

LEWELLEN, ROBERT T., and LINDA M. PAKISH, USDA, Agricultural Research Service
1636 E. Alisal St., Salinas, CA 93905. **Performance of sugarbeet cyst nematode resistant cultivars and a search for sources of resistance.**

ABSTRACT

Sugarbeet cyst nematode (SBCN) (*Heterodera schachtii*) can be a very damaging pest of sugarbeet (*Beta vulgaris*). At different times and locations, it has been considered problem number one. Much research has been expended to study the biology of SBCN, to determine control practices, and to find host-plant resistance. SBCN has necessitated the use of crop rotations, chemical protectants, and soil fumigants and has been responsible for the dislocation of production areas, usually away from factory sites. Worldwide breeding for resistance to SBCN in sugarbeet has been an objective for about 90 years. At Salinas, since about 1950, breeding for resistance to SBCN has been a primary objective. Scientists who have worked on the biology and control of SBCN and resistance in sugarbeet at Salinas have included Mr. C. Price and A.E. Steele and Drs. A.M. Golden, H. Savitsky, D.L. Doney, E.D. Whitney, J.S. McFarlane, M.H. Yu, and more recently, R.T. Lewellen. Extensive research has also been done by the University of California at Riverside and Davis. In the 2003 California Sugar Beet Annual Report, California Beet Growers Association, Dr. M.H. Yu reviewed the history of the worldwide breeding efforts to produce sugarbeet cultivars that are highly resistant to SBCN.

In summary, within cultivated beet, *B. vulgaris*, high resistance has not been found. In the progenitor of all cultivated beets, *B. vulgaris* subsp. *maritima*, tolerance and partial resistance has been reported. The highest level of resistance was identified in the *Procumbentes* section of *Beta* in the hard seeded species *B. procumbens*, *B. webbiana*, and *B. patellaris*. Because of the near-immunity of resistance in these hard seeded species, this resistance has received the most attention of genetic and breeding efforts. Recently in Europe, hybrid cultivars with resistance to SBCN from *B. procumbens* conditioned by the gene *Hs^{pro-1}* have been marketed on a limited scale. In 2004, experimental hybrids from Betaseed and Syngenta (Hilleshog) and from the USDA program at Salinas with resistance from *B. procumbens* were evaluated in tests at Brawley and Salinas.

As mentioned, partial resistance has been known in one or a very few accessions of *B. vulgaris* subsp. *maritima*. For example, H. Reitberg in the Netherlands identified from the Loire Valley Estuary in France specific collections that had partial resistance. The best known of these is now known as Wild Beet 242 (WB242) and is stored in the national seed bank as PI546413. There now also may be other sources of resistance identified and being used from within the *B. vulgaris* – *B. vulgaris* subsp. *maritima* continuum. These *maritima* and/or other sources of resistance have received renewed interest and breeding activity in USDA-ARS research programs at Fort Collins, CO and Salinas, CA and by commercial seed companies. Breeding lines CN12, CN72, and C927-4 have recently been released from the program at Salinas. Based upon field and greenhouse tests, these lines segregate for high levels of resistance to SBCN. The resistance in CN12 is believed to be from WB242. It is less clear where the resistance in CN72 and C927-4 was derived and whether it is different from the resistance in CN12. In tests at Salinas and Brawley in 2004, these breeding lines and two experimental hybrids from Betaseed with non-*B. procumbens* resistance to SBCN were evaluated.

The tests in 2004 at Brawley and Salinas of the nematode resistant varieties and lines were grown under both SBCN infested and noninfested conditions. Where there was SBCN infestation, the soil was infested also with rhizomania (*Beet necrotic yellow vein virus*). In the SBCN tests, there were 24 varieties in 2-row plots with eight replications. Soil cores from eight varieties were taken for SBCN counts. Cores were taken 12 inches deep, 3-4 inches from the plants on the inside shoulder of the beds. Eight random cores were taken per plot and combined into one sample per plot. Nematode counts were made by L. Pakish at Salinas. For the Brawley test B504, soil was sampled 03/04/04 and at harvest 05/23/04. Samples for initial SBCN population counts were not made. At Salinas, the trial 3504 was sampled three times: early in the season on 06/01/04; midseason on 09/03/04; and at harvest at 11/05/04. The trials were harvested and root yield and sugar content determined. At Brawley, the sugars were determined by Spreckels Sugar. The test B504 at Brawley was under high SBCN pressure and mild rhizomania. An adjacent test B304 under similar cultural conditions was nearly disease free and was used to calculate relative sugar yield between diseased and nondiseased conditions. At Salinas, in test 3504, rhizomania was considered to be more severe than the SBCN infestation. At harvest on 11/23/04 for test 3504, the roots were lifted, scored for rhizomania on a scale of 0 to 9 where 9 = very severe or dead, bagged, washed, weighed, and run through the sugar lab. For rhizomania, roots scored 0-4 were considered resistant.

Based upon the 2004 test results at Brawley and Salinas, combined resistance to SBCN and rhizomania is happening. Under high nematode populations at Brawley, it appears that both resistance from *B. procumbens* and the other sources condition resistance. The interesting and highly encouraging finding is that the resistance from the other sources appears to be as efficacious at protecting potential sugar yield and reducing nematode buildup as the *B. procumbens* source. Under lower populations at Salinas, the results are less dramatic, but the final SBCN counts were reduced by both kinds of resistance.

The lines evaluated from the Salinas breeding program appeared to be intermediate to the results from the commercial hybrids. Tests in the greenhouse on individual plants showed that CN12, CN72, and C927-4 segregate for reaction to SBCN. Within each source, highly resistant plants occur. Evaluation, screening, and selection within these lines and others should produce homogeneous resistant lines. It is believed that when these reselected lines and their hybrids are tested, that their nematode resistance will be highly effective.

These test results based upon only one year's data need to be considered preliminary. The tests are being repeated in 2005 at both Brawley and Salinas. In addition to the Syngenta and Betaseed hybrids, nematode resistant hybrids from Holly Hybrids also will be evaluated. The Betaseed hybrid tested as 2AP0852 has been provisionally accepted for limited marketing by the Imperial Valley Seed Committee as 'Beta 8520N.' After so many decades of work, it is exciting to think that resistance to SBCN is now approaching commercial reality in California.