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Breeding for dual resistance in sugarbeet to cyst nematode and rhizomania.

The homozygous, sugarbeet cyst nematode (SBCN) (*Heterodera schachtii*) resistant line B883 from the Netherlands was used as the source of nematode resistance (NR). B883 had been developed from Savitsky's 19 chromosome alien addition line with NR from *Beta procumbens*. B883 and C603 and C604 developed at Salinas from B883 are true breeding for NR, but they do not possess other requirements for disease resistance and productivity; they are very low in sucrose content. In addition, hybridization reinstates heterozygosity for NR that creates lower than normal transmission rates making recovery of new, useful, true-breeding NR lines difficult. NR genotypes have retarded flowering and pollen development and a tight linkage with crown galling and shoot proliferation. This linkage to galling is very useful to identify NR plants in segregating populations. Ultimately, galling is potentially deleterious, but field tests under high plant populations suggest that it will be mostly benign. Resistance to rhizomania using the Holly gene was incorporated into the NR breeding program. All recent scoring, selection, and performance testing was done under field conditions with infestations to both rhizomania and SBCN. Segregating lines through backcross four have been developed with dual resistance. Each succeeding backcross has given expected root yields and improved sucrose content; within the backcross populations, the nematode susceptible segregates approach the level of the recurrent parent as expected but the NR counterparts remain 1-3% points lower in sucrose content. Reciprocal backcrosses had different rates of NR transmission. Among different backcross lines, transmission rates through the male ranged from 1-16% and 3-26% through the female rather than the theoretical 50% rate. A modified backcross procedure using homozygous NR pollinators in parallel to conventional backcrossing should greatly increase the rate of recovering new homozygous NR lines and synthetics useful for parental line development and population improvement.