2005 SUGAR BEET CYST NEMATODE UDATE

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The sugar beet cyst nematode disease of sugar beets (*Beta vulgaris* L.) was first reported by Schacht in Germany in 1859, and described as *rubenmudigkeit* (beet weariness). The causal agent, sugar beet cyst nematode (SBCN, *Heterodera schacthii*) was subsequently described in 1871 by Schmidt. By 1911, forty-five scientific papers had been published about this nematode (Shaw, 1915). SBCN was known in western U.S.A. as early as 1918, and the first Michigan (MI) survey for this nematode was conducted in 1920 (Thorne, 1961; Knobloch and Bird, 1981). SBCN, however, was not detected in Michigan until 1948 (Bockstaller, 1950). It was subsequently shown to be a major pest under Michigan growing conditions (Knobloch and Bird, 1981). In 1986, Caswell, MacGuidwin, Miline, Nelson, Thomason and Bird published a simulation model for SBCN-infested sugar beets. Currently, SBCN is a key pest, significantly limiting sugar beet yield potentials under MI growing conditions. Six other species of cyst nematodes are known to be associated with Michigan agriculture (*H. glycines, H. trifolii, H. carotae, H. avenae, H. iri* and *Cactodera milleri*), with *H. glycines* and *H. carotae* being key limiting factors in MI soybean and carrot production, respectively.

In a 1998 industry-wide survey, cyst nematodes were recovered from 54% of the 214 sugar beet fields sampled (Miller, 1999). Survey information in 1999 and 2000 also indicated that SBCN is present in *circa* 50% of MI sugar beet acreage. Some infested sites have high population densities of SBCN, visible foliar symptoms and yield losses estimated to exceed 10 tons per acre. Other infested sites have relatively low population densities of SBCN, no foliar symptoms and yield losses estimated to be in the range of 2 to 4 tons per acre. It is apparent that in MI, SBCN functions as the pathogen for the infectious disease known as Sugar Beet Cyst Nematode Disease of Sugar Beets, and is a key component of the current low beet yield problem in the state.

The first SBCN tolerant sugar beet variety (Beta 3455N) was available for testing under field scale conditions in 2005. A total of 11 trials were conducted throughout MI. In the presence of low to high SBCN population densities, Beta 3455N beet yields averaged 6.9 tons per acre or 27.3% higher than those associated with the SBCN susceptible cultivar, B5388R. Yield increased ranged from 2.6 ton per acre in a field with a low SBCN population density to 10.4 tons per acre at a site with a high SBCN population density. In the one site where SBCN could not be detected, B3455N yielded 0.6 tons per acre less than the nematode susceptible variety (B5388R). In two of the three sites where SBCN status was unknown, the average yield increase associated with B3455N was 9.9 tons per acre; whereas, in a third site with unknown SBCN status, there was a yield differential of only 1.5 tons per acre in favor of B3455N. In addition to creating a significant amount of excitement and optimism in the MI sugar beet industry, research associated with the first SBCN tolerant cultivar provided indirect evidence that both fumigant and non-fumigant nematicides have not provided adequate SBCN control efficacy under MI growing conditions during the past 20 years.

Plant parasitic nematodes are also known to serve as predisposition agents for infectious diseases caused by fungi and bacteria. Nematodes can also vector plant viruses. Lownsbery *et al*. demonstrated that SBCN in a predisposition agent for the *Rhizoctonia* seedling disease of sugar beets. Although the relationship between this seedling disease and late-season Rhizoctonia crown

rot is not known, Rhizoctonia crown rot is commonly observed in fields with known population densities of SBCN.

Sugar beet is the only major field crop grown in MI that is a host of SBCN. Because of this, it was possible to successfully manage SBCN for many years through a strict system of crop rotation (Berney and Bird, 1998). Recently, however, the MI sugar beet industry has undergone several changes, including a shortening of crop rotation intervals and beet yield declines. In some fields in Michigan, it has been shown that rotations as long as eight years in length are no longer suitable for management of SBCN. Recent nematode community structure analysis indicates that various agricultural production system practices alter soil biology in ways that favor increases in population densities of phytopathogenic nematodes, crop risks to associated infectious diseases and decreases in soil nutrient mineralization potentials.

Oilseed radish planted as a trap crop following dry bean or corn had mixed results in reducing SBCN populations (Koch *et al*., 1998). Cultural management of SBCN trap crops impacts the amount of growth of the trap crop (Krall, *et al*., 2000). A study in Wyoming found that trap crops grown after wheat reduced SBCN populations by 48 to 55 % compared to the control when grown for a full season trap crops reduced SBCN populations by 14 to 43% (Koch *et al*. 2001). Recent research at MSU has shown that oil seed radish cvs Adgio and Colonel function as SBCN trap crops under MI conditions. Although beet yield increased have been obtained when the trap crop is planted following wheat, there are a few agronomic challenges that need to be resolved. Although the first trials with integrating the trap crop into a dry bean system were not successful, a full season of soil seed radish, cv Colonel resulted in increasing beet yields from 5.4 to 18.1 cwt per acre. Other studies with Colonel have indicated that it is a much better host for the northern root-knot nematode (a pathogen of sugar beets) than other cultivars of oil seed radish. Much remains to be learned about how various trap crops should be used in MI farming systems. Incorporation of SBCN trap crops into sugar beet rotations should not only decrease SBCN populations, but also create an improved balance of soil organisms and an enhancement of overall soil quality. In recent years, the MSU G. W. Bird Nematology Laboratory has developed a major focus in the area of soil biology in relation to soil quality (Bird, 2000, Sanchez *et al.*, 2002).

In addition to SBCN being widely distributed throughout MI sugar beet production areas, the soybean cyst nematode (SCN) is known to exist in all counties where sugar beets are grown. This very significant key pest was first detected in MI in 1986. Today, MI is the only place in the world where SBCN and SCN are known to exist in the same fields. Genetically these species are closely related and have been shown to interbreed under laboratory conditions. In 2005, a cooperative project was initiated with the University of Illinois to evaluate the biology of the hybrids resulting from SBCN x SCN crosses. If a hybrid of this type exists under MI commercial agricultural conditions, how will the current SBCN tolerant and future resistant varieties respond in relation to yield potential and nematode fecundity? What will be the response of SCN resistant soybean varieties to a SBCN x SCN hybrid? These are very significant questions that could have a major impact on the future sugar beet and soybean industries in MI.