

## Ditylenchus dipsaci, A Pest of Alfalfa in Arizona

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The alfalfa stem nematode, Ditylenchus dipsaci, Kuhn has been reported as a pest of alfalfa from all the western states. However, its role in the decline of the forage crop is frequently overlooked as the primary incitant in the disease syndrome. In Utah, Colorado and Wyoming where temperatures decline rapidly from late September until late spring, activity and reproduction is restricted to the warmer summer months. In the more temperate and humid climates of Oregon, Washington and northern California, the nematode is active for a longer period with reproduction possible in the early spring. In the lower desert areas of California and Arizona, summer temperatures exceed the maximum sustained by the nematode. Therefore, its activity is almost entirely restricted to a short period in late fall and early spring. In the coastal areas of California both temperature and humidity are within the optimum range that permit feeding and reproduction throughout much of the year.

It is where the activity of the nematode is restricted to short periods of infection that it is usually not considered a serious pest of alfalfa. Too frequently by the time that disease symptoms appear or the gradual decline of the stand is detected, the nematode may no longer be active, making it difficult to correctly determine the primary pest. Secondary pathogens may also mask the primary pest.

Until 1983, the geographic distribution of this alfalfa pest was known in but two areas in Arizona; the Salt River Valley in and around metropolitan Phoenix, extending into the northern limits of adjoining Pinal county, and in Graham county. In the spring of 1983 the first infestations in the western area of the state were detected in Yuma county. Repeated attempts to find it there and further west into the Imperial Valley of California had failed. In the Wellton-Mohawk agricultural area along the Gila River in Yuma county, over 500 acres involving at least four different fields of alfalfa have been found. Probably more acreage will be detected when climatic conditions become more favorable for the nematodes' activity in late fall. It is difficult to understand why the pest has never become established until now since it has probably had repeated opportunities to be introduced on contaminated farm machinery, livestock, or hay trucks from areas where the nematode is well established.

Because of the short active periods in Arizona, the nematode is considered a chronic pest. It increases stress in alfalfa making it more susceptible to several pathogens that infect the crop. In heavily infested fields hay yields in November or early December may be reduced 20%-40% while in the spring, when feeding activity extends for longer periods, some cuttings are reduced by 60%-75%. Such fields usually have a rapid stand decline the following year that necessitates renovation of the infested areas during September and October. Since the remaining plants are infested, the newly emerging plants may soon become infested.

A study of the life cycle occurring during a normal year of precipitation and temperature in the Salt River Valley area has indicated the nematode becomes active when average temperatures drop below 70°F. Penetration of alfalfa may occur as low as 50°F with reproduction most active between 58°F-75°F and even to 82°F, depending on the average temperature. The nematode has the capability of remaining in a totally inactive state without detectable metabolism, surviving unfavorable high and low temperatures as a pre-adult or 4th instar larva. The periods of hibernation are usually within the crown of the alfalfa. During October and November as temperatures decline and fall to averages in the 60°F-70°F range, the nematode becomes active, developing into the adult stage. Sexual reproduction occurs in the case of D. dipsaci and not asexually as in many of the other plant parasitic nematodes. Mating is within the stems and is unknown to occur in the soil. Therefore, unless both male and female infest the same stem, reproduction does not occur.

As lower December temperatures approach, the generation produced by the fall mating becomes inactive and feeding is reduced, eventually ceasing until the warmer temperatures

of early March. The fall generation becomes sexually mature in the spring and reproduces. The second generation larvae reach the pre-adult stage by May and go into hibernation until the following fall. During unusually heavy rainfall in the spring, an additional generation may be produced. Where a population was followed by sampling every two weeks for a year, the adult populations were highest in March and April, declining to the lowest levels in July and August, the months with the highest temperatures during the study. Larval populations peaked in April and May and reached their lowest recoverable level in October. At that time both the mature and immature forms increased in number until mid-December.

### RACES

There are at least 11 races of D. dipsaci that are restricted to specific hosts upon which they feed and reproduce. They may also feed on alternate hosts but lack the capacity to complete development or become sexually active. This fact is important in rotation with susceptible crops since initial infection may severely stunt or kill the new crop. The alfalfa race can go to onion where it may severely damage the seedlings, even though reproduction does not occur in the secondary host. The population will eventually die out if sufficient time is allowed before alfalfa is replanted. Three years are usually sufficient in the desert areas to eliminate the potential threat of reinfestation if weeds are eliminated in the rotational crops. At this time, investigations are in progress to determine those weeds that serve as host to the alfalfa race of D. dipsaci. They have been recovered from londonrocket and shepardspurse, however, it is not known if they reproduce in these hosts. As far as is known, other races of this nematode are incapable of infesting alfalfa.

### SURVEY

During periods of activity in the fall and spring months surveys for the alfalfa stem nematode may be made by collecting stem and crown material from growth suppressed areas or where stand decline is noted. Collect 20 to 30 samples, each containing a few grams of plant material from different sites over an area comprising approximately 10 acres. Samples should also be taken from plants that appear normal that border on the suspected areas, since the nematodes may have been eliminated if the alfalfa has been dead for extended periods of time. Chop the stem and crown pieces from the sample into segments  $\frac{1}{2}$  inch or less and thoroughly mix before removing a gram sub-sample for detection purposes. This sample is then further masedated with knife, or better, in a food blender with 20-30 cc of water to disrupt the tissue which frees the nematodes and eggs. Since the cellular contents of leaves and stems is toxic to the nematode, the most effective approach to isolating the worms is to remove plant debris in a 20 mesh screen. The strained liquid material is then increased in volume with approximately 500 cc of water, agitated thoroughly, and strained through 100 and 325 mesh sieves. Back flush each screen and remove a few cc of the liquid to a watch glass for identification and counting. Identification should be thorough since many free-living nematode species are usually recovered from alfalfa.

### ECONOMIC THRESHOLDS

The presence of the alfalfa stem nematode should be considered as the economic threshold since they possess the ability to increase rapidly into severe pathogenic populations which are a constant threat to the crop. If found in one or more sampled areas of a field, additional sampling may be warranted to delineate the total infested area since treatment of only the infested sites may be possible and economically feasible. Where 30%-40% of a field is infested, total treatment is usually warranted to prevent further spreading of the pest.

### CONTROL

Various insecticides for insect pests effectively suppress alfalfa stem nematode populations. Like insects, the control for the nematode never eradicates the total populations and additional applications may be necessary. To date, these pesticides are not labeled for nematode control and can therefore be used only when recommended for a particular insect pest. Temik, Dasanit, Dysyston, Thimet, Vydate and Nemacur have been used successfully, applied either by air or ground application after cutting and immediately before the following irrigation. They may be applied during the irrigation, especially if irrigated by overhead sprinkler systems. Applications are made in either the fall or

spring months. The most effective control has been in the spring, probably due to the longer period of time the pesticides are available during nematode feeding and reproduction. Pesticides have increased yields by 350% in several infested alfalfa fields where almost the entire stand contained the pest. The total longevity of the stand may also be increased by 2 or more years with controls made at the appropriate time.

### RESISTANCE

Alfalfa cultivars released as resistant to the nematode usually appear only tolerant during most of the year in Arizona. Both Lew and Maxidor recommended for the desert areas as resistant have become infected and damaged by attack of this nematode. These cultivars should still be considered for use in infested areas. Coupled with insecticide control of insect pests, nematode damage will be reduced and prolong the life of the stand.

Cultural controls are highly important. These include sanitation practices that prevent contaminated farm machinery and livestock from introducing soil and/or hay that could contain the nematode. Alfalfa seed can be contaminated and should be inspected for alfalfa stem nematode. Seed produced in the hot and drier desert areas has not been found infected as the pest is inactive at the time seed production is in progress. Contaminated tail water, another source of dissemination both within a field and between fields, should be avoided.

### BREEDING FOR RESISTANCE

Breeders are reminded that tolerance is a poor substitute for resistance or immunity. Tolerant cultivars are a source of infection to the next crop or to other alfalfa fields. Since the nematode may actually penetrate resistant lines, it is necessary to assess the reproductive potential of the pest in each cultivar to evaluate resistance. Where invasion of a particular line occurs it is better to avoid it as a potential breeding source in further crosses as such cultivars usually become susceptible to attack. The use of the "rag doll" technique for establishing susceptibility or resistance should be used with caution. Always test for reproduction by staining the roots of seedlings for positive determination.