascular necrosis and rot).

Tests I and II were similar, with disease index means of 39.3 and 40.3, respectively, while tests III and IV were rated at 30.0 and 31.3, respectively. All check plants remained disease-free.

DISCUSSION

The data show that susceptibility to the *Erwinia* species that causes vascular necrosis and rot in sugar beet is common in the *Beta* genus. Susceptibility is not restricted to the *vulgaris* section of *Beta* but extends to the *corollinae* section, because *B. corolliflora* was susceptible. It is also significant that all of the *patellaris* section is highly resistant to the sugar beet *Erwinia* sp.

Where *Erwinia* root rot is a problem, a testing program will be essential when wild species are used to introduce new characters into the sugar beet. A more comprehensive survey of the *Beta* genus (1), encompassing the testing of several collections of every wild species, should be done.

The high incidence of susceptibility of the fodder beet to the sugar beet *Erwinia* sp. would necessitate the development of resistant cultivars if fodder beets were to be grown in California, Arizona, or other areas where *Erwinia* root rot is known to affect the production of susceptible sugar beet cultivars. Most fodder beets are also thought to be susceptible to curly top and the yellowing viruses, so resistance to these diseases should also be included in a comprehensive breeding program if fodder beets are shown to have potential as a source of biomass for energy production.

LITERATURE CITED

1. Coons, G. H. 1975. Interspecific hybrids between *Beta vulgaris* L. and the wild species of *Beta*. J. Am. Soc. Sugar Beet Technol. 18:281-306.
2. King, E. O., Ward, M. K., and Raney, D. E. 1954. Two simple media for the demonstration of pyocyanin and fluorescein. J. Lab. Clin. Med. 44:301-307.
3. Lewellen, R. T., Whitney, E. D., and Goulas, C. K. 1978. Inheritance of resistance to *Erwinia* root rot in sugarbeet. Phytopathology 68:947-950.
4. Thomson, S. V., and Schroth, M. N. 1972. Vascular necrosis and rot of sugarbeet. Calif. Plant Pathol. 12:1-2.
5. Whitney, E. D., and Lewellen, R. T. 1977. Bacterial vascular necrosis and rot of sugarbeet: Effect on cultivars and quality. Phytopathology 67:912-916.
6. Whitney, E. D., and Lewellen, R. T. 1978. Bacterial vascular necrosis and rot of sugarbeet: Genetic vulnerability and selecting for resistance. Phytopathology 68:657-661.