

Weed Hosts of *Heterodera*, the Cyst, and *Pratylenchus*, the Root-Lesion, Nematodes

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Weed Hosts of Heterodera, the cyst,
and
Pratylenchus, the root-lesion, Nematodes

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Among the plant-parasitic nematodes, those which live on plant roots pose the greatest threat to agriculture since they are predominant, are difficult to control, and inflict the greatest damage to plants. Root-knot (Meloidogyne), cyst (Heterodera), and root-lesion (Pratylenchus) nematodes live on plant roots and cause more damage to crops worldwide than any other genera of nematodes. They are among the world's most destructive plant pathogens, causing damage to the minor as well as the major crops sustaining mankind.

INTEGRATED NEMATODE MANAGEMENT

Nematode control must employ integrated nematode management principles if sustainable agroecosystems are to be developed and maintained. As in weed control, the first-order defense is exclusion or prevention. The well-known proverb that "an ounce of prevention is worth a pound of cure" is all too seldom practiced. If one adds "and cheaper" after "cure", the import of this proverb for nematode control becomes apparent (25). Means of nematode dissemination are similar to those for weed dissemination: movement of soil, plant tissue, machinery, containers, fertilizer, animals, water, and wind.

Another principle of integrated nematode management is to increase crop tolerance by use of resistant crop cultivars, chemical applications, and cultural manipulations. An increased understanding of nematode biology is of highest priority to make integrated nematode management successful (22).

Elimination of established nematode populations is generally not feasible, therefore, nematode population reduction is a desired goal in production agriculture and is the third principle of integrated nematode management. Population reduction is achieved by using biological, chemical, physical, and cultural means, again means common to weed control. Examples of means used for nematode population reduction include use of cover crops and trap crops, roguing of infested plants, fallowing, and weed management. Also, a major means of nematode population reduction in agriculture is rotation to non-host crops. Although infested fields will not become completely freed of nematodes in that span of time, and there is great variability among species, absence of host crops for a period of 4 to 5 years may be necessary in order to reduce the pathogenicity of cyst-forming nematodes below the economic threshold level. However, the good effects of crop rotations are lost if nematode populations

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are maintained by weeds. Weeds which serve as hosts must be exterminated in order to free the soil of the nematodes. All too often, those who determine the measures for control of plant-parasitic nematodes underestimate the value of weed control.

WEED HOSTS AS PEST RESERVOIRS

Since weeds as well as crops are primary producers, they provide energy, nutrients, and shelter for various classes of pests, such as insects, nematodes, pathogens, and vertebrates, which are primary or secondary consumers. Under these circumstances as producers, plants serve as hosts for consumers. As hosts, they serve as pest reservoirs by maintaining populations of those organisms. Nematodes not only feed on plants, but use them as temporary or permanent dwelling places. A nematode population may increase several-fold or decline rapidly within a short period of time under the influence of the plant cover. Therefore, the use of weeds for supposedly desirable purposes may be counter-productive if those weeds maintain populations of crop-destroying pests.

Plants are arbitrarily designated "weeds", however, depending upon specific circumstances. These are subjective decisions, generally relating to competition by unwanted plants with crops for limited supplies of water, mineral nutrients, or light. Consequently, a plant designated as a weed under one set of circumstances may not necessarily always be a weed. Plants reducing the aesthetic value of an area or polluting aquatic environs used by man are termed weeds, as are plants causing such human health problems as mechanical injury, dermatitis, or allergies. Plants poisonous to man or animals are referred to as weeds. Some plants also host vectors or alternate hosts of some of the world's most devastating and widespread human diseases, such as encephalitis, trypanosomiasis, schistosomiasis, scrub typhus, and clonorchiasis, and, thus, might properly be termed weeds. Plants which host pests of crops might also be termed weeds, whether or not they interfere directly with crops as strong competitors.

Weeds which host pests are examples of an indirect influence of weeds on crop production. However, whether the influence is positive or negative is determined by whether the species hosted is beneficial or pestiferous. Weeds exert other indirect influences on crop production, such as in microclimate modification. As a result of their physical stature and density, weeds alter air movement and relative humidity in the microenvironment. These microclimate modifications have an indirect effect in reducing or enhancing crop pest populations, as well as having a direct effect on crop growth.

In agriculture, our usual concern for weeds relates to their direct influence as competitors with crops for limited supplies of water, mineral nutrients, and light. Another direct influence of one plant on another is allelopathy, resulting from chemical exudations or degradation products from plants, which may restrict seed germination, plant establishment, or plant growth. It is often very difficult, however, to distinguish between the effects of competition and allelopathy in crop yield reductions.

HOST-NEMATODE INTERACTION

It may be equally difficult to distinguish the impact of nematode infestation on crop yield reductions. Each host-parasite combination has its own characteristics. Some nematode species appear to be weak pathogens. Individual nematodes have only a slight effect on their hosts. Other species are such strong pathogens that one individual nematode can stunt a seedling. Hosts also differ in their responses to nematodes. Sedentary endoparasitic nematodes illustrate the important principle that the interrelationships between parasites and hosts depend on a continuing exchange of information between the two organisms. For example, infective larvae of Meloidogyne spp. are attracted by a signal from plant roots. Larvae of Heterodera spp. require a signal to activate them to emerge from their cysts prior to being attracted.

When phyto-parasitic nematodes increase rapidly to high populations, disease results. The development of disease also depends on the growth stage of the host when nematodes enter. A high population of nematodes present in soil when crop seeds germinate is much more damaging than the same numbers later in the season. Crop yields are generally reduced in proportion to the intensity of nematode infestation. Although infections generally result in yield reductions, disturbances to plant growth are not always the same. Furthermore, such environmental conditions as temperature, moisture, nutrition, and soil type also influence the development of disease. Two additional factors important in determining whether disease will occur are environmental or physiological stress on the host (e.g. drought or fruit load) and the interaction of other pathogenic organisms (e.g. plant pathogenic fungi).

ENVIRONMENTAL FACTORS

The main climatic factors influencing nematode development are temperature and moisture. Their effect is primarily through the soil or the plant. Although climate determines the geographic distribution of many species of nematodes, weather conditions exert a significant influence on population density and the degree of damage caused by plant-parasitic nematodes. Light has an indirect effect on nematodes through stimulation of plant growth, with long being more stimulatory than short photoperiods. Soil pore space, as determined by soil texture and structure, also is vital to nematode distribution (259). The principal soil factors in the nematode's environment are pore size, water, aeration, temperature, and the chemistry of the soil solution.

Pratylenchus crenatus, P. penetrans, Heterodera avenae, and H. rostochiensis are observed mainly in regions with temperate climates. For H. schachtii, the optimum temperature is 15 C for mobility, 25 C for hatching of the larvae, and 27.5 C for breeding. For H. rostochiensis the most suitable temperature for infestation and breeding is 15 to 20 C. The lower temperature limit at which activity ceases ranges from 5 to 10 C. Development ceases at 11 C. The upper temperature threshold for development is about 30 C.

NEMATODE CLASSIFICATION

The nematodes of present concern fit into the following taxonomic sequence:

Order: Tylenchida (Thorne, 1949)

Superfamily: Tylenchoidea (Orley, 1880; Chitwood and Chitwood, 1937)

Family: Pratylenchidae (Thorne, 1949; Siddiqi, 1963)

Genus: Pratylenchus (Filipjev, 1936)

Superfamily: Heteroderoidea (Filipjev, 1934)

Family: Heteroderidae (Filipjev, 1934; Skarbilovich, 1947)

Genus: Heterodera (Schmidt, 1871)

Meloidogyne (Goeldi, 1887)

They also might be described by their feeding sites in the following way:

1. Ectoparasites, which remain outside the plant and penetrate with only a small portion of their body, and
2. Endoparasites, which enter plant tissues completely or with a large portion of their body,
 - a. Migratory in herbaceous plants and feed on roots: Pratylenchus
 - b. Sessile, entirely within roots: Heterodera
Meloidogyne

These endoparasites might be described also as:

Motile: Pratylenchus, the root-lesion nematodes, and

Sedentary: Heterodera, the cyst nematodes, and
Meloidogyne, the root-knot nematodes.

CYST NEMATODES

The cyst nematodes (Heterodera) are considered to be the second most serious genera of plant-parasitic nematodes affecting worldwide crop production, exceeded only by the root-knot nematodes (Meloidogyne). Cyst nematodes were first recognized as plant pathogens causing a disease of sugarbeets. Repeated use of the same land for beet production resulted in severely depressed yields. Such soils were described as displaying "beet tiredness." In 1871, Heterodera schachtii was identified as the cause of "beet tiredness." Potato production had a similar history, with Heterodera rostochiensis being identified as the causal organism. Cyst nematodes have been studied extensively in an effort to develop advisory services for growers.

Nematodes of several genera of sedentary endoparasites are adapted to a sessile life, either partly or entirely, within the roots of host plants. Adult females are

swollen and remain in one position. Males are elongate and active. All species of this group induce the formation of specialized cells in the host, which are feeding sites around the head of the parasite. Some of the translocated plant materials are diverted to support the nematodes.

In Heterodera, infective second-stage larvae move into host cortex which induces plant cells to enlarge and the walls between them to break down in part. The resulting syncytium invades the stele. It continues to incorporate additional cells distally from the nematode. Syncytium walls next to xylem vessels develop finger-like ingrowths, and the central vacuoles disappear. Nuclei of incorporated cells enlarge but do not divide.

The syncytia which result from infections with Heterodera and Meloidogyne have characteristics in common with normal "transfer cells" observed in certain sites within healthy plants where there is very active transport. The cytoplasm of transfer cells appears dense, the central vacuoles are lost, the nuclei are larger than normal, and numerous wall ingrowths are formed, usually adjacent to vessels. Transfer cells occur where there is temporary, high demand for nutrients in such regions as leaf traces in stems or in flower buds. They are believed to facilitate the movement of solutes such as amino acids from a vessel to growing tissues. They are also found in nitrogen-fixing nodules of legume roots. Sessile nematodes convert plant metabolites into their own bodies and into a large population of eggs and accessory gelatinous proteins. Thus, syncytia may be considered as large, specialized transfer cells which develop in relation to the nematode's utilization of plant resources. For example, sugarbeet roots of susceptible plants infected with Heterodera schachtii have more total free amino acids than resistant roots, and in particular, increased amounts of aspartic and glutamic acids as well as glutamine.

Cyst formation. Heterodera, as classified herein, differs from all other known nematodes in the transformation of females into cysts which form protective sacs for all or a large part of their eggs (46). A spherical or lemon-shaped adult female is observed to protrude from the root, its head inserted into cortex cells while most of the body is at the root surface. The female develops a thick cuticle. Its uterus becomes packed with fertilized eggs that mature to second-stage juveniles but no further. Each female may produce several hundred eggs. The life cycle is completed in 3 to 4 weeks. When the adult female dies, its cuticle tans into a brown leathery sac, the "cyst", that drops from the root into the soil. Here it may remain for years, a package of quiescent, unhatched juveniles. When a stimulus leaching out of growing host roots reaches the cyst, the enclosed nematodes become active. Some of these emerge into the soil, are attracted to host plants, and penetrate close to root tips. Not all embryonated eggs yield up their contents in any one season, so that infested soil may contain cysts with diminishing numbers of unhatched but viable larvae. Soil that has not had host plants for 10 years or more may still have enough nematodes to build dangerous populations when suitable hosts are planted again. Some species of Heterodera produce gelatinous egg sacs into which eggs are deposited in addition to those that remain enclosed in a cyst.

The species of Heterodera hosted by weeds may be divided into the following cyst-forming nematode groups (adapted from 25, 46; 95):

- 1) The rostochiensis group, referred to as the subgenus, and more recently as the genus, Globodera, (characterized by spherical or pyriform circumfenestral cysts):

H. punctata (Thorne, 1928), of cereals;
H. rostochiensis (Wollenweber, 1923), of potato;
H. tabacum (Lownsbery & Lownsbery, 1954) of tobacco.

- 2) The schachtii group (characterized by lemon-shaped semifenestral cysts with bullae):

H. avenae (Wollenweber, 1924), of oats;
H. galeopsidis (Goffart, 1936), of nettles;
H. glycines (Ichinohe, 1952), of soybean;
H. lespedezae (Golden and Cobb, 1963), of lespedeza;
H. oryzae (Luc and Brizuela, 1961); of rice;
H. rumicis (Pogosjan, 1966), of Armenian rumex;
H. sacchari (Luc and Merny, 1963), of sugarcane;
H. schachtii (Schmidt, 1871), of beet;
H. trifolii (Goffart, 1932), of clover.

- 3) The cacti group (characterized by lemon-shaped circumfenestral cysts without bullae):

H. cacti (Filipjev and Schuurmans-Stekhoven, 1941), of cactus;
H. weissi (Steiner, 1949), of buckwheat.

- 4) The goettingiana group (characterized by lemon-shaped semifenestral cysts without bullae):

H. carotae (Jones, 1950), of carrot;
H. cruciferae (Franklin, 1945), of cabbage;
H. cyperi (Golden, Rau, and Cobb, 1962), of American cyperus;
H. goettingiana (Liebscher, 1892), of pea;
H. humuli (Filipjev, 1934), of hop.

This genus includes more than 40 species, many of which are parasites of agricultural crops. As the following list shows, species of this genus are important pests of many crops, principally in temperate regions.

Heterodera avenae in barley, oats, rye, and wheat;

H. glycines in soybean and Phaseolus spp.;

H. goettingiana in peas, vetch, and field bean;

H. oryzae in rice;

H. rostochiensis in potato, tomato, and eggplant;

H. schachtii in beets, cabbage, and rape;

H. trifolii in red and white clovers.

ROOT-LESION NEMATODES

Pratylenchus, the root-lesion nematode, is considered to be the third most serious genera of plant-parasitic nematodes affecting worldwide crop production, exceeded by the root-knot (Meloidogyne) and cyst (Heterodera) nematodes. The particular effect of phyto-nematodes on their hosts is related to their feeding habits. Some nematodes habitually enter plant tissues and move about actively. Pratylenchus is an example. These migratory endoparasites move about within roots, destroying tissues as they feed. They feed on a cell, kill it, and move to an adjacent cell, usually in a longitudinal direction. All stages, especially juveniles and adults, migrate freely between roots and soil, as well as moving within the roots.

Reproduction in some species of this genus, notably P. penetrans, is bisexual. The complete life cycle takes about one to three months, depending on the host, parasite, and soil temperature. Adult females usually deposit eggs within the root cortex. The first molt, within the egg, produces a motile second-stage juvenile that hatches. The feeding of emerging larvae is such that extensive regions of the roots may be destroyed.

Roots of many plants infected with Pratylenchus spp. have elongated narrow brown streaks at the surface. These enlarge to form extensive necrotic areas which often coalesce into discolored lesions harboring bacteria, fungi, and free-living nematodes. Probably the most important means by which the root-lesion nematodes cause damage is the interaction of other pathogens with them. Many species of this genus of migratory endoparasites are implicated in vascular wilts and root-rots. Apparently, large numbers of nematodes are necessary to cause significant root damage to host plants. However, the population density of Pratylenchus hazardous to hosts in the field varies from one crop to the next. Severe attack usually results in poor top growth, sensitivity to moisture stress, and reduced yield. Important damage occurs in coffee, citrus, manila hemp, tree nurseries, orchards, deciduous fruits and nuts, peaches, grapes, and olives. Pruning of host tops increases the suitability of roots for the nematodes.

The effects of Pratylenchus go beyond cell destruction. The electrical resistance of lightly infected sunflower roots is lower than normal before macroscopic lesions are visible. Perhaps this reflects generalized damage to root cell membranes, resulting in increased quantities of electrolytes in the intercellular spaces. Altered root function brought about by nematodes probably results in increased water stress since nematode-infected plants wilt before healthy plants in the field.

The interrelationships between parasite and host plant among migratory root nematodes have not been studied as extensively as among the sedentary endoparasites Heterodera and Meloidogyne. However, it has been established that legumes, cereals, potato, and plants of Rosaceae host Pratylenchus penetrans; cereal crops host P. crenatus; deciduous fruits and nuts, peaches, grapes, and olives host P. vulnus; and beet and carrot host Pratylenchus species.

NEMATODE-PATHOGEN INTERACTIONS

In general, nematodes parasitizing the roots of plants facilitate the penetration and transmission of pathogens by puncturing an opening for pathogen penetration and by

acting as a vector. Nematode infestation also may cause physiological changes within the host resulting in susceptibility to a disease to which the host is normally resistant. In some cases, simultaneous attack by a nematode and a pathogen may produce a disease unlike that resulting from attack by either organism alone.

Associations between nematodes and other pathogens in plant diseases encompass a wide array of species. The following are relevant examples:

<u>Disease</u>	<u>Nematode</u>	<u>Pathogen</u>	<u>Host</u>
"White foot"	<u>Heterodera</u>	<u>Rhizoctonia solani</u>	Potato
Verticillium wilt	<u>Heterodera</u>	<u>Verticillium dahliae</u>	Potato
	<u>Pratylenchus</u>	<u>Verticillium dahliae</u>	Potato
	<u>Pratylenchus</u>	<u>Verticillium albo-atrum</u>	Tomato Eggplant
Root rot	<u>Pratylenchus</u>	<u>Cylindrocarpon radicicola</u>	Carrot
			Potato
			Red clover
			Spinach
			Tomato
Rhizoctonosis	<u>Heterodera</u>	<u>Rhizoctonia solani</u>	Tomato
	<u>Pratylenchus</u>	<u>Rhizoctonia solani</u>	Wheat
Fusarium wilt	<u>Heterodera</u>	<u>Fusarium oxysporum</u>	Soybean
Collar rot	<u>Pratylenchus</u>	<u>Trichoderma viride</u>	Celery

HORIZONTALLY INTEGRATED PEST MANAGEMENT

Usually, integrated pest management (IPM) is interpreted as vertical integration for management of one pest species, using appropriate combinations of preventive, biological, physical-mechanical, and chemical methods or tools in crop cultural practices. In concert with these four tools, the interacting effects of climate, crop, and soil are used in regulating pest populations. In addition to the vertical perspective, IPM must be perceived also in the horizontal perspective, integrating control of all classes of pests, using the strategies generally considered in vertically integrated pest management, but applied to all of the interacting pest problems. Concern for control of weeds hosting other pests should assume a multidisciplinary approach. The result would include horizontal as well as vertical integration in IPM. That is a logical direction if IPM is to achieve its ultimate goal. Whether or not total integration is considered in crop production plans and activities, the web of interaction among species occurs in nature.

The "Weed Hosts as Pest Reservoirs" concept is one approach to horizontal integration in pest management. The premise is that, if the weed hosts of specific pests -- insect, nematode, pathogen, or vertebrate -- are controlled, the populations of those pests will be reduced. A further significant consideration is that weed hosts provide a very favorable environment for race development in nematode species. Race

development in nematodes reduces the effectiveness of resistance bred into crops to withstand specific infection. Consequently, the cost of breeding for crop resistance and the cost of sustained yield losses are increased. The purpose of research on the weed hosts as pest reservoirs concept, therefore, is to emphasize the role of weeds and the importance of weed control in crop production (21). Specific aspects of weed hosts of nematodes have been published (21, 22, 157, 158, 159). This concept offers another criterion, in addition to interference by competition and allelopathy, in defining the significance of weeds in crop production (20).

WEED HOSTS OF NEMATODES

Since classification of a plant as a weed is a subjective matter, largely dependent upon individual circumstances and most often related to crop production, the plants included herein were those reported by Holm et al. to be serious, principal, or common weeds or present as a weed (83). For this reason, plants considered to be weeds by others may have been omitted. The publication by Goodey et al. (76) was used as a chief source of plant host information to 1965. Only the earliest available report of a plant as a host is included in the tables. Information on nematode biology and classification were obtained from several sources (25, 45, 46, 63, 95).

Over 500 entries are listed as weed species hosting one or more of the 23 Heterodera species included in this work (Appendix A, Tables 1-24). These weed hosts are distributed non-uniformly among 30 plant families, 145 genera, and 314 species. More than half of the weed hosts of Heterodera species are members of three families: Cruciferae, with 44 species in 29 genera, Gramineae, with 47 species in 24 genera, and Leguminosae, with 85 species in 25 genera, making a total of 176 species in 78 genera. Next most numerous are Chenopodiaceae, with 19 species in 3 genera, and Solanaceae, with 23 species in 6 genera. Four plant genera have a total of 55 host species: Vicia with 15, Solanum with 14, and Chenopodium and Lathyrus each with 13 host species. All other genera had less than 10 host species each.

Among the cyst nematodes, H. schachtii, which infects beets, cabbage, and rape, was hosted by more weed species distributed throughout more families than any other species. Of the 111 weed host entries, 43 were Cruciferae, 24 were Chenopodiaceae, 11 were Polygonaceae, and 8 were Amaranthaceae (Table 19). H. glycines infects soybeans and Phaseolus species. Of the 73 weed host entries, 64 were Leguminosae (Table 7). H. trifolii, which infects clovers, ranked third with 53 weed host entries. Of these, 22 were Leguminosae and 12 were Caryophyllaceae (Table 22). H. cruciferae, which infects cabbages, ranked fourth with 32 weed host entries, of which 28 were Cruciferae (Table 4).

Over 650 entries are listed as weed species hosting one or more of the 20 Pratylenchus species included in this work (Appendix B, Tables 26-46). These weed hosts are distributed non-uniformly among 69 plant families, 239 genera, and 326 species. Almost half of the weed hosts of Pratylenchus species are members of three families; Compositae, with 45 species in 37 genera, Gramineae, with 61 species in 36 genera, and Leguminosae, with 56 species in 33 genera, making a total of 162 species in 106 genera. Five plant genera have a total of 28 host species: Crotalaria with 7, Cassia and Vicia each with 6, and Amaranthus and Trifolium each with 5 host species. Solidago, Brassica, Digitaria, Panicum, Paspalum, Poa, Setaria, Rosa, and Solanum are represented by 4 species each. All other genera have less than 4 host species each.

Among the root-lesion nematodes, P. penetrans was hosted by more weed species distributed throughout more families than any other species. Of the 189 weed host entries, 32 were Compositae, 28 were Gramineae, 22 were Leguminosae, and 17 were Cruciferae (Table 36). P. brachyurus ranked second with 83 weed host entries. Of these, 27 were Leguminosae and 18 were Gramineae (Table 28). H. coffeae ranked third with 61 weed host entries, of which 20 were Leguminosae (Table 29). Of the 46 weed entries hosting fourth ranking P. neglectus, 13 were Gramineae (Table 35). Ranking fifth was P. zaeae with 30 weed host entries, of which 14 were Gramineae (Table 45).

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Appendix A. Tables of weed hosts and distribution of weed hosts of Heterodera, the cyst nematode, arranged alphabetically by plant family, genus, and species under respective nematode species and relevant literature cited.

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Table 1. Weed hosts of H. avenae

FAMILY & WEED SPECIES	REFERENCE
Gramineae	
<u>Agropyron repens</u> Beauv.	27
<u>Agrostis stolonifera</u> L.	in 45
<u>Alopecurus geniculatus</u> L.	in 45
<u>Alopecurus pratensis</u> L.	27,70
<u>Apera spica-venti</u> (L.) Beauv.	in 84
<u>Arrhenatherum elatius</u> (L.) J. & C. Presl.	27
<u>Avena fatua</u> L.	245,202
<u>Avena strigosa</u> Schreb.	263
<u>Bromus arvensis</u> L.	27
<u>Bromus mollis</u> L.	in 45
<u>Bromus secalinus</u> L.	in 45
<u>Bromus sterilis</u> L.	in 45
<u>Dactylis glomerata</u> L.	27
<u>Digitaria sanguinalis</u> (L.) Scop.	109
<u>Festuca ovina</u> L.	70
<u>Festuca pratensis</u> Huds.	in 45
<u>Festuca rubra</u> L.	27,70
<u>Holcus lanatus</u> L.	in 45
<u>Hordeum jubatum</u> L.	263
<u>Hordeum marinum</u> Huds	263
<u>Hordeum murinum</u> L.	114
<u>Hordeum spontaneum</u> C. Koch	263
<u>Hordeum vulgare</u> L.	93
<u>Koeleria phleoides</u> (Vill.) Pers.	263
<u>Lolium multiflorum</u> Lam.	27,10
<u>Lolium perenne</u> L.	245,100
<u>Lolium temulentum</u> L.	263
<u>Phalaris canariensis</u> L.	114
<u>Phalaris minor</u> Retz.	263
<u>Phalaris paradoxa</u> L.	70
<u>Phleum pratense</u> L.	27
<u>Poa pratensis</u> L.	27
<u>Poa trivialis</u> L.	27
<u>Secale cereale</u> L.	126
<u>Sorghum vulgare</u> Pers.	263
<u>Triticum aestivum</u> L.	125

Total: families, 1; genera, 20;
species (entries), 36.

Table 2. Weed hosts of H. cacti

FAMILY & WEED SPECIES	REFERENCE
Cactaceae	
<u>Opuntia stricta</u> (Haw.) Haw.	151

Table 3. Weed hosts of H. carotae

FAMILY & WEED SPECIES	REFERENCE
Umbelliferae	
<u>Daucus carota</u> L. ssp. <u>carota</u>	116
<u>Daucus carota</u> L. ssp. <u>sativus</u> (Hoffm.) Thell.	117

Table 4. Weed hosts of H. cruciferae

FAMILY & WEED SPECIES	REFERENCE
Cruciferae	
<u>Barbarea vulgaris</u> R.Br.	263
<u>Biscutella laevigata</u> L.	263
<u>Brassica juncea</u> (L.) Czern. & Coss.	263
<u>Brassica napus</u> L. v. <u>arvensis</u> (Lam.) Thellung	116
<u>Brassica napus</u> L. v. <u>napobrassica</u> (L.) Rchb.	61
<u>Brassica nigra</u> (L.) Koch	263
<u>Brassica rapa</u> L. ssp. <u>rapa</u>	116
<u>Capsella bursa-pastoris</u> (L.) Medic.	263
<u>Cardamine pratensis</u> L.	263
<u>Coronopus didymus</u> (L.) Sm.	91
<u>Coronopus squamatus</u> (Forsk.) Aschers	263
<u>Descurainia sophia</u> (L.) Prantl.	263
<u>Diplotaxis erucoides</u> (L.) DC.	263
<u>Erysimum cheiranthoides</u> L.	263
<u>Erysimum hierachiifolium</u> L.	263
<u>Isatis tinctoria</u> L.	263
<u>Lepidium sativum</u> L.	61
<u>Myagrum perfoliatum</u> L.	263
<u>Nasturtium officinale</u> R. Br.	263
<u>Raphanus sativus</u> L.	61

<u>Rapistrum rugosum</u> (L.) All.	263
<u>Rorippa amphibia</u> (L.) Besser	263
<u>Rorippa islandica</u> (Oeder) Borbas	263
<u>Sinapis alba</u> L.	61
<u>Sinapis arvensis</u> L.	263
<u>Sisymbrium irio</u> L.	263
<u>Sisymbrium orientale</u> L.	263
<u>Thlaspi arvense</u> L.	in 24

Labiatae

<u>Lamium album</u> L.	263
<u>Lamium purpureum</u> L.	263
<u>Stachys annua</u> L.	263
<u>Stachys arvensis</u> L.	91

Total: families, 2; genera, 21; species (entries), 32.

Table 5. Weed hosts of H. cyperi

FAMILY & WEED SPECIES	REFERENCE
Cyperaceae	
<u>Cyperus esculentus</u> L.	78

Table 6. Weed hosts of H. galeopsidis

FAMILY & WEED SPECIES	REFERENCE
Caryophyllaceae	
<u>Saponaria officinalis</u> L.	116
<u>Stellaria media</u> (L.) Vill.	116
<u>Vaccaria pyramidata</u> Med.	116

Chenopodiaceae

<u>Beta vulgaris</u> L. ssp. <u>vulgaris</u>	116
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Labiatae

<u>Galeopsis speciosa</u> Mill.	263
<u>Galeopsis tetrahit</u> L.	71
<u>Lamium album</u> L.	239
<u>Lamium purpureum</u> L.	263
<u>Leonurus cardiaca</u> L.	263
<u>Leonurus sibiricus</u> (?)	263

Leguminosae

<u>Trifolium glomeratum</u> L.	263
<u>Trifolium pratense</u> L.	263
<u>Trifolium repens</u> L.	263

Polygonaceae

<u>Rumex alpinus</u> L.	263
<u>Rumex conglomeratus</u> Murr.	263
<u>Rumex hydrolapathum</u> Huds.	263
<u>Rumex sanguineus</u> L.	263

Scrophulariaceae

<u>Veronica agrestis</u> L.	116
<u>Veronica hederifolia</u> L.	in 84
<u>Veronica persica</u> Poir.	263

Total: families, 6; genera, 10; species (entries), 20.

Table 7. Weed hosts of H. glycyines

FAMILY & WEED SPECIES	REFERENCE
Caryophyllaceae	
<u>Agrostemma githago</u> L.	227
<u>Cerastium vulgatum</u> L.	227
<u>Stellaria media</u> (L.) Cyr.	227

Labiatae

<u>Lamium amplexicaule</u> L.	52
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Leguminosae

<u>Acacia</u> spp.	208
<u>Astragalus cicer</u> L.	208
<u>Canavalia ensiformis</u> (L.) DC.	208
<u>Cassia tora</u> L.	227
<u>Cassia</u> sp.	208
<u>Crotalaria incana</u> L.	208
<u>Crotalaria intermedia</u> Kotschy	208
<u>Crotalaria juncea</u> L.	208
<u>Crotalaria lanceolata</u> E. Mey.	208
<u>Crotalaria mucronata</u> Desv.	208
<u>Crotalaria saltiana</u> Andrews	208
<u>Crotalaria verrucosa</u> L.	208
<u>Desmodium barbatum</u>	
Benth. & Oerst.	208
<u>Dolichos lablab</u> L.	208
<u>Glycyne hispida</u> Max	108
<u>Glycyne soja</u> Sieb. & Zucc.	108
<u>Indigofera anil</u> L.	208

<u>Indigofera mucronata</u> Spreng.	208	Phytolaccaceae	
<u>Indigofera subulata</u> Vahl	208	<u>Phytolacca americana</u> L.	209
<u>Indigofera sumatrana</u> Gaertn.	208		
<u>Indigofera tinctoria</u> L.	208	Portulacaceae	
<u>Lathyrus aphaca</u> L.	208	<u>Portulaca oleracea</u> L.	209
<u>Lathyrus cicera</u> L.	208		
<u>Lathyrus sativus</u> L.	208	Scrophulariaceae	
<u>Lathyrus tuberosus</u> L.	208	<u>Digitalis</u> sp.	209
<u>Lespedeza cuneata</u> G. Don.	224	<u>Linaria canadensis</u> Dum.-Cours.	209
<u>Lespedeza stipulacea</u> Maxim.	225	<u>Penstemon digitalis</u> Nutt.	227
<u>Lespedeza striata</u> Hook	224	<u>Verbascum thapsus</u> L.	227
<u>Lotus arabicus</u> L.	208		
<u>Lotus corniculatus</u> L.	208	Total: families, 6; genera, 35; species	
<u>Lupinus albus</u> L.	52	(entries), 73.	
<u>Lupinus arboreus</u> Sims	208		
<u>Lupinus luteus</u> L.	208		
<u>Lupinus rivularis</u> Doug. ex Lindl.	208		
<u>Medicago arabica</u> (L.) All.	208	Table 8. Weed hosts of <u>H. goettingiana</u>	
<u>Medicago hispida</u> Gaertn.	208		
<u>Medicago orbicularis</u> All.	208	FAMILY & WEED SPECIES REFERENCE	
<u>Medicago sativa</u> (L.) L.	208	Leguminosae	
<u>Melilotus alba</u> Desr.	208	<u>Glycine hispida</u> Max.	35
<u>Melilotus indica</u> (L.) All.	208	<u>Glycine soja</u> Sieb. & Zucc.	35
<u>Melilotus officinalis</u> (L.) Lam.	208	<u>Lathyrus heterophyllus</u> (?)	263
<u>Phaseolus angularis</u> W. F. Wight	108	<u>Lathyrus hirsutus</u> L.	263
<u>Phaseolus atropurpureus</u> Moc. & Sesse	208	<u>Lathyrus nissolia</u> L.	263
<u>Phaseolus lathvroides</u> L.	208	<u>Lathyrus ochrus</u> DC.	263
<u>Phaseolus lunatus</u> L.	208	<u>Lathyrus palustris</u> L.	263
<u>Phaseolus</u> sp.	208	<u>Lathyrus sativus</u> L.	263
<u>Pisum elatius</u> Bieb.	208	<u>Lupinus albus</u> L.	129
<u>Psoralea bituminosa</u> L.	208	<u>Lupinus luteus</u> L.	58
<u>Sesbania exaltata</u> (Raf.) Cory	53	<u>Medicago sativa</u> (L.) L.	223
<u>Sesbania</u> sp.	208	<u>Vicia angustifolia</u> L.	in 45
<u>Spartium junceum</u> L.	208	<u>Vicia atropurpurea</u> Desf.	183
<u>Trifolium agrarium</u> L.	208	<u>Vicia calcarata</u> Desf.	263
<u>Trifolium procumbens</u> L.	86	<u>Vicia cracca</u> L.	263
<u>Trifolium resupinatum</u> L.	208	<u>Vicia ervillia</u> Willd.	184
<u>Ulex europaeus</u> L.	208	<u>Vicia faba</u> L.	129
<u>Vicia angustifolia</u> (L.) Reichard	208	<u>Vicia lutea</u> L.	263
<u>Vicia atropurpurea</u> Desf.	208	<u>Vicia sativa</u> L.	129
<u>Vicia graminea</u> Sm.	208	<u>Vicia sepium</u> L.	263
<u>Vicia hirsuta</u> (L.) S. F. Gray	208	Total: families, 1; genera, 5; species	
<u>Vicia lutea</u> L.	208	(entries), 20.	
<u>Vicia narbonensis</u> L.	208		
<u>Vicia sativa</u> L.	225		
<u>Vicia tetrasperma</u> (L.) Schreb.	208		
<u>Vicia villosa</u> Roth.	224		

Table 9. Weed hosts of H. graminophila

FAMILY & WEED SPECIES	REFERENCE
Gramineae	
<u>Echinochloa colonum</u> (L.) Link	24
<u>Sorghum halepense</u> (L.) Pers.	24

Table 10. Weed hosts of H. humuli

FAMILY & WEED SPECIES	REFERENCE
Cannabaceae	
<u>Cannabis sativa</u> L.	263
<u>Humulus lupulus</u> L.	116
Urticaceae	
<u>Urtica dioica</u> L.	116
<u>Urtica urens</u> L.	116

Table 11. Weed hosts of H. lespedezae

FAMILY & WEED SPECIES	REFERENCE
Leguminosae	
<u>Lespedeza stipulacea</u> Maxim.	100
<u>Lespedeza striata</u> Hook	77
<u>Trifolium pratense</u> L.	100
<u>Trifolium repens</u> L.	100

Table 12. Weed hosts of H. longicaudata

FAMILY & WEED SPECIES	REFERENCE
Gramineae	
<u>Agropyron repens</u> (L.) Beauv.	213
<u>Alopecurus pratensis</u> L.	213
<u>Arrhenatherum elatius</u> Merth. & Koch	213
<u>Festuca arundinacea</u> Schreb.	213
<u>Lolium</u> spp.	213
<u>Poa annua</u> L.	213

Table 13. Weed hosts of H. mothi

FAMILY & WEED SPECIES	REFERENCE
Cyperaceae	
<u>Cyperus esculentus</u> L.	167

Table 14. Weed hosts of H. oryzae

FAMILY & WEED SPECIES	REFERENCE
Gramineae	
<u>Oryza sativa</u> L.	143
Leguminosae	
<u>Pueraria phaseoloides</u> (Roxb.) Benth.	31
Solanaceae	
<u>Lycopersicon lycopersicum</u> (L.) Karsten	31

Table 15. Weed hosts of H. punctata

FAMILY & WEED SPECIES	REFERENCE
Gramineae	
<u>Agrostis</u> sp.	74
<u>Agrostis stolonifera</u> L.	59
<u>Agrostis tenuis</u> Sibth.	35
<u>Poa annua</u> L.	in 99
<u>Triticum aestivum</u> L.	248

Table 16. Weed hosts of H. rostochiensis

FAMILY & WEED SPECIES	REFERENCE
Chenopodiaceae	
<u>Chenopodium opulifolium</u> Schrad.	19
Solanaceae	
<u>Atropa belladonna</u> L.	60

<u>Datura tatula</u> L.	30
<u>Hyoscyamus niger</u> L.	182
<u>Lycopersicon esculentum</u> Mill.	168
<u>Lycopersicon esculentum</u> Mill v. <u>aureum</u>	263
<u>Lycopersicon peruvianum</u> (L.) Mill.	152
<u>Lycopersicon pimpinellifolium</u> (Jusl.) Mill.	152
<u>Solanum chacoense</u> Bitt.	29
<u>Solanum commersonii</u> Dun.	50
<u>Solanum dulcamara</u> L.	17,168
<u>Solanum elaeagnifolium</u> Cav.	153
<u>Solanum marginatum</u> L.	238
<u>Solanum melongena</u> L.	54
<u>Solanum miniatum</u> Bernh.	in 45
<u>Solanum nigrum</u> L.	206
<u>Solanum rostratum</u> Dun.	182
<u>Solanum sarrachoides</u> Sendt.	17
<u>Solanum triflorum</u> Nutt.	182
<u>Solanum tuberosum</u> L. ssp. <u>andigena</u> Juz. & Buk.	50
<u>Solanum tuberosum</u> L. ssp. <u>tuberosum</u> L.	126
<u>Solanum villosum</u> Willd.	263

Total: families, 2; genera, 6; species (entries), 22.

Table 17. Weed hosts of H. rumicis

FAMILY & WEED SPECIES	REFERENCE
Polygonaceae	
<u>Rumex alpinus</u> L.	201
<u>Rumex crispus</u> L.	201

Table 18. Weed hosts of H. sacchari

FAMILY & WEED SPECIES	REFERENCE
Gramineae	
<u>Saccharum officinarum</u> L.	145

Table 19. Weed hosts of H. schachtii

FAMILY & WEED SPECIES	REFERENCE
Amaranthaceae	
<u>Amaranthus caudatus</u> L.	263
<u>Amaranthus deflexus</u> L.	80
<u>Amaranthus gangeticus</u> L.	4
<u>Amaranthus graecizans</u> L.	204
<u>Amaranthus palmeri</u> S. Wats	80
<u>Amaranthus quitensis</u> H.B. & K.	116
<u>Amaranthus retroflexus</u> L.	204
<u>Amaranthus tricolor</u> L.	80
Caryophyllaceae	
<u>Holosteum umbellatum</u> L.	195
<u>Saponaria officinalis</u> L.	116
<u>Stellaria holostea</u> L.	in 45
<u>Stellaria media</u> (L.) Vill.	93
<u>Vaccaria pyramidata</u> Med.	116
Chenopodiaceae	
<u>Atriplex confertifolia</u> (Torr. & Frem.) S. Wats.	249
<u>Atriplex hastata</u> L.	71
<u>Atriplex hortensis</u> L.	126
<u>Atriplex patula</u> L.	115
<u>Atriplex rosea</u> L.	42
<u>Atriplex</u> spp.	in 45
<u>Beta vulgaris</u> L. ssp. <u>maritima</u> (L.) Thell.	116
<u>Beta vulgaris</u> L. ssp. <u>vulgaris</u> (Beetroot, garden or red beet)	147
<u>Beta vulgaris</u> L. ssp. <u>vulgaris</u> (Fodder beet, mangel wurzel, mangold)	252
<u>Beta vulgaris</u> L. ssp. <u>vulgaris</u> (Sugarbeet)	211
<u>Beta vulgaris</u> L. ssp. <u>vulgaris</u> (Swiss chard)	96
<u>Chenopodium album</u> L.	126
<u>Chenopodium ambrosioides</u> L.	195
<u>Chenopodium ambrosioides</u> L. v. <u>chilensis</u> (Schrad.) Spegaz	80
<u>Chenopodium bonus-henricus</u> L.	118
<u>Chenopodium capitatum</u> (L.) Aschers	116
<u>Chenopodium ficifolium</u> Sm.	263
<u>Chenopodium glaucum</u> L.	93
<u>Chenopodium hybridum</u> L.	199
<u>Chenopodium murale</u> L.	116
<u>Chenopodium polyspermum</u> L.	242

<u>Chenopodium rubrum</u> L.	42	<u>Raphanus sativus</u> L.	212
<u>Chenopodium schraderianum</u> Roem. & Schult.	80	<u>Rapistrum rugosum</u> (L.) All.	263
<u>Chenopodium vulvaria</u> L.	116	<u>Rorippa amphibia</u> (L.) Besser	263
Compositae		<u>Rorippa islandica</u> (Oeder) Borbas	263
<u>Cichorium intybus</u> L.	3	<u>Sinapis arvensis</u> L.	126
<u>Galinsoga parviflora</u> Cav.	258	<u>Sisymbrium irio</u> L.	263
<u>Sesbania exaltata</u> (Raf.) Cory	187	<u>Sisymbrium loeseli</u> L.	195
		<u>Sisymbrium officinale</u> (L.) Scop.	199
		<u>Sisymbrium orientale</u> L.	263
		<u>Thlaspi arvense</u> L.	70
Cruciferae		Euphorbiaceae	
<u>Alliaria petiolata</u> (Bieb.) Cavara & Grande	263	<u>Euphorbia peplus</u> L.	in 81
<u>Arabis hirsuta</u> Scop.	in 45	Labiatae	
<u>Barbarea verna</u> (Mill.) Aschers	187	<u>Galeopsis speciosa</u> Mill.	115
<u>Barbarea vulgaris</u> R. Br.	263	<u>Galeopsis tetrahit</u> L.	263
<u>Berteroa incana</u> (L.) DC.	263	Leguminosae	
<u>Biscutella auriculata</u> L.	263	<u>Dalea alopecuroides</u> Willd.	208
<u>Biscutella laevigata</u> L.	71	<u>Glycine hispida</u> Max.	98
<u>Brassica juncea</u> (L.) Czern. & Coss.	126	<u>Glycine soja</u> Sieb. & Zucc.	98
<u>Brassica kaber</u> (DC.) L. C. Wheeler	65	<u>Vicia atropurpurea</u> Desf.	204
<u>Brassica napus</u> L. v. <u>arvensis</u> (Lam.) Thellung (Rape or coleseed)	126	Polygonaceae	
<u>Brassica napus</u> L. v. <u>napobrassica</u> (L.) Rchb. (Swede or rutabaga)	126	<u>Polygonum convolvulus</u> L.	186
<u>Brassica nigra</u> (L.) Koch	126	<u>Polygonum persicaria</u> L.	in 45
<u>Brassica rapa</u> L. ssp. <u>rapa</u>	126	<u>Polygonum</u> sp.	174
<u>Bunias orientalis</u> L.	195	<u>Rumex acetosa</u> L.	195
<u>Calepina corvini</u> Desv.	195	<u>Rumex acetosella</u> L.	187
<u>Camelina sativa</u> Crantz	126	<u>Rumex alpinus</u> L.	263
<u>Capsella bursa-pastoris</u> (L.) Medic.	252	<u>Rumex crispus</u> L.	4
<u>Cardamine pratensis</u> L.	263	<u>Rumex hydrolapathum</u> Huds.	182
<u>Cardaria draba</u> (L.) Desv.	195	<u>Rumex obtusifolius</u> L.	in 45
<u>Chorispora tenella</u> Pall.	195	<u>Rumex patientia</u> L.	187
<u>Descurainia sophia</u> (L.) Prantl.	116	<u>Rumex sanguineus</u> L.	263
<u>Diplotaxis eruroides</u> (L.) DC.	263	Portulacaceae	
<u>Diplotaxis tenuifolia</u> DC.	195	<u>Portulaca grandiflora</u> Hook	4
<u>Erysimum cheiranthoides</u> L.	70	<u>Portulaca oleracea</u> L.	247
<u>Erysimum hierachiifolium</u> L.	263	Scrophulariaceae	
<u>Iberis amara</u> L.	4	<u>Chaenorrhinum minus</u> (L.) Lange	263
<u>Isatis tinctoria</u> L.	in 45	<u>Linaria vulgaris</u> Mill.	80
<u>Lepidium sativum</u> L.	126	Solanaceae	
<u>Lepidium</u> sp.	42	<u>Lycopersicon esculentum</u> Mill.	79
<u>Myagrum perfoliatum</u> L.	263	<u>Lycopersicon esculentum</u> Mill. v. <u>aureum</u>	204
<u>Nasturtium officinale</u> R. Br.	263	<u>Solanum nigrum</u> L.	204
<u>Neslea paniculata</u> Desv.	195	<u>Solanum sarrachoides</u> Sendt.	79
<u>Raphanus raphanistrum</u> L.	126		

Tetragoniaceae
Tetragonia expansa Murr. 116

Total: families, 13; genera, 52; species (entries), 111.

Table 20. Weed hosts of H. schachtii = ?avenae; schachtii = ?humuli; schachtii = ?rostochiensis; or ?schachtii

FAMILY & WEED SPECIES REFERENCE

Boraginaceae

Anchusa officinalis L. 126
Lycopsis arvensis L. 256
Myosotis sylvatica Ehrh. 60

Cannabaceae

Cannabis sativa L. 93
Humulus lupulus L. 198

Caryophyllaceae

Agrostemma githago L. 126

Compositae

Helianthus annuus L. 212
Helianthus tuberosus L. 180
Senecio vernalis Waldst. & Kit. 42
Senecio vulgaris L. 42
Sonchus asper (L.) Hill 242
Sonchus oleraceus L. 252
Taraxacum officinale L. 256

Cruciferae

Alliaria petiolata
 (Bieb.) Cavara & Grande 71
Isatis tinctoria L. 93
Sinapis alba L. 126

Geraniaceae

Erodium cicutarium L. 126

Gramineae

Agropyron repens Beauv. 242
Agrostis canina L. 42
Ammophila arenaria (L.) Link 253
Arrhenatherum elatius
 (L.) J. & C. Presl. 93
Avena sterilis L. 166
Bromus mollis L. 70

Bromus rubens L. 166
Bromus secalinus L. 202
Poa annua L. 126
Saccharum officinarum L. 173,145
Sorghum vulgare Pers. 93

Labiatae

Lamium amplexicaule L. 93
Lamium sp. 252
Mentha arvensis L. in 81

Leguminosae

Lathyrus aphaca L. 71
Lathyrus cicera L. 126
Lathyrus sativus L. 42
Lathyrus tingitanus L. 42
Medicago lupulina L. 242
Medicago sativa (L.) L. 94
Phaseolus angularis W. F. Wight 119
Phaseolus lunatus L.
 v. macrocarpus 42
Trifolium incarnatum L. 93
Trifolium pratense L. 70
Trifolium repens L. 93
Trifolium resupinatum L. 166
Vicia faba L. v. equina 42
Vicia hirsuta (L.) S. F. Gray 42
Vicia monanthos Desf. 42
Vicia narbonensis L. 42
Vicia villosa Roth. 42

Papaveraceae

Papaver rhoeas L. 66
Papaver sp. 252

Plantaginaceae

Plantago lanceolata L. 42

Polygonaceae

Polygonum acre H. B. & K. 231
Polygonum aviculare L. 199
Polygonum lapathifolium L. 126
Polygonum nodosum Pers. 182
Polygonum pennsylvanicum L. 231
Polygonum persicaria L. 115
Rumex crispus L. 219
Rumex obtusifolius L. 199
Rumex sp. 252

Resedaceae

Reseda lutea L. 66

Rubiaceae			
<u>Galium aparine</u> L.	199	<u>Saponaria officinalis</u> L.	263
Scrophulariaceae		<u>Scleranthus annus</u> L.	in 45
<u>Veronica officinalis</u> L.	252	<u>Silene antirrhina</u> L.	263
Solanaceae		<u>Spergula arvensis</u> L.	263
<u>Hyoscyamus niger</u> L.	256	<u>Stellaria holostea</u> L.	in 45
<u>Solanum nigrum</u> L.	256	<u>Stellaria media</u> (L.) Vill.	263
		<u>Stellaria nemorum</u> L.	in 45
		<u>Vaccaria pyramidata</u> Med.	263
Umbelliferae		Chenopodiaceae	
<u>Daucus carota</u> L. ssp. <u>sativus</u>		<u>Beta vulgaris</u> L. ssp. <u>vulgaris</u>	62
(Hoffm.) Thell.	254	(Beet, unspecified)	
<u>Pastinaca sativa</u> L.	93	<u>Beta vulgaris</u> L. ssp. <u>vulgaris</u>	96
		(Beetroot, garden or red beet)	
		<u>Beta vulgaris</u> L. ssp. <u>vulgaris</u>	96
		(Chard, Swiss chard)	
Urticaceae		<u>Chenopodium glaucum</u> L.	175
<u>Urtica dioica</u> L.	252		
<u>Urtica urens</u> L.	252	Compositae	
		<u>Sesbania grandiflora</u> Poir.	96
Violaceae			
<u>Viola tricolor</u> L.	71	Cruciferae	
		<u>Brassica juncea</u>	
		(L.) Czern. & Coss.	96
		<u>Isatis tinctoria</u> L.	62
		<u>Sinapis alba</u> L.	62
		Curcurbitaceae	
		<u>Cucumis sativus</u> L.	217
		<u>Cucurbita pepo</u> L.	217
		Labiatae	
		<u>Lamium album</u> L.	in 45
		Leguminosae	
		<u>Desmodium canum</u> Schinz & Thellung	96
		<u>Desmodium uncinatum</u> DC.	96
		<u>Glycine hispida</u> Max.	155,263
		<u>Glycine soja</u> Sieb. & Zucc.	155,263
		<u>Lathyrus articulatus</u> L.	183
		<u>Lathyrus sativus</u> L.	183
		<u>Lathyrus tingitanus</u> L.	96
		<u>Lespedeza stipulacea</u> Maxim	67
		<u>Lotus corniculatus</u> L.	67
		<u>Medicago sativa</u> (L.) L.	260
		<u>Melilotus alba</u> Desr.	67
		<u>Melilotus officinalis</u> (L.) Lam.	67
		<u>Phaseolus</u> sp.	72
		<u>Trifolium dubium</u> Sibth.	263
		<u>Trifolium hybridum</u> L.	67
		<u>Trifolium incarnatum</u> L.	72
		<u>Trifolium pratense</u> L.	183

Total: families, 13; genera, 40; species (entries), 80.

Table 21. Weed hosts of H. tabacum

FAMILY & WEED SPECIES	REFERENCE
Solanaceae	
<u>Lycopersicon esculentum</u> Mill.	137
<u>Nicotiana tabacum</u> L.	137
<u>Solanum dulcamara</u> L.	137
<u>Solanum nigrum</u> L.	137
<u>Solanum rostratum</u> Dun.	137

Table 22. Weed hosts of H. trifolii

FAMILY & WEED SPECIES	REFERENCE
Caryophyllaceae	
<u>Agrostemma githago</u> L.	263
<u>Cerastium arvense</u> L.	263
<u>Cerastium perfoliatum</u> L.	263
<u>Moehringia trinervia</u>	
(L.) Clairv.	in 45

<u>Trifolium repens</u> L.	205
<u>Vicia atropurpurea</u> Desf.	183
<u>Vicia ervillia</u> Willd.	183
<u>Vicia narbonensis</u> L.	72
<u>Vicia villosa</u> Roth.	72

Polygonaceae

<u>Polygonum persicaria</u> L.	154
<u>Rumex alpinus</u> L.	263
<u>Rumex conglomeratus</u> Murr.	263
<u>Rumex crispus</u> L.	205
<u>Rumex hydrolapathum</u> Huds.	263
<u>Rumex sanguineus</u> L.	263

Scrophulariaceae

<u>Veronica persica</u> Poir.	263
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Solanaceae

<u>Lycopersicon esculentum</u> Mill.	96
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Total: families, 10; genera, 32; species (entries), 53.

Table 23. Weed hosts of H. weissi

FAMILY & WEED SPECIES REFERENCE

Polygonaceae	
<u>Polygonum pennsylvanicum</u> L.	233
<u>Polygonum persicaria</u> L.	156

Table 24. Weed hosts of unidentified Heterodera spp.

FAMILY & WEED SPECIES REFERENCE

Alliaceae	
<u>Allium cepa</u> L.	223

Caryophyllaceae

<u>Spergula arvensis</u> L.	182
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Geraniaceae

<u>Erodium cicutarium</u> L.	89
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Leguminosae

<u>Lathyrus latifolius</u> L.	89
<u>Lathyrus sylvestris</u> L.	89
<u>Medicago lupulina</u> L.	89
<u>Medicago sativa</u> (L.) L.	89
<u>Melilotus alba</u> Desr.	89
<u>Trifolium dubium</u> Sibth.	89
<u>Trifolium hybridum</u> L.	89
<u>Trifolium incarnatum</u> L.	89
<u>Trifolium resupinatum</u> L.	89
<u>Vicia sativa</u> L.	89

Pinaceae

<u>Pinus monticola</u> Dougl.	179
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Scrophulariaceae

<u>Odontites verna</u> (Bell.) Dum.	27
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Solanaceae

<u>Nicotiana suaveolens</u> Lehm.	165
<u>Nicotiana tabacum</u> L.	165
<u>Solanum carolinense</u> L.	165

Total: families, 7; genera, 12; species (entries), 18.

Appendix B. Tables of weed hosts and distribution of weed hosts of Pratylenchus, the root-lesion nematode, arranged alphabetically by plant family, genus, and species under respective nematode species and relevant literature cited.

Table	Page
25. Weed hosts of <u>Pratylenchus alleni</u> .	40
26. Weed hosts of <u>Pratylenchus andinus</u> .	40
27. Weed hosts of <u>Pratylenchus brachvurus</u> .	40
28. Weed hosts of <u>Pratylenchus coffeae</u> or <u>P. coffeae brasiliensis</u> .	41
29. Weed hosts of <u>Pratylenchus convallariae</u> .	42
30. Weed hosts of <u>Pratylenchus crenatus</u> .	43
31. Weed hosts of <u>Pratylenchus delattrei</u> .	43
32. Weed hosts of <u>Pratylenchus hexincisus</u> .	43
33. Weed hosts of <u>Pratylenchus loosi</u> .	43
34. Weed hosts of <u>Pratylenchus neglectus</u> .	44
35. Weed hosts of <u>Pratylenchus penetrans</u> .	45
36. Weed hosts of <u>Pratylenchus pratensis</u> .	48
37. Weed hosts of <u>Pratylenchus ? pratensis</u> .	48
38. Weed hosts of <u>Pratylenchus sacchari</u> .	49
39. Weed hosts of <u>Pratylenchus scribneri</u> .	49
40. Weed hosts of <u>Pratylenchus steineri</u> .	50
41. Weed hosts of <u>Pratylenchus thornei</u> .	50
42. Weed hosts of <u>Pratylenchus tumidiceps</u> .	50
43. Weed hosts of <u>Pratylenchus vulnus</u> .	50
44. Weed hosts of <u>Pratylenchus zaeae</u> .	51
45. Weed hosts of unidentified <u>Pratylenchus</u> spp.	51

Table 25. Weed hosts of *P. alleni*

FAMILY & WEED SPECIES	REFERENCE
Leguminosae	
<i>Glycine hispida</i> Max.	55
<i>Glycine soja</i> Sieb. & Zucc.	55

Table 26. Weed hosts of *P. andinus*

FAMILY & WEED SPECIES	REFERENCE
Solanaceae	
<i>Solanum</i> spp.	133
<i>Solanum tuberosum</i> L. spp. <i>andigena</i> Juz. & Buk.	133

Table 27. Weed hosts of *P. brachyurus*

FAMILY & WEED SPECIES	REFERENCE
Amaranthaceae	
<i>Amaranthus hybridus</i> L.	124
<i>Amaranthus spinosus</i> L.	92
<i>Celosia argentea</i> L.	33
Anacardiaceae	
<i>Mangifera indica</i> L.	266
Apocynaceae	
<i>Vinca rosea</i> L.	148
Bignoniaceae	
<i>Camphis radicans</i> (L.) Seem.	92
Campanulaceae	
<i>Specularia perfoliata</i> (L.) A. DC.	92
Commelinaceae	
<i>Commelina</i> spp.	144
Compositae	
<i>Ageratum conyzoides</i> L.	144
<i>Ambrosia artemisiifolia</i> L.	92
<i>Indigofera hirsuta</i> L.	49
<i>Sida spinosa</i> L.	92

<i>Spigal anthelmia</i> L.	49
<i>Tridax procumbens</i> L.	49
<i>Xanthium pensylvanicum</i> Wallr.	241
Convolvulaceae	
<i>Ipomoea batatas</i> Lam.	144
Cucurbitaceae	
<i>Citrullus vulgaris</i> Schrad.	51
Cyperaceae	
<i>Cyperus</i> sp.	92
Erythroxylaceae	
<i>Erythroxylon coca</i> Lamk.	144
Euphorbiaceae	
<i>Croton capitatus</i> Michx.	92
Geraniaceae	
<i>Geranium carolinianum</i> L.	92
Gramineae	
<i>Chloris gayana</i> Kunth	33
<i>Cynodon dactylon</i> (L. C. Rich) Pers.	222
<i>Digitaria sanguinalis</i> (L.) Scop.	51
<i>Digitaria</i> sp.	160
<i>Eleusine africana</i> Kenn-O'byrne	124
<i>Panicum brevifolium</i> L.	144
<i>Panicum maximum</i> Jacq.	144
<i>Paspalum conjugatum</i> Berg.	144
<i>Paspalum dilatatum</i> Poir.	33
<i>Paspalum scrobiculatum</i> L.	144
<i>Pennisetum clandestinum</i> Hochst. ex Chior.	33
<i>Pennisetum purpureum</i> Schum.	144
<i>Rottboellia exaltata</i> L.	144
<i>Saccharum officinarum</i> L.	112
<i>Sorghum halepense</i> (L.) Pers.	92
<i>Sorghum vulgare</i> Pers.	51
<i>Sorghum vulgare</i> Pers. v <i>sudanense</i> Hitchc.	51
<i>Triticum aestivum</i> L.	51
Labiatae	
<i>Lamium amplexicaule</i> L.	92
Leguminosae	
<i>Arachis hypogaea</i> L.	233
<i>Calopogonium mucunoides</i> Desv.	144

<u>Canavalia ensiformis</u> (L.) DC.	144	Tiliaceae	
<u>Cassia absus</u> L.	144	<u>Corchorus capsularis</u> L.	144
<u>Cassia hirsuta</u> L.	144	<u>Corchorus olitorius</u> L.	144
<u>Cassia obtusifolia</u> L.	92		
<u>Cassia occidentalis</u> L.	92	Urticaceae	
<u>Centrosema pubescens</u> Benth.	144	<u>Boehmeria nivea</u> Gaudich.	144
<u>Clitoria ternatea</u> L.	144		
<u>Crotalaria intermedia</u> Kotschy	144	Verbenaceae	
<u>Crotalaria juncea</u> L.	144	<u>Verbena</u> sp.	148
<u>Crotalaria usaramoensis</u> E. G. Baker	144		
<u>Desmodium polycarpum</u> DC.	144	Total: families, 24; genera, 62; species (entries), 83.	
<u>Dolichos lablab</u> L.	144		
<u>Glycine hispida</u> Max.	134		
<u>Glycine soja</u> Sieb. & Zucc.	134		
<u>Lepidium virginicum</u> L.	92		
<u>Lespedeza</u> sp.	221		
<u>Mimosa invisa</u> Mart.	144	Table 28. Weed hosts of <u>P. coffeae</u> or <u>P. coffeae brasiliensis</u>	
<u>Phaseolus lunatus</u> L.	160		
<u>Pueraria phaseoloides</u> Benth v. <u>javanica</u> Benth.	144		
<u>Talinum triangulare</u> (Jacq.) Willd.	49		
<u>Tephrosia candida</u> DC.	144	FAMILY & WEED SPECIES REFERENCE	
<u>Trifolium incarnatum</u> L.	51	Acanthaceae	
<u>Trifolium pratense</u> L.	41	<u>Justicia simplex</u> D. Don	57
<u>Trifolium repens</u> L.	41		
<u>Vicia angustifolia</u> L.	92	Alliaceae	
		<u>Allium cepa</u> L.	132
Malvaceae			
<u>Hibiscus cannabinus</u> L.	221	Amaranthaceae	
<u>Hibiscus esculentus</u> L.	221	<u>Alternanthera sessilis</u> R. Br.	57
		<u>Amaranthus lividus</u> L.	57
Pinaceae			
<u>Pinus palustris</u> Mill.	97	Caryophyllaceae	
<u>Pinus taeda</u> L.	97	<u>Spergula arvensis</u> L.	41
Rubiaceae		Compositae	
<u>Richardia scabra</u> L.	222	<u>Ageratum mexicanum</u> Sims	57
		<u>Aster</u> sp.	11
Scrophulariaceae		<u>Bellis</u> sp.	222
<u>Linaria canadensis</u> Dum.-Cours.	222	<u>Crassocephalum crepidioides</u> (Benth.) S. Moore	57
		<u>Hypochoeris radicata</u> L.	41
Solanaceae		<u>Sonchus oleraceus</u> L.	41
<u>Lycopersicon esculentum</u> Mill.	160	<u>Tagetes</u> sp.	11
<u>Nicotiana tabacum</u> L.	38	<u>Vernonia cinerea</u> (L.) Less.	48
<u>Physalis subglabrata</u> Mack. & Bush.	222		
<u>Solanum tuberosum</u> L.	233	Cruciferae	
ssp. <u>tuberosum</u> L.		<u>Coronopus didymus</u> (L.) Sm.	41
		Cucurbitaceae	
		<u>Cucurbita</u> spp.	57
		<u>Momordica charantia</u> L.	57

Cyperaceae		Piperaceae	
<u>Cyperus rotundus</u> L.	57	<u>Piper betle</u> L.	48
Euphorbiaceae		Polygonaceae	
<u>Euphorbia geniculata</u> Orteg.	57	<u>Rumex acetosella</u> L.	41
Gramineae		Portulacaceae	
<u>Cynodon dactylon</u> (L.) Pers.	41	<u>Portulaca oleracea</u> L.	48
<u>Digitaria adscendens</u> (H. B. & K.) Henrard	41	Rosaceae	
<u>Lolium rigidum</u> Gaud.	41	<u>Rubus occidentalis</u> L.	48
<u>Paspalum conjugatum</u> Berg.	57	Scrophulariaceae	
<u>Tripsacum laxum</u> Scribn. & Merrill	11	<u>Antirrhinum majus</u> L.	48
Labiatae		Solanaceae	
<u>Leucas aspera</u> (Willd.) Link	48	<u>Solanum melongena</u> L.	57
<u>Ocimum sanctum</u> L.	48	<u>Solanum nigrum</u> L.	48
Leguminosae		<u>Solanum tuberosum</u> L. ssp. <u>tuberosum</u> L.	11,130
<u>Albizzia falcata</u> Backer	57	Umbelliferae	
<u>Arachis hypogaea</u> L.	57	<u>Pastinaca sativa</u> L.	222
<u>Calopogonium mucunoides</u> Desv.	16	Urticaceae	
<u>Cassia laevigata</u> Willd.	57	<u>Boehmeria nivea</u> Gaudich.	57
<u>Cassia mimosoides</u> L.	57	<u>Pouzolzia indica</u> Gaudich.	57
<u>Cassia obtusifolia</u> L.	48	Vitaceae	
<u>Centrosema pubescens</u> Benth.	16	<u>Vitis</u> sp.	41
<u>Crotalaria incana</u> L.	48	Total: families, 25; genera, 53; species (entries), 61.	
<u>Crotalaria juncea</u> L.	57		
<u>Crotalaria striata</u> DC.	48		
<u>Derris elliptica</u> Benth.	57		
<u>Desmodium axillare</u> DC.	48		
<u>Desmodium uncinatum</u> (Jacq.) DC.	48		
<u>Dolichos lablab</u> L.	48		
<u>Lupinus angustifolius</u> L.	41		
<u>Medicago sativa</u> (L.) L.	11		
<u>Mimosa invisa</u> Mart.	57		
<u>Mimosa pudica</u> L.	48		
<u>Phaseolus lunatus</u> L.	57		
<u>Trifolium pratense</u> L.	41		
Liliaceae		Table 29. Weed hosts of <u>P. convallariae</u>	
<u>Convallaria majalis</u> L.	190	FAMILY & WEED SPECIES REFERENCE	
Linaceae		Liliaceae	
<u>Linum usitatissimum</u> L.	41	<u>Convallaria majalis</u> L.	130,215
Musaceae			
<u>Musa acuminata</u> Colla	240		
Oxalidaceae			
<u>Oxalis acetosella</u> L.	48		

Table 30. Weed hosts of P. crenatus

<u>FAMILY & WEED SPECIES</u>	<u>REFERENCE</u>
Asparagaceae	
<u>Asparagus officinalis</u> L.	130
Caryophyllaceae	
<u>Stellaria media</u> (L.) Vill.	123
Chenopodiaceae	
<u>Beta vulgaris</u> L. ssp. <u>vulgaris</u> (Beet, unspecified)	130
Compositae	
<u>Chrysanthemum leucanthemum</u> L.	130
<u>Cichorium endivia</u> L.	130
<u>Cichorium intybus</u> L.	130
Gramineae	
<u>Avena sativa</u> L.	123
<u>Lolium perenne</u> L.	130
<u>Poa annua</u> L.	123
<u>Secale cereale</u> L.	130
Leguminosae	
<u>Laburnum anagyroides</u> Medic.	130
<u>Trifolium repens</u> L.	130
Liliaceae	
<u>Convallaria majalis</u> L.	130
Papaveraceae	
<u>Papaver somniferum</u> L.	130
Rosaceae	
<u>Fragaria</u> spp.	130
<u>Rosa</u> sp.	130
Solanaceae	
<u>Solanum tuberosum</u> L. ssp. <u>tuberosum</u> L.	130
Umbelliferae	
<u>Daucus carota</u> L. ssp. <u>sativus</u> (Hoffm.) Thell.	130
Total: families, 11; genera, 17; species (entries), 18.	

Table 31. Weed hosts of P. delattrei

<u>FAMILY & WEED SPECIES</u>	<u>REFERENCE</u>
Gramineae	
<u>Sorghum vulgare</u> Pers.	140
Tiliaceae	
<u>Corchorus acutangulus</u> Lam.	140

Table 32. Weed hosts of P. hexincisus

<u>FAMILY & WEED SPECIES</u>	<u>REFERENCE</u>
Gramineae	
<u>Andropogon ischaemum</u> L.	10
<u>Andropogon scoparius</u> Michx.	10
<u>Avena sativa</u> L.	56
<u>Cynodon dactylon</u> (L.) Pers.	10
<u>Digitaria</u> sp.	10
<u>Elymus</u> sp.	10
<u>Panicum fasciculatum</u> Sw.	10
<u>Sorghum halepense</u> (L.) Pers.	10
<u>Sorghum</u> sp.	181
Leguminosae	
<u>Glycine hispida</u> Max.	56
<u>Glycine soja</u> Sieb. & Zucc.	56
Total: families, 2; genera, 8; species (entries), 11.	

Table 33. Weed hosts of P. loosi

<u>FAMILY & WEED SPECIES</u>	<u>REFERENCE</u>
Liliaceae	
<u>Convallaria majalis</u> L.	127
Solanaceae	
<u>Solanum tuberosum</u> L. ssp. <u>tuberosum</u> L.	106

Table 34. Weed hosts of *P. neglectus*

<u>FAMILY & WEED SPECIES</u>	<u>REFERENCE</u>		
Amaranthaceae		<u>Avena fatua</u> L.	13
<u>Amaranthus</u> spp.	222	<u>Avena sativa</u> L.	6
Anacardiaceae		<u>Cynodon dactylon</u> (L. C. Rich) Pers.	222
<u>Rhus</u> sp.	15	<u>Dactylis glomerata</u> L.	261
Apocynaceae		<u>Hordeum vulgare</u> L.	207
<u>Nerium oleander</u> L.	103	<u>Lolium multiflorum</u> Lam.	261
Cactaceae		<u>Phalaris arundinacea</u> L.	261
<u>Opuntia</u> sp.	222	<u>Phleum pratense</u> L.	261
Chenopodiaceae		<u>Secale cereale</u> L.	207
<u>Atriplex</u> sp.	207	<u>Sorghum halepense</u> (L.) Pers.	222
<u>Beta vulgaris</u> L. ssp. <u>vulgaris</u> (Beet, unspecified)	185	<u>Triticum aestivum</u> L.	207
<u>Beta vulgaris</u> L. ssp. <u>vulgaris</u> (Sugarbeet)	207	Labiatae	
<u>Chenopodium</u> sp.	222	<u>Salvia apiana</u> Jeps.	222
<u>Salsola kali</u> L.	222	<u>Salvia mellifera</u> Greene	222
Compositae		Leguminosae	
<u>Bellis</u> spp.	222	<u>Astragalus</u> spp.	222
<u>Taraxacum</u> spp.	222	<u>Caesalpinia gilliesii</u> (Hook.) Wall.	222
Convolvulaceae		<u>Medicago sativa</u> (L.) L.	15
<u>Dichondra</u> spp.	222	<u>Trifolium pratense</u> L.	15
Cruciferae		<u>Trifolium repens</u> L.	9
<u>Brassica napus</u> L. v. <u>arvensis</u> (Lam.) Thellung (Rape or coleseed)	207	Papaveraceae	
<u>Brassica napus</u> L. v. <u>napobrassica</u> (L.) Rchb. (Swede or rutabaga)	207	<u>Papaver</u> sp.	207
<u>Brassica rapa</u> L. ssp. <u>rapa</u>	130	Polygonaceae	
<u>Capsella bursa-pastoris</u> (L.) Medic.	221	<u>Rumex</u> spp.	222
Cyperaceae		Rosaceae	
<u>Scirpus acutus</u> Muhl.	222	<u>Prunus cerasus</u> L.	7
Gramineae		<u>Rosa</u> sp.	190
<u>Alopecurus pratensis</u> L.	261	Solanaceae	
<u>Arrhenatherum elatius</u> (L.) J. & C. Presl.	261	<u>Lycopersicon esculentum</u> Mill.	171
		<u>Nicotiana glauca</u> L.	222
		<u>Nicotiana tabacum</u> L.	169
		<u>Solanum nigrum</u> L.	222
		Zygophyllaceae	
		<u>Larrea</u> sp.	222
		Total: families, 17; genera, 39; species (entries), 46.	

Table 35. Weed hosts of *P. penetrans*

FAMILY & WEED SPECIES	REFERENCE	
Aceraceae		
<i>Acer negundo</i> L.	7	
<i>Acer platanoides</i> L.	192	
<i>Acer</i> sp.	8	
Alliaceae		
<i>Allium cepa</i> L.	226	
Amaranthaceae		
<i>Amaranthus retroflexus</i> L.	5	
<i>Amaranthus</i> sp.	196	
Apocynaceae		
<i>Nerium oleander</i> L.	103	
Aquifoliaceae		
<i>Ilex glabra</i> A. Gray	110	
Asclepiadaceae		
<i>Asclepias syriaca</i> L.	250	
Balsaminaceae		
<i>Impatiens balsamina</i> L.	90	
<i>Impatiens capensis</i> Meerb.	250	
Berberidaceae		
<i>Berberis thunbergii</i> DC.	192	
Brassicaceae		
<i>Barbarea vulgaris</i> R. Br.	250	
Caryophyllaceae		
<i>Arenaria serpyllifolia</i> L.	250	
<i>Cerastium vulgatum</i> L.	250	
<i>Stellaria media</i> (L.) Vill.	250	
Chenopodiaceae		
<i>Atriplex</i> sp.	250	
<i>Beta vulgaris</i> L. ssp. <i>vulgaris</i> (Beet, unspecified)	188	
<i>Beta vulgaris</i> L. ssp. <i>vulgaris</i> (Sugar beet)	192	
<i>Chenopodium album</i> L.	250	
<i>Chenopodium</i> sp.	196	
Compositae		
<i>Achillea</i> sp.	250	
<i>Ambrosia artemisiifolia</i> L.	250	
<i>Anthemis cotula</i> L.	250	
<i>Arctium minus</i> (Hill) Bernh.	250	
<i>Artemisia dracunculus</i> L.	192	
<i>Bellis</i> sp.	222	
<i>Centaurea cyanus</i> L.	214	
<i>Chrysanthemum indicum</i> L.	214	
<i>Chrysanthemum leucanthemum</i> L.	250	
<i>Chrysanthemum</i> sp.	203	
<i>Cichorium endivia</i> L.	192	
<i>Cichorium intybus</i> L.	192	
<i>Cirsium arvense</i> (L.) Scop.	250	
<i>Emilia sonchifolia</i> (L.) DC. ex Wight	262	
<i>Erigeron annuus</i> (L.) Pers.	250	
<i>Erigeron canadensis</i> L.	250	
<i>Erigeron strigosus</i> Muhl. ex Willd.	250	
<i>Gnaphalium uliginosum</i> L.	250	
<i>Helianthus annuus</i> L.	170	
<i>Hieracium pratense</i> Tausch.	250	
<i>Lactuca serriola</i> L.	250	
<i>Lactuca scariola</i> L.	250	
<i>Matricaria matricarioides</i> (Less.) Porter	250	
<i>Onopordum acanthium</i> L.	250	
<i>Senecio vulgaris</i> L.	250	
<i>Solidago altissima</i> L.	43	
<i>Solidago</i> spp.	250	
<i>Sonchus arvensis</i> L.	250	
<i>Sonchus oleraceus</i> L.	250	
<i>Tagetes patula</i> L.	192	
<i>Taraxacum officinale</i> L.	192	
<i>Xanthium pensylvanicum</i> Wallr.	250	
Convolvulaceae		
<i>Convolvulus arvensis</i> L.	250	
<i>Ipomoea batatas</i> Lam.	107	
Cruciferae		
<i>Brassica kaber</i> (DC.) L. C. Wheeler	250	
<i>Brassica napus</i> L.	192	
<i>Brassica napus</i> L. v. <i>napobrassica</i> (L.) Rchb (Swede or rutabaga)	192	
<i>Brassica nigra</i> (L.) Koch	130	
<i>Brassica rapa</i> L. ssp. <i>campestris</i>	192	
<i>Brassica rapa</i> L. ssp. <i>rapa</i>	192	

<u>Capsella bursa-pastoris</u>		<u>Phleum pratense</u> L.	111,170
(L.) Medic.	250	<u>Poa compressa</u> L.	146
<u>Capsicum annuum</u> L.	172	<u>Poa pratensis</u> L.	111
<u>Capsicum frutescens</u> L.	218	<u>Saccharum officinarum</u> L.	130
<u>Erysimum cheiranthoides</u> L.	250	<u>Secale cereale</u> L.	26
<u>Lepidium campestre</u> (L.) R. Br.	250	<u>Setaria glauca</u> (L.) Beauv.	5
<u>Raphanus sativus</u> L.	203	<u>Setaria viridis</u> (L.) Beauv.	43
<u>Rorippa sylvestris</u> (L.) Bess.	250	<u>Sorghum vulgare</u> Pers.	
<u>Sinapis alba</u> L.	192	v. <u>sudanense</u> Hitchc.	146
<u>Sisymbrium altissimum</u> L.	250	<u>Triticum aestivum</u> L.	111
<u>Sisymbrium loeseli</u> L.	250		
<u>Thlaspi arvense</u> L.	250	Hypericaceae	
		<u>Hypericum punctatum</u> L.	250
Cucurbitaceae			
<u>Cucumis sativus</u> L.	192	Iridaceae	
		<u>Gladiolus</u> sp.	226
Cupressaceae			
<u>Chamaecyparis lawsoniana</u>		Labiatae	
(Murr.) Parl.	190	<u>Lamium amplexicaule</u> L.	250
<u>Juniperus virginiana</u> L.	32	<u>Mentha</u> sp.	177
<u>Thuja occidentalis</u> L.	107	<u>Phystostegia virginiana</u> Benth.	189
Equisetaceae		Leguminosae	
<u>Equisetum arvense</u> L.	250	<u>Coronilla varia</u> L.	203
		<u>Crotalaria spectabilis</u> Roth.	203
Ericaceae		<u>Glycine hispida</u> Max.	192
<u>Calluna vulgaris</u> (L.) Hull	176	<u>Glycine soja</u> Sieb. & Zucc.	192
		<u>Laburnum anagyroides</u> Medic.	185
Gramineae		<u>Lespedeza</u> sp.	34
<u>Agrostis stolonifera</u> L.	192	<u>Lotus corniculatus</u> L.	111
<u>Alopecurus pratensis</u> L.	111	<u>Lupinus angustifolius</u> L.	44
<u>Arrhenatherum elatius</u>		<u>Lupinus luteus</u> L.	185
Merth. & Koch	111	<u>Medicago lupulina</u> L.	192
<u>Avena sativa</u> L.	170,221	<u>Medicago sativa</u> (L.) L.	111
<u>Bromus inermis</u> Leyss.	43	<u>Melilotus alba</u> Desr.	250
<u>Cynodon dactylon</u>		<u>Phaseolus lunatus</u> L.	107
(L. C. Rich) Pers.	111	<u>Robinia pseudoacacia</u> L.	192
<u>Dactylis glomerata</u> L.	111	<u>Trifolium hybridum</u> L.	111
<u>Dactylis</u> sp.	196	<u>Trifolium incarnatum</u> L.	192
<u>Digitaria ischaemum</u>		<u>Trifolium pratense</u> L.	111,170
(Schreb.) Schreb.	163	<u>Trifolium repens</u> L.	111
<u>Digitaria sanguinalis</u> (L.) Scop.	196	<u>Trifolium subterraneum</u> L.	121
<u>Eragrostis cilianensis</u>		<u>Vicia faba</u> L.	185
(L.) E. Mosher	163	<u>Vicia sativa</u> L.	170,192
<u>Festuca arundinacea</u> Schreb.	111	<u>Vicia villosa</u> Roth.	111
<u>Festuca rubra</u> L.	192		
<u>Festuca rubra</u> v. <u>commutata</u> Gawd.	146	Liliaceae	
<u>Hordeum vulgare</u> L.	111,130	<u>Convallaria majalis</u> L.	130,226
<u>Lolium multiflorum</u> Lam.	192	<u>Scilla</u> sp.	226
<u>Lolium perenne</u> L.	192		
<u>Panicum capillare</u> L.	163	Linaceae	
<u>Phalaris canariensis</u> L.	192	<u>Linum usitatissimum</u> L.	192

Magnoliaceae		<u>Rosa canina</u> L.	185
<u>Liriodendron tulipifera</u> L.	192	<u>Rosa eglanteria</u> L.	192
		<u>Rosa multiflora</u> Dum.- Cours.	192
Malvaceae		<u>Rosa</u> sp.	15
<u>Malva neglecta</u> Wallr.	250	<u>Rubus idaeus</u> L.	26
		<u>Rubus</u> sp.	105
Molluginaceae		Salicaceae	
<u>Mollugo verticillata</u> L.	163	<u>Salix alba</u> L.	189
Oleaceae		Scrophulariaceae	
<u>Syringa vulgaris</u> L.	192	<u>Antirrhinum majus</u> L.	221
Onograceae		<u>Digitalis purpurea</u> L.	192
<u>Epilobium</u> sp.	250	<u>Veronica arvensis</u> L.	250
Oxalidaceae		Solanaceae	
<u>Oxalis corniculata</u> L.	128	<u>Atropa belladonna</u> L.	192
Papaveraceae		<u>Lycopersicon esculentum</u>	
<u>Papaver somniferum</u> L.	192	Mill.	170,171
		<u>Nicotiana tabacum</u> L.	34
Pinaceae		<u>Solanum dulcamara</u> L.	250
<u>Pinus sylvestris</u> L.	188	<u>Solanum melongena</u> L.	149
<u>Pseudotsuga menziesii</u>		<u>Solanum nigrum</u> L.	250
(Mirbel) Franco	190	<u>Solanum tuberosum</u> L.	
		ssp. <u>tuberosum</u> L.	185,170
Plantaginaceae		Ulmaceae	
<u>Plantago major</u> L.	214	<u>Ulmus pumila</u> L.	5
Polygonaceae		Umbelliferae	
<u>Fagopyrum esculentum</u> Moench	250	<u>Angelica archangelica</u> L.	192
<u>Polygonum aviculare</u> L.	250	<u>Carum carvi</u> L.	192
<u>Polygonum convolvulus</u> L.	250	<u>Daucus carota</u> L. ssp. <u>carota</u> .	192
<u>Polygonum persicaria</u> L.	250	<u>Daucus carota</u> L.	
<u>Rumex crispus</u> L.	250	ssp. <u>sativus</u> (Hoffm.) Thell.	170,91
		<u>Foeniculum vulgare</u> Mill.	192
Ranunculaceae		<u>Pastinaca sativa</u> L.	85
<u>Delphinium ajacis</u> L.	192	Violaceae	
<u>Delphinium</u> sp.	221	<u>Viola</u> sp.	170, 221
<u>Ranunculus abortivus</u> L.	250	<u>Viola tricolor</u> L.	192
Rhamnaceae			
<u>Rhamnus cathartica</u> L.	192	Total: families, 44; genera, 138; species	
		(entries), 189.	
Rosaceae			
<u>Amelanchier laevis</u> Wieg.	192		
<u>Fragaria</u> spp.	185		
<u>Fragaria vesca</u> L.	6		
<u>Fragaria virginiana</u> Duch.	75		
<u>Potentilla norwegica</u> L.	250		
<u>Prunus avium</u> L.	196		
<u>Prunus cerasus</u> L.	14		

Table 36. Weed hosts of *P. pratensis*

FAMILY & WEED SPECIES	REFERENCE
Leguminosae	
<i>Trifolium pratense</i> L.	260
Umbelliferae	
<i>Pastinaca sativa</i> L.	105

Table 37. Weed hosts of *P. ? pratensis*^a

FAMILY & WEED SPECIES	REFERENCE
Amaranthaceae	
<i>Amaranthus gracilis</i> Desf.	197
<i>Amaranthus retroflexus</i> L.	43
Araceae	
<i>Colocasia</i> sp.	2
Caryophyllaceae	
<i>Stellaria media</i> (L.) Vill.	81
Chenopodiaceae	
<i>Chenopodium album</i> L.	43
Commelinaceae	
<i>Commelina nudiflora</i> L.	in 81
Compositae	
<i>Ageratum conyzoides</i> L.	in 81
<i>Chrysanthemum</i> sp.	236
<i>Emilia coccinea</i> Sweet	197
<i>Emilia sonchifolia</i> DC.	68
<i>Solidago altissima</i> (?)	236
<i>Solidago missouriensis</i> Nutt.	236
<i>Solidago rugosa</i> Mill.	236
<i>Sonchus oleraceus</i> L.	in 81
<i>Taraxacum officinale</i> L.	43
Convolvulaceae	
<i>Ipomoea batatas</i> Lam.	in 81

Cruciferae

<i>Brassica napus</i> L.	
v. <i>arvensis</i> (Lam.) Thellung	43
(Rape or coleseed)	
<i>Sinapis alba</i> L.	43

Cyperaceae

<i>Cyperus strigosus</i> L.	in 81
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Fagaceae

<i>Quercus palustris</i> Muench.	257
<i>Quercus rubra</i> L.	257

Gramineae

<i>Agrostis stolonifera</i> L.	81
<i>Arrhenatherum elatius</i>	
(L.) J. & C. Presl.	111
<i>Avena fatua</i> L.	43
<i>Avena sativa</i> L.	69
<i>Cynodon dactylon</i> (L.) Pers.	81
<i>Dactylis glomerata</i> L.	in 81
<i>Digitaria chinensis</i> Hornem.	in 81
<i>Digitaria sanguinalis</i>	
(L.) Scop.	in 81
<i>Eleusine indica</i> Gaertn.	in 81
<i>Hordeum vulgare</i> L.	69
<i>Lolium perenne</i> L.	82
<i>Oryza sativa</i> L.	232
<i>Paspalum orbiculare</i> Forst.	in 81
<i>Secale cereale</i> L.	210
<i>Setaria verticillata</i>	
(L.) Beauv.	in 81
<i>Setaria viridis</i> (L.) Beauv.	43
<i>Tricholaena rosea</i> Nees	in 81
<i>Triticum aestivum</i> L.	69

Leguminosae

<i>Cassia mimosoides</i> L.	in 81
<i>Cassia occidentalis</i> L.	in 81
<i>Crotalaria anagyroides</i> H.B. & K.	64
<i>Crotalaria saltiana</i> Andrews	in 81
<i>Cytisus monspessulanus</i> L.	235
<i>Glycine hispida</i> Max.	68
<i>Glycine soja</i> Sieb. & Zucc.	68
<i>Indigofera anil</i> L.	in 81
<i>Lupinus luteus</i> L.	69
<i>Lupinus</i> sp.	229

<u>Medicago sativa</u> (L.) L.	40	<u>Nicotiana</u> sp.	43
<u>Melilotus alba</u> Desr.	43	<u>Nicotiana tabacum</u> L.	230
<u>Sesbania</u> sp.	235	<u>Solanum nigrum</u> L.	in 81
<u>Trifolium hybridum</u> L.	26	<u>Solanum tuberosum</u> L.	
<u>Trifolium pratense</u> L.	43	ssp <u>tuberosum</u> L.	39
<u>Trifolium</u> sp.	69	Tiliaceae	
<u>Vicia faba</u> L.	84	<u>Corchorus capsularis</u> L.	113
<u>Vicia tetrasperma</u> (L.) Schreb.	81	Ulmaceae	
Liliaceae		<u>Ulmus parvifolia</u> Jacq.	235
<u>Triumfetta rhomboidea</u> Jacq.	in 81	Umbelliferae	
Malvaceae		<u>Daucus carota</u> L.	
<u>Hibiscus esculentus</u> L.	122	ssp. <u>sativus</u> (Hoffm.) Thell.	69
Myrtaceae		Verbenaceae	
<u>Psidium guajava</u> L.	in 81	<u>Lantana camara</u> L.	in 81
Oxalidaceae		<u>Verbena bonariensis</u> L.	in 81
<u>Oxalis martiana</u> Zucc.	in 81	Vitaceae	
Papaveraceae		<u>Vitis</u> sp.	43
<u>Papaver somniferum</u> L.	73	Total: families, 29; genera, 67; species (entries), 87.	
Pedaliaceae		^a A question remains as to whether the nematode species was <u>P. pratensis</u> .	
<u>Sesamum indicum</u> L.	122		
Pinaceae			
<u>Pinus sylvestris</u> L.	188		
Plantaginaceae			
<u>Plantago major</u> L.	in 84		
Polygonaceae			
<u>Fagopyrum esculentum</u> Moench	81		
<u>Polygonum aviculare</u> L.	81		
<u>Rumex crispus</u> L.	43		
Ranunculaceae			
<u>Delphinium</u> sp.	43		
Rosaceae			
<u>Fragaria indica</u> Andr.	43		
<u>Fragaria vesca</u> L.	6		
<u>Prunus avium</u> L.	188		
<u>Prunus cerasus</u> L.	214		
<u>Rosa canina</u> L.	188		
<u>Rubus idaeus</u> L.	23		
<u>Rubus</u> sp.	43		
Solanaceae			
<u>Lycopersicon esculentum</u> Mill.	68		

Table 38. Weed hosts of P. sacchari

FAMILY & WEED SPECIES	REFERENCE
Gramineae	
<u>Saccharum officinarum</u> L.	221, 228

Table 39. Weed hosts of P. scribneri

FAMILY & WEED SPECIES	REFERENCE
Amaranthaceae	
<u>Amaranthus</u> sp.	222
Betulaceae	
<u>Carpinus caroliniana</u> Walt.	36

Chenopodiaceae	
<u>Beta vulgaris</u> L. spp. <u>vulgaris</u> (Sugarbeet)	246
<u>Chenopodium album</u> L.	222
Gramineae	
<u>Saccharum officinarum</u> L.	141
<u>Sorghum vulgare</u> Pers. v. <u>sudanense</u> Hitchc.	246
Leguminosae	
<u>Phaseolus lunatus</u> L.	246
<u>Trifolium pratense</u> L.	107
Rosaceae	
<u>Rosa</u> sp.	178
Solanaceae	
<u>Lycopersicon esculentum</u> Mill.	246
<u>Solanum tuberosum</u> L. ssp. <u>tuberosum</u> L.	233
Ulmaceae	
<u>Celtis laevigata</u> Willd.	36
Vitaceae	
<u>Vitis</u> sp.	216

Total: families, 9; genera, 13; species (entries), 13.

Table 40. Weed hosts of P. steineri

FAMILY & WEED SPECIES	REFERENCE
Solanaceae	
<u>Solanum tuberosum</u> L. ssp. <u>tuberosum</u> L.	135

Table 41. Weed hosts of P. thornei

FAMILY & WEED SPECIES	REFERENCE
Convolvulaceae	
<u>Dichondra</u> sp.	222

Compositae

<u>Taraxacum</u> sp.	222
Gramineae	
<u>Agrostis</u> spp.	222
<u>Cynodon dactylon</u> (L. C. Rich) Pers.	222
<u>Paspalum dilatatum</u> Poir.	222
<u>Pennisetum clandestinum</u> Hochst.	222
<u>Poa annua</u> L.	222
<u>Sorghum halepense</u> (L.) Pers.	222
<u>Triticum aestivum</u> L.	221
Total: families, 3; genera, 9; species (entries), 9	

Table 42. Weed hosts of P. tumidiceps

FAMILY & WEED SPECIES	REFERENCE
Gramineae	
<u>Secale cereale</u> L.	161
<u>Triticum aestivum</u> L.	161

Table 43. Weed hosts of P. vulnus

FAMILY & WEED SPECIES	REFERENCE
Berberidaceae	
<u>Berberis thunbergii</u> DC.	193
Euphorbiaceae	
<u>Ricinus communis</u> L.	111
Leguminosae	
<u>Acacia</u> spp.	111
<u>Crotalaria juncea</u> L.	111
<u>Crotalaria spectabilis</u> Roth.	111
<u>Cytisus scoparius</u> (L.) Link	111
<u>Lotus corniculatus</u> L.	111
<u>Medicago sativa</u> (L.) L.	111
<u>Melilotus alba</u> Desr.	111
<u>Phaseolus lunatus</u> L.	35
<u>Vicia benghalensis</u> L.	111
<u>Vicia faba</u> L.	111
Liliaceae	
<u>Convallaria majalis</u> L.	222

Moraceae		<u>Dactyloctenium aegyptium</u>	
<u>Ficus</u> sp.	1	(L.) Richt.	87
Oleaceae		<u>Digitaria sanguinalis</u> (L.) Scop.	51
<u>Syringa vulgaris</u> L.	190	<u>Echinochloa crus-galli</u>	
		(L.) Beauv.	120
Polygonaceae		<u>Eleusine indica</u> Gaertn.	120
<u>Polygonum aviculare</u> L.	222	<u>Eragrostis curvula</u>	
		(Schrud.) Nees	220
Rosaceae		<u>Saccharum officinarum</u> L.	41
<u>Prunus avium</u> L.	139	<u>Secale cereale</u> L. v. <u>abruzzii</u>	51
<u>Prunus cerasus</u> L.	139	<u>Setaria italica</u> Beauv.	51
<u>Rosa californica</u>		<u>Sorghum halepense</u> (L.) Pers.	120
Cham. & Schlecht	222	<u>Sorghum vulgare</u> Pers.	51
<u>Rosa</u> sp.	221	<u>Sorghum vulgare</u> Pers.	
<u>Rubus idaeus</u> L.	1	v. <u>sudanense</u> Hitchc.	51
		<u>Sporobolus poiretii</u>	
Salicaceae		(Roem. & Schult.) Hitchc.	120
<u>Salix babylonica</u> L.	1	Leguminosae	
Vitaceae		<u>Crotalaria spectabilis</u> Roth.	148
<u>Vitis</u> sp.	1	<u>Glycine hispida</u> Max.	51
		<u>Glycine soja</u> Sieb. & Zucc.	51
Total: families, 10; genera, 19; species (entries), 23.		Malvaceae	
		<u>Sida rhombifolia</u> L.	148
		Rubiaceae	
		<u>Diodea teres</u> Walt.	87
		Solanaceae	
		<u>Lycopersicon esculentum</u> Mill.	148
		<u>Nicotiana tabacum</u> L.	38
		Verbenaceae	
		<u>Verbena</u> sp.	148
		Zygophyllaceae	
		<u>Tribulus terrestris</u> L.	12
		Total: families, 12; genera, 27; species (entries), 30.	
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Table 44. Weed hosts of <u>P. zea</u>			
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FAMILY & WEED SPECIES REFERENCE			
Amaranthaceae			
<u>Amaranthus retroflexus</u> L.	255		
Apocynaceae			
<u>Vinca rosea</u> L.	148		
Chenopodiaceae			
<u>Chenopodium album</u> L.	255		
Compositae			
<u>Ambrosia artemisiifolia</u> L.	255		
<u>Aster</u> sp.	148		
<u>Helianthus</u> sp.	148		
Euphorbiaceae			
<u>Ricinus communis</u> L.	148		
Gramineae			
<u>Andropogon virginicus</u> L.	87		
<u>Cynodon dactylon</u> (L.) Pers.	12		
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Table 45. Weed hosts of unidentified <u>Pratylenchus</u> spp.			
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FAMILY & WEED SPECIES REFERENCE			
Amaranthaceae			
<u>Amaranthus spinosus</u> L.			87

Araceae		<u>Oryza sativa</u> L.	144
<u>Colocasia antiquorum</u> Schott	104	<u>Phleum pratense</u> L.	45
		<u>Poa annua</u> L.	45
Asparagaceae		<u>Poa pratensis</u> L.	45
<u>Asparagus officinalis</u> L.	185	<u>Poa trivialis</u> L.	45
		<u>Stenotaphrum secundatum</u>	
Balsaminaceae		(Walt.) Kuntze	37
<u>Impatiens parviflora</u> DC.	45		
		Labiatae	
Caryophyllaceae		<u>Mentha</u> sp.	104
<u>Stellaria media</u> (L.) Vill.	45		
		Leguminosae	
Chenopodiaceae		<u>Arachis hypogaea</u> L.	28
<u>Atriplex</u> sp.	45	<u>Crotalaria spectabilis</u> Roth.	87
<u>Chenopodium album</u> L.	45	<u>Glycine hispida</u> Max.	131
<u>Chenopodium ambrosioides</u> L.	87	<u>Glycine soja</u> Sieb. & Zucc.	131
		<u>Lespedeza</u> sp.	87
Compositae		<u>Lupinus angustifolius</u> L.	87
<u>Ambrosia artemisiifolia</u> L.	87	<u>Trifolium pratense</u> L.	107
<u>Aster</u> sp.	101	<u>Vicia villosa</u> Roth.	45
<u>Carduus crispus</u> L.	45		
<u>Centaurea cyanus</u> L.	45	Oleaceae	
<u>Centaurea</u> sp.	191	<u>Syringa vulgaris</u> L.	107
<u>Chrysanthemum</u> sp.	191		
<u>Cichorium intybus</u> L.	45	Pinaceae	
<u>Erigeron canadensis</u> L.	87	<u>Picea glauca</u> (Moench) Voss	8
<u>Galinsoga parviflora</u> Cav.	45		
<u>Heterotheca subaxillaris</u>		Plantaginaceae	
(Lam.) Britt. & Rusby	87	<u>Plantago lanceolata</u> L.	45
<u>Rudbeckia</u> sp.	101	<u>Plantago major</u> L.	45
<u>Solidago canadensis</u> L.	243		
<u>Taraxacum officinale</u> Web.	45	Ranunculaceae	
<u>Xanthium strumarium</u> L.	87	<u>Ranunculus acris</u> L.	103
Cruciferae		Rosaceae	
<u>Capsella bursa-pastoris</u>		<u>Fragaria</u> spp.	87
(L.) Medic.	45	<u>Potentilla anserina</u> L.	45
<u>Raphanus raphanistrum</u> L.	45	<u>Prunus avium</u> L.	265
<u>Sinapsis arvensis</u> L.	45		
<u>Thlaspi arvense</u> L.	45	Rubiaceae	
		<u>Diodia teres</u> Walt.	87
Cupressaceae			
<u>Thuja occidentalis</u> L.	107	Urticaceae	
		<u>Boehmeria</u> sp.	102
Gramineae		<u>Urtica urens</u> L.	45
<u>Agropyron repens</u> (L.) Beauv.	45		
<u>Agrostis stolonifera</u> L.	45	Total: families, 19; genera, 54; species	
<u>Alopecurus pratensis</u> L.	45	(entries), 70.	
<u>Andropogon virginicus</u> Trin.	87		
<u>Bromus inermis</u> Leyss.	45		
<u>Dactylis glomerata</u> L.	45		
<u>Dactyloctenium aegyptiacum</u> Willd.	87		

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