

# Parasitism of Nonhost Cultivars by Ditylenchus dipsaci<sup>1</sup>

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*Abstract:* The alfalfa race of *Ditylenchus dipsaci* parasitized and caused characteristic symptoms on nonhost seedlings of sweet clover, onion, tomato, sugarbeet, and wheat in controlled growth-chamber studies. Although the nematode was unable to reproduce on any of the cultivars, it caused plant mortality ranging from 20% on sugarbeet and tomato to 100% on onion. *Key Words:* alfalfa stem nematode, onion, sweet clover, tomato, sugarbeet, wheat, temperature, mortality, reproduction.

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*Ditylenchus dipsaci* (Kühn) Filipjev has always been a source of wonder to researchers because of the number of biological races ascribed to this species. A great amount of attention has been given to the race concept (1, 2, 3, 6, 7). These races have been shown to be constant and distinguishable only in relation to hosts. Seinhorst (10) showed a combination of eleven distinct biological races on nine plant species.

The alfalfa race of the stem nematode is found wherever alfalfa is grown under irrigation in the western United States. Although this nematode inflicts severe losses on alfalfa in this region, little attention has been given to its importance on crops grown in rotation with alfalfa. This study was

initiated to determine the relationship between *D. dipsaci* and several nonhost cultivars that are used in a crop rotation with alfalfa in the western United States.

## MATERIALS AND METHODS

A study was initiated to determine if *D. dipsaci* could infect and parasitize supposedly nonhost cultivars. Seeds of onion, *Allium cepa* L. 'Sweet Spanish'; tomato, *Lycopersicon esculentum* Mill. 'Stone Improved'; sugarbeet, *Beta vulgaris* L. (Amalgamated Sugar Company, Lot No. 041-0); wheat, *Triticum durum* Desf. 'Wasatch'; sweet clover, *Melilotus indica* (L.) All. 'Yellow'; and alfalfa, *Medicago sativa* L. 'Ranger', as a susceptible control, were germinated and inoculated with 20 *D. dipsaci* per germinated (3-6 mm radicle) seed in 75-mm pots (4 seeds per pot). Twenty pots of inoculated-germinated seeds, and 16 pots of

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TABLE 1. Effect of *Ditylenchus dipsaci* on growth of plant cultivars 14 and 28 days after inoculation<sup>a</sup>.

Plant cultivar	Plant height (Percent of uninoculated control)		Top weight (Percent of uninoculated control)
	14 days	28 days	28 days
Alfalfa, 'Ranger'	32	20	7
Onion <sup>b</sup> , 'Sweet Spanish'	39	...	...
Sweet clover, 'Yellow'	41	50	30
Tomato, 'Stone Improved'	66	71	41
Sugarbeet <sup>c</sup>	84	82	51
Wheat, 'Wasatch'	73	92	57

Difference between inoculated and uninoculated-control plants significant,  $P = 0.01$ , in all cultivars, except that wheat height after 28 days is significant,  $P = 0.05$ .

<sup>a</sup>Germinated seed inoculated with 20 *D. dipsaci*.

<sup>b</sup>100% mortality before 28 days.

<sup>c</sup>Amalgamated Sugar Company Seed Lot No. 041-0.

control-germinated seeds of each cultivar, were grown in a growth chamber at 20 C. To compensate for any mortality that may have occurred between inoculation and harvest, the experiment contained more pots of inoculated and uninoculated-control plants than necessary. Twenty plants of each cultivar were harvested 10 days after inoculation, stained with acid fuschin-lactophenol solution, and nematode penetration determined. Twenty plants of each cultivar were harvested 14 days after inoculation, and root and top weights were determined. Another 20 plants of each cultivar were harvested after 28 days, root and top weights obtained. Plants then were stained as described above, and nematode penetration determined. All plants in each pot (four or fewer) were harvested until the desired number per cultivar were obtained.

A second experiment was conducted to determine the effect of temperature on the pathogenicity of *D. dipsaci* to each of the different plant cultivars. Twenty seeds of each cultivar were inoculated in a similar manner with 50 *D. dipsaci* and grown at 15, 20, and 25 C. Plant mortality was recorded after 32 days.

## RESULTS AND DISCUSSION

*Ditylenchus dipsaci* stunted all cultivars at 20 C (Table 1), and symptoms were characteristic of those noted by other researchers.

All onion plant stems were infected and were abnormally white, twisted, and distorted, with enlarged areas. This agrees with symptoms reported by Chitwood (2). Onion was the most susceptible; all seedlings

had died 28 days after inoculation.

Yellow sweet clover was stunted and showed symptoms similar to those on Ranger alfalfa. Typical swellings of the cotyledonary node and hypocotyl occurred, and some plants showed a marked necrosis. These results were similar to those described on red clover by Dijkstra (4), but differed from those of Seinhorst who reported no swelling of red clover seedlings inoculated with stem nematode from rye, potato, onion, and marigolds (9).

Tomato and sugarbeet showed similar reactions to *D. dipsaci*. Cotyledonary petioles were malformed and bloated, cotyledons were distorted and malformed, primary leaves were distorted and swollen, and stem tissue, especially in tomato was distinctly swollen. Blindness (destruction of the apical meristematic tissue) was observed in both tomato and sugarbeet which soon led to the death of the plant. These symptoms were similar to those described on sugarbeet by Dunning (5).

Infected wheat showed little or no distortion or galling, but a few plants developed slight leaf curling, which resembled symptoms reported on oat by Goodey and Hooper (7). However, most infected wheat plants showed a distinct initial stunting from which they partly recovered as they became older.

The alfalfa stem nematode was most pathogenic on alfalfa and onion, and least pathogenic on wheat. Differences in plant growth between inoculated and control plants became less as the plants increased in age.

Temperature affected plant mortality with the death rate of most cultivars higher at 15 C

TABLE 2. Pathogenicity of *Ditylenchus dipsaci* to different plant cultivars at three temperatures<sup>a</sup>.

Plant cultivar	Percent mortality <sup>b</sup>		
	15 C	20 C	25 C
Alfalfa, 'Ranger'	80	30	0
Onion, 'Sweet Spanish'	100	100	40
Sweet clover, 'Yellow'	70	10	0
Tomato, 'Stone Improved'	20	30	0
Sugarbeet <sup>c</sup>	20	20	0
Wheat, 'Wasatch'	30	0	0

<sup>a</sup>Plants inoculated with 50 *D. dipsaci* per seed.<sup>b</sup>Mortality recorded 32 days after inoculation.<sup>c</sup>Amalgamated Sugar Company Seed Lot No. 041-0.

than at 25 C (Table 2). This indicates greater nematode activity in relation to plant growth, or a greater physiological shock to plant tissue at 15 C. Onion was the most susceptible, and wheat, the most resistant.

*D. dipsaci* did not reproduce on any

cultivar except alfalfa (Table 3). This verified the race concept, since the Utah population of the alfalfa stem nematode has been shown to reproduce only on alfalfa and sainfoin (8). Therefore, the physiological incapability of *D. dipsaci* to reproduce on these cultivars appears to be entirely responsible for the host specificity in this instance. Nevertheless, all plants were parasitized by this population, and under conditions ideal for the nematode, plant loss to a given cultivar may be significant, if the nematode is present soon after seed germination. This was especially true with onion, where all plants died within 28 days after inoculation.

We have had reports from growers and county agents of poor sugarbeet stands in fields that previously were planted with alfalfa. Our test results indicate that *D. dipsaci* may well have been a factor in these poor sugarbeet stands.

TABLE 3. Infection and population trends of *Ditylenchus dipsaci* in different plant cultivars 10 and 28 days after inoculation<sup>a</sup>.

Plant cultivar	Percent plants infected <sup>b</sup>		Nematodes per infected plant <sup>b</sup>	
	10 days	28 days	10 days	28 days
Alfalfa, 'Ranger'	100	100	26	68
Onion, 'Sweet Spanish'	100	...	11	...
Sweet clover, 'Yellow'	90	65	12	10
Tomato, 'Stone Improved'	85	50	13	9
Sugarbeet <sup>c</sup>	75	55	10	7
Wheat, 'Wasatch'	65	30	7	4

<sup>a</sup>Germinated seed inoculated with 20 *D. dipsaci* and grown at 20 C.<sup>b</sup>Results taken from 20 plants per cultivar.<sup>c</sup>Amalgamated Sugar Company Seed Lot No. 041-0.

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