

# MANAGEMENT OF NEMATODES AND ALFALFA DISEASES

Dr. Donald R. Miller<sup>1</sup>

## ABSTRACT

Management of the potential economic damage to alfalfa production fields due to nematodes and/or diseases is generally accomplished by a combination of three factors; **genetics, cultural practices and to a lesser extent chemical control**. The selection of a highly resistant variety is the first line of defense in combating nematodes and alfalfa diseases. Cultural practices can be very effective in preventing the initial spread of the nematodes and/or pathogens into new production fields, and help minimize the damage in established alfalfa fields. However nematode and disease control in established alfalfa fields is difficult, especially since most of the major damage occurs at or below the soil surface. Once an alfalfa field is planted, there are few chemical controls available that are effective and/or economical, with the exception of controlling some leaf diseases.

**Keywords: Alfalfa, plant pathology, disease control, cultural practices, management, alfalfa diseases, alfalfa fungicides, nematode control, alfalfa nematodes, stem nematode, root knot nematode, lesion nematode, alfalfa scald, cotton root rot.**

## INTRODUCTION

Much progress has been made by alfalfa breeders in the last 30 years in improving the genetic resistance of alfalfa varieties to nematodes and diseases. Utilization of these genetic advances in the selection of adapted resistant varieties is still the best and most economical means of insuring maximum yield, quality, and stand life. Variety selection, beyond yield and forage quality, should be based on knowledge of which alfalfa nematodes and diseases are most prevalent in a grower's field or are historically known to reduce yield and stand life in the region. Knowledge of any potential new nematode or disease reported in the area should be also considered in the selection of a variety with resistant traits.

Selecting an adapted variety that has a high level of genetic resistance to the major pests, combined with proper cultural practices, is the grower's best defense in minimizing nematode and disease incurred production losses. Selecting a good resistant variety, adapted to his or her farm, is also the cheapest line of defense against potential production losses. It is hard not to overemphasize this point. The variety choice the grower makes at planting, will often determine the extent and severity of any future outbreaks, and more importantly the length of time that field will remain profitable. Growers often become fixated on the initial cost of the alfalfa seed, but often fail to realize that the choice they make will determine the profitability of that field for many years. A poor choice can actually cost money in the form of lost yield and/or quality due to stand losses and the resulting weed encroachment. A poor variety choice can result in the grower having to prematurely take fields out of production. The unexpected replanting costs can be

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<sup>1</sup> Dr. Donald R. Miller, Director of Product Development, Alforex Seeds, 16 12<sup>th</sup> Ave, South, Suite 209, Nampa, ID 83851 Email ( [Don.miller@alforexseeds.com](mailto:Don.miller@alforexseeds.com) ) ; **In:** Proceedings, 2018 California Alfalfa and Forage Symposium, Reno , NV 27-30 November, 2018. UC Cooperative Extension, Plant Sciences Department, University of California, Davis, CA 95616. (See <http://alfalfa.ucdavis.edu> for this and other Alfalfa Symposium Proceedings

significantly more than what the producer would have paid in seed costs for a better nematode or disease resistant variety. Picking a low cost inferior susceptible variety often results in the grower having to fight an uphill battle to optimize forage production and profit.

For the most part, once a variety is planted, there are only a limited amount of options available to the grower to prevent or eliminate nematodes and/or pathogens from damaging an established field. There are few chemical controls available that are effective and/or economical, with the exception of controlling some leaf diseases. Proper cultural practices implemented during the life of the stand can limit the spread and extend of damage. However complete control in established fields is often difficult once a nematode or pathogen has become established.

## **ALFALFA NEMATODES**

Nematodes are microscopic wormlike animals that live in the water held between soil particles. These plant parasitic animals are generally more prevalent in sandy soils and have a high reproductive rate. They can persist in soil for many years in the absence of a host, and move from field to field on farm equipment and/or irrigation water contaminated from runoff water of infested fields. Numerous plant parasitic nematodes are known to occur in alfalfa fields, but the majority of damage is attributed to the following five.

### **Major Nematodes Species that Damage Alfalfa**

1. Stem Nematode (Ditylenchus dipsaci)
2. Southern Root Knot Nematode ( Meloidogyne incognita.)
3. Northern Root Knot Nematode ( Meloidogyne hapla)
4. Columbia Root Knot Nematodes ( Meloidogyne chitwoodi)
5. Root Lesion Nematodes (Pratylenchus penetrans)

### **Management of Nematodes In Alfalfa: What Are Your Options?**

The best control option is to eliminate or reduce the nematode threat prior to planting. This can be approached in several ways. First take a soil sample and send it to a lab to see if any harmful nematodes are present. Your local soils lab or extension office should be able to help you locate a nematode lab. The nematode lab can identify any problem nematodes found in the soil you send them. I recommend sending soil and plant samples (if field is not fallow) to get the most accurate evaluation. Depending on where the nematode is in its life cycle it may be more prevalent in the soil or the plant tissue.

### **Approximate Nematode Threshold Levels For Soil Samples/gram: ( Samples that contain a majority of female nematodes is more of a concern)**

- STEM – any number
- NRKN – 500
- CRKN – 1,000
- LESION – 2,000

If an alfalfa parasitic nematode is present you can use the following management options to eliminate or minimize the number nematodes in the field:

**-Fallow The Field :** Cultivation of the field drastically reduces the number of nematodes and eliminates their food source. Most parasitic nematodes can only survive on living plants.

**-Trap Crop:** Some species of nematodes can lay dormant in the soil for a period of time even following periods of fallowing. Planting a specific crop that is known to stimulate the dormant parasitic nematode to hatch and feed, is a method of control called a “Trap Crop”. Plowing down this “trap crop” before the newly hatched nematodes have a chance to reproduce, can be effective in further reducing a nematode population.

**-Fumigation (Chemical or Bio-Fumigation):** Chemical fumigation is generally considered too expensive for new fields for alfalfa production. However some alfalfa growers have taken advantage of rotating with high value crops where soil fumigations are cost effective, such is the case for potatoes. Alfalfa following the potato crop can take advantage of the prior fumigation by starting out with few if any nematodes in the soil profile.

A more cost effective alternative to chemical fumigation, is bio-fumigation . Certain species of plants when grown and subsequently plowed down and incorporated into the soil, release a natural bio fumigant that controls parasitic nematodes. Several varieties of radish and mustards are currently available to growers to use in short term rotations for this purpose. Bio-Fumigation can be a very effective tool in an integrated approach of controlling nematodes prior to planting.

**-Non-Host Plant Rotation:** This is a practice of planting a rotational crop that the problem nematode can't feed or reproduce on. Growing a non-host crop for 1-2 years can reduce nematodes numbers, especially if used in conjunction with other control measures.

The following is some specific information on the nematodes known to damage alfalfa in order of importance:

### **Stem Nematode (Ditylenches dipsaci)**

Conditions that promote damage:

- Sandy soil
- Cool moist spring
- Sprinkler irrigation (surface moisture on lower plant canopy increases stem infestation)
- Susceptible plant and weed hosts

Symptoms:

- In the spring or fall sporadic white stems or “White flags” may be seen throughout the field
- Stunting in somewhat circular patterns in the field
- Swollen stem buds
- Shortened internodes and swollen nodes on lower stems
- In advanced stages lower stem may blacken
- Fewer symptoms seen during summer months
- Alternate host- potatoes, garlic, and beets

Control:

- Plant a Resistant Variety or rotate with non-host crop for 2-3 yrs.
- Alternate host- potatoes, garlic, and beets
- Non host crops-sorghum, small grains, beans, and corn

### **Root Knot Nematode (Meloidogyne spp.)**

Conditions that promote damage:

- sandy soil
- susceptible plant and weed hosts

Symptoms:

- Stunting in somewhat circular patterns in the field
- Stand reduction
- Excessive root branching and small galls on roots

Control:

- Resistant varieties
- Alternate Host: Potato , sugar beet, bean, tomato, and cotton
- Crop rotation with a non-host is generally not feasible due to wide host range

### **Lesion Nematode (Pratylenchus spp.)**

Conditions that promote damage:

- sandy soil

Symptoms:

- Major symptoms occur in the form of black lesions on the outside of the root. Lesions may become severe enough to completely darken taproot.
- Taproots appear stunted with reduced lateral root growth.

Control:

- Resistant varieties
- Crop rotation with a non-host is generally not feasible due to wide host range
- Leaving field fallow followed by a nematicide treatment

## **INTEGRATED APPROACH TO NEMATODE CONTROL: BENEFICIAL CULTURAL PRACTICES AND CROP ROTATION OPTIONS**

### **Cultural Practices:**

- Don't reuse tail-water from infested fields (nematodes can be spread in the water from infested fields)
- Clean equipment between infested field to prevent spread

### **Crop Rotation Options For Stem Nematode Control:**

Alfalfa > 2yrs small grain > Bio-fumigant crop > Alfalfa ( Plant Variety with High Resistance to Stem Nematode)

### **Crop Rotation Options For Root Knot Nematode Control:**

Alfalfa > fallow > Bio-fumigant crop > Alfalfa ( Plant Variety with High Resistance to Root Knot Nematode)

## ALFALFA DISEASES

Limiting the potential economic damage of alfalfa diseases to a production field are generally accomplished by a combination of three factors; **genetics, cultural practices and to a lesser extent chemical control**. Selecting an **adapted** variety that has genetic resistance to the major diseases, combined with proper cultural practices that limit disease infection are the growers best defense to the major alfalfa diseases. Chemical control is generally limited to seed treatments that reduce seedling damping off problems at planting or foliar applications in established fields that prevent or minimize the effect of foliar leaf diseases. Chemical control of established root diseases in alfalfa is generally considered less effective and/or uneconomical.

### IDENTIFYING HEALTHY AND DISEASED ALFALFA PLANTS

One of the simplest tools a grower has at his disposal for gauging the health of his alfalfa field is his shovel. Once or twice a year, growers should dig up 20-30 plants and slice open the crown and taproot with a knife to look for disease symptoms. The inside of a healthy alfalfa root should be relatively white, any brown or red discoloration is an indication that the root system is suffering from a disease infection. The severity of the damage tends to get worse with age, and often these plants don't survive the winter. If you are not sure if there is a disease problem, take plant samples into your nearest extension agent and they can help you with the identification.

### ALFALFA DISEASE MANAGEMENT

As mentioned earlier, the first line of defense in preventing disease outbreaks is planting an **Adapted Variety** with a disease rating of **High Resistance (HR)** or a **Resistant (R)** for those diseases known to occur in the region. After selecting the proper variety, growers should then implement cultural practices that **prevent a new disease introduction** and also **limit the disease build-up and severity** of those pathogens currently in the field.

The following are a few of the common recommended cultural practices that minimize alfalfa diseases: (1) Plant clean disease free seed from a reputable seed company (avoid bin run seed) ; (2) Avoid spreading disease spores from old fields into newly planted fields, cut newly planted fields before older fields to reduce spread of diseases; (3) Disinfect equipment by washing or spraying with a 10% Clorox solution before moving between fields to prevent diseased soil and/or plant residue transfer from older infected fields. (4) Use tiling to reduce excess water in fields. (5) In irrigated regions, use land preparation and irrigation practices that limit excess water conditions, i.e. land leveling or sprinkler vs. flood irrigation. If using furrow or flood irrigation, shorten irrigation time and/or distances to avoid water logged conditions. Avoid reuse of excess irrigation water from diseased fields. (6) Minimize traffic and/or excessive cultivation in established fields. This often results in damaged or wounded plants and increased disease infection. All of these should be considered in a proper management plan to reduce the economic effect of alfalfa diseases.

### CHEMICAL CONTROL

**Seed treatments:** There are several commercial fungicides that can be applied to alfalfa seed to control damping off diseases at planting time. Most commercial seed companies offer these as a

seed treatment option at time of purchase . These fungicide seed treatments can be very beneficial in stand establishment, especially if conditions are cool and wet at planting. One of the most common fungicides used as a seed treatment is Apron XL , which controls many of the major damping off diseases. However a new fungicide called Stamina has been recently added along with Apron XL to control a wider range of damping off diseases. Stamina also controls the various races of Aphanomyces which is known to significantly reduce seedling establishment in the Midwest and East. .

**Foliage/top-growth treatment:** In recent years several new fungicides have come on the market that offer cool season foliar disease prevention in alfalfa. It should be noted that these fungicides in order to be economically effective, must be sprayed as a preventative application. Any fungicide application after the infection is well established or severe, has little economic advantage, since leaf loss and a reduction in forage quality has already occurred. If a foliar fungicide is used, it may be beneficial to add foliar micro nutrients as part of the spray package to get an added benefit. Producers should check with their local pesticide/chemical supplier to see what is currently registered for alfalfa in their area.

The following is a list of some of the current fungicides being used:

Headline (*pyraclostrobin*) is active against common diseases such as downy mildew, common leaf spot, spring black stem (Phoma), Stemphyllium leafspot, Cerospora and Stagnospora leaf spot. Pristine (*pyraclostrobin* and *boscalid*) also controls these diseases as well as Sclerotinia stem and crown rot ('white mold') and can prevent stand losses in seedling fields infected by this fungal pathogen when applied in a timely manner. Quadris (*azoxystrobin*) is labeled against common diseases such as downy mildew and Cercospora leaf spot in alfalfa.

It is important to know that more most of the fungicides are contact sprays and not systemic. Lower leaves tend to be most affected by diseases due to the higher humidity and prolonged moisture time low in the canopy, so good spray coverage of lower leaves is essential.

Fungicides can be costly therefore it's important to use the fungicides before a disease problem affects alfalfa yields, quality and stands for maximum efficacy with minimal costs. Disease occurrence and development is very dependent on humidity/moisture and temperature. The cost/benefit ratio of application will depend on geographic location and local weather. As these fungicides are more effective when applied prior to or at first signs of infection, the challenge will be deciding if and when to make a spray application. Varietal differences in levels of resistance to specific diseases may also be a factor.

#### **Crown and root disease treatments :**

At this time there are no chemicals registered for alfalfa that economically control crown and/or root diseases in established alfalfa fields.

### **MAJOR ALFALFA DISEASES AND CONTROL MEASURES**

**Crown Rot Complex** (*Complex of various pathogens: Fusarium, Pythium , Rhizoctonia , Phoma , and Stagnospora*)

*Optimal disease conditions* - Can occur in most soil types but damage can be more severe in the

presence of nematodes or root feeding insects that create sites for entry into root system. Recent studies have shown that crown rots may be more severe as they result of crown damage due to livestock grazing and/or wheel traffic. Crown rot diseases are more common in warm climates, but are known to occur in almost all production areas.

*Symptoms* - Stunting of plants; Red to reddish brown discoloration inside the root that becomes more severe with age of stand.

*Control* - Resistant varieties; Root knot nematode resistance may also be desirable, to complement Fusarium wilt resistance. This reduces exposure of the plant to the pathogen by stem nematode feeding on the crowns. Variety selection for grazing and/or wheel traffic tolerance may also reduce severity of crown rots that are the result of mechanical crown damage.

### **Phytophthora root rot** (*Phytophthora megasperma f. sp. medicaginis*)

*Optimal disease conditions* - Occurs most often in soils with poor drainage, or where water stands for an extended amount of time (> 24 hours).

*Symptoms* - Stunting and/or plant death in low areas of field where water stands. Damaged plants may have taproot girdled at same depth as water table in soil. Damaged roots may be brown in color. Top growth may be wilted due to poor water uptake from damaged roots.

*Control* - Resistant varieties, Cultural practices that promote better drainage i.e. deep plowing, tiling, laser leveling, and planting on beds .

### **Bacterial wilt** (*Clavibacter michiganense subsp insidiosum*)

*Optimal disease conditions* – Damage can occur in most soil types but damage is most severe in conditions where crowns and/or roots are damaged due to insects, grazing, wheel traffic or excessive cultivation. Bacterial wilt is more common in cold climates.

*Symptoms* - Stunting of plants; Yellowish to brown discoloration inside the root that becomes more severe with age of stand.

*Control* - Resistant varieties. Cultural practices that limit crown/root damage resulting from excessive cultivation, grazing, or repeated wheel traffic damage.

### **Fusarium wilt** (*Fusarium oxysporum f.sp. medicaginis*)

*Optimal disease conditions* - Can occur in most soil types but damage can be more severe in the presence of nematodes or root feeding insects that create sites for entry into root system. Fusarium wilt is more common in warm climates.

*Symptoms* - Stunting of plants; Red to reddish brown discoloration inside the root that becomes more severe with age of stand.

*Control* - Resistant varieties, Cultural practices that limit crown/root damage resulting from cultivation, grazing, or repeated wheel traffic damage.

### **Anthracnose** (*Colletotrichum trifolii*)

*Optimal disease conditions* - Occurs most often in spring or fall and spreads rapidly under warm wet conditions from spores produced on lower stems of infected plants.

*Symptoms* - Early stages may appear as individual straw colored stems on plants that display a curved top "Shepherds Crook". Diamond shaped lesions will occur on lower part of the stem. Advanced stages will be seen in the crown tissue as a dark black or coal color. Plant death usually occurs at this stage.

*Control* - Resistant varieties, Growers should avoid spreading spores from plant debris on harvest equipment to uninfected fields. 10% Clorox wash sprayed on harvest equipment or cutter bars may be advisable when moving from severely infected fields into new fields.

### **Verticillium wilt** (*Verticillium albo-atrum*)

*Optimal disease conditions* - Thought to occur only in cooler northern climates until it was identified in the late 1980's in parts of Southern California. The pathogen can be spread by dry or fresh plant material on harvest equipment. Cutter bar blades of mowing equipment are extremely effective in spreading the pathogen spores. Manure from infected hay can also have viable disease spores unless composted.

*Symptoms* - Stunting of plants; Yellow 'V' shape at the tip of leaves. Leaves may curl along midrib and turn a pinkish color. Stems will remain green after leaves die.

*Control* - Resistant varieties; Clean farm equipment between fields, and mow younger fields before older to prevent spore transfer on mower blades. Cutter bar sanitation with 10% bleach has been shown to be effective in limiting plant infection.

### **Cotton Root Rot/Texas Root Rot** (*Phymatotrichum omnivorum*)

*Optimal disease conditions* – Cotton root rot is a pathogen fairly common in Mexico and the southwestern United States that causes sudden wilt and death of affected plants, usually during the warmer months. It is a soil-borne fungus . It has a very large host range and is reported to cause damage to 2300 species of broadleaf plants, making it more difficult to control.

The pathogen is best adapted to alkaline soils (high pH) that are low in organic matter. It is known to survive on Mesquite and therefore the pathogen may already be present in the soil of new farm land cleared of mesquite. Damage is usually during the warmer months and spreads slowly from plant to plant when a fungal strand from an infected root grows through the soil to a nearby healthy root . Cotton root rot is reported to occur most often in elevations below 5000 ft.

*Symptoms* –Plant death may occur rapidly with the leaves remaining firmly attached. Slight yellowing and bronzing of leaves. Fungal threads can be seen on the alfalfa roots , and reddish lesions may be seen on the crown. A circular patches of dead plants will occur in the field. Growth of spore mats may be seen around infected plants.

*Control* – There are no known alfalfa varieties that have genetic resistance. Soil amendments that reduce the pH of the soil (sulfur) and increase the organic content may give some limited advantage. A new fungicide, Flutriafol (Topguard Terra) is showing some promise as a possible soil treatment to control the pathogen. However at this time it is not registered for alfalfa.

### **Scald** (Abiotic disease)

*Optimal disease conditions* – Occurs in water saturated soils when soil temperatures are high. Plant death is seen mainly in fields with flood irrigation and damage usually occurs when the air temperatures are 104- 113 degrees F and the soils remain saturated for 30hrs or more. Plant death is due to lack of oxygen.

*Symptoms* – First indication of scald damage is when the alfalfa field doesn't regrow following a recent mowing and irrigation. Top growth will appear to be dead and straw colored. Plants are often easily pulled out of the ground by the dead stubble. If plant death is due to scald, the majority of the taproot's outside bark is easily peeled off, separating it from the interior of the root. Unlike Phytophthora root rot where the taproot appears to be pinched off at some point below ground and may break off at the point of damage. Plants that are growing in slightly higher parts of the field, such as on borders, are less affected by scald and may still be green and healthy.

*Control* – No known resistant varieties. Avoid irrigation when air temperatures are greater than 109 degrees F. During hot periods, irrigation at night is preferred and tail water should be managed to minimize standing water periods. Newly mowed fields should not be irrigated until there is 4-5 inches of top growth to prevent regrowth submersion.

## **SUMMARY**

A grower's first line of defense against nematodes and alfalfa diseases should always be the variety he plants. A superior variety's built in genetic protection is the best insurance policy a grower can get against yield losses. Whenever conditions occur that are favorable for nematode and disease buildup, the genetic protection is always there and doesn't have to be applied by the farmer. **Purchasing a variety that lacks adequate resistance may result in an uphill battle in preventing yield and stand losses due to nematode and diseases.** Alfalfa is a perennial crop, so a poor variety choice at planting time is one that the farmer will have to live with for many years.

Following the selection of a good adapted disease resistant variety, the grower should use good common sense agronomic practices to prevent the spread and/or limit the buildup of nematodes and/or pathogens on their farm.

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