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# Alfalfa Stem Nematode Biology and Management

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## Introduction

The stem nematode (SN), *Ditylenchus dipsaci*, causes major losses of alfalfa in Wyoming. It occurs in most areas where irrigated alfalfa is grown, but is worse in those areas having high clay (>30 percent) soils such as the Big Horn Basin[1]. It is not a problem in dryland alfalfa. Severe infestations of this parasitic round worm can result in a dramatic decrease in alfalfa stand and yield. Control of this nematode depends primarily on the use of resistant cultivars. However, the use of certain cultural practices is essential for their maximum performance.

## Symptoms

The most common symptom of SN-parasitized plants is an overall stunting (Figure 1). Scattered plants or areas in the field may grow out slowly in the spring and may

*Figure 1. Stem nematode parasitized and healthy alfalfa plants removed from a field one week after harvest. Note regrowth of healthy plant compared to no regrowth on the parasitized plant.*

continue to have poor growth throughout the season (Figure 2). Localized areas infested with the stem nematode are usually round or oval in shape and vary in size from 3-6 feet in diameter. Over time, these areas increase in size and eventually overlap, resulting in larger stunted areas in the field. Stems of stunted plants are swollen and

*Figure 2. Localized area with stunted plants infested with the stem nematode. Note height difference of parasitized and healthy plants.*

distorted (Figure 3). Severly parasitized stem buds cannot be seen unless plants are dug and soil removed from the crown. On a given plant, several or all of the stems may be affected. Moderately parasitized stems may be dark brown, swollen, and hollow from the base of the plant and extending upward 2-4 inches. This stem discoloration may be confused with a fungal disease called "spring black stem." Both diseases may occur on the same plant. A very small percentage of parasitized plants may have one or more stems, including leaves, which are completely

*Figure 3. Healthy and heavily parasitized stems. Note severe stunting and swelling. Both stems are the same age.*

*Figure 4. Single plant parasitized with the stem nematode with the "white flagging" symptom. Note leaves and stems are entirely white. Either a portion or all stems may be affected.*

white (Figure 4). This symptom is referred to as "white flagging" and is a useful tool in diagnosing this disease. Research conducted in Wyoming has shown this symptom to be more prevalent on regrowth following the first cutting[1]. However, only a very small percentage (5 percent or less) of SN-parasitized plants actually show the white flagging symptom. So even though the "white flagging" symptom may alert you to the presence of the stem nematode, it doesn't tell you how bad the field is infested. After harvest, regrowth of parasitized plants is slow and the unevenness of parasitized and healthy plants becomes more noticeable as the season progresses, giving the field a uneven or lumpy appearance. Severely parasitized plants eventually die and are replaced by weeds, resulting in lower hay quality. Plants parasitized with the stem nematode are predisposes to winter injury (Figure 5). Research conducted in Wyoming has shown that the stem nematode interferes with the storage of nonstructural carbohydrates, essential for winter survival[2].

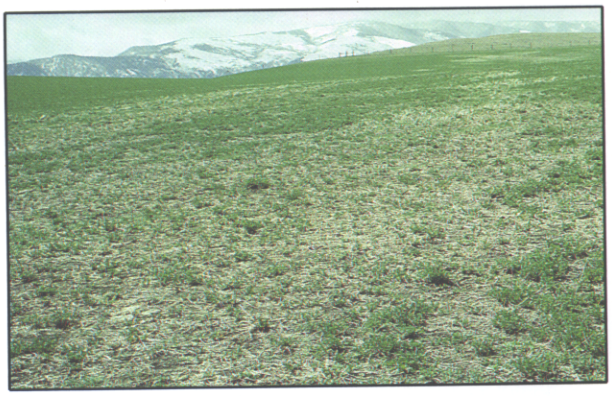

*Figure 5. Severe winterkill in a field that was heavily infested with the stem nematode.*

The incidence of bacterial wilt may be increased in the presence of the stem nematode. Research conducted in Canada has shown the stem nematode may break down resistance of alfalfa to bacterial wilt, even in wilt-resistant cultivars.

## Disease Cycle

The alfalfa stem nematode is an obligate, indoparasitic round worm that lives inside the stem buds and developed stems of the plant. It can also be found in leaves and in the inside of rotting crowns and upper roots. Initial parasitism occurs under or at the soil surface in newly forming stem buds following irrigation or rain. Research conducted in Wyoming has shown these nematodes survive the winter in parasitized alfalfa tissues, as well as in rhizosphere soil of parasitized plants. Survival of the nematode in plant tissues, and or as damage to the hay crop the following spring is most likely greater when plants are covered with snow. The stem nematode is spread in surface water of infested fields, in dried parasitized stems in hay and seed, and in infested soil attached to machinery or hooves of animals. The stem nematode consists of adult male and female, eggs, and four juvenile stages. Adults are colorless and approximately 0.04 inches long and cannot be seen without magnification. A complete cycle from egg to adult takes between 19 and 23 days when temperatures are around 65-75F (Figure 6). A single female can lay up to 500 eggs. All stages develop inside the stem tissues (Figure 7). The fourth stage juvenile is unique in that it can survive in dried tissue for up to 10 years. However, survival for more than three years has not been documented in irrigated fields when nonhost crops are grown.

Studies conducted in Wyoming have recently found a second foliar nematode, the chrysanthemum foliar nematode, *Apelenchoides ritzemabosi*, to occur with the stem nematode in alfalfa plants. All SN-infested fields sampled to date have contained both nematodes. Dual parasitism of alfalfa by these two nematodes appears to be


*Figure 6. Disease cycle of the alfalfa stem nematode. The cycle consists of eggs (A), juveniles (B,C,D,E), and adults (F).*

quite common in the western United States. Damage caused by *A. ritzemabosi* is similar to *D. dipsaci*, except no swelling occurs in plant tissues.

## Management

Proper cultural practices, including crop rotation, proper cutting and irrigation management, fall burning, and the use of resistant cultivars will decrease losses from the stem nematode.

### Crop Rotation

A two-three year rotation between alfalfa plantings with crops such as barley or corn will decrease soil populations of the stem nematode. However, care must be taken during this time to avoid reintroducing the stem nematode into the field by means mentioned in the previous section. The primary means of reintroduction, which unfortunately is unavoidable, is through the application of irrigation water from canals or streams within alfalfa growing areas. The stem nematode enters the irrigation water supply from run-off surface water of infested alfalfa fields that is returned to the irrigation system. Therefore, growers in these areas should anticipate a more rapid reinfestation than those using well water applied through overhead irrigation.

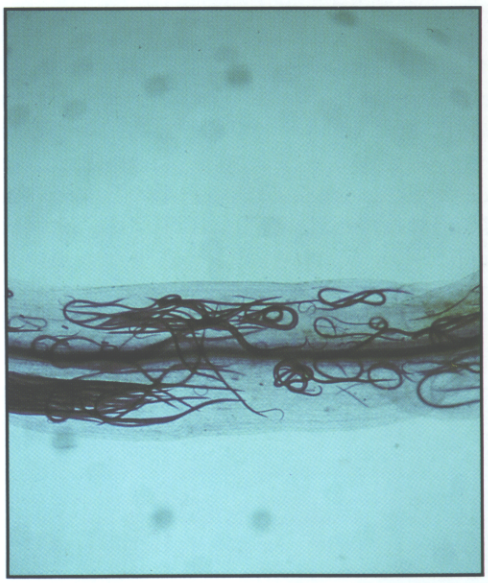

*Figure 7. Parasitized alfalfa stem showing swelling and destruction of cell walls resulting in a large open living area for the stem nematode. Stem tissue and nematodes were stained with a red dye and stem tissue later cleared. Most of the stages of the nematode cycle can be seen inside the stem (100 magnifications).*

Fields with the stem nematode present should be harvested when the top 2-3 inches of soil are dry. After harvest, the regrowth should be allowed to reach 6-8

inches prior to irrigation. Both of these practices will reduce the chances of stem bud infection by this aquatic parasite.

### Fall Burning

Another practice that has been shown to reduce infection in established fields in Utah is fall burning of the dried aftermath (frosted-down alfalfa hay). Burning actually destroys infested tissue and has resulted in a recovery of stands the following year. **Fields should not be burned in the spring,** however, as this practice actually results in an increase in parasitism.

### Nematicide Application

There are currently no post-plant applied nematicides labeled for use on alfalfa for the control of the stem nematode. However, the ground application of the insecticide/nematicide Furadan®, following harvest, to control the alfalfa weevil[3], may suppress the alfalfa stem nematode.

### Resistant Cultivars

Lastly, and most importantly, certified cultivars, resistant to the stem nematode, should be planted in fields or areas known to have the stem nematode. The benefit of using a stem nematode resistant cultivar can be seen in Figure 8. There are currently 92 certified alfalfa cultivars with a moderate or higher level of resistance to the stem nematode that are adapted to the growing conditions in Wyoming[4]. Eighty-one of the 92 cultivars also have a moderate or higher level of resistance to bacterial wilt, Verticillium wilt and Phytophthora root rot, all major stand decline diseases in Wyoming. Twenty-one of these cultivars are rated as "resistant" (R) to all four diseases. All of these cultivars are listed in bulletin B-919 entitled, **"Selecting Alfalfa Cultivars with Disease Resistance"**[5].

*Figure 8. Response of host resistance to the stem nematode in preventing stand decline in alfalfa. Research plots are four years old and are heavily infested with the stem nematode.*

If you need to select a cultivar, this publication is available from your county agent's office or from the Bulletin Room in the College of Agriculture.

Research conducted in Wyoming has shown that overall, cultivars with resistance to the stem nematode also have some resistance to the chrysanthemum foliar nematode.

The percentage of plants resistant to the stem nematode, in "resistant" cultivars, varies from as low as 6 percent in cultivars rated as having **low resistance** (rating of 'LR'), to around 60 percent in cultivars rated as being **highly resistant** ('HR'). The higher the level of resistance, the greater the expected performance in SN-infected fields. Therefore, even if you plant a highly resistant cultivar, up to 40 percent of the plants in the field will be susceptible. Because of this, it is important to include the cultural practice given above in your overall management program for maximum control of the stem nematode.

## Summary

Effective management of the alfalfa stem nematode can be obtained by the combination of crop rotation to reduce soil nematode populations and the planting of a resistant, certified cultivar. Harvest and irrigation management, to reduce parasitism of emerging stems of susceptible plants, will increase the effectiveness and ensure maximum performance of the resistant cultivar.

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