Susceptibility of Several Beta Species to the Sugar-Beet Nematode (Heterodera Schachtii) and Root-Knot Nematodes (Meloidogyne spp.)

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The current interest in various wild *Beta* species apparently arises because of their possession of some very desirable characteristics which might eventually be incorporated into commercial varieties of sugar beet, *Beta vulgaris* L. As pointed out by Coons (1)[2] and Doxtater (2), certain wild species possess high resistance to curly-top virus and *Cercospora* leaf-spot and might possibly serve as valuable sources for other important characters. Stewart (6) noted that the wild species, *Beta procumbens* Chr. Sm., was reported by two German investigators as resistant to the sugar-beet nematode, *Heterodera schachtii* Schmidt. and that this same plant species, as well as *B. patellaris* Moq. and *B. webbiana* Moq., also has immunity to leaf spot and at least high resistance to curly-top virus. Different workers have since further examined *B. patellaris, B. procumbens,* and *B. webbiana* for susceptibility to the sugar-beet nematode. For example, both Hijner (4) and Winslow (7) reported these three species as resistant to the sugar-beet nematode. Hijner (4) further found five other *Beta* species (*B. lomatogona* Fisch. and Mey, *B. trigyna* Wald. and Kitt., *B. maritima* L., *B. macrocarpa* Guss., and *B. atriplicifolia* Rouy) to be susceptible to this nematode. Winslow (7) also found *B. trigyna* susceptible and Jones (5) reported *B. maritima* as susceptible.

The present work was initiated (1) to determine the susceptibility to the sugar-beet nematode of several *Beta* species[3] as given in Table 1 and, (2) to test all *Beta* special found resistant to sugar-beet nematodes with six species and subspecies of root-knot nematodes (*Meloidogyne* spp.).

Materials and Methods

Seeds of the various test and control plants were germinated in sterilized sand and the resulting plants allowed to grow several days before transplanting. For the test with the sugar-beet nematode, the methods and system of rating infection as described by Golden and Shafer (3) were used. Briefly, each of 20 young plants of each of the test plants and the sugar-beet control was placed individually in aluminum-foil cylinders, 2½ inches in

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[2] Numbers in parentheses refer to literature cited.

[3] Seeds of several of the test plants were kindly supplied by Dr. Gerald Coe, Crops Research Division, Agricultural Research Service, United States Department of Agriculture, Beltsville, Maryland.

diameter and 7 inches long, which were filled with homogeneously-mixed soil heavily infested with cysts of the sugar-beet nematode. These were grown for two months in the greenhouse at a maintained night temperature of 72° to about 85° F. The plants were then examined for white females and cysts of the sugar-beet nematode and rated according to the degree of infection.

In the root-knot nematode test, seven plants each of *B. patellaris, B. procumbens,* and *B. webbiana,* were placed in 6-inch pots containing soil heavily infested with one of the species of root-knot nematodes named on Table 2. Tomato plants were similarly planted as controls. All were grown for three months in the greenhouse under essentially the same environmental conditions as above. Then the plants were examined and rated for root-knot nematode infection after being washed from the pots with a gentle stream of water.

Results and Discussion

Examination of the infection index data in Table 1 shows that six of the test plants are highly susceptible to the sugar-beet nematode, having an infection rating the same or almost the same as the sugar-beet control (4.0). Microscopic examina-

Table 1.—Susceptibility of Several *Beta* Species to *H. schachtii*, the Sugar-Beet Nematode.

Test Plants	Average Infection Index[a]
Beta atriplicifolia Rouy x B. vulgaris L. (Fa)	4.0
B. macrocarpa Guss.	3.9
B. maritima L.	4.0
B. patellaris Moq.	0
B. patula Ait.	4.0
B. procumbens Chrys. Sm.	0
Beta sp. (annual from Turkey)	3.8
B. trigyna Wald. and Kitt.	4.0
B. webbiana Moq.	0
B. vulgaris L. (sugar beet)—control	4.0

[a] Indicates the degree of infection as determined by visual estimate of the number of white females and cysts on the roots.

Scale:
0 = no infection (no white females or cysts found)
1 = trace (only a few white females or cysts found)
2 = light (white females or cysts in small numbers)
3 = moderate (white females or cysts numerous)
4 = heavy (white females or cysts very numerous)

Table 2.—Susceptibility of Certain *Beta* Species to Root-Knot Nematodes (*Meloidogyne* spp.)

Nematode	Root-Knot Rating[a]			
	B. patellaris	B. procumbens	B. webbiana	Tomato (control)
M. arenaria	4.0	2.7	2.5	4.0
M. arenaria thamesi	3.0	2.7	2.5	4.0
M. hapla	3.7	2.9	3.0	4.0
M. incognita	2.2	3.3	2.3	4.0
M. incognita acrita	3.7	3.3	4.0	4.0
M. javanica	3.0	3.0	3.0	4.0

[a] Scale:
0 = no infection
1 = trace
2 = light
3 = moderate
4 = heavy

tion revealed that cysts from the roots of these six test plants and the sugar-beet control were filled with eggs and larvae, indicating normal development of the nematode. In the other three test plants (*B. patellaris,* B. *procumbens,* and *B. webbiana*), however, no females of the sugar-beet nematode were found on the roots even with microscopic examination, indicating a high degree of resistance.

Table 2 shows that the three wild *Beta* species above which were highly resistant to the sugar-beet nematode are quite susceptible to all of the six species and subspecies of root-knot nematodes known to occur in the United States. By microscopic examination it was determined that within the roots there were numerous mature females with eggs, the nematode apparently having developed normally on these wild species as on the tomato control.

Although these three wild *Beta* species did not prove to be resistant to any of the root-knot nematodes tested, their demonstrated resistance to the very important sugar-beet nematode, as well as their possession of other desirable characters would seem to justify continued interest in and work with them.

Summary

Of nine different *Beta* species examined for susceptibility to the sugar-beet nematode, six were found to be very susceptible and three species (*B. patellaris, B. procumbens,* and *B. webbiana*) were shown to be highly resistant. In another test, these same three species proved to be quite susceptible to all of the six species and subspecies of root-knot nematodes known to occur in the United States.

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