Resistance to the Sugar Beet Nematode (Heterodera schachtii) in F_1 Tetraploid Hybrids between Beta vulgaris and Beta patellaris[1]

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Introduction

In the genus *Beta*, only species of the section *Patellares* Trans.: *B. patellaris* Moq., *B. procumbens* Chr. Sm., and *B. webbiana* Moq., have proved to be highly resistant to the nematode, *Heterodera schachtii* Schmidt (2,3,7)[3].

The occurrence of a single female nematode on a few plants of *B. patellaris* as reported by Shepherd (5) and by Steele and Savitsky (6), does not preclude use of hybridization of species of the section *Patellares* with sugar beet for transmission of nematode resistance to sugar beets. The high resistance of species of the section *Patellares* to nematode infestation distinguishes them from all other *Beta* species.

The viable semi-fertile polyploid hybrids obtained by H. Savitsky (4) permit selection for nematode resistance and the study of manifestation of resistance in a heterozygote, which is important in breeding for resistance and for acquiring knowledge of the mechanism of the inheritance of resistance. Studies of the resistance of F_1 hybrids between sugar beet and *B. patellaris* are presented in this report.

The hybrids used in this study were produced by the senior author, infestation of soil and the growing of the plants under test conditions were performed by the junior author, examination of the plants was performed by both authors.

Materials and Methods

Seed of two parental species, tetraploid *B. vulgaris* L. (sugar beet) susceptible to nematode and tetraploid *B. patellaris* resistant to nematode, together with F_1 hybrid seed obtained from hybridization of these species, were planted in soil in a greenhouse. Viable matings were selected in which seedlings grew on their own roots. Seedlings which showed good growth and well-developed root systems were used for test (Figure 1).

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[1] Cooperative investigations of the Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, and the Beet Sugar Development Foundation.

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[3] Numbers in parentheses refer to literature cited.

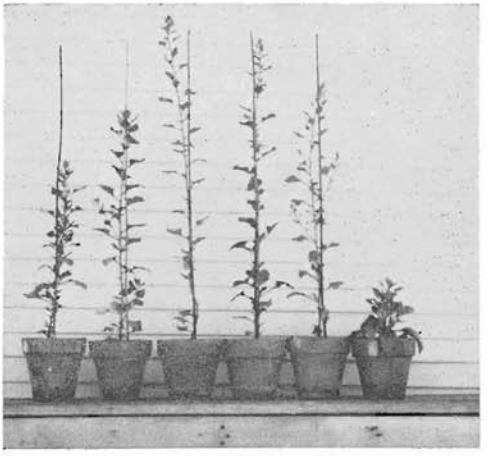

Figure 1.—F_1 allotetraploid hybrids (*B. vulgaris* × *B. patellaris*) examined for nematode resistance.

Ten seedlings of each parent species and 10 seedlings of the F_1 hybrids were transplanted in the two-leaf stage into cyst-infested soil to test for nematode resistance. After 60 days of growth under comparable conditions in a greenhouse, the roots of all plants were examined for the presence of female nematodes.

Experimental Results

The 10 sugar beet plants were heavily infested with female nematodes. Nine of 10 *B. patellaris* plants were free of nematodes and 1 plant had 2 females. The F_1 hybrids had well developed root systems (Figure 2). Of 10 F_1 hybrid plants, 8 plants were free of nematodes, 1 plant had a single comparatively well-developed female, and on 1 plant, 2 females were found (Table 1).

Table 1.—Number of female nematodes per plant.

Material	Number of plants in indicated category			
	Hundreds of females per plant	1-2 females per plant	No females per plant	Total plants
B. patellaris	0	1	9	10
B. vulgaris (sugar beet)	10	0	0	10
F_1 hybrids	0	2	8	10

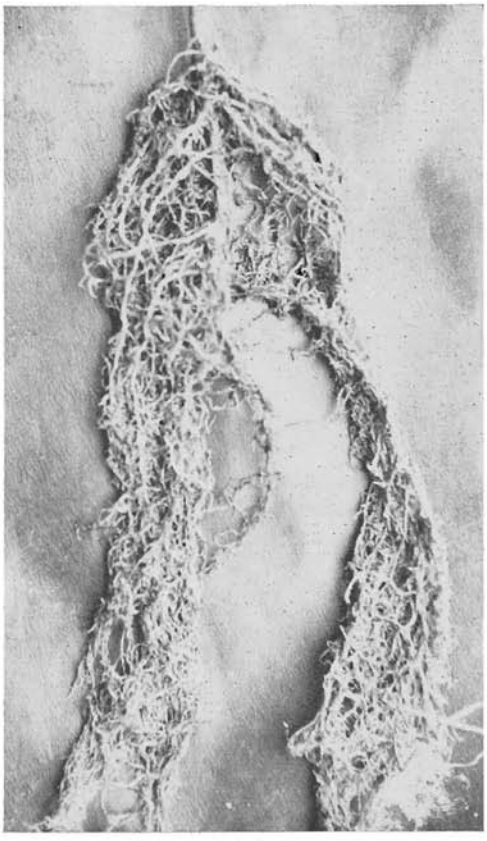

Figure 2.—Root system of an allotetraploid F_1 hybrid free of females.

The plants examined fell into two groups: a highly susceptible group which contained sugar beets, and a resistant group which included *B. patellaris* and F_1 hybrids. Resistance in F_1 hybrids was not intermediate between the 2 species, *B. vulgaris* and *B. patellaris,* but approached closely the resistance of the resistant parent, *B. patellaris.* To determine whether the grade of resistance in F_1 hybrids was the same as in *B. patellaris* an assumption was made that the ratio of the plants with a few nematodes on the roots to all plants examined was the same in the population of *B. patellaris* and F_1 hybrids. This assumption was verified by calculation of the chi-square. The value of the chi-square was 0.3922. Tabulated value at the 5% level for d.f. = 1 is $\chi^2 0.05 = 3.841$ and at 1% level $\chi^2 0.01 = 6.63$.

This value is much larger than the calculated value of chi-square, which indicates that the difference in resistance between *B. patellaris* and F_1 hybrids is not significant. The data obtained give no indication that F_1 hybrids differ in resistance from the resistant parental species *B. patellaris.*

Gaskill (1) reported that F_1 hybrids between Swiss chard and *B. webbiana* (4 plants) and between Swiss chard and *B. procumbens* (2 plants) grown in nematode infested soil, had no female nematodes on the roots. He states, however, that "most of the hybrids were small, and the results cannot be considered as conclusive, but they suggest that the high degree of nematode resistance was transmitted to the hybrids."

Conclusion

Resistance to nematode (*Heterodera schachtii*) is a dominant character. The tetraploid F_1 hybrids (*B. vulgaris* × *B. patellaris*) did not differ in the grade of resistance from the resistant parent, *B. patellaris.*

The data presented here, and that previously presented by Gaskill, indicate with a high degree of probability that nematode resistance transmitted by all 3 species of the section *Patellares,* namely *B. patellaris, B. procumbens,* and *B. webbiana,* is dominant in the F_1 hybrids regardless of whether they are diploids or tetraploids.

Literature Cited

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