2010 BLOAT NEMATODE PROBLEM ON GARLIC: SYMPTOMS, DISTRIBUTION, AND MANAGEMENT GUIDELINES

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The stem and bulb (bloat) nematode (*Ditylenchus dipsaci*) is a destructive plant-parasitic nematode of many crops, specially garlic, onion and leek. It is widely distributed in temperate production regions of the world and has been known and studied intensively for a long time, since 1877 in Europe. This nematode occurs in many biological races with different host ranges and crop damage potential. The garlic and onion race of *D. dipsaci* beside infecting garlic, onions, leeks, and chives; it also attacks celery, certain varieties of peas and lettuce, hairy nightshade, Canada thistle, flower bulbs and other plant species.

In the United States, the bloat nematode was first reported in 1935 occurring on garlic in California. However, the first report of this nematode damaging to onions was in 1929/30 from a farm in Canastota, Madison county, New York and again in 1939 on onions in the same and adjacent farms in Canastota, and also on farms in Pine Island and Florida in Orange County, New York. In 1962, this nematode was also reported to be damaging onions in SW Ontario, Canada. In June 2010, Cornell Vegetable Program Specialist Christy Hoepting observed the bloat nematode causing severe damage to garlic in a field in western New York, reporting as high as 80-90% crop loss in sections of the field. Thus, statewide effort to assess the distribution of this nematode throughout the garlic producing areas in New York was undertaken in collaboration between Cornell Cooperative Extension personnel (lead by Crystal Stewart) and the Garlic Seed Foundation (David Stern). It is interesting that the bulb and stem nematode was also reported causing severe problems to garlic production in Ontario, Canada during the 2010 season. In addition, infections and damage by the bloat nematode on garlic were also observed and confirmed in Vermont and Massachusetts.

Symptoms and Damage: severely infected garlic plants grown from infected seeds exhibit stunting, yellowing and collapse of leaves, and premature defoliation. The bulbs of infected plants initially show light discoloration, but later the entire bulb or individual cloves become dark brown in color, shrunken, soft, light in weight and eventually exhibit cracks and various decay symptoms due to the additional activities of numerous saprophytic soil organisms (Figure1). Onion and other hosts infected by *D. dipsaci* often show distinct swellings, twisting and also deformation of leaves, stems, bulbs and other foliar parts (Figure 2). Severely infected seedlings and older plants may die before harvest or culled at harvest. Nematode reproduction and damage to bulbs continue and often increase considerably during storage.

Distribution on Garlic Grown in New York: over 100 garlic samples were collected from commercial producers throughout New York and analyzed for the presence of the bloat nematode. Usually, about 5 – 20 grams of tissues were collected from each

submitted sample (often 5 – 10 bulbs) and processed for the extraction of live stages of the bloat nematode over 3 - 4 days of incubation by the pie-pan (modified Baermann) method. Results obtained in 2010 confirmed the presence of the bloat nematode in a total of 28 garlic samples collected from garlic plantings in 16 counties (Figure 3). These results documented the widespread of this nematode throughout New York and at infestation levels as high as 987 nematodes per gram of garlic tissue. In addition, *D. dipsaci* was also recovered from soil samples from a couple sites, with the highest density recovered was120 nematodes/100 cc soil.

Biology: the bloat nematode (Figure 4) is vermiform in shape, upto 1.5 mm long, with a small and delicate spear, has a diagnostically pointed tail, and differentiated males and females. Mating is required for reproduction and the life cycle can be completed in 19 - 23 days at 15 C (59 F). The bloat nematode, specially the fourth-stage juveniles, is known to withstand desiccation conditions, thus it may survive for several years in the dry state in infected plant tissues or free in soil. After fertilization, mature females deposit about 10 eggs/day and for as many as 20 – 50 days. Under favorable conditions, the second stage juveniles hatch from the eggs and undergo two molts to produce the infective and long-surviving fourth-stage juveniles. These juveniles move in a film of water and can penetrate and feed on young tissues of leaves, stems, bulbs, and other plant parts, but generally not roots. The fourth-stage juveniles go through the fourth molt and differentiate into mature males and females and may complete several generations in the succulent cells of the cortex layer of leaf or bulb tissues of garlic and onions. The nematodes move out of the host tissues into the soil only when the tissues become highly degraded or at late stages of decay. The bloat nematode moves only to limited distances on its own, but it spreads mainly in infected seeds and planting materials, irrigation water or surface run-off, contaminated equipment, and other means of transporting infested soil.

Management Guidelines: Crop losses can be significant and at times complete without monitoring and implementing an effective management program against the bloat nematode. Effective control of the bloat nematode requires strict sanitation practices to prevent the introduction of the nematode into production areas as well as the implementation of multiple management options (IPM strategies). The following are suggested practices to consider:

1. **Plant Only Nematode-Free Seeds.-** Infected planting materials is the major source for introducing this important pathogen into new production area, thus it is critical to use only clean seeds to prevent the establishment and damage of this nematode.

2. **Hot Water Treatment of Planting Materials.-** Considerable information is available in the literature on various hot water treatment protocols against the bloat nematode in garlic bulbs and plant materials of other crops. Depending on the soaking time, water temperature reported to reduce the population of this nematode have ranged from 38 – 49 C (100 - 120 F). However, water temperature above 50 C (122 F) appears to injure garlic tissues. Also, dipping garlic bulbs in hot water alone without other additives (sodium hypochlorite,

avermectin, formaldehyde, various fungicides, or other chemicals) were not as effective. It appears that the most used protocol is dipping for 20 minutes at 49 C (120 F). Hot water treatment should be considered only when clean bulb are not available, as even the best hot water treatment does not completely eliminate the nematode and may also increase other disease problems.

3. **Avoid infested Sites or Treat the Soil with an Appropriate Control Product.-** Nematode-free seeds should be planted in soil free of infestation with the bloat nematode. If there is any question, the soil of the target site should be sampled and analyzed for the presence of the bloat nematode. Garlic grown for seeds should be planted in nematode-free soil. In addition, a population of as low as 10 bloat nematodes/500 cc soil has been reported to cause damage in many crops. Pre-plant soil fumigation with registered nematicides will control this nematode as well as other plant-parasitic nematodes, where needed and if cost-effective. Mixed results have been obtained with the use of non-fumigant-type nematicides in controlling the bloat nematode and they have not been tested or registered for use on garlic in New York.

4. **If Possible, Practice a Four Years Rotation.-** Planting garlic only once every 4 years in the same site will contribute to reducing the population of the bloat nematode or prevent its build-up. The site should be rotated away from all species of *Allium* (garlic, onions, leek, chives) and other known host crops including celery, parsley, Shasta pea, or salsify as well as controlling weed hosts such as hairy nightshade and Canadian thistle. Carrots, potatoes, spinach, corn, and wheat are among the non-hosts or poor hosts to the garlic and onion race of the bloat nematode.

5. **Planting Bio-Fumigant Cover Crops.-** Several cover crops (mustard, rapeseed, oilseed radish, sorghum-sudangrass hybrids and others) have been shown to reduce soil populations of a number of plant-parasitic nematodes when incorporated as green manures into the soil. The latter is due to the production of toxic metabolites during the decompositions of their green manures in soil. Thus, planting and incorporating green manures of such cover crops after the harvest of garlic might be effective in reducing the bloat nematode population in soil, but this need confirmation.

Figures 1 – 4. Infection symptoms of the bloat nematode on garlic plants and bulbs are illustrated in Fig 1, whereas those on onion seedlings in Fig 2. Counties where infection of garlic with the bloat nematodes was confirmed in 2010 are shown in Fig. 3 and the gross morphology of *D. dipsaci* is illustrated in Fig. 4.

Fig 1

Fig 2

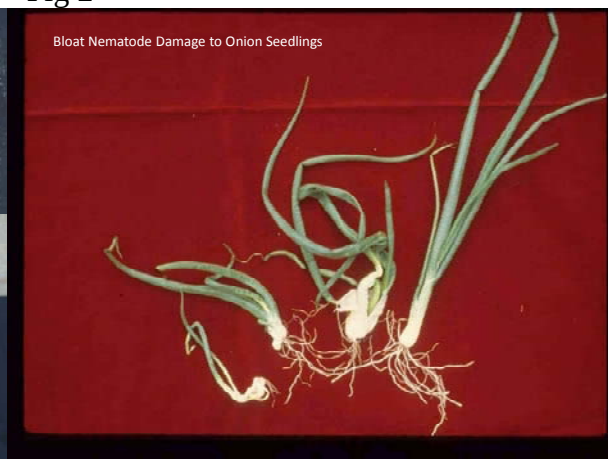

Fig 3

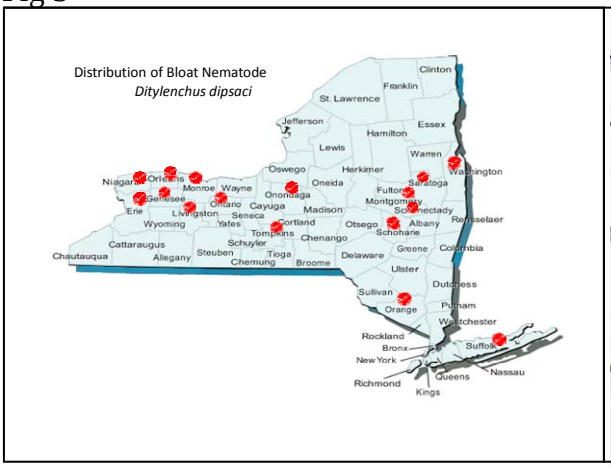

Fig 4