

## How to Take Seed, Bulb, Corm and Tuber Samples From Dry Storage for Nematode Analysis<sup>1</sup>

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**INTRODUCTION:** The geographic distribution of a number of economically important nematode pests is largely a consequence of the movement of infected or infested seeds, bulbs, tubers, corms, and other types of plant tissue from dry storage to new geographic sites. *Ditylenchus dipsaci* (Kühn, 1857) Filipjev 1936, the bulb and stem nematode, has spread to almost all parts of the world via infested alfalfa seed (Sanwal 1975), and *Anguina tritici* (Steinbuch, 1799) Chitwood 1935, seed gall nematode has reached almost all parts of the world where wheat is grown via seed galls.

**INFECTION:** Nematode juveniles, adults or eggs become established in soil from fallen or planted infected or infested seeds, leaves, tubers, corms, bulbs, roots, or rhizomes. Excess soil moisture in the spring usually stimulates nematode activation and migration. Nematodes that produce galls or lesions in seeds, stems, leaves, or flowers migrate from the soil to the stems of host plants, moving upward on a film of water until the site of infection is reached. Nematodes that invade below ground plant tissue migrate laterally in soil from infected underground tissue to infect adjacent host plants.

**ABUNDANCE:** *Anguina tritici* seed galls contain 3600-32,400 second stage nematode juveniles per seed (Thorne 1961). Alfalfa seed after fine-screening contained 16,629 *D. dipsaci* per pound, and re-cleaned seed, market-ready contained 236 *D. dipsaci* per pound (Thorne 1961).

**LONGEVITY:** Wheat galls in storage for 37 years yielded live nematodes (Thorne 1961). *Aphelenchoides subtenuis* (Cobb, 1926) Steiner & Buhner, 1932 survived 38 months in narcissus bulbs in dry storage. *Aphelenchoides fragariae* (Ritzema bos, 1890) Christie, 1932 survived 3 years in dry rice (Sanwall 1974).

**INSPECTION AND SAMPLING SEED:** Consult Table 1 for priority target hosts. Symptoms of nematode presence and nematodes will usually not be evident in infected or infested seed. Take small samples (about 1/2 cup) randomly from seed lots, place samples one per plastic or paper bag, and submit for laboratory processing. Always include diseased or off-color seed or seed galls in the sample when present. Soybean seed infested with soybean cyst nematodes (*Heterodera glycines*, Ichinohe, 1952) presents a unique situation that may also occur in other species of cyst nematodes. Soybean cyst nematode become embedded in soil balls called peds that round up and are found contaminating soybean seed. The peds are very similar in appearance to soybean seed. If soybean seeds are examined for peds, one should look for the slightly irregular off-color peds mixed in with the seed. Subsamples should be taken from suspected ped infested seed for laboratory analysis. Samples should be placed in labeled plastic bags. If peds are present, it should be noted in the data.

**INSPECTION AND SAMPLING BULBS, CORMS, AND TUBERS IN DRY STORAGE:** Samples from bulbs, corms, or tubers are usually taken in surveys for potato rot (*Ditylenchus destructor* Thorne, 1945) or bulb and stem (*D. dipsaci*) nematodes. A few bulbs (1-3) are removed from each bin. Bulbs, tubers, or corms showing rot, or other physical disorders should be selected for sampling. Cut or peel a few random samples if no exterior damage is evident. Look for whitish pockets or necrotic areas that may contain nematodes. Six to nine bulbs, corms, or tubers are placed in a labeled paper bag or box to represent a single sample. Bulbs, corms, or tubers with rotted areas should be placed in paper rather than in plastic bags since they will deteriorate rapidly

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in a very short time, resulting in difficult if not impossible analysis.

**Caladium:** Root-knot nematodes are the principal nematode pest associated with caladium bulbs. Unfortunately, symptoms of this pest are not evident on stored bulbs therefore a random selection must be made. Three to five bulbs randomly selected from one bulb storage container represents one sample. At least 3 samples should be taken. If 50 or less storage containers are present, take one sample per 5 containers. When more than 50 containers are present, take one sample per 10 containers.

**Garlic:** Survey for *Ditylenchus dipsaci* usually occurs in grocery stores and warehouses where garlic are transhipped to retail outlets. Look for off-color or rotting cloves. Two to five garlic packages should be taken from storage containers.

Table 1 does not include all instance of nematodes in seed, bulbs or tubers. Several of the nematode species in Table 1 have an extensive host list. There is extensive literature on nematode control in seeds and other plant tissues, one of which Jeffs (1986), would serve as a good reference.

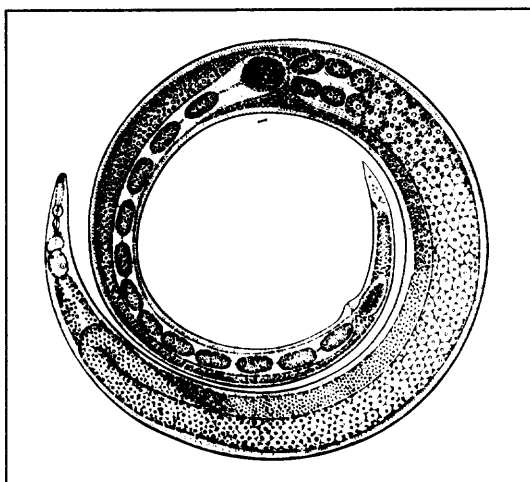


Fig. 1. *Anquina tritici*, 1961 the seed gall nematode. (After Thorne 1961)

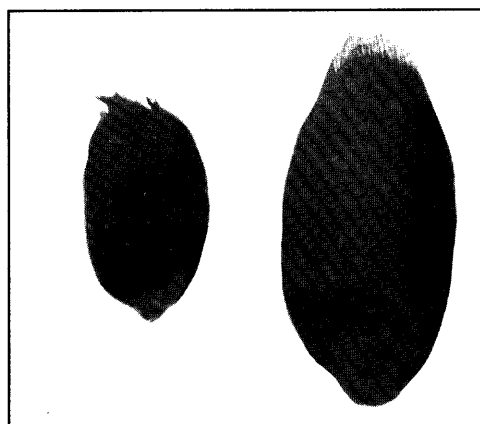


Fig. 2. Left: Wheat seed gall infected with *Anquina tritici*; right: healthy wheat seed.

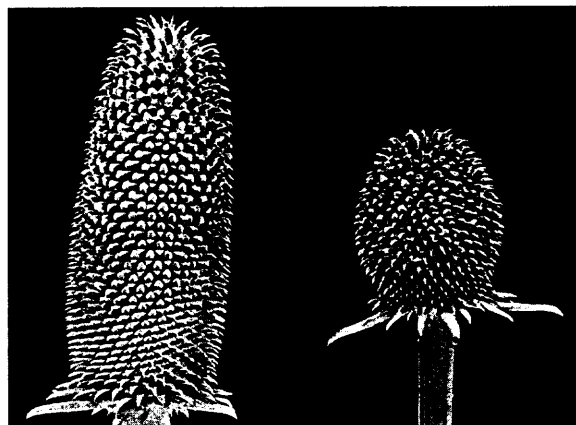


Fig. 3. Left: healthy teasel seed-head; right: seed head infected with *Ditylenchus dipsaci*. (After Courtney 1952)

Table 1. Target plants in seed, bulb, tuber, and corm surveys.

| Target Plant                           | Nematode Pest                                     | Plant Tissue Infected/infested | Reference |
|--|---|--------------------------------|-----------|
| <i>Agrostis</i> spp.                   | <i>Anguina agrostis</i>                           | seeds                          | 6         |
| <i>Allium</i> spp. (garlic)            | <i>Ditylenchus dipsaci</i>                        | cloves                         | 6         |
| <i>Allium cepa</i> (onion)             | <i>Ditylenchus dipsaci</i>                        | bulb, seeds                    | 8         |
| <i>Arachis hypogea</i> (peanut)        | <i>Pratylenchus</i> spp., <i>Meloidogyne</i> spp. | hull                           | 6         |
| <i>Avena sativa</i> (oats)             | <i>Anguina tritici</i>                            | seeds                          | 8         |
| <i>Beta vulgaris</i> (Beets)           | <i>Heterodera schachtii</i>                       | seeds, plant debris            | 6         |
| <i>Callistephus chinensis</i> (aster)  | <i>Aphelenchoides ritzema-bosi</i>                | seeds                          | 6         |
| <i>Cocos nucifera</i> (coconut palm)   | <i>Rhadinaphelenchus cocophilus</i>               | seed husk                      | 5,6       |
| <i>Dipsacus fullonum</i> (teasel)      | <i>Ditylenchus dipsaci</i>                        | seeds                          | 6         |
| <i>Festuca ovina</i> (sheep fescue)    | <i>Anguina agrostis</i>                           | seeds                          | 8         |
| <i>Hyacinthus</i> spp.                 | <i>Ditylenchus dipsaci</i>                        | bulbs                          | 6         |
| <i>Hordeum vulgare</i> (barley)        | <i>Anguina tritici</i>                            | seeds                          | 8         |
| <i>Medicago sativa</i> (alfalfa)       | <i>Ditylenchus dipsaci</i>                        | seeds                          | 5         |
| <i>Phaseolus vulgaris</i> (bean)       | <i>Ditylenchus dipsaci</i>                        | seeds                          | 5         |
| iris                                   | <i>Ditylenchus destructor</i>                     | bulbs                          | 6         |
| Koeleria                               | <i>Ditylenchus destructor</i>                     | seeds                          | 6         |
| <i>Lilium aurelianense</i>             | <i>Aphelenchoides fragariae</i>                   | bulbs                          | 8         |
| <i>Lilium longiflorum</i> (croft lily) | <i>Aphelenchoides fragariae</i>                   | bulbs                          | 6         |
| <i>Medicago sativa</i> (alfalfa)       | <i>Ditylenchus dipsaci</i>                        | seeds                          | 6         |
| <i>Narcissus</i>                       | <i>Ditylenchus dipsaci</i>                        | bulbs                          | 6         |
| <i>Narcissus</i>                       | <i>Aphelenchoides subtenuis</i>                   | bulbs                          | 6         |
| <i>Oryzae sativa</i> (Rice)            | <i>Aphelenchoides besseyi</i>                     | seeds                          | 6         |
| <i>Oryzae sativa</i>                   | <i>Ditylenchus angustis</i>                       | seeds                          | 6         |
| <i>Phleum boeheimeri</i>               | <i>Anguina agrostis</i>                           | seeds                          | 6         |
| <i>Poa</i> spp.                        | <i>Anguina agrostis</i>                           | seeds                          | 6         |
| <i>Saccharum spontaneum</i>            | <i>Anguina spermaphaga</i>                        | seeds                          | 8         |
| <i>Secale cereale</i> (rye)            | <i>Anguina agropyri</i>                           | basal stem galls               | 4         |

|  |                                |       |   |
|--|--------------------------------|-------|---|
| <i>Secale cereale</i> (rye)            | <i>Anguina tritici</i>         | seeds | 5 |
| <i>Secale cereale</i> (rye)            | <i>Ditylenchus dipsaci</i>     | seeds | 8 |
| <i>Solanum tuberosum</i> (potato)      | <i>Ditylenchus destructor</i>  | tuber | 6 |
| <i>Solanum tuberosum</i> (potato)      | <i>Globodera rostochiensis</i> | tuber | 6 |
| <i>Solanum tuberosum</i> (potato)      | <i>Meloidogyne hapla</i>       | tuber | 6 |
| <i>Solanum tuberosum</i> (potato)      | <i>Meloidogyne incognita</i>   | tuber | 6 |
| <i>Solanum tuberosum</i> (potato)      | <i>Meloidogyne javanica</i>    | tuber | 6 |
| <i>Solanum tuberosum</i> (potato)      | <i>Pratylenchus scribneri</i>  | tuber | 8 |
| <i>Solanum tuberosum</i> (potato)      | <i>Pratylenchus penetrans</i>  | tuber | 8 |
| <i>Tulipa genseana</i> (tulip)         | <i>Ditylenchus destructor</i>  | bulbs | 6 |
| <i>Trifolium pratense</i> (red clover) | <i>Ditylenchus dipsaci</i>     | seeds | 5 |
| <i>Triticum aestivum</i> (wheat)       | <i>Anguina tritici</i>         | seeds | 5 |
| <i>Triticum dicoccum</i> (emmer)       | <i>Anguina tritici</i>         | seeds | 6 |
| <i>Triticum spelta</i> (spelt)         | <i>Anguina tritici</i>         | seeds | 6 |
| <i>Vicia faba</i> (broadbean)          | <i>Ditylenchus dipsaci</i>     | seeds | 7 |

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