Rapid Laboratory Screening of Sugar Beet Cultivars for Resistance to Rhizoctonia solani

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ABSTRACT

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In growth chamber tests at 26 C, resistance among sugar beet cultivars to seedling damping-off incited by *Rhizoctonia solani* was found to be an accurate index of the relative resistance of cultivars to Rhizoctonia root rot. This indication of relative root rot resistance can be obtained within 3 weeks using this technique which is more rapid and economical than traditional field tests.

Additional key words: Beta vulgaris.

Root rot of mature sugar beet (*Beta vulgaris* L.), which is incited by *Rhizoctonia solani* Kühn [*Thanatephorus cucumeris* (Frank) Donk.], is an important disease in several sugar beet-producing areas of the USA. Presently, there are no satisfactory chemical controls for this disease, and crop rotation gives only limited protection (1, 8). Substantial gains in genetic resistance of sugar beets to Rhizoctonia root rot have been reported (2, 3); however, evaluations of breeding lines for resistance have been conducted exclusively in costly field trials.

Since *R. solani* also causes damping-off in sugar beet (6, 7), seedlings were tested for disease reaction in the greenhouse and under standardized conditions in growth chambers. This report describes a rapid laboratory method for preliminary screening of sugar beet cultivars for resistance to root rot using the seedling damping-off phase as a criterion.

MATERIALS AND METHODS

Sugar beet cultivars tested included: FC 701/5 and FC 702/5, Rhizoctonia root rot-resistant breeding lines (2, 4); MSH 212, a moderately resistant hybrid from the Great Western Sugar Company; Mono Hy Al, a susceptible Great Western Sugar Company commercial cultivar; and FC 901, a highly susceptible cultivar.

Steam-treated soil mixture [top soil, unwashed sand, and peat moss (1:1:1, v/v)] was mixed with barley grain inoculum (2) of *R. solani* (isolate RR9, Anastomosis group 2) at 200 μg/g. Isolate RR9, which was obtained from a rotted beet root and previously has been used experimentally to incite root rot epidemics in sugar beets (7) was used in these tests. Polyethylene plastic pots 7.6 cm in diameter were filled with 500 g of soil-inoculum mix. Ten seeds of the respective cultivars were equally spaced and planted 1.5 cm deep in each pot of soil. Noninoculated controls of each cultivar were included.

Tests were done in a growth chamber with a 12-hour photoperiod (31,200 lux) at a constant 16 C or 26 C and in a greenhouse where temperatures ranged from 20 to 38 C. No artificial light was used in the greenhouse tests. Pots were irrigated as needed. A randomized complete block design with five replications was used and each experiment was repeated at least once with similar results. Seedling survival, based on percentage survival of noninoculated control seedlings, was recorded 21 days after planting.

RESULTS AND DISCUSSION

Survival of seedlings at 16 C was greater than at 26 C or in the greenhouse (Fig. 1). Differences in survival between cultivars were not significant at 16 C with survival for all cultivars in inoculated soil between 84 and 90% of inoculated controls. Our data support Leach's finding (5) that low temperatures were more favorable for growth of sugar beet seedlings than for growth of *R. solani,* thus screening for resistance at 16 C is not suitable.

Similarly, due to the environmental conditions in the greenhouse, many replications had no seedlings surviving after 21 days and no significant difference was found between seedling survival of the five cultivars. At 26 C constant temperature, however, percentage survival of cultivars differed significantly ($P = 0.05$). Survival of FC 701/5 and FC 702/5 was greater than for FC 901 and Mono Hy A1. Survival of MSH 212 was intermediate between FC 701/5 and FC 901 (Fig. 1). These results are in agreement with previous field trials (E. G. Ruppel, *personal communication*).

Testing for resistance in laboratory growth chambers at 26 C is more rapid and economical than field trials. Within a 3-week period a preliminary indication of potential cultivar resistance to Rhizoctonia root rot can be obtained. Cultivars in which percentage survival does not differ significantly from the resistant breeding lines

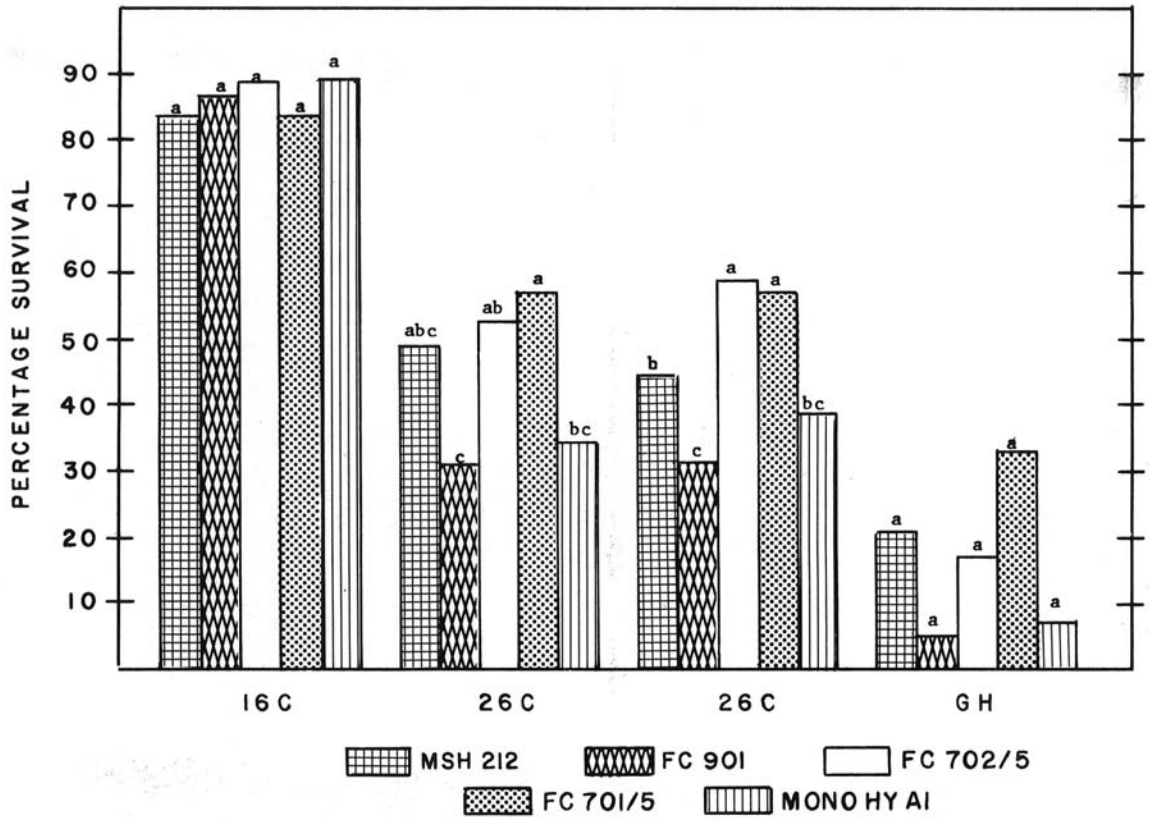

Fig. 1. Percentage seedling survival (noninoculated control = 100%) of five sugar beet cultivars 21 days after planting in steamed soil infested with 200 μg/g barley-grain inoculum of *Rhizoctonia solani*. Conditions: 16 C and 26 C were constant temperatures; GH = greenhouse with a temperature range from 20-38 C. Values are the average of five replications. Means not having the same letter within a trial were significantly different, $P = 0.05$.

FC 702/5 and FC 701/5 (4) would be potentially Rhizoctonia-resistant selections and should be tested further in field trials.

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