Trap Crops: A Promising Alternative for Sugar Beet Nematode Control

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SBN: A costly pest

Sugar Beet Nematode (SBN), *Heterodera schachtii*, is one of the most destructive pests of sugar beets worldwide. It is present in all sugar beet growing areas of Wyoming and is particularly severe in fields located in close proximity to processing plants where sugar beets have been grown the longest. This soilborne, parasitic nematode attacks and destroys the small feeder roots of sugar beet plants, causing severe stunting and as much as 50 percent yield loss.

The presence and level of SBN can easily be determined by soil analysis, and SBN can be managed by long-term (three to five years) rotation with non-host crops such as barley or corn. However, due to sugar beet crop's high cash value, as well as the lack of other crops of similar value adapted to Wyoming, this method of control has not been widely used. Many fields in Wyoming had no rotation during the early years of sugar beet production and only a short rotation (usually two years or less) during the past ten years or more. Not surprisingly, these fields now have high soil populations of *H. schachtii*. To provide acceptable yields, these fields usually require application of a nematicide or soil fumigant each time sugar beets are planted.

The insecticide/nematicide Temik® and the biocide/soil fumigant, Telone II® are commonly used in Wyoming. Although both constitute a significant dollar investment, they can be cost effective when soil populations are high. However, both are classified as **restricted-use** pesticides and are potentially hazardous to applicators and to the environment. Temik® (aldicarb) has been found in the groundwater in Wyoming.

Sustaining sugar beet production

One of the goals of sustainable agriculture is to explore alternative pest control strategies, thus reducing risk to humans and to the environment. Therefore, while nematicides and soil fumigants are important control tools, non-chemical alternatives will be needed to sustain sugar beet production into the future.

Trap crops: An alternative control method

Varieties of SBN-resistant radish (*Raphanus sativus*) and yellow mustard (*Sinapis alba*), bred in Germany, offer an alternative method of SBN control for Wyoming sugar beet growers (See Photo 1). These varieties act as hosts in that they stimulate

Photo 1. Adagio Radish, left, and Metex Mustard, right, after 60 days growth.

nematode eggs within the cyst (dead female) to hatch, whereas non-host or neutral crops, such as corn and barley, have no effect on the SBN (See Figure 1). Hatched juvenile nematodes in search of food are attracted by root exudates. However, after penetration of the root, these varieties do not allow the nematode to develop and reproduce as it does in susceptible crops. The SBN becomes trapped in the roots of these plants. Because trap crops are planted in late summer, trapped nematodes die during the winter months, resulting in a reduction of the soil population.

Trap crop varieties available for the purpose of biological control of SBN are Adagio Radish and Metex Mustard. Forage turnips, forage rape, and canola, which are closely related to these trap crops, are susceptible to the SBN and should not be grown in rotation with sugar beets, since they will increase the soil population of this destructive nematode.

Trap crops proven effective in Europe

In Germany and the Netherlands, nematicides have been banned due to groundwater contamination. As a result, SBN-resistant varieties of trap crop radish and mustard, along with rotation with non-host crops, constitutes the primary means of SBN control. This method of control has been used successfully in Europe for more than ten years. These varieties are usually planted following small grain harvest the year preceding sugar beet production. Trap crops are grown full-season in some severely infested fields as part of a "set-aside" program. The object of this process is to trap nematodes and remove excess soil nitrates. When grown full-season, the trap crop is mowed at early flowering in order to prevent seed production.

Adaptation to U.S. sugar beet rotations

In areas with sugar beet/barley rotations, barley is harvested between late July and mid-August, and the land is left fallow until a sugar beet crop or another crop of barley is planted the next spring. Dry beans and corn are harvested later than barley and allow less time for trap crop growth. Although irrigated oats and winter and spring wheat or other annual forage crops are not commonly grown in rotation with sugar beets in Wyoming, they may offer potential for using trap crops, particularly in southeastern Wyoming.

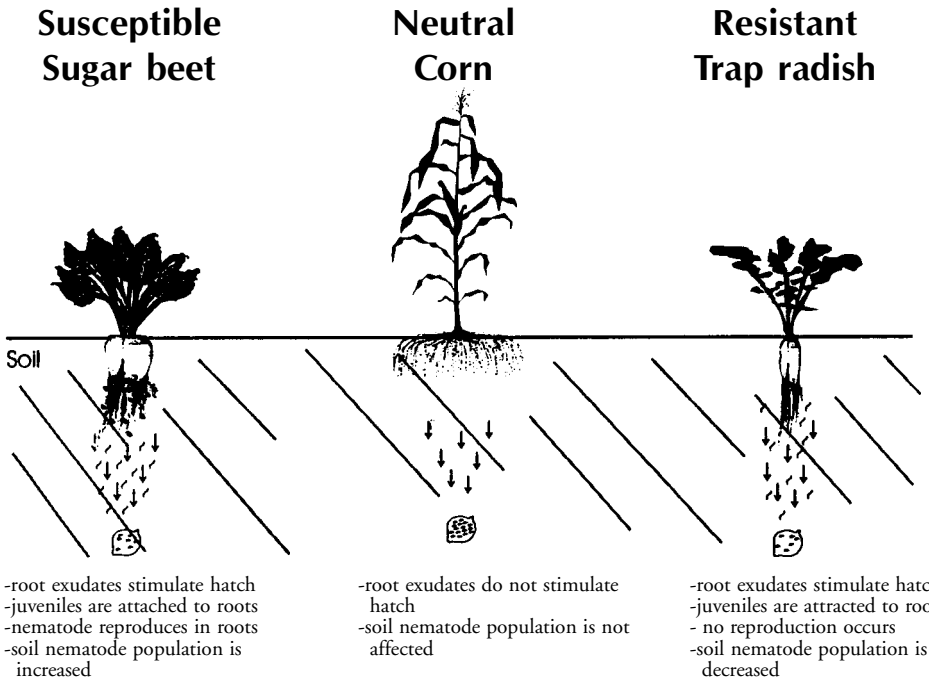

Figure 1. This diagram shows the effect of trap crop host and non-host crops on the soil population of *H. schachtii*.

Studies conducted in Germany show that a minimum soil temperature of 46 degrees Fahrenheit is needed for the SBN to hatch. Radish and mustard will grow at a lower temperature, however. Adequate proliferation of trap crop roots and contact with SBN cysts are needed before the soil temperature drops below 46 degrees Fahrenheit in order to obtain maximum benefit. Research at the Nebraska Panhandle Station, Scottsbluff, showed that radishes need to be planted before August 15, when soil temperatures are above 60 degrees Fahrenheit, for adequate top and root growth. Adequate soil moisture is critical for growing trap crop roots and is also necessary for moving the root exudates to the immobile cysts to stimulate hatching and moving the juvenile nematodes to the roots.

Requirements for growing trap crops

Cultural practices recommended for maximum effectiveness of the trap crop include seeding as early as possible after a small grain harvest, establishing a thick stand, controlling weeds and volunteer grain, providing good fertility, and irrigating as needed. Planting into stubble of the previous crop saves time and expense and, in some locations, conserves soil (see Photo 2). However, a tilled seed bed may be needed in some fields, particularly if soils are compacted. If soil is not tilled, loose straw may need to be removed to facilitate planting. If seeds are broadcast, a follow-up light tillage is recommended.

Additional benefits of trap crops

Secondary benefits from using traps crops are: economic feasibility of growing sugar beets without nematicides; capturing residual soil nitrates from the previous crop, thus preventing groundwater contamination; protecting soil against wind and water erosion during the fall; improving soil health with the reduction of pesticides and the addition of organic matter; and using the highly nutritious top-growth for livestock grazing.

Photo 2. Planting trap crops directly into the stubble of the previous crop, as shown above, saves time and money.

Trap crop features that promote these benefits are: the ability to grow at relatively low temperatures, rapid growth and formation of a ground cover, and high nitrogen and low fiber content, leading to high animal performance or, if not grazed, a relatively rapid decomposition when incorporated. Fields on which sugar beets have been grown for many years are characteristically low in organic matter and would likely respond positively to the addition of green manure. Organic matter can stimulate microorganisms that are antagonistic and parasitic to the SBN, as well as to other sugar beet pests and disease pathogens.

Photo 3. These lambs are grazing trap crop radish at the University of Wyoming Research and Extension Center at Powell.

Wyoming research

In the Big Horn Basin, trap crop radish that was planted by early August, in conjunction with applying 50 to 75 pounds of nitrogen per acre, good volunteer barley control, and adequate irrigation, resulted in a 50 to 75 percent reduction in SBN populations. Also, sugar beet yields increased the following year by 4.0 to 4.9 tons per acre. (See Reference 3). The sugar beet yield increase was greater when using trap crop radish than it was with Temik®. Radish plantings after August 15 and insufficient volunteer barley control resulted in poor reduction of SBN populations and no increase in sugar beet yield.

In southeast Wyoming, trap crop radish planted after dry beans and silage corn (average date September 7) produced much less growth and SBN control than trap crops planted after malt barley in the Big Horn Basin (See Reference 4). In only one of four plantings was SBN reduced or sugar beet yield increased the following year. Following dry beans and corn, growth of trap crop radish was less than one-third of that following malt barley.

Average gain of lambs grazing Adagio Radish was 0.32 pounds per day, which is similar to lambs grazing turnips (See Reference 5). The 270 pounds per acre of lamb gain, on average, was enough in most years to defray costs of growing the trap crop.

Adding an SBN-resistant trap crop variety into sugar beet farming operations offers an exciting prospect for safe and effective control of the SBN.

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