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PLANTS REPORTED RESISTANT OR TOLERANT TO ROOT KNOT NEMATODE INFESTATION

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CONTENTS

SCOPE OF THE COMPILATION

This publication is a compilation of reports on all plant species and varieties that have been called either resistant or tolerant to infestation by the root knot nematode, *Heterodera marioni* (Cornu) Goodey (formerly called *H. radicicola* (Greeff) Müller). The purpose is twofold: To bring together all available information on the subject in condensed form for the use of growers, plant breeders, and other investigators, and to establish a basis for the contribution of further data. It must not be assumed that all of the plants here listed are recommended as resistant. The intention is rather to present technical source material, not only useful to those who need practical information on particular plants but also suggestive to future workers. The literature on this subject contains many contradictions. Some of the reports are hasty in observation or careless in definition and others are incomplete, but they are all included impartially, together with the more reliable and helpful information that is available.

[1] Grateful acknowledgment is made to staff members of the Division of Plant Exploration and Introduction, Bureau of Plant Industry, for checking the entire list of plant names for botanical accuracy. Valuable assistance with the classification of cultural varieties has been received from crop specialists of the Divisions of Cereal Crops and Diseases, Cotton and Other Fiber Crops and Diseases, Forage Crops and Diseases, Fruit and Vegetable Crops and Diseases, and Tobacco and Plant Nutrition.

L. H. Day and W. W. Mackie, of the California Agricultural Experiment Station, C. J. King, of the Division of Cotton and Other Fiber Crops and Diseases, and members of the Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry, have cooperated by supplying information on their latest results and by permitting the use of their data. The Nematode Committee of the California Agricultural Experiment Station has permitted the use of certain citations from its unpublished correspondence.

In order to supply background material for evaluating the most varied interpretations of resistance and also to be useful in the greatest possible number of practical problems, the subject is interpreted rather broadly. A number of definitely susceptible crop plants and ornamentals are included because they have at some time been called "resistant"; it is quite possible that a useful degree of tolerance may be found in some of these plants. A few weeds and certain other plants of no agricultural value are also listed; one or another of these may ultimately give a clue to some phase of the fundamental problem of resistance. The fact that resistant varieties may lack other important qualities, such as market value or congeniality as rootstocks, cannot be considered here; horticulturists are making progress on these problems.

Preliminary Discussion of the Problems Involved in Studying Resistance

Resistance may depend to some extent on plant vigor, which in turn depends on climate, plant nutrition, and other soil conditions. It is therefore obvious that no absolute listing of resistant plants or evaluation of degree of resistance can be made for all conditions; neither is any one writer or organization able to take responsibility for such statements.

Information on plant resistance is based largely on negative evidence and is thus considerably more controversial than are the positive records of infestation. It requires a complete root and a most careful search to be certain that even one plant is entirely free from infestation; it requires careful examination of the roots of many plants, grown for a sufficient length of time in soil known to contain an abundant and well-distributed nematode population, preferably also in several different regions, to pronounce the species or variety resistant. To evaluate any report, the reader should know how carefully this examination was made. The following factors, not always sufficiently taken into account, are suggested as responsible for some of the negative results that have been reported:

Field infestations are far from uniform as they occur in nature; in addition, a large proportion of the existing infestation is sometimes removed from the plot, on the trap-crop principle, when the indicator plants of one nematode experiment are examined before starting another. Not all experimenters state that their plots were heavily infested, but all do imply that they considered the infestation adequate for the conclusions drawn; for this reason their statements on this point are not usually quoted here.

The egg or larval stages necessary to carry on an infestation may at certain seasons be lacking from what appears to be an abundant inoculum of detached galls.

Small amounts of inoculum, unless absolutely fresh, may have been subject to desiccation or, if kept too wet, to putrefaction or to an unbalanced activity of nematode enemies.

Almost any plant may at some time escape infestation (*188*) [2] under conditions of reduced nematode activity and be reported resistant. Therefore a single report of resistance requires confirmation, though the plant may merit further investigation. The fact that such a plant has

[2] Italic numbers in parentheses refer to Literature Cited, p. 78.

never been reported as a host may possibly indicate resistance, though this cannot be assumed, especially for trees, weeds, uncommon plants, or plants usually grown in northern regions.

The question of host preferences by the nematode population under test is not sufficiently understood, but it must be taken into consideration as a possible factor in all negative results. Rootstocks that have seemed highly resistant in many trials have been attacked when tested in other plots (see **Amygdalus,** pp. 13–15), or for an extended time. The recent report of Sherbakoff (see **Gossypium,** p. 36), though far from conclusive, opens for further investigation this problem, which was explained by Steiner (*220*) in 1925.

Reports based on crop growth, on yield, or on superficial healthy appearance should be questioned unless adequately compared with control plants, because plant growth can be greatly influenced by soil fertility and by other cultural and environmental conditions, minimizing for a time the injuries caused by root knot infestation.

Definitions

Because terms relating to the resistance or susceptibility of a plant to its parasites have not yet become standardized, a few commonly used words are again defined according to the best usage that can be determined, but with special reference to the root knot nematode. These definitions are based in part on the Report of the Committee on Technical Words (*197a*). Some minor differences may be noted: (1) The Committee's definition of resistance combines two distinct conditions; the first is substantially the same as in the definition given here, but the second, to "overcome the effects" of the pathogen, seems to fit more accurately into the definition of tolerance on the same page of the report. (2) Symptom expression and damage are often closely connected in fungus diseases, whereas root knot damage may be more or less independent of the symptom of gall formation. (3) Wilbrink's definitions draw a pertinent distinction between susceptibility and sensitivity.

Susceptibility in a plant is its condition of being a suitable host for a given parasite. In the case of root knot even resistant plants, under certain conditions, may be more or less susceptible.

The word affected has been used more or less indiscriminately in the literature on root knot, without explanation of the meaning intended. It may refer either to the mere fact of infestation or to the effect of the infestation on the plant. It should be dropped in favor of the more exact words. It is used in this compilation only as a quotation, when the meaning of the author cited is in doubt.

Tolerance is a capacity to endure without injury or, as applied to root knot, the ability of a plant to continue productive growth even while it is subject to a heavy and increasing infestation—year after year in the case of a perennial. This productiveness or absence of above-ground symptoms (but not absence of galls) has sometimes been taken for resistance; the practical difference is that tolerant plants contribute to the unlimited multiplication of the parasite, whereas resistant plants may be grown to reduce the infestation of the soil.

Resistance in plants is the ability to obstruct the invasion of parasites. The term implies a considerable but not necessarily an absolute freedom from infestation in infested soil. Highly resistant plants show

only an occasional trace of infestation; moderately resistant plants usually support some nematodes, though seldom great numbers of them. However, under conditions either unfavorable to the growth of the plant or else unduly favorable to the nematodes, especially in the greenhouse, where much experimental work is done, resistance may break down entirely. There is nothing in the conception of resistance to imply that the plant will then escape the usual injuries of a heavy infestation.

The causes of resistance are imperfectly understood. They may be physical, chemical, or physiological. They probably differ with the type of plant. The theory of resistance based on lack of attractiveness is disproved for certain plants by the recent work of Linford (*142*). The theory that larvae are unable to penetrate resistant roots is disputed by the recent work of Barrons (*13*), at least for the conditions of his experiment; preliminary investigations by the Division of Nematology may have a similar implication. All of these studies challenge further fundamental investigations on the nature of resistance.

Lack of gall formation following nematode invasion is no criterion of resistance. Although certain grasses and other resistant plants form only very small swellings and harbor only a few nematodes, it cannot be said that they are successfully obstructing the invasion when those nematodes are able to develop and reproduce. Moreover, lack of gall formation may be observed also in certain susceptible plants. The roots of freesia and of cyclamen, for example (*221*), do not react to this parasite with the usual hypertrophy of cortical tissue and, perhaps even for this reason, both of these plants suffer severely from a very few nematode parasites. The opposite case of large galls serving as sap reservoirs for plants in the Sahara Desert (*245*) has been quoted many times. This is not resistance, though it might be called a local and accidental sort of tolerance.

Immunity is freedom or exemption from disease—in this case, complete freedom from nematode infestation. It is possible that in the future this conception may be modified to include plants in which the nematode, though it may occasionally penetrate a rootlet, is never under any conditions able to complete its development. The word immunity has often been used loosely, meaning sometimes resistance and sometimes only tolerance or profitable growth, but promising too much in either sense. Complete immunity is exceedingly rare.

The above distinctions in meaning may seem unnecessary to a grower whose needs can be satisfied by any plant that will thrive in his infested ground. However, they become exceedingly important when resistant plants are to be selected for the purpose of controlling root knot by starvation. Unless marked as quotations, these words are used in accordance with the definitions, except that it is necessary to quote an author's exact words when he gives no explanation of his meaning, even though it seems probable that his meaning was not that of the definitions.

Basis for Selection of Material

Because of the number and diversity of reports on resistance and other relationships of plants to root knot infestation, it is necessary

to be more or less arbitrary in determining what plants should be included in this compilation and also what reports should be cited about the plants listed.

The following kinds of material are included:

1. Every known report of resistance in any plant species or variety, provided that the report was based on first-hand experience or observation. Where contradictory statements were made by one author, his earlier statements have sometimes been omitted, but the latest statement, based on broader experience, is always given; the change is usually in the direction of reporting greater susceptibility than had been found previously. When revisions of a publication make no changes, the original edition is cited.

Reports that infestation, though present, is usually light cannot always be ignored, because they may indicate partial resistance or at least a vigorous root system. Plants rated "c" in Bessey's (*16*) list, meaning "nematodes not abundant and no injury observed," are included, except some weeds and two crop plants, parsley and parsnip, for which all other reports indicate more severe infestation. Bessey cautioned that his ratings should not be depended on altogether, but that they indicated the most severe infestation he had observed on each plant, frequently under uncontrolled conditions.

2. The majority of the reports of tolerance for all plants except weeds, some of which are omitted for reasons explained later. The known hosts should be reconsidered in this connection, because certain plants have a definite capacity for enduring infestation even though they show conspicuous gall development. There are, unfortunately, no experimental measurements of the degree of injury or lack of injury to heavily infested plants, whereas data from mere observation are subject to individual evaluation as well as to external influences. What material is available is given as a starting point for further contributions.

3. The most informative reports on every plant listed, however contradictory. The reason for this is to give a perspective on the present knowledge concerning each plant discussed.

4. Reports from growers considered observant and dependable. Although such data are commonly ignored as unscientific, it is felt that growers have opportunities for making practical observations that are fully as accurate as the majority of the unstandardized experiments and opinions that have been reported in the literature.

5. A few reports included merely for the academic purpose of correcting erroneous published citations of otherwise unfamiliar papers. For example, many errors have been caused by a lack of information concerning the several genera and species of nematodes that parasitize plants. It is easy to lose sight of the fact that the root knot nematode is not the only nematode.

6. Citations of early publications, valuable not only for their historical interest but also because they show the sources of many statements that are still repeated in current bulletins. On the subject of resistance many writers have culled from previously published lists until requotations have become so involved that their origins are frequently not recognized even by the writers who use the material.

7. Unpublished data on recent investigations, by special permission. Breeding and testing projects with beans, cowpeas, and stone fruits are now advancing rapidly enough to change the status of certain recently tested varieties, even discarding some in favor of others more newly discovered or developed.

No attempt is made to include the following kinds of material in entirety, although occasional citations from them are given where additional information is needed on particular plants:

1. Host lists unaccompanied by ratings on susceptibility.

2. Lists or data taken by a writer from other sources, whether or not acknowledged, if there is no reason to believe that original observations are included. Familiarity with many lists and comparison of statements on the less common plants have helped in tracing the sources of compilations. This has not been possible in the case of all popular bulletins, whose authors frequently have considerable practical experience on this subject, although they may also legitimately make use of data from other sources.

3. Reports of plants found "not infested," where there is no good evidence that the plants were exposed to infestation.

4. Reports on plants found "not infested" in one case only, when the same publication reports another case of infestation on the same kind of plant.

5. Reports of "no apparent injury" to infested plants, unless it is clear that the plants were infested heavily and might thus have evidenced tolerance.

6. Certain reports of light infestation. A degree of infestation called light by one observer might be overlooked by another, who would then report as light what the first would call moderate. For example, Neal (*176*) listed host plants as "slightly affected" and as "badly affected." He explained the first heading on page 12: "The 'tap-root,' descending deeply is rarely affected, and the plants seem slightly affected till the sub-cortical layer is filled with worms in all stages of growth. This checks growth . . . the food supply is cut off before decay is visible . . . the plant dies." Another observer could have called such an infestation heavy or severe.

7. Weeds reported only lightly infested and weeds not specifically identified. The growth of weeds is usually so vigorous as to show no apparent injury, even though the roots harbor a sufficient nematode population to be a definite menace to later crop plants.

8. Generalized statements on the resistance of certain plants, e. g., cotton, of which only certain varieties are conceded to be resistant, others susceptible.

9. A number of publications difficult of translation. For example, Ustinov (*241*) discusses in Russian the usual series of resistant field crops; it is assumed, perhaps without justification, that no new experience on the reactions of these plants is reported.

10. Early reports by certain authors if later altered by them.

Possible Standardization of Tests and Reports

The conditions of plant growth and the many factors affecting plant parasites are obviously not amenable to absolute standardization. It is too early even to suggest a uniform method for testing the resistance or tolerance of particular plants. Probably every test will require a number of hosts of known susceptibility and of several degrees of resistance for comparison. A reasonable moderation in claiming resistance will increase the value of all statements. These remarks must not, however, be allowed to discourage the reporting of observations that might in any possible way be of use to either growers or investigators. The possible errors mentioned above can be minimized by well-planned controls.

On the other hand, such a compilation as this shows very clearly the need for standardization, a need that was emphasized at the Nashville [3] and Atlanta [4] conferences on root knot. For the present it is merely urged that all possible controls be included; that all conditions of growth be described very fully; that the terms resistance, tolerance, etc., be used in accordance with some specified definitions; that the basis of the conclusions be explained (how carefully roots were examined, or whether plants were judged mainly by their above-ground growth); and that the horticultural variety as well as the species of every plant be reported.

If variety names were more usually included in plant-disease records, the assembled data would undoubtedly give much information. Where reports concerning susceptibility appear contradictory, the trouble may be merely a lack of information on the reactions of particular varieties of the plant in question. A report of resistance in a notably susceptible species may be discredited if the resistant variety is not named; when the variety is named, additional reports on the same variety are needed for comparison Examples in this publication are corn, dahlia, fig, peony, rose, soybean, and tomato.

[3] U. S. Bureau of Plant Industry. Proceedings of the root-knot nematode conference held at Nashville, Tennessee, Feb. 2 and 3, 1937. U. S. Bur. Plant Indus., Plant Dis. Rptr. Sup. 102, pp. 97–122, illus. 1937. [Mimeographed.]

[4] Tyler, Jocelyn, Ed. Proceedings of the root-knot-nematode conference held at Atlanta, Georgia, February 4, 1938. U. S. Bur. Plant Indus., Plant Dis. Rptr. Sup. 109: 133–142. 1938. [Mimeographed.]

Arrangement

In the list of plant species and varieties (beginning on p. 11), botanical synonyms are given only where these names have been used in one or more of the publications cited. Common names used in the publications cited are given in addition to the standardized common names. Names of cultural varieties that could not be checked are cited in quotation marks.

Where the common name of a plant is included in a citation, it indicates that the botanical name was not reported by the author quoted. The common name is not always repeated in cases where there is no possibility of mistaking the species.

Because the available material is unstandardized and often contradictory, an authority is cited for every statement, giving all data that might affect the conclusions if found in his report. The value of any statement depends obviously on the experience of its author and on his use of terms. A minimum of editorial interpretation has been added; where this is given it follows the citation, separated from it only by brackets. Brackets are used also to indicate supplementary unpublished data of the investigator cited.

Where possible the geographical location is given for each observation. It has never been determined whether the geographical differences in reaction of a given plant are caused by differences in cultural conditions, soil type, climate, nematode population, plant strain, or in the observer's basis of estimation. Latitude is less important to greenhouse experiments than to field observations, but authors have not always indicated the growth conditions of the plants noted.

All statements have presumably been traced back to the original observer except where an indirect source is credited. Because an author's original observations are not always distinguishable from his quotations of other publications, doubtful citations are included, but are indicated by the words "listed as . . ." or else by a question mark following the geographical information. Care has been taken to ascertain that every report refers to the root knot nematode, and this may be assumed for all citations not otherwise indicated, though subject to the confusion and inaccuracies of the literature, where even scientific names have been misapplied.

Capital letters in parentheses follow certain plant names to give supplementary information, as follows:

(**C**) marks the first plant of a genus for which complete data have been cited. The available information may or may not be adequate to indicate the true status of these plants, but every known report is included.

(**M**) marks the first plant of a genus that includes additional species that are conspicuously more susceptible than those listed.

(**N**) marks a species on which infestation has been observed by members of the Division of Nematology. It is thus an evidence of one or more additional instances of infestation, though not necessarily of heavy infestation, for which individual citations are not always given.

(**S**) marks a species that is usually highly susceptible, although either the species or some of its varieties have been reported resistant.

The presence or absence of the key letters (C) and (N) gives information on the completeness of the citations about particular plants, whereas (M) and (S) are used as warnings that this publication is not primarily a list of resistant plants.

GENERALIZED REPORTS BY PLANT GROUPS

Whole groups of related plants do not as a rule show uniform behavior toward root knot infestation, yet generalizations have been made. Grains and grasses are commonly accepted as resistant; writers of bulletins have quoted each other to this effect in a continuous series, but—far from adding any species to those named by Bessey (*16*)—few workers have recorded any original observations of resistance in particular species. When grasses are found infested, on the other hand, the fact is almost invariably reported. This results in a lack of balance in the citations under certain species, in that instances of infestation have been reported more often than instances of resistance. Other grasses, undoubtedly resistant, have never specifically been so reported and are thus not listed at all. Again, there are no reports on any species of fern, yet ferns are possibly as nearly immune as any plants can be. Thus there are certain data that can best be presented in a group arrangement.

Filicineae, ferns.

CHRISTIE, J. R. (Division of Nematology, Bureau of Plant Industry. 1938): Ferns are probably as nearly immune as any plant.

STEINER, G. (Division of Nematology, Bureau of Plant Industry. 1939): Never found nor reported infested.

STONE and SMITH 1898 (*224*): Ferns are listed among greenhouse plants "attacked by nematodes." [Although root knot is the subject of the bulletin, this statement, from whatever source, refers undoubtedly to the fern-leaf nematode, *Aphelenchoides fragariae* (Ritzema Bos) Christie (syn. *Aphelenchus olesistus* Ritzema Bos).]

Taxaceae, yew family, and **Pinaceae**, pine family.

HUME 1937: [5] Harmful infestation never found on the commonly grown conifers, including *Chamaecyparis*, *Juniperus*, *Pinus*, and the Taxaceae. Florida.

YOUNG, V. H. (Arkansas station; in letter, 1937): Coniferous stock seems to show no galls.

The only conifers so far reported infested are *Cedrus*, *Chamaecyparis*, *Juniperus* (only one report each), and *Pinus* (q. v.).

Gramineae (Poaceae), grass family.

BAKER 1910 (*5*): Millet is easily grown on the worst infested soils. Brazil (Para).

BALACHOWSKY and MESNIL 1935 (*6*): Cereals are resistant when they have more than four leaves. [Question: To what nematode? These authors claim to have seen root knot on wheat, but they have included under *Heterodera marioni*, without reference to authorities, citations dealing with *H. schachtii* Schmidt, the sugar-beet nematode (see **Avena** and **Hordeum**), and they describe symptoms for cereals that suggest other nematode diseases (see final paragraph under **Avena**).]

BESSEY 1911 (*16*): Many of the grasses seem to be resistant.

CALIFORNIA NEMATODE COMMITTEE 1925: [6] Cereals resistant.

COBB 1890 (*39*): The cereals generally are "but little affected."

FIKRY 1939 (*64*): Grasses are attacked throughout the Nile Valley. Egypt.

FRANK 1885 (*68*): Infestation conspicuously absent from all cereals; other hosts preferred (one planting). Germany. [The fact that the potato plants and the Cruciferae tested were also conspicuously free from infestation throws considerable doubt on the uniformity of infestation in the test plot.]

GEORGIA COASTAL PLAIN EXPERIMENT STATION 1936 (*83*): In 3-year rotations for tobacco growing, bull grass (*Paspalum boscianum*) has been observed to be very susceptible; tobacco has failed, because of root knot, following this weed; crabgrass, Sudan grass, carpet grass, and Bermuda grass are also susceptible but to a lesser degree.

[5] See discussion of host plants by H. Harold Hume on p. 118 of reference given in footnote 3, p. 6.

[6] CALIFORNIA AGRICULTURAL EXPERIMENT STATION. NEMATODE COMMITTEE. Unpublished data. [1925?]

GOFFART 1934 (*97*): Various plants were grown 6 years in the same plots, infested with the sugar-beet nematode, *Heterodera schachtii;* potato and the legumes became infested by the root knot nematode, not previously known to be present in this land; barley, mustard, oats, rye, sugar beet, and wheat remained free from root knot. Goffart concludes that cereals are never attacked, or are at least unlikely to increase the soil population, but he exempts sugar beet and mustard from this generalization because they were infested by *H. schachtii.* The same four cereals remained free in another plot where root knot developed rather gradually on the legumes. When inoculated with root knot, sugar beets became infested but wheat and oats remained free. [Mustard was not tested in the latter series.] Germany (Berlin-Dahlem).

JACK 1920 (*119*): Small cereals not attacked. Rhodesia (?).

KING and HOPE 1934 (*127*): Small grains beneficial in rotation for control. Arizona.

MCCLINTOCK 1922 (*145*): In tests thus far cereals and grasses are not seriously infested. Georgia.

ORTON 1903 (*187*): Corn, oats, or other grains and grasses ("immune") are recommended for a starvation rotation.

REH 1906 (*198*): Especially injurious in Germany to cereals. [This statement is not documented. It is followed by an extended citation (see **Avena**) from papers on the sugar-beet nematode, *Heterodera schachtii,* in Sweden. Wilke's (*264*) 1925 revision of this material in Sorauer's Handbuch repeats, under root knot, the statement that cereals are sometimes heavily infested in Sweden.]

ROLFS 1907 (*201*): "The grasses generally" are "almost quite immune."

SCOTT, LINDSAY, and HARRISON 1939 (*209*): Root knot present on all grasses in certain districts. [Ms. data: No apparent injury; carries over soil populations.] California (San Joaquin Valley).

SHAW 1940 (*213a*): Tobacco in enclosure units showed less than 10 percent severe infestation following bare fallow or certain highly resistant crops, 75.8 percent following weeds with crabgrass, and 100 percent following tobacco or other susceptible crops. [North Carolina. See **Weeds,** below, for results of other weed rotations, presumably also "with crabgrass."]

STONE and SMITH 1898 (*224*): According to Kühn (*134*), the grass family, with 46 species "subject to nematodes," is one of the most susceptible. [This misquotation of a paper on the sugar-beet nematode, *Heterodera schachtii,* is found in a bulletin on root knot. Kühn's statement, moreover, was that only 4 of the 46 species tested became infested.]

WATSON 1929 (*255*): Millet is usually "immune" or only slightly infested. Florida (?).

——— and GOFF 1937 (*258*): Most grasses harbor some root knot, which does not materially interfere with their growth. Florida.

WHITTLE and DRAIN 1935 (*263*): Practically all weeds and wild grasses are susceptible. Tennessee (?).

Galls are formed on grass roots by the nematode *Ditylenchus radicicola* (Greeff) Filipjev. Until recently (*99*) the species described by Greeff (*101*) was thought to be the root knot nematode. Grasses are infested by a number of other nematodes, more specific in their host relationships, which form galls on the various above-ground parts. See also the final paragraph under **Avena.**

Umbelliferae (Apiaceae), parsley family.

FRANK 1896 (*69*): Especially favored as host plants; e. g., angelica, caraway, carrot, and parsnip. Germany.

NEAL 1889 (*176*): Umbelliferae not susceptible. Florida.

The following genera are known as hosts: *Anethum, Angelica, Apium, Astrantia, Carum, Coriandrum, Cuminum, Daucus, Foeniculum, Hydrocotyle, Oenanthe, Pastinaca, Petroselinum, Sanicula, Trachymene, Trachyspermum. Apium, Daucus, Pastinaca,* and *Petroselinum* are frequently reported infested.

Weeds.

ANONYMOUS 1939 (*2*): One of the rotations in the Texas rose industry uses Bermuda grass and weeds for 3 or more years; "root knot is no longer a serious problem."

CHRISTIE, J. R. (Division of Nematology, Bureau of Plant Industry. 1939): Weeds are sometimes useless as indicator plants. During a field survey in Caroline County, Virginia, the notably susceptible weeds such as amaranth and lambsquarters were not found growing, but buffalo-bur, goldenrod, and ragweed predominated.

CUNNINGHAM 1936 (*51*): All of the more common weeds, e. g., lambsquarters, wild mustard, purslane, ragweed, and smartweed, were found infested at some time during the season. New York (Long Island).

FIKRY 1939 (*64*): Weeds are attacked throughout the Nile Valley. Egypt.

GEORGIA COASTAL PLAIN EXPERIMENT STATION 1935 (*81*): The growth of weeds for 2 successive years has shown satisfactory though not complete prevention of root knot; beggarweed and Florida pursley (*Richardia scabra*) are more resistant than crabgrass. High-quality tobacco can be grown after certain weeds.

——— 1936 (*83*): In various experimental 3-year rotations infestation on tobacco, the third year has averaged between 12 and 15 percent after velvetbeans or native weeds (beggarweed, crabgrass, and Florida pursley) compared with 2 percent after harvested peanuts or after 2 years of bare fallow and 45 percent after less resistant crops; 2-year rotations with weeds have been unsuccessful; 3-year rotations with oats and weeds were successful and practical when susceptible grasses were less numerous than beggarweed and Florida pursley, but much less effective where bull grass (*Paspalum boscianum*) and crabgrass predominated. [See also **Cassia** and **Gramineae.**]

——— 1938 (*85*): Successful control for one tobacco crop by two or more successive crops of oats followed by weeds. [The Nematology report (*84*) in the same bulletin states: "In most places in this vicinity a nearly pure stand of Florida pursley will spring up on plowed ground."]

LE ROUX and STOFBERG 1935 (*137*): Infestation high in experimental plot following weeds, though less than in plot following beans and tobacco. Transvaal.

LUNN and MATTISON 1938 (*143*): A crop of volunteer weeds reduces the root knot population of the soil to the extent that a normal crop of quality tobacco may be expected. Percentage of severe infestation was relatively low on tobacco following horseweed [7] and ragweed [8] planted separately as experimental crops, compared with a high percentage of infestation following corn or cotton. The above weed rotations produce a yield and quality of tobacco superior to that following corn or cotton. Following partridge-pea, "a native wild legume," tobacco showed very little evidence of root knot, with relatively high yield but poor quality. Lambsquarters [9] not only builds up the nematode population but apparently leaves the soil in a somewhat toxic condition (3-year tests). South Carolina.

NAUDE 1939 (*175*): Weeds "heavily affected" included *Amaranthus paniculatus, Atriplex* spp., castor-oil plant, *Chenopodium ambrosioides*, mallow (*Malva parviflora*), nightshade (*Solanum nigrum*), thornapple, and wild tobacco. South Africa (Oudtshoorn).

SCOTT, LINDSAY, and HARRISON 1939 (*209*): Root knot present on all weeds and grasses in certain districts. California (San Joaquin Valley).

SHAW 1940 (*213a*): Tobacco in enclosure units showed less than 10 percent severe infestation following bare fallow or certain highly resistant crops, 75.8 percent following weeds (with crabgrass), 77.5 percent following oats and weeds, and 100 percent following tobacco or other susceptible crops. In field plots, tobacco showed 11 percent severe infestation following peanuts, 35.5 percent following weeds, 43.5 percent following oats and weeds, and 93.3 percent following tobacco (2-year averages); in 3-year rotations, tobacco showed less than 10 percent severe infestation following 2 years' weeds, the same following oats and weeds after peanuts, less than 25 percent following oats and weeds after corn, 45 percent following weeds after cotton, and 93 percent following continuous tobacco (1 year's results). [North Carolina.]

UNITED STATES DEPARTMENT OF AGRICULTURE, OFFICE OF INFORMATION 1935: "Native weeds . . . practically immune." [A misleading statement based on a misunderstanding of results reported from the Georgia Coastal Plain Experiment Station or those of Lunn and Mattison.]

[7] *Erigeron canadensis*, according to Mandelson (*155*).
[8] *Ambrosia elatior* (*A. artemisiaefolia*), according to Mandelson (*155*).
[9] *Chenopodium album*, according to Mandelson (*155*).

WATSON, GOFF, and BRATLEY 1937 (*259*): Most weeds were found to be infested but none heavily. Florida.
WHITTLE and DRAIN 1935 (*263*): Practically all weeds and wild grasses are susceptible. Tennessee (?).

Generalizations on "weeds" are practically meaningless in an analysis of root knot problems. The weed flora varies widely in different regions, and plants that are weeds in some places may even be cultivated in others. Certain weeds have been found useful in nematode-control rotations, as shown above; yet the fact remains that weeds are very often a means of increasing soil infestation, and that the control of weeds is an essential part of all sanitation measures for root knot control.

PLANT SPECIES AND VARIETIES REPORTED RESISTANT OR TOLERANT

Abrus precatorius, paternoster-bean, rosary-pea. (C)
BEELEY 1939 (*14*): Found attacked, but somewhat "resistant." Malaya (?).
BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.

Acanthospermum australe (*A. xanthoides*). (C)
GODFREY 1935:[10] Infestation commonly observed to be light. Hawaii.

Acokanthera (*Toxicophlaea*) sp. (C)
GROWER: Not injured. California.

Agapanthus umbellatus, agapanthus. (C, N)
GROWER: Infestation evident on only a few plants; not particularly troublesome. Florida.

Agave americana, centuryplant. (C)
GROWERS: Vigorous; not injured by infestation. California. [Such statements, from two different growers, do not clearly constitute a host record; there are no other reports on this plant.]

Ageratum conyzoides. (C)
BALLY and REYDON 1931 (*8*): Frequently infested; galls found on dead roots. Java.
BARBER 1901 (*9*): "Very severely attacked, although it did not seem much the worse for it." India (Madras).
BREDA DE HAAN 1899 (*24*): More galls than on other weeds. Sumatra.
FAJARDO and PALO 1933 (*60*): Rated as "resistant" (judged by growth); five plants, all infested. Philippine Islands.
LINFORD 1939 (*142*): Green stem tissue attracted larvae *in vitro*, though somewhat more slowly than did other highly attractive tissues. Hawaii.

Infestations have been reported also from Belgian Congo (*86*), China (*138*), Nyasaland (*214*), and Tanganyika (*269*).

Ageratum sp.
GOFF 1936 (*96*): No infestation found (25 plants, 1 test). Florida.
WATKINS 1929 (*248*): Seriously injured (annual ornamental). Florida.
ZIMMERMANN 1900 (*268*): Heavily infested weed in coffee plantations. Java.

Agropyron repens (*Triticum repens*), couchgrass, quackgrass. (C)
Apparently all citations of this plant as a host of *H. marioni* refer to Greeff (*101*), and Greeff probably had a different nematode (see Goodey, *99*).

Agrostis alba, "herdsgrass," redtop. (C)
BESSEY 1911 (*16*): No infestation found.
GODFREY 1928 (*92*): No infestation found on redtop (one test). Hawaii.
SHAW 1940 (*213a*): Tobacco in enclosure units showed no severe infestation following 2 years' bare fallow, 8.3 percent following 2 years' herdsgrass (redtop), and 100 percent following 2 years' tobacco. [North Carolina.]
WHITTLE and DRAIN 1935 (*263*): Redtop listed as seldom infested or highly resistant. Tennessee (?).

[10] GODFREY, G. H. HITHERTO UNREPORTED HOSTS OF THE ROOT-KNOT NEMATODE. U. S. Bur. Plant Indus., Plant Dis. Rptr. 19: [29]–31. 1935. [Mimeographed.]

Aleurites fordii, tung-oil tree. (N)

DICKEY and MOWRY 1939 (*54*): Young seedlings in nursery stunted or killed, as reported by Newell (*178*); galls almost never found on trees 1 to 18 years of age in heavily infested soil. Ten out of 19 "severely affected" seedlings outgrew all root symptoms in 4 years (illustrations), but remained stunted, 1 required longer, but 8 died. Seedlings from parent tree No. 9 (single fruits) appear extremely vigorous, and more of them have survived than from tree No. 2, Var. Florida (cluster type). Florida.

USTINOV 1936 (*242*): Of no economic importance in the Soviet Union, although root knot occurs wherever tung can be grown; found as one of the principal pests on tung saplings in Abkhazia.

Alfalfa, see **Medicago.**

Algaroba, see **Prosopis.**

Allium cepa, onion. (N)

BARRONS 1939 (*13*): Numerous larvae entered root tips of seedlings (Var. Prizetaker) heavily inoculated in Alabama greenhouse. Onion "has been said to be repellant." [No such statement can be found in literature on the root knot nematode. Steiner (*220*), presumably the authority for this remark on repellancy, and the authorities cited by Steiner all referred to the sugar-beet nematode, *Heterodera schachtii*.]

BESSEY 1911 (*16*): Nematodes abundant, injury apparently not great.

BYARS 1919 (*28*): "Only occasionally reported on onions." [The following paragraph calls onion a susceptible crop; illustration shows approximately 40 galls on 1 root.]

CALIFORNIA NEMATODE COMMITTEE 1925:[11] Sometimes infested, but profitable.

FAJARDO and PALO 1933 (*60*): Rated as "resistant"; five plants infested, five plants free. Philippine Islands.

HUME 1901 (*113*): Infestation does not interfere seriously with the crop. Florida.

KING and HOPE 1934 (*127*): Used with sesbania and vetch in a profitable 2-year rotation. Arizona.

LINFORD 1939 (*142*): Onion leaf tissue attracted larvae *in vitro*, though somewhat more slowly than did other highly attractive tissues. Hawaii.

McCLINTOCK 1922 (*145*): The only vegetable tested that showed much resistance. Georgia.

NEWHALL 1934:[12] Infestation threatened to handicap onion production on muck lands. New York.

PITTMAN 1929 (*192*): Not usually attacked to such an extent as other market-garden plants. Western Australia.

TAUBENHAUS and EZEKIEL 1933 (*226*): Losses rarely serious. Texas.

UNITED STATES BUREAU OF PLANT INDUSTRY 1919:[13] Infestation caused great difficulty in growing onions on a farm near Laredo, Tex.

WATSON 1929 (*255*): Usually "immune" or only slightly infested. Florida.

WILSON 1936 (*265*): Most seriously affected in the seedling stage, plants seldom develop normally afterward. (Grown 40 years in some fields with little rotation.) Ohio.

Onion is infested also by the bulb-and-stem nematode, *Ditylenchus dipsaci* (Kühn) Filipjev, causing stunting, twisting and swelling of leaves, and bloatiness.

Allium porrum, leek.

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.

BRUEL 1938 (*26*): Galls on young plants; infrequent. Belgium.

SANDOROUND 1922 (*207*): Parasitized more or less severely in South Africa.

WHITTLE and DRAIN 1935 (*263*): Leek is listed as slightly infested. Tennessee (?).

Allium sativum, garlic.

FAJARDO and PALO 1933 (*60*): Rated as "resistant" (judged by growth); 15 plants, all infested. Philippine Islands.

Allium schoenoprasum, chive.

No reports whatever have been found for this plant.

[11] See footnote 6, p. 8.

[12] NEWHALL, A. G. ROOT KNOT NEMATODE POPULATION IN NEW YORK REDUCED BY COLD WINTER. U. S. Bur. Plant Indus., Plant Dis. Rptr. 18: 111. 1934. [Mimeographed.]

[13] HASKELL, R. J., and MARTIN, G. H., JR. SUMMARY OF PLANT DISEASES IN THE UNITED STATES IN 1918. II. DISEASES OF FIELD AND VEGETABLE CROPS. U. S. Bur. Plant Indus., Plant Dis. Bul. Sup. 2, pp. 42-83, illus. 1919. [Mimeographed.] See p. 83.

Allium vineale, wild garlic ("wild onion").

BARRONS 1939 (*13*): Appreciable signs of resistance have been observed; when heavily inoculated in greenhouse, numerous larvae entered root tips of seedlings. Alabama.

There are no other host records for this weed.

Almond, see **Amygdalus.**

Aloe spp.

GROWER: Vigorous; not injured by infestation. California. (N)

Alyssum, see **Lobularia.**

Amaranth, globe-, see **Gomphrena.**

Amaranthus caudatus, love-lies-bleeding. (M)

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.
KRISHNA AYYAR 1933 (*131*): Host in south India. [Specific and common names given as above, then "(crimson)".]

Amaranthus caudatus atropurpureus (*A. atropurpureus*), redleaf love-lies-bleeding.

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.

Amaranthus spinosus, carelessweed, pigweed, spiny amaranth. (N)

ATKINSON 1889 (*4*): Found free at Auburn, growing beside an infested species. Alabama.
BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.
NEAL 1889 (*176*): "Badly affected"; favorite host, most dreaded in the spread of root knot. Florida.
STEINER 1934 (*222*): Not attacked, among infested rice plants, though known to be a host. Arkansas.
WATSON and GOFF 1937 (*258*): Infestation comparatively heavy. Florida.

Carelessweed has been called irregularly infested (i. e., not a certain indicator) by an observant pathologist. California.

Amaranthus spp. (N)

GOFF 1936 (*96*): Infestation very heavy on "molten fire," most of the plants greatly stunted. Florida.
WATKINS 1929 (*248*): Annual *Amaranthus* rated as "resistant." Florida.

Amaryllis hybrids. (C)

GROWER: Not attacked. Florida.

Ammi, see **Trachyspermum.**

Amygdalus communis (*Prunus amygdalus*), almond. (N, S)

CALIFORNIA AGRICULTURAL EXPERIMENT STATION 1936 (*30*): Of more than 200 seedlings from a selection by Tufts and Day, only 8 percent "became affected." [According to L. H. Day (in letter, 1939) nearly all developed knots in 1938. See recent publication by Day and Tufts (*53a*).]
HUTCHINS 1937 (*114*): Seedling rootstocks of Var. Nonpareil have been variable in resistance. Georgia.
TUFTS and DAY 1934 (*234*): Seedlings of 15 common commercial varieties and of several crosses were tested 1 to 3 seasons in California; every lot had some severely infested trees. A few vigorous seedlings free from knots were found in Vars. Languedoc, Lewelling, Peerless, Almond 1–11, Seedling 8–23 (Nonpareil × Harriott), crosses Nonpareil × Eureka, Nonpareil × Jordan, and Texas × Eureka. Some seedlings of Bitter No. 23–20 (var. *amara*) were free from knots (1 season, 1934).

Amygdalus davidiana (*Prunus davidiana*), Chinese wild peach.

FIKRY 1939 (*64*): Infestation (verified by Dr. Goodey) very slight and limited to collar region, found on 20 trees; percentage of infestation increased with the growth period (64 trees tested 2 to 5 years). About 5 percent of seedlings are attacked, very slightly, in nursery. Egypt.
HUTCHINS 1937 (*114*): Seedlings vigorous but susceptible. Georgia.
TUFTS and DAY 1934 (*234*): "Has been variously reported as resistant and as susceptible"; according to other records, "has often failed to grow well because of nematodes"; in California tests, 4 trees lightly infested, 1 moderately, all vigorous (1 season). [Data in letter, 1939: More than 100 seedlings planted in 1 orchard, all "affected."]

Amygdalus persica, peach. (N, S)

McCLINTOCK 1922–24 (*145, 146, 147*): Seeds gathered in 1918 from a tree of considerable age, near Tallahassee, Fla.; seedlings grown in Georgia practically free from knots. A large percentage of second-generation seedlings [grown in Tennessee (?)] were free from knots.

Var. AUSTRALIAN SAUCER.

TUFTS 1930 (*233*): Somewhat resistant in California tests, but far behind Shalil. The Saucer type has been "credited with resistance."

——— and DAY 1934 (*234*): Infestation moderate. California.

Var. BELL OCTOBER.

TUFTS and DAY 1934 (*234*): Infestation light (tentative rating). California.

Var. BOKHARA.

TUFTS 1930 (*233*): No knots found on 25 seedlings out of 27 (1 season). California.

——— and DAY 1934 (*234*): No visible infestation on nursery seedlings (3 years) but results not conclusive; a few knots found in heavily infested soil in orchard. [Data in letter, 1939: 701 seedlings 1 to 5 years old in several orchard plots, 21.4 percent "affected."] California.

Var. EARLY WHEELER.

TUFTS and DAY 1934 (*234*): No visible infestation (preliminary test). California.

Vars. HONEY and LEWKINS HONEY [same as Lukens Honey].

TUFTS 1930 (*233*): The Honey type has been "credited with resistance." In California tests, both varieties appeared somewhat resistant but fell far behind Shalil.

——— and DAY 1934 (*234*): Infestation moderate on both varieties. California.

P. I. No. 41395 [dwarf peach, from Swatow, China].

TUFTS and DAY 1934 (*234*): No visible infestation (preliminary test). California.

P. I. No. 61302 [Bolivian Cling peach × Quetta nectarine].

HUTCHINS 1937 (*114*): Vigorous understock; roots have remained entirely free from infestation (tested since 1928). Georgia.

TUFTS and DAY (California station; in letter, L. H. Day, 1939): 236 seedlings in nursery in 1938, 23.3 percent "affected."

Selection "PURPLE LEAF" [from wild seedlings received from New Jersey station].

UNITED STATES BUREAU OF PLANT INDUSTRY 1938 (*238*): "Complete immunity from attack" in parent trees and in a large planting of 1-year seedlings; growth vigorous (tested 4 years). [Subsequent observation by the Division of Fruit and Vegetable Crops and Diseases has indicated that this stock is susceptible to attack.]

SHALIL selections.

DAY, L. H. (*in* 1937 revision of California Circular 330 (*236, p. 32*)): Seedlings of P. I. No. 36485 are perhaps the most resistant of the peaches tested. California.

HUTCHINS 1937 (*114*): Seedlings from P. I. No. 63850 are completely resistant (tested in Georgia since 1928); vigorous as understock; trees for seed production should be propagated in direct clonal line from the original tree at Chico, Calif.

TUFTS and DAY 1934 (*234*): No visible infestation in nursery on seedlings from P. I. Nos. 36485, 63850, and 63851 (3 years); 2 suspected knots on a Shalil seedling in orchard. [Data in letter, 1939: Of 62 seedlings, No. 63850 ("syn. 36485"), in nursery in 1938, 24.2 percent were "affected." Seedlings 1 to 5 years old, in several orchard plots: 326 seedlings of No. 63850, 19.6 percent "affected"; 337 seedlings of No. 63851, 9.79 percent "affected"; 82 seedlings of No. 63852, 9.75 percent "affected."] California.

Var. SMITH.

TUFTS and DAY 1934 (*234*): Infestation light (tentative rating). California.

Var. SUTTER CREEK.

TUFTS and DAY 1934 (*234*): Infestation light (tentative rating). California.

YUNNAN selections, P. I. Nos. 55885, 55886, 55888.
TUFTS and DAY 1934 (*234*): No visible infestation on seedlings (3 years in nursery; 1 season in heavily infested orchard); seedlings vigorous. [Data in letter, 1939: 461 seedlings 1 to 5 years old in several orchard plots, 16.0 percent "affected."] California.

Amygdalus persica nectarina, nectarine. (S)
TUFTS and DAY 1934 (*234*): Moderate and heavy infestations found on 40 varieties of nectarine. California.

Var. LIPPIATT LATE ORANGE.
TUFTS and DAY 1934 (*234*): Infestation light. California.

Var. QUETTA.
TUFTS and DAY 1934 (*234*): No visible infestation; seedlings rather vigorous (preliminary test; six seedlings, 1 season). [Data in letter, 1939: Ten seedlings in nursery in 1936, 1 "affected"; viability of seeds is extremely low.] California.

Var. TOGATCH MONECK.
TUFTS and DAY 1934 (*234*): Infestation light (tentative rating); seedlings rather vigorous. California.

Var. TRAVELER.
TUFTS and DAY 1934 (*234*): No visible infestation (preliminary test). [Data in letter, 1939: No infestation found in 1937 (15 seedlings in test nursery).] California.

Anagallis arvensis, poisonous pimpernel, red pimpernel. (C)
GODFREY 1935: [14] Infestation commonly observed to be light. Hawaii.

Ananas comosus (*A. sativus*), pineapple. (N, S)
COLLINS and HAGAN 1932 (*43*): A wild form from Kailua showed some variation in size of infested plants, lateral and fibrous roots somewhat reduced, relatively low percentage of terminal galls and of infestations on short roots. Hawaii.
VOSBURY and WINSTON 1921 (*244*): Var. Spanish is "less susceptible" than Var. Cayenne. Florida. [Question: Does this statement refer to root knot or to red wilt?]
WATSON and GOFF 1937 (*258*): Rated as No. 24 in order of susceptibility [from okra, No. 1, to corn, No. 46]; there is no definite knot formation when the fleshy roots are infested. Florida.

Var. "NATAL."
COLLINS and HAGAN 1932 (*43*): Fibrous roots somewhat reduced; fewer terminal galls than on some other varieties. Hawaii.

Var. PERNAMBUCO.
COLLINS and HAGAN 1932 (*43*): Size of infested plants irregular; root tips not blinded by infestation; relatively high percentage of roots free from galls; considerable reduction, however, in root development. Hawaii.
HAGAN and COLLINS 1935 (*102*): Reduction in root length and in plant weight, though less severe than in Var. Cayenne. Hawaii.

Ananas sp., and hybrid.
HAGAN and COLLINS 1935 (*102*): A wild pineapple from Brazil was highly tolerant of nematode attack; no reduction in plant weight nor in average length of roots. Hawaii.

Lot 520 (F_1 hybrid, vegetatively reproduced, between Var. Cayenne and a wild pineapple from Brazil).
COLLINS and HAGAN 1932 (*43*): Highly tolerant; root tips not blinded by infestation; root length not significantly reduced during test (8 months); a greater proportion of gall-free roots than other varieties tested. Hawaii.
HAGAN and COLLINS 1935 (*102*): Losses in stump weight and in fibrous roots, though less severe than in Var. Pernambuco; considerable genetic variability found. Hawaii.

[14] See footnote 10, p. 11.

Andropogon virginicus (name supplied), broomsedge. (C)

NEAL 1889 (*176*): No nematodes found where "broom-sedge grass" has grown many years; it smothers other weeds. Florida.

There is no report of infestation on this species; however, *A. schoenanthus* was reported as heavily infested in Sumatra by Breda de Haan (*24*).

Andropogon, see also **Sorghum**.

Anethum graveolens, dill. (C)

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.

Annona cherimola, cherimoya. (C)

CLARK 1925 (*37*): Roots entirely uninjured; trees remain vigorous and healthy where other plants are badly infested. California.

Antirrhinum majus, common snapdragon. (N, S)

BARBER 1901 (*9*): Snapdragons very badly attacked. India (Madras).
BESSEY 1911 (*16*): Injury severe.
GODFREY 1935: [15] Infestation heavy. California and Hawaii.
GOFF 1936 (*96*): Rated as heavily infested; tolerant unless dry. Florida.
GUTERMAN 1931: [16] Seedlings in pots stunted, leaves slightly distorted; little or no growth. New York.
TAUBENHAUS and EZEKIEL 1933 (*226*): May cause serious losses. Texas.
UNITED STATES BUREAU OF PLANT INDUSTRY 1919: [17] Destroyed all the plants in an Omaha greenhouse. Nebraska.
WATKINS 1929 (*248*): Antirrhinum rated as "resistant." Florida.

Apple, see **Malus**.

Apricot, see **Prunus**.

Arachis hypogaea, groundnut, peanut. (N)

BESSEY 1911 (*16*): No infestation found; appears to be free under most conditions.
——— and BYARS 1915 (*17*): Spanish peanut should be suitable for a control rotation.
CALIFORNIA NEMATODE COMMITTEE 1925: [18] Infested but profitable.
COLLINS 1938 (*41*): Vars. Jumbo, "Masumbika," Valencia, and Virginia Bunch were not attacked (1 season). Rhodesia.
FAJARDO and PALO 1933 (*60*): Rated as "resistant" (judged by growth); 15 plants, all infested. Philippine Islands.
GEORGIA COASTAL PLAIN EXPERIMENT STATION 1938 (*85*): Successful control for tobacco by two or more successive crops of Spanish peanuts, harvested; Var. Runner also is highly resistant.
KRISHNA AYYAR 1933 (*132*): Infestation "mild" in pot experiment. India (Madras).
MCCLINTOCK 1922 (*145*): All commercial varieties of both bush and running types have shown marked resistance. Georgia.
MECKSTROTH and CHRISTIE 1931 [19] Generally considered rather resistant; a heavy infestation found on land where strawberry plants had died out the previous year; poor stand of peanuts, plants much stunted. North Carolina.
NEAL 1889 (*176*): Masses of knotty roots, worst case of root knot ever seen. Florida.
NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION 1934 (*181*): Found highly resistant under a variety of conditions.

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[15] GODFREY, G. H. HERBACEOUS ORNAMENTALS HEAVILY INFESTED BY HETERODERA MARIONI (CORNU) GOODEY. U. S. Bur. Plant Indus., Plant Dis. Rptr. 19: 274. 1935. [Mimeographed.]
[16] BARRUS, M. F., BOYD, O. C., and WOON, JESSIE I. DISEASES OF PLANTS IN THE UNITED STATES IN 1930. U. S. Bur. Plant Indus., Plant Dis. Rptr. Sup. 81, pp. 30–135. 1931. [Mimeographed.] See report of C. Guterman, p. 129.
[17] HASKELL, R. J., and MARTIN, G. H., JR. SUMMARY OF PLANT DISEASES IN THE UNITED STATES IN 1918. V. DISEASES OF FIBER CROPS, SUGAR CROPS, FOREST TREES, ORNAMENTAL AND MISCELLANEOUS PLANTS. U. S. Bur. Plant Indus., Plant Dis. Bul. Sup. 5, pp. 160–185. 1919. [Mimeographed.] See p. 183.
[18] See footnote 6, p. 8.
[19] U. S. BUREAU OF PLANT INDUSTRY. ROOT KNOT ON PEANUT. U. S. Bur. Plant Indus., Plant Dis. Rptr. 15: 145. 1931. [Mimeographed.] (Reported by G. A. Meckstroth and J. R. Christie.)

SHAW 1940 (*213a*): Tobacco in enclosure units showed less than 10 percent severe infestation following bare fallow or certain highly resistant crops, 14 percent following peanuts, and 100 percent following tobacco or other susceptible crops. In field plots, tobacco showed 11 percent severe infestation following peanuts and 93.3 percent following tobacco (2-year averages); in 3-year rotations, tobacco showed less than 10 percent severe infestation following peanuts after cotton, the same following oats and weeds after peanuts, less than 25 percent following cotton after peanuts, and 93 percent following continuous tobacco (1 year's results). [North Carolina.]

SMEE 1928 (*214*): Groundnuts can be seriously attacked; little risk "on very slightly infected soil." Nyasaland.

WATSON and GOFF 1937 (*258*): Harbors some root knot, which does not materially interfere with growth; rated as No. 42 in order of susceptibility [from okra, No. 1, to corn, No. 46]. Florida.

Arctotis stoechadifolia (*A. grandis*), bushy arctotis. (C)

GOFF 1936 (*96*): Infestation 0 to heavy; 51 plants free from galls in 2 winter tests, only 1 free in the spring test (92 plants, 3 tests); average rating "very lightly infested." Florida.

WATKINS 1929 (*248*): Annual arctotis rated as "resistant." Florida.

Argemone sp., argemone, pricklepoppy. (C)

GOFF 1936 (*96*): No infestation found (21 plants, 1 test). Florida.

Arrhenatherum elatius, tall oatgrass. (C, N)

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.

Artichoke, see **Cynara.**

Artilleryplant, see **Pilea.**

Aster tradescanti, Michaelmas-daisy. (C)

GOFF 1936 (*96*): 56 plants not infested, 2 plants lightly infested (2 winter tests). Florida.

STEINER, G. (Division of Nematology, Bureau of Plant Industry, 1939): Considerable resistance.

Aster spp., aster. (N)

WATKINS 1929 (*248*): Annual asters rated as "resistant." Florida.

There are four or five reports of root knot on unspecified asters, and one on *A. alpinus.*[20] *Callistephus,* winter-aster, reported infested in Denmark (*23, pp. 468 and 496*), has been erroneously cited as "*Aster* sp."

Avena fatua, "broad-leaved oatgrass," wild oat.

GODFREY 1935:[21] Infestation commonly observed to be light. [In 1930 Godfrey (*94*) reported a heavy infestation.] Hawaii.

Avena sativa, oat.

BALACHOWSKY and MESNIL 1935 (*6*): Injuries on oats especially in northern Europe and southern Australia. [No such reports are known for the root knot nematode; the sugar-beet nematode, *Heterodera schachtii,* has been reported on oats in Germany (*134*), in Sweden (*179*; see Reh, below), and in South Australia (*53*). See also **Gramineae.**]

BARRONS 1939 (*13*): Numerous larvae entered root tips of seedlings (Var. Hastings Hundred Bushel) heavily inoculated in greenhouse; 7 weeks later this series showed only "a few very slight swellings." Alabama.

BESSEY 1911 (*16*): No infestation found on some varieties of oats, but some are susceptible; nematodes not abundant and no injury observed; Var. Winter Turf ("Virginia") used in rotation experiment [no other varieties named].

FRANDSEN 1916 (*67*): "We have succeeded in getting a marked infestation." California.

[20] BUHRER, EDNA M., COOPER, CORINNE, and STEINER, G. A LIST OF PLANTS ATTACKED BY THE ROOT KNOT NEMATODE (HETERODERA MARIONI). U. S. Bur. Plant Indus., Plant Dis. Rptr. 17: 64-96. 1933. [Mimeographed.]

[21] See footnote 10, p. 11.

GEORGIA COASTAL PLAIN EXPERIMENT STATION 1938 (*85*): Successful control for one tobacco crop by two or more successive crops of oats followed by weeds.

GODFREY 1928 (*92*): Infestation abundant (one test). Hawaii.

GOFFART 1934 (*97*): Not infested in greenhouse experiment (8-week tests). Germany (Berlin-Dahlem). [See also **Gramineae.**]

HALSTED 1891 (*103*): "Nematodes" found "in the roots of sickly oats." New Jersey. [This has been cited as the original report of root knot on oats. However, there are reasons for doubt: There is no mention of galls on the roots; the general term "nematodes" is used in the same publication for several very different species; and the disease had already been diagnosed as caused by bacteria.]

LE ROUX and STOFBERG 1935 (*137*): Resistant in rotation experiment. Transvaal.

ORTON 1903 (*187*): Oats ("immune") recommended for a starvation rotation.

REH 1906 (*198*): Injuries up to 75 percent in Sweden. [The paragraph describing these injuries is taken directly from an abstract of papers by Nilsson-Ehle (*179*) on the sugar-beet nematode, *Heterodera schachtii*.]

SHAW 1940 (*213a*): Tobacco in enclosure units showed less than 10 percent severe infestation following oats and bare fallow, 77.5 percent following oats and weeds, and 100 percent following tobacco or other susceptible crops. In field plots, tobacco showed 11 percent severe infestation following peanuts, 43.5 percent following oats and weeds, and 93.3 percent following tobacco (2-year averages); in 3-year rotations, tobacco showed less than 10 percent severe infestation following oats [and weeds after peanuts], less than 25 percent following oats and weeds after corn, and 93 percent following continuous tobacco (1 year's results). [North Carolina.]

WATSON and GOFF 1937 (*258*): Harbors some root knot, which does not materially interfere with growth. Florida.

Oats and other cereals are attacked by the bulb-and-stem nematode, *Ditylenchus dipsaci*, with swelling of stems ("tulip root"), stunting, and twisting or thickening of leaves, which may stand rigidly upright ("segging"); by the sugar-beet nematode, *Heterodera schachtii*, which causes severe stunting and yellowing, and even "nodular thickenings on the roots, from which numerous lateral roots are given off" (*53*); and by the meadow nematode, *Pratylenchus pratensis* (deMan) Filipjev.

Avocado, see **Persea.**

Azalea, see **Rhododendron.**

Banana, see **Musa.**

Barley, see **Hordeum.**

Barnyard grass, see **Echinochloa.**

Bean, see **Phaseolus**; see also blackeye, guar, hyacinth-bean, jackbean, kudzu-bean, lablab, paternoster-bean, soybean, velvetbean, yam-bean.

Beggarweed, see **Desmodium.**

Berkheya gracilis. (C)

COLLINS 1937 (*41*): No signs of nematode attack. Rhodesia.

Bermuda grass, see **Cynodon.**

Berseem, see **Trifolium.**

Bidens bipinnata, Spanish needles. (C)

BESSEY 1911 (*16*): Always found free.

Bidens insecta (*Coreopsis insecta*).

COLLINS 1937 (*41*): No signs of nematode attack. Rhodesia.

Bidens leucantha.

BESSEY 1911 (*16*): Always found free.

Bidens pilosa, blackjack, Spanish-needles, stick-tight.

COLLINS 1937 (*41*): No signs of nematode attack. Rhodesia.
GODFREY 1935:[22] Infestation rare. Hawaii.

[22] See footnote 10, p. 11.

LINFORD 1939 (*142*): Green stem tissue attracted larvae *in vitro*, though somewhat more slowly than did other highly attractive tissues. Hawaii.
SMEE 1928 (*214*): Found attacked in Nyasaland.

Bidens spp.

GHESQUIÈRE 1925 (*87*): Harbors many nematodes. Belgian Congo. [Question: One of the above species?]
MUSZYNSKI and STRAZEWICZ 1932 (*174*): *B. tripartita* found infested. Poland.

Blackberry, see **Rubus.**

Blackeye-bean, see **Vigna.**

Bluegrass, see **Poa.**

Boerhaavia erecta.

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.

Brassica alba (*Sinapis alba*), white mustard. **(M)**

HÖSTERMANN 1922 (*111*): Infestation very light. Germany (experimental).

Brassica campestris var. **napo-brassica,** rutabaga. **(N)**

ATKINSON 1889 (*4*): "Badly affected" in Alabama.
BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.
SANDGROUND 1922 (*207*): Turnip ("*B. campestris*") parasitized more or less severely in South Africa.
TAUBENHAUS and EZEKIEL 1933 (*226*): Infested occasionally, little loss. Texas.

Brassica japonica, mustard, potherb mustard.

BARRONS 1939 (*13*): Appreciable signs of resistance have been observed. When heavily inoculated in greenhouse, numerous larvae entered root tips of seedlings (var. Giant Southern Curled). Alabama.

Brassica juncea (*B. integrifolia*), Chinese mustard.

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.
FAJARDO and PALO 1933 (*60*): Subject to injury. Philippine Islands.
KRISHNA AYYAR 1933 (*131*): Host in south India.

Brassica oleracea botrytis, broccoli. **(N)**

BESSEY 1911 (*16*): Nematodes abundant, injury apparently not great.
CUNNINGHAM 1936 (*51*): No evidence of infestation in the field; seedlings severely infested in greenhouse. New York (Long Island).

Brassica oleracea gemmifera, brussels sprouts.

No reports whatever have been found for this plant.

Brassica oleracea viridis (*B. oleracea acephala*), collards, kale. **(N)**

BAKER 1910 (*5*): Collards "fairly resistant." [Question: Meaning tolerant?] Brazil (Para).
BESSEY 1911 (*16*): Nematodes abundant, injury apparently not great.
TAUBENHAUS and EZEKIEL 1933 (*226*): Infested occasionally, little loss. Texas.
WATSON and GOFF 1937 (*258*): Collards rated as No. 33 in order of susceptibility [from okra, No. 1, to corn, No. 46]. Florida.
WHITTLE and DRAIN 1935 (*263*): Listed as slightly infested. Tennessee (?).
ZIMMERLEY and SPENCER 1923 (*267*): Kale is less severely attacked but serves as a host. Virginia.

Brassica rapa, turnip. **(N)**

BAKER 1910 (*5*): Turnip extremely susceptible. Brazil (Para).
BARRONS 1939 (*13*): Listed as showing "appreciable signs of resistance"; Var. "Purple Top White Globe" infested experimentally. Alabama.
BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.
BOYD 1926:[23] Generally of slight importance on turnips in southern Georgia, but observed to be severe in three gardens.
COBB 1890 (*39*): Young turnips die in a few weeks. New South Wales.

[23] JEHLE, R. A., and WOOD, JESSIE I. DISEASES OF VEGETABLE AND FIELD CROPS IN THE UNITED STATES IN 1925. U. S. Bur. Plant Indus., Plant Dis. Rptr. Sup. 45, pp. 1–152, illus. 1926. [Mimeographed.] See report of Boyd, p. 83.

HARRIS 1938 (*104*): "Observed to be tolerant," supporting a moderate infestation without showing ill effects. Tanganyika.
HUME 1901 (*113*): Infestation does not interfere seriously with the crop. Florida.
TAUBENHAUS and EZEKIEL 1933 (*226*): Losses rarely serious. Texas.
UNITED STATES BUREAU OF PLANT INDUSTRY 1920:[24] Common in South Carolina, loss estimated at 1 percent.
WATSON 1929 (*255*): Turnips usually "immune" or only slightly infested. Florida.

Brassica spp. **(N, S)**

FRANK 1885 (*68*): Infestation conspicuously absent from Cruciferae; other hosts preferred (one planting). Germany. [In 1896 Frank (*69*) listed "*Brassica* spp." as host plants.]
NEAL 1889 (*176*): The genus *Brassica* "badly affected."

Several species of *Brassica* are commonly known as mustard; reports of infestation on "mustard," which should be given to balance the above reports of resistance, have been omitted because species were not recorded.

Broccoli, see **Brassica.**

Bromus catharticus (*B. schraderi*), rescue grass.

BESSEY 1911 (*16*): No infestation found.

Broomcorn millet, see **Panicum.**

Broomsedge, see **Andropogon.**

Brussels sprouts, see **Brassica.**

Buckwheat, see **Fagopyrum.**

Buffel, see **Panicum** and **Pennisetum.**

Bur-clover, see **Medicago.**

Bushclover, see **Lespedeza.**

Butternut, see **Juglans.**

Cactus, see **Cereus** and **Opuntia.**

Cajanus indicus, pigeonpea, red gram. **(C)**

BEELEY 1939 (*14*): Found attacked, but somewhat resistant. Malaya (?).
BESSEY 1911 (*16*): Nematodes abundant, injury apparently not great.
COLLINS 1938 (*41*): Attacked (1 season). Rhodesia.
GODFREY 1928 (*93*): In general a very high degree of resistance, plants sometimes badly hit; Var. New Era showed striking resistance. Hawaii.
KRISHNA AYYAR 1933 (*131, 132*): No infestation found in pot experiment nor in infested plot, and soil population reduced. India (Madras).
MACKIE, W. W. (California station; in letter, 1939): Susceptible forms may be killed. Recent work [of Mackie] has produced many highly resistant strains, both by plant selection and from hybrid origin.
SANDGROUND 1922 (*207*): Parasitized more or less severely in South Africa.

Calendula sp., calendula, pot-marigold. **(N, S)**

MELCHERS 1915 (*159*): Vars. "Eldorado" and "Vaughan's Mammoth Mixture" apparently "unaffected." Kansas (in greenhouse). [This statement, unquestioned, was quoted by Tyler (*236*). It is the only report of resistance in calendula; other authors report heavy infestations. The resistant plants in the experiment are now assumed to have been true African marigold, *Tagetes erecta.* No "Eldorado" calendula has been found in any seed catalog, old or recent. In Vaughan's catalogs from 1910 through 1915 the variety name Eldorado was applied only to marigold and to Oenothera; there was a "Vaughan's Special Mixture" of marigolds, and "All Colors Mixed" of calendulas.]

California-poppy, see **Eschscholtzia.**

Calla, see **Zantedeschia.**

Calliopsis, see **Coreopsis.**

[24] HASKELL, R. J., and WOOD, JESSIE. DISEASES OF FIELD AND VEGETABLE CROPS IN THE UNITED STATES IN 1919. U. S. Bur. Plant Indus., Plant Dis. Bul. Sup. 10, pp. 180–273. 1920. [Mimeographed.] See p. 242.

Camellia japonica, common camellia. (C)

FLORIDA STATE PLANT BOARD 1919 (*66*): One infested shipment of "japonica" intercepted, from Georgia.

HUME 1937: [25] Never seen infested; all camellias appear to be free from attack. Florida.

UNITED STATES BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE: Infestation intercepted in 1934, from Japan.

Camellia sasanqua, sasanqua-tea.

HUME 1937: [26] Never seen infested. Florida.

Canavalia ensiformis, jackbean.

BESSEY 1911 (*16*): Nematodes abundant, injury apparently not great.

COLLINS 1930 (*42*): Hybrid forms were found infested. Hawaii.

GODFREY 1928 (*93*): Resistance high, perhaps complete immunity. Hawaii.

KRISHNA AYYAR 1933 (*131*): Host in south India.

Candytuft, see **Iberis.**

Cane, see **Saccharum** and **Sorghum.**

Canistel, see **Lucuma.**

Canna spp., and hybrids, canna. (C)

FLORIDA STATE PLANT BOARD 1919 (*66*): One infested shipment intercepted, from New York.

GODFREY 1928 (*91*): Infestation abundant on one planting of edible canna, *C. edulis*, striking resistance on another planting; heavy infestation on red canna, which is less vigorous. Hawaii.

KRISHNA AYYAR 1926 (*130*): *C. indica*, "Indian-shot," badly infested in south India.

MELCHERS 1915 (*159*): "Canna varieties . . . apparently unaffected." Kansas (in greenhouse).

Capriola, see **Cynodon.**

Caraway, see **Carum.**

Carelessweed, see **Amaranthus.**

Carissa bispinosa, amatungula. (C)

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.

Carnation, see **Dianthus.**

Carob, see **Ceratonia.**

Carthamus tinctorius, safflower. (C)

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.

KRISHNA AYYAR 1933 (*132*): No infestation found in pot experiment. India (Madras).

Carum carvi, caraway. (C, N)

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.

FRANK 1885 (*68*): Heavily galled plants suffer especially during the second and later years. Germany.

Carya pecan (*C. olivaeformis; Hicoria pecan*), pecan. (N)

BESSEY 1911 (*16*): Injury severe.

NEAL 1889 (*176*): "Slightly affected"; older trees remain stationary a year or so and die with the occasion of a severe drought. Florida.

TAUBENHAUS and EZEKIEL 1933 (*226*): Losses rarely serious. Texas.

UNITED STATES DIVISION OF POMOLOGY 1896 (*240*): "Known to be free from injury or but slightly affected."

WATSON and GOFF 1937 (*258*): Attacked to some extent but not so seriously injured; can usually be successfully raised in heavily infested soil; rated as No. 37 in order of susceptibility [from okra, No. 1, to corn, No. 46]. Florida.

Cassava, see **Manihot.**

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[25] [26] See footnote 5, p. 8.

Cassia tora (*C. obtusifolia*), ("coffeeweed"), wild senna. **(M, N)**

ATKINSON 1889 (*4*): Found "affected" in Alabama.
BESSEY 1911 (*16*): No infestation found.
GEORGIA COASTAL PLAIN EXPERIMENT STATION 1936 (*83*): More resistant than the larger species, *C. occidentalis*.
UNITED STATES BUREAU OF PLANT INDUSTRY (unpublished data in files of Division of Nematology. 1939): Light infestation recently submitted from Georgia, and also specimens from South Carolina showing mostly the young stages, in large numbers.

Castanea dentata (*C. americana*), American chestnut. **(C)**

No reports whatever have been found for this species; there is, however, one report of galls found on *C. sativa* (*C. vesca*), Spanish chestnut, and one record for *C. henryi*.

Castor-bean, see **Ricinus.**

Catalpa spp., catalpa. **(C, N)**

STEINER 1938:[27] Infested in forest nurseries. [Additional observation: Apparently the top growth is little disturbed by heavy infestation.]
WATSON and GOFF 1937 (*258*): Catalpa rated as No. 44 in order of susceptibility [from okra, No. 1, to corn, No. 46]. Plants "at the bottom of the list are little affected and for all practical purposes can be considered as immune." Florida.
WHITTLE and DRAIN 1935 (*263*): Catalpa listed as badly infested. Tennessee.

C. bignonioides, common catalpa, native in the Southern States, has not been reported specifically as a host plant. R. F. Poole mentioned at the root knot conference at Nashville in 1937 that infestation prevents the growth of catalpa in a sand-hill area in North Carolina. *C. ovata* was reported once as a host, from Maryland; *C. speciosa*, western catalpa, is severely injured according to Bessey (*16*), but according to Taubenhaus and Ezekiel (*226*) it is infested occasionally in Texas, with little loss.

Catjang-pea, see **Vigna.**

Cecropia palmata. **(C)**

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.

Centaurea cyanus, cornflower. **(N, S)**

BARBER 1901 (*9*): Cornflowers very badly attacked. India (Madras).
BESSEY 1911 (*16*): Injury severe.
GOFF 1936 (*96*): Infestation heavy; tolerant unless dry. Florida.
WATKINS 1929 (*248*): "Centaurea" seriously injured. Florida.

Centaurea imperialis, royal sweet-sultan.

MELCHERS 1915 (*159*): Apparently "unaffected." Kansas (in greenhouse).

Centrosema pubescens. **(M, S)**

BEELEY 1939 (*14*): Has formed a satisfactory cover in instances where the more woody covers had been killed by root knot. Severe infestation illustrated. Malaya.

Centuryplant, see **Agave.**

Ceratonia siliqua, carob, St. Johnsbread. **(C)**

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.
CALIFORNIA NEMATODE COMMITTEE 1925:[28] Resistant.

Cereus spp. **(N)**

GROWER: Vigorous; not injured by infestation. California.

Chaetochloa, see **Setaria.**

Chamaecyparis spp., "cypress," "retinispora." **(C)**

BLATTNÝ 1930 (*18*): Knotted root illustrated. Czechoslovakia.
HUME 1937:[29] No harmful infestation ever seen. Florida.

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[27] See discussion by Steiner on p. 139 of reference given in footnote 4, p. 6.
[28] See footnote 6, p. 8.
[29] See footnote 5, p. 8.

Chenopodium album, lambsquarters. (N, S)

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.
COURTNEY, W. D. (Division of Nematology, Bureau of Plant Industry. 1937): Useful as an indicator weed. Oregon.
CUNNINGHAM 1936 (*51*): Infested weed. New York (Long Island).
HAUSER 1937 (*106*): Weed attacked in greenhouse.
HÖSTERMANN 1922 (*111*): Infestation very light. Germany (experimental).
LUNN and MATTISON 1938 (*143*): Nematode population built up by lambsquarters. South Carolina.
MUSZYNSKI and STRAZEWICZ 1932 (*174*): No infestation found. Poland.

Cherimoya, see **Annona.**

Cherry, see **Prunus.**

Chestnut, see **Castanea.**

Chinaberry, see **Melia.**

Chive, see **Allium.**

Chloris gayana, Rhodes grass. (C)

COLLINS 1938 (*41*): Rhodes grass not attacked (1 season). Rhodesia.
GODFREY 1935: [30] Infestation commonly observed to be light. Hawaii.

Chokecherry, see **Prunus.**

Chrysanthemum frutescens, marguerite. (N)

BOSHER and NEWTON 1933: [31] No root knots nor other symptoms. Canada (in window box).
BUHRER, E. M. (Division of Nematology, Bureau of Plant Industry. 1934): A heavy infestation observed (white marguerite). District of Columbia.
COTTE 1912 (*48*): Var. "Rêve d'Or" most heavily attacked, "Mme. Aunie" less, and "Coronation" very little. France. [This is a citation of a paper by Jumelle and Raybaud, which cannot be found in this country; whether or not Cotte also saw the specimens is not clear.]
MELCHERS 1915 (*159*): Galls found. Kansas (in greenhouse).

Chufa, see **Cyperus.**

Cinchona sp., Peruvian-bark, quinine tree.

BARBER 1901 (*9*): Pretty extensively "affected," but the trees appear perfectly healthy; illustration of heavily infested root. India (Madras).
MENZEL 1925 (*160*): Not much injury. Netherland East Indies.

Cineraria, see **Senecio.**

Citrullus vulgaris crosses, watermelon. (N, S)

BESSEY 1911 (*16*): Root knot found on only 4 out of 333 plants of 1 of the strains of watermelon × "citron" bred by Orton for wilt resistance. [There are no reports on nematode resistance in the strains now cultivated.]

Citrus spp. (C, N)

BESSEY 1911 (*16*): No infestation found on any species of citrus (3 years in a part of Florida where root knot is abundant). "Dr. H. J. Webber and Prof. P. H. Rolfs . . . confirm this."
CALIFORNIA NEMATODE COMMITTEE 1925: [32] Citrus roots resistant.
EASSON (quoted by Cobb 1890 (*39*)): Roots of orange trees are not troubled. [New South Wales.]
GANDARA 1920 (*74*): "*Heterodera radicicola*" ("un anélido microscópico"!) on *C. aurantium* at a ranch in Yucatan. [Root knot galls in figure 17 are sketched after Göldi's (*98*) illustration of coffee roots; the "anguflula" illustrated in figure 18 is not *H. marioni*.]
GHESQUIÈRE 1921 (*86*): Root knot found on several species. Belgian Congo.

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[30] See footnote 10, p. 11.
[31] BOSHER, J. E., and NEWTON, W. HOST PREFERENCE OF THE ROOT KNOT NEMATODE. U. S. Bur. Plant Indus., Plant Dis. Rptr. 17: 18–19. 1933. [Mimeographed.]
[32] See footnote 6, p. 8.

LAVERGNE 1901 (*135, 136*): "*Anguillula vialae*" was found after considerable searching in decayed roots of orange and lemon; orange was much more resistant to the citrus disease than was lemon; bitter orange seemed absolutely free. Chile. [Lavergne's *Anguillula vialae* measured 2.0 to 2.5 mm., much larger than the root knot nematode; sketches show stylet-bearing nematodes, annelids, and insect larvae, all labeled "anguillule." There is no statement that galls were found on any citrus roots. Some of the galls on grape were probably root knot, others probably phylloxera galls, but grape was not affected by the citrus disease.]

NEAL 1889 (*176*): Bitter-sweet orange, lemon, and orange "slightly affected." "The grape, fig, mulberry, and orange are prone to circular knob-like knots on the sides of the larger roots, and an occasional enlargement at the junction of small roots." The hardy bitter-sweet or sour species nearly disease-proof and a vigorous grower; *Citrus nobilis unshiu*, Satsuma orange, and also *Poncirus trifoliata* (*Citrus trifoliata*), hardy orange, seem resistant, "but the time of trial has been too short." Florida.

WATSON and GOFF 1937 (*258*): Citrus trees seem to be entirely free from attack. Florida.

WEBBER and ORTON 1902 (*260*): Roots of orange trees in all parts of Florida were carefully examined; no trace of nematode injury found.

Reports of infestation by the citrus-root nematode, *Tylenchulus semi-penetrans* Cobb, should not be mistaken as root knot.

Clematis spp., clematis. **(N, S)**

BESSEY 1911 (*16*): Injury to *C. paniculata* severe.

CHIFFLOT 1900 (*35*): Varieties of five species are named as most affected by a severe disease that wilts the plants overnight, rapidly blackens the collar and branches, and desiccates the plant. A few dead plants [the kind not stated] were pulled up; they showed numerous small and large galls. France.

LINDINGER (oral communication quoted by Wilke (*264*)): Roots of *C. viticella*, Italian clematis, heavily knotted but without injury to the plants. Germany (Bavaria).

MILBRATH 1927 (*163*): Normal flower production is prevented. California.

MÜLLER 1884 (*173*): Plants badly diseased; finally killed. Germany.

RITZEMA BOS 1900 (*199*): Plants in nurseries with favorable growth conditions appear equally healthy whether or not the roots are covered with galls.

TAUBENHAUS and EZEKIEL 1933 (*226*): Losses rarely serious. Texas.

WHITE 1930 (*262*): Listed among the ornamentals generally considered most highly susceptible.

Only these few references discuss the amount or severity of infestation; 20 species and numerous varieties have, however, been reported as hosts. According to the experience of the Division of Nematology infestation is serious, in some cases at least, on *C. jackmanii* and other species.

Cleome gynandra, small spider-flower.

GODFREY 1935:[33] Infestation commonly observed to be light. Hawaii.

Clover, Egyptian, see **Trifolium**; bur-clover, see **Medicago**; bushclover, Japanese-clover, see **Lespedeza**; Mexican-clover, see **Richardia**; sweetclover, see **Melilotus.**

Coffea arabica, Arabian coffee. **(N, S)**

BESSEY 1911 (*16*): Injury severe.

FRANK 1885 (*68*): Galls fairly numerous in several inoculated pots; in two pots the inoculum was apparently inadequate. Germany.

JOBERT 1878 (*120*): Galls found on the feeding rootlets of trees that appeared vigorous; black mycelium on the roots of dead trees. Brazil. [Although the above are the only definite statements of facts concerning the etiology of a disease that caused rapid and extensive destruction in many plantations, the discussion in this paper seems to have started the idea of the severity of root knot on *C. arabica*. This paper has been cited as the original report of root knot on this species. Root knot is unmistakably described, but the kind of coffee is not named.]

[33] See footnote 10, p. 11.

RITCHIE 1926 (*218*): Infestation is becoming serious in the Congo; considerable damage in new plantings.

THIERRY 1900 (*228*): Infested plants may appear vigorous, but they require good nutrition in order to form new superficial roots as the older roots die. Martinique.

ZIMMERMANN 1900 (*268*): Apparently resistant in Java; root knot could not be identified on any coffee roots, although weeds were found infested in many plantations; experimental inoculation of four plants in two pots was twice negative.

——— 1903 (*269*): Many young trees infested in seedbeds, but when set out they grew vigorously and in some cases the galls seemed to disappear; no galls were found on coffee growing near heavily infested lupine. Tanganyika (German East Africa).

Coffea canephora.

GHESQUIÈRE 1921 (*86*): "Var. Sankuruensis" is infested but seems somewhat "resistant." Belgian Congo.

Coffea excelsa.

GHESQUIÈRE 1921 (*86*): Found infested but seems somewhat "resistant." Belgian Congo.

Coffea liberica, Liberian coffee. (N)

BORDAZ 1914 (*21*): Only Liberian and robusta coffees remain in Martinique; the eelworms attack Arabian coffee especially.

BOUQUET DE LA GRYE 1899 (*22*): Not attacked (quoting Thierry's (*228*) work).

GHESQUIÈRE 1921 (*86*): Infested, but seems somewhat "resistant." Belgian Congo.

GÖLDI 1888 (*98*): More hardy, but does not escape the disease. Brazil. [Question: Which disease? Göldi concluded that the chronic form of the coffee disease differed only in intensity from the acute form, which killed trees without warning in 8 to 15 days and was obviously not caused primarily by root knot; he gave root galls, however, as a characteristic of "the disease."]

SARDELYS 1902 (*208*): "*Meloidogyne exigua*" was definitely determined on "*C. liberica* hybrids" which died suddenly. Madagascar. [*M. exigua* is the name given by Göldi (*98*) to the root knot nematode, but Sardelys took it for the name of a disease caused by the nematode "*Tylenchus coffeae*"; the basis of his diagnosis is left obscure; the lack of original observations is concealed in a mass of generalities, mostly taken from other authors. Delacroix (in *208*) answered this letter without seeing the specimens and assumed that the disease was root knot.]

THIERRY 1900 (*228*): Not attacked; observations and experiments appear entirely conclusive; *C. arabica* can be grafted onto these resistant roots. Martinique.

ZIMMERMANN 1900 (*268*): Not found infested in Java.

——— 1903 (*269*): Galls observed on young plants. Tanganyika (German East Africa).

Coffea myrtifolia.

RITCHIE 1926 (*218*): Is being considered in the Congo as a rootstock because of its resistance.

Coffea robusta. (N)

BALLY 1927 (*7*): Infestation in Java only sporadic.

——— and REYDON 1931 (*8*): No infestation found on roots inoculated with galls from tobacco and indigo. Java.

BORDAZ 1914 (*21*): Only Liberian and robusta coffees remain in Martinique; the eelworms attack Arabian coffee especially.

CEYLON DEPARTMENT OF AGRICULTURE 1936 (*33*): Seedlings listed among plants attacked in Ceylon.

CRAMER 1906 (*49*): Coffee is subject to two nematode diseases. Netherland East Indies. [This paper shows no first-hand knowledge except that *C. robusta* was suffering from some serious disease.]

GHESQUIÈRE 1921 (*86*): Found infested in Belgian Congo.

Coffea spp., coffee [species not stated by authors].

BALLY and REYDON 1931 (*8*): Infested trees often seem to flourish. Java. [The species most discussed in this paper are *C. arabica* and *C. robusta*, but even the illustration of young plants with badly infested taproots is labeled merely "coffee."]

BARBER 1901 (*9*): No authentic case of infestation has been reported in south India.

BONDAR 1915 (*20*): Found free in infested soil; instances of infestation have been found, usually on tender young roots in damp, shaded land; inoculation experiment negative (eight pots, 8 months). Brazil.

FAWCETT 1915 (*61*): Root knot (confirmed by Bessey (*16, p. 75*)) found at the base of the trunk. "No real evidence that the trees are really injured by this disease," possibly because of heavy soil. Puerto Rico.

SOLTWEDEL 1889 (*217*): Infestation found in three different plantations in central Java.

Coffee roots are infested by a number of other nematodes, including *Tylenchus coffeae* and *T. acutocaudatus* of Zimmermann (*268*), either of which may cause severe injuries; references to these "coffee nematodes" have been quoted in bulletins on root knot. Symptoms that suggest fungus disease (cf. Nowell, *183*) were ascribed to root knot in much of the early literature. Papers that failed to name the kind of coffee have been listed in compilations as referring to *C. arabica*—which is known to be heavily infested at times. Only a few of the reports of injury to coffee are cited.

Collards, see **Brassica.**

Commelina nudiflora, creeping dayflower [called locally "Honohono-grass," "wandering Jew"]. (C)

GODFREY 1935:[34] Infestation commonly observed to be light. [In 1930 Godfrey (*94*) reported infestation frequent.] Hawaii.

Unspecified wild plants of this genus have been found attacked in Florida (*258*) and in Nyasaland (*214*).

Coreopsis lanceolata, lance coreopsis.

GOFF 1936 (*96*): No infestation found (42 plants, 2 winter tests). Florida.

Coreopsis tinctoria, calliopsis.

GOFF 1936 (*96*): No galls found on 52 plants, very light infestation on 16 plants (3 tests). Florida.

WATKINS 1929 (*248*): Calliopsis rated as "resistant." Florida.

Coreopsis sp., leptosyne.

GOFF 1936 (*96*): Infestation 0 to heavy (16 plants, 1 winter test); average rating "very lightly infested." Florida.

Coreopsis, see also **Bidens.**

Coriandrum sativum, coriander. (C)

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.

KRISHNA AYYAR 1933 (*132*): Infestation "doubtful" in pot experiment. India (Madras).

Corn, see **Zea.**

Cornflower, see **Centaurea.**

Cosmos bipinnatus, common cosmos. (C)

BARRONS 1939 (*13*): Numerous larvae entered root tips of seedlings (Var. Early White) heavily inoculated in greenhouse. Alabama.

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.

GOFF 1936 (*96*): Infestation very light, but moderate on 1 plant; many plants free, especially in winter (90 plants, 3 tests). Florida.

WATKINS 1929 (*248*): Rated as "resistant." Florida.

Infestation on cosmos has been reported also from California (*75*) and from Rhodesia (*41*, 1938).

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[34] See footnote 10, p. 11.

Cosmos sulphureus, golden cosmos, yellow cosmos. (N)

BARRONS 1939 (*13*): Numerous larvae entered root tips of seedlings (Var. Orange Flare) heavily inoculated in greenhouse. Alabama.

WATKINS 1929 (*248*): Rated as "resistant." Florida.

Cotton, see **Gossypium.**

Couchgrass, see **Agropyron.**

Cowpea, see **Vigna.**

Crabgrass, see **Digitaria.**

Cracca, see **Tephrosia.**

Cress, see **Lepidium.**

Crotalaria juncea, sunn-hemp. (C)

BEELEY 1939 (*14*): Found attacked, but somewhat "resistant." Malaya (?).

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.

COLLINS 1938 (*41*): Sunn-hemp not attacked (1 season). Rhodesia.

GODFREY 1928 (*93*): "Appears to be absolutely immune to root knot." Hawaii.

KRISHNA AYYAR 1933 (*132*): No infestation found in pot experiment. India (Madras).

LE ROUX and STOFBERG 1935 (*137*): Resistant; used in rotation. Transvaal.

LINFORD 1939 (*142*): Green stem tissue was highly attractive to larvae *in vitro.* Hawaii.

SMEE 1928 (*214*): "Sunn-hemp has so far appeared to be entirely immune" (grown several years). Nyasaland.

Crotalaria retusa.

See reports of Georgia Coastal Plain Experiment Station under *C. spectabilis.*

Crotalaria saltiana, rattlepod.

GODFREY 1935: [35] Infestation commonly observed to be light. Hawaii.

Crotalaria spectabilis.

BARRONS 1939 (*13*): Numerous larvae entered root tips of seedlings heavily inoculated in greenhouse.

GEORGIA COASTAL PLAIN EXPERIMENT STATION 1936 (*83*): Crotalaria grown every other year with tobacco gives fair commercial control.

——— 1938 (*85*): Crotalaria is highly resistant. [The 1935 report (*81*) states that the two species being tested are *C. spectabilis* and *C. retusa.*]

HUME 1937: [36] Has been used in summer rotations, making possible the continuation of tobacco black-shank experiments that were being ruined by the increasing abundance of root knot. Florida.

SHAW 1940 (*213a*): Tobacco in enclosure units showed less than 10 percent severe infestation following *C. spectabilis* or other highly resistant crops, and 100 percent following tobacco or other susceptible crops. [North Carolina.]

WATSON 1929–32 (*256*): No infestation observed, even in heavily infested soil. Grown in rows with constant cultivation after a heavy loss on cucumbers in 1931; root knot apparently eliminated; no infestation observed on 1932 cucumbers. Florida.

Crotalaria striata.

WATSON 1932 (*256*): A considerable infestation was found on one planting in an orange grove. Florida.

——— and GOFF 1937 (*258*): Has generally been "absolutely immune"; some infestations have been seen. Florida.

Crotalaria usaramoënsis.

COLLINS 1930 (*42*): Infestation rather heavy after 10 months' growth, though not seen at 6 months. Hawaii.

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[35] See footnote 10, p. 11.

[36] See remarks of Hume on p. 113 of reference given in footnote 3, p. 6.

Crotalaria spp.

BEELEY 1939 (*14*): Frequently found infested. Malaya.
McKEE 1937 (*150*): All species are "practically if not entirely immune."
MENZEL 1929 (*161*): Infestation must be reckoned with in certain cases. Netherland East Indies.
WATSON 1933 (*256*): 17 species tested in heavily infested plots; no nematodes found on roots of any species. Florida.
WATKINS 1929 (*248*): "Resistant" (annual ornamental). Florida.

Cucurbita maxima, squash. (N, S)

LI and LEI 1938 (*138*): Vars. Early Yellow Scallop, Italian Marrow, and Table Queen "less infected" (experimental; five plants each). China (Lingnan).

The family Cucurbitaceae is generally considered as one of the most frequently and severely infested.

Currant, see **Ribes.**

Cyamopsis tetragonoloba, cluster-bean, guar. (C)

BESSEY 1911 (*16*): Nematodes abundant, injury apparently not great.
KRISHNA AYYAR 1933 (*132*): Infestation abundant in pot experiment. India (Madras).
MACKIE, W. W. (California station; in letter, 1939): Highly resistant; ordinarily only a trace of root knot; tested many years in the worst infested area.

Cydonia oblonga (*C. vulgaris*), common quince. (C, N)

BESSEY 1911 (*16*): Nematodes abundant, injury apparently not great.
MINZ, G. (Research station, Rehovot, Palestine; in letter, 1940): Found infested in Palestine.
TAUBENHAUS and EZEKIEL 1933 (*226*): Losses rarely serious. Texas.
TUFTS and DAY 1934 (*234*): No galls found on cuttings of Vars. Angers (selection Gregory), Antequera (P. I. No. 33214), Burbank, Orange, Rea, and the East Malling stocks A, C, and D (2 years in Delhi nursery). California.
WATSON and GOFF 1937 (*258*): Quince rated as No. 45 in order of susceptibility [from okra, No. 1, to corn, No. 46]. Florida.
WHITTLE and DRAIN 1935 (*263*): Quince listed as slightly infested. Tennessee.

"*Cydonia* sp." was observed to be a host by Gardner (*75*). Flowering-quince is now placed in the genus *Chaenomeles*.

Cynara scolymus, artichoke. (C, N)

GROWER: Infested but profitable. California.
MINZ 1936 (*166*): Reported infested in Palestine.
PITTMAN 1929 (*192*): Not usually attacked to such an extent as other market-garden plants. Western Australia.
UNITED STATES BUREAU OF PLANT INDUSTRY (unpublished data in files of Division of Nematology): Specimens from California, collected in 1939 by C. E. Scott, rather heavily infested, with a large number of larvae.
WHITTLE and DRAIN 1935 (*263*): Listed as slightly infested. Tennessee (?).

Cynodon dactylon (*Capriola dactylon*), Bermuda grass. (C, N)

ANONYMOUS 1939 (*2*): One of the rotations in the Texas rose industry uses Bermuda grass and weeds for 3 or more years; "root knot is no longer a serious problem."
BARRONS 1939 (*13*): Numerous larvae entered root tips of seedlings heavily inoculated in greenhouse. Alabama.
BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.
GARNNER 1926 (*75*): Bermuda grass "or Devils grass" observed to be a host. California.
GEORGIA COASTAL PLAIN EXPERIMENT STATION 1936 (*83*): Bermuda grass somewhat susceptible.
GODFREY 1935: [37] Infestation commonly observed to be light. Hawaii.
MOSSERI 1904 (*170*): Usually considered resistant, but found infested in survey. Egypt.

[37] See footnote 10, p. 11.

UNITED STATES BUREAU OF PLANT INDUSTRY (unpublished data in files of Division of Nematology): Infested specimen received from California in 1937, collected by G. J. Harrison and C. E. Scott.
WATSON 1916 (*249*): Bermuda grass listed among plants "immune or partially immune." Florida.
WHITTLE and DRAIN 1935 (*263*): Listed as seldom infested or highly resistant. Tennessee (?).

Cynoglossum nervosum, great houndstongue. (C, S)

GOFF 1932 (*95*): Infestation very light.
——— 1936 (*96*): Infestation very light to very heavy on "*Cynoglossum* sp., Chinese forget-me-not" (64 plants, 3 tests); average rating "heavily infested." Florida.

Cyperus esculentus, chufa. (M)

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.
GILBERT 1914 (*88*): Listed as "largely or entirely immune."

Dactylis glomerata, orchard grass. (C, N)

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.
WHITTLE and DRAIN 1935 (*263*): Listed as seldom infested or highly resistant. Tennessee (?).

Dahlia hybrids, dahlia. (N, S)

SCHMIDT 1937:[38] Infestation severe in 13 of the varieties tested; moderate in 9 varieties; light infestation, limited to small rootlets, in the following: Vars. Alice Whittier, City of Trenton, Dancing Sultana, Fordhook Marvel, Fort Monmouth, Ida Perkins, Jane Cowl, Jean Trimbee, Lady Moyra Ponsonby, Long Hill, Monmouth Radiance, Mrs. Bruce Collins, Robert Emmett, Satan, White Wonder, Yankee King, and the Pompon Vars. Atom, Gertrude, and Little Edith. Observations during 4 years, "in most cases made on several plants of each variety." North Carolina.

Other authors report infestation severe on dahlia.

Daisy, see **Aster** and **Gerbera**.

Date palm, see **Phoenix.**

Dayflower, see **Commelina.**

Daylily, see **Hemerocallis.**

Delphinium sp. (probably *D. ajacis)*, larkspur. (N, S)

GOFF 1936 (*96*): Infestation very heavy (four plants, one winter test). Florida.
WATKINS 1929 (*248*): Rated as "resistant." Florida.

Derris elliptica. (C)

BEELEY 1939 (*14*): Infestation apparently not observed [Malaya?] nor reported [in literature?]; experiments projected.

Derris malaccensis.

BEELEY 1939 (*14*): Infestation apparently not observed [Malaya?] nor reported [in literature?]; experiments projected.

Desmodium molle (*Meibomia mollis*), beggarweed. (C)

BEELEY 1939 (*14*): Found attacked, but somewhat resistant. Malaya (?).
BESSEY 1911 (*16*): No infestation found; appears to be free under most conditions.
NEAL 1889 (*176*): A fine substitute for susceptible cowpeas. Florida.

Desmodium strictum (*Meibomia stricta*).

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.

Desmodium tortuosum (*Meibomia purpurea*; *M. tortuosa*), Florida beggarweed.

GEORGIA COASTAL PLAIN EXPERIMENT STATION 1935 (*81*): Beggarweed more resistant than crabgrass.
——— 1936 (*83*): Can be used in a successful control rotation.
GODFREY 1928 (*93*): "Appeared to be absolutely immune." Hawaii.

[38] SCHMIDT, ROBERT. RELATIVE SUSCEPTIBILITY OF CERTAIN VARIETIES OF DAHLIAS TO ROOT-KNOT NEMATODE. U. S. Bur. Plant Indus., Plant Dis. Rptr. 21: 32-33. 1937. [Mimeographed.]

ROLFS (quoted by Smith 1899 (*215*)): Rarely attacked.
——— 1907 (*201*): Beggarweed "almost quite immune." [For the "host record" based on Rolfs 1898 (*200*), see **Stizolobium deeringianum** Var. FLORIDA.]

Desmodium triflorum, three-flowered beggarweed.
BEELEY 1939 (*14*): Infestation apparently not observed [Malaya?] nor reported [in literature?]; experiments projected.
GODFREY 1935: [39] Infestation commonly observed to be light. Hawaii.

Desmodium spp., beggarweed.
BARBER 1901 (*9*): Infested legume collected, "probably a *Desmodium.*" India (Madras).
BEELEY 1939 (*14*): Infestation frequent on *D. ovalifolium;* illustration of severely galled roots. Malaya.
MENZEL 1929 (*161*): Infestation found in Netherland East Indies.
ORTON 1903 (*187*): Beggarweed ("immune") recommended for a starvation rotation.
WATSON 1929 (*255*): Beggarweed usually "immune" or only slightly infested. Florida.

Dewberry, see **Rubus.**

Dianthus barbatus, sweet-william.
BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.
TAUBENHAUS and EZEKIEL 1933 (*226*): May cause serious losses. Texas. [No distinction was made between *D. barbatus* and *D. caryophyllus* in the discussion of their several diseases.]

Dianthus spp. (N, S)
GOFF 1936 (*96*): Infestation ranged from 0 to very heavy in annual dianthus (two tests) and in carnation, marguerite-carnation, and pink (one test each). Average rating: Dianthus "lightly infested." Florida.
HÖSTERMANN 1922 (*111*): No infestation found in one test, but inconclusive. Germany.
WATKINS 1929 (*248*): Annual dianthus rated as "resistant." Florida.
WATSON and BRATLEY 1936 (*257*): Progress reported in the selection of ornamental pinks for resistance. Florida.

Carnation is heavily infested according to numerous other reports; pinks have been called moderately infested.

Didiscus, see **Trachymene.**

Digitaria pruriens (*Syntherisma pruriens*), ("crabgrass"). (C)
GODFREY 1935: [40] Infestation commonly observed to be light. Hawaii.

Digitaria sanguinalis (*Panicum sanguinale*; *Syntherisma sanguinalis*), crabgrass. (N)
BARRONS 1939 (*13*): Numerous larvae entered root tips of seedlings heavily inoculated in greenhouse. Alabama.
BESSEY 1911 (*16*): Apparently free; no infestation found.
BODENHEIMER 1930 (*19*): Infestations occur locally, seldom serious. Palestine.
CHRISTIE, J. R. (Division of Nematology, Bureau of Plant Industry. 1939): Little or no infestation found on crabgrass in one survey in Virginia.
GEORGIA COASTAL PLAIN EXPERIMENT STATION 1936 (*83*): Crabgrass moderately susceptible; not effective for control rotation.
GODFREY 1935: [41] Infestation commonly observed to be light. Hawaii.
ROLFS 1907 (*201*): Crabgrass "almost quite immune."
SHAW 1940 (*213a*): See **Weeds** for results of rotations including crabgrass.
STEINER and BUHRER 1936: [42] Specimen submitted from North Carolina, courtesy of E. E. Clayton. [Well infested.]
WATSON 1916 (*249*): Crabgrass listed among plants "immune or partially immune." Florida.

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[39], [40], [41] See footnote 10, p. 11.
[42] STEINER, G., and BUHRER, EDNA M. OBSERVATIONS OF INTEREST ON NEMATODE DISEASES OF PLANTS. U. S. Bur. Plant Indus., Plant Dis. Rptr. 20: 90–91. 1936. [Mimeographed.]

Digitaria spp.

A distinctly heavy infestation has been reported on Chinese crabgrass, *D. chinensis*.[43] *D. ischaemum*, smooth crabgrass, is also a host (N).

Dill, see **Anethum.**

Diospyros kaki, Japanese, kaki, or Oriental persimmon. (C)

BESSEY 1911 (*16*): Injury severe.

HUME 1937: [44] Many of the Oriental persimmon roots may probably be resistant. Florida.

TAUBENHAUS and EZEKIEL 1933 (*226*): Losses rarely serious. Texas. [No distinction was made between *D. kaki* and *D. virginiana* in the discussion of their several diseases.]

WATSON and GOFF 1937 (*258*): Japanese persimmon rated as No. 38 in order of susceptibility [from okra, No. 1, to corn, No. 46]. Florida.

Diospyros virginiana, common persimmon.

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.

HUME 1937: [45] Native persimmon roots quite free from damage. Florida.

Diospyros spp., persimmon.

CALIFORNIA NEMATODE COMMITTEE 1925: [46] Resistant on some types of root.

ERNST 1924 (*58*): Persimmon was thought "immune," but found susceptible in a survey of Los Angeles County by the Horticultural Commissioner's office. California.

RYERSON 1927 (*204*): Root knot has been reported on injured roots, but apparently the persimmon is not very susceptible. R. H. McLean, Agricultural Commissioner of San Diego County, has made a study of persimmon roots and fig roots in a heavily infested soil area at Point Loma. No infestation was found on the persimmon roots even when intertwining with badly infested fig roots. California.

TAUBENHAUS and EZEKIEL 1933 (*226*): Losses rarely serious. Texas. [No distinction was made between *D. kaki* and *D. virginiana* in the discussion of their several diseases.]

WHITTLE and DRAIN 1935 (*263*): Listed as slightly infested. Tennessee (?).

In California three different species of persimmon have been used as rootstocks at different times.

Diplolophium zambesianum. (C)

COLLINS 1937 (*41*): No signs of nematode attack. Rhodesia.

Dolicholus, see **Rhynchosia.**

Dolichos lablab, bonavist-bean, hyacinth-bean, lablab, Madagascar-bean. (S)

BESSEY 1911 (*16*): Injury severe.

HARRIS 1938 (*104*): Madagascar-bean susceptible. Tanganyika.

KRISHNA AYYAR 1933 (*132*): Infestation slight in pot experiment. India.

ORTON 1902 (*186*): Good early growth, bad injury later (P. I. No. 6319, white, and No. 6320, purple). South Carolina.

PIPER and MORSE 1915 (*189*): Many if not all varieties susceptible.

Dolichos umbellatus.

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.

Dolichos, see also **Pueraria** and **Vigna.**

Drymaria cordata. (C)

LINFORD 1939 (*142*): No grouping of root knot larvae around roots *in vitro*, in limited tests; roots of all other plants tested proved highly attractive. Hawaii.

There are no field nor greenhouse reports for this genus.

Dusty-miller, see **Senecio.**

Echeveria spp. (N, S)

GROWER: All species very susceptible, but grow new roots if sufficiently moist. California.

[43] See footnote 10, p. 11
[44] [45] See footnote 5, p. 8.
[46] See footnote 6, p. 8.

Question: Is this partial tolerance possibly the reason that there are not many reports of infestations in this genus?

Echinochloa colonum, jungle-rice. (C, N)

UNITED STATES BUREAU OF PLANT INDUSTRY (unpublished data in files of Division of Nematology): Infested specimens received from California in 1937, collected by G. J. Harrison and C. E. Scott.

Echinochloa crusgalli, barnyard grass. (N)

STEINER 1934 (*222*): Considerable infestation observed; "tissues are seemingly less interfered with" than those of rice. Arkansas.

Echinochloa crusgalli var. frumentacea, Japanese millet.

BESSEY 1911 (*16*): No infestation found.

Eleusine coracana, African millet, ragi millet. (C)

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.
COLLINS 1938 (*41*): "Rapoko" not attacked (1 season). Rhodesia.
KRISHNA AYYAR 1933 (*131, 132*): Found free in infested plot, and soil population reduced; very slight infestation in pot experiment (only one instance). India (Madras).

Eleusine indica, goosegrass, "wiregrass." (N)

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.
GODFREY 1930 (*94*): "Occasionally shows light infestation." Hawaii.
STEINER, G. (Division of Nematology, Bureau of Plant Industry. 1927): Infested in greenhouse (experimental). District of Columbia.

Englerastrum schweinfurthii. (C)

COLLINS 1937 (*41*): No signs of nematode attack. Rhodesia.

Eragrostis abyssinica (name supplied), teff. (C)

COLLINS 1938 (*41*): Teff not attacked (one season). Rhodesia.
JACK 1913 (*118*): Teff grass little subject to attack. Rhodesia. (N)

Eragrostis spp.

G. Minz (research station, Rehovot, Palestine; in letter, 1940) reports infestation on *E. cilianensis* (*"E. megastachya"*). The Division of Nematology, Bureau of Plant Industry, has observed root knot on *E. diffusa*, collected in California in 1937 by G. J. Harrison and C. E. Scott.

Erechtites hieracifolia (*Senecio hieracifolius*), fireweed. (N)

GODFREY 1935:[47] Infestation commonly observed to be light. Hawaii.

Erigeron albidus. (C)

LINFORD 1939 (*142*): Appears highly resistant under Hawaiian field conditions; roots highly attractive to larvae *in vitro*, but two separate roots of a single plant differed markedly in their apparent attractiveness.

Erigeron spp. (N)

UNITED STATES BUREAU OF PLANT INDUSTRY (unpublished data in files of Division of Nematology): Greenhouse infestations on *E. philadelphicus* and on *E.* sp. observed in the District of Columbia in 1927 and 1929.

Eriobotrya japonica, loquat. (C)

CALIFORNIA NEMATODE COMMITTEE 1925:[48] Infested but profitable.

Eriocaulon sp. (C)

COLLINS 1937 (*41*): No signs of nematode attack. Rhodesia.

Erlangea laxa. (C)

COLLINS 1937 (*41*): No signs of nematode attack. Rhodesia.

Eruca sativa, roquette, salad-rocket. (C)

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.

[47] See footnote 10, p. 11.
[48] See footnote 6, p. 8.

Eschscholtzia californica, California-poppy. (S)

BESSEY 1911 (*16*): Injury severe.
GOFF 1936 (*96*): Infestation 0 to very heavy; majority of plants heavily infested (57 plants, 2 winter tests). [In 1932 Goff (*95*) found no infestation on this plant.] Florida.
TAUBENHAUS and EZEKIEL 1933 (*226*): Losses rarely serious. Texas.
WATKINS 1929 (*248*): Eschscholtzia rated as "resistant." Florida.

Euchlaena mexicana (*E. luxurians*), teosinte. (C)

BESSEY 1911 (*16*): No infestation found.

Euphorbia hirta.

LINFORD 1939 (*142*): Appears highly resistant under Hawaiian field conditions; roots highly attractive to larvae *in vitro*.

Euphorbia hypericifolia (*E. pilulifera*).

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.

Euphorbia nutans (*E. preslii*), nodding spurge, upright spotted spurge.

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.
GODFREY 1935:[49] Infestation commonly observed to be light. Hawaii.

Euphorbia spp. (N)

GROWER: All euphorbias are seriously injured. California.

A single host report, without estimate of severity, is known for each of 33 additional species including poinsettia, *E. pulcherrima*. The available data on infestation are probably incomplete.

Eustachys petraea. (C)

BESSEY 1911 (*16*): No infestation found.

Evening-primrose, see **Oenothera.**

Everlasting, see **Helichrysum.**

Fagopyrum vulgare (*F. esculentum*), buckwheat. (C)

ATKINSON 1889 (*4*): Insusceptible so far as observed here. Alabama.
BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.
SANDGROUND 1922 (*207*): Parasitized more or less severely in South Africa.
WHITTLE and DRAIN 1935 (*263*): Listed as slightly infested. Tennessee (?).

Feijoa sellowiana, feijoa. (C)

CALIFORNIA NEMATODE COMMITTEE 1925:[50] Resistant.
RYERSON 1933 (*205*): No diseases have so far appeared [nematodes not specifically considered]. California.

The California State Department of Agriculture has a record of infestation in this genus.

Festuca elatior, meadow fescue. (C)

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.

Festuca ovina, sheep fescue.

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.

Festuca sp. (N)

BUHRER, COOPER, and STEINER 1933:[51] Infestation observed [in greenhouse, District of Columbia].

Ficus carica, common fig. (N, S)

CONDIT 1933 (*45*): Many infested trees can apparently produce fair crops in fertile soil; the replacing of killed rootlets is a drain on the vitality of the tree, the seriousness of which depends on the extent of infestation. California.

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[49] See footnote 10, p. 11.
[50] See footnote 6, p. 8.
[51] See footnote 20, p. 17.

GEORGE 1923 (*77*): More subject to attack than any other plant; seldom killed because of rapid new root growth. Arizona.
HEALD and WOLF 1912 (*110*): No apparent injury on older trees. Texas.

It is considered unnecessary to cite the numerous reports of losses due to root knot on fig. As the majority of these reports give no data on the varieties injured, they may or may not include the varieties listed below.

Var. CELESTE.

BARKER and NEAL 1924 (*11*): Somewhat more "resistant" than other varieties observed. Mississippi.
BESSEY 1911 (*16*): Is said to be less subject to injury.
HAYWARD 1939 (*107*): One of the principal varieties for Florida; all are highly susceptible.

Var. POULETTE.

BESSEY 1911 (*16*): Is said to be less subject to injury.

Ficus glomerata.

MOWRY 1925 (*171*): P. I. No. 52406 [introduced from North Queensland] is decidedly more resistant than the common fig. Florida.

Fig, see **Ficus.**

Figmarigold, see **Mesembryanthemum.**

Fireweed, see **Erechtites.**

Flax, see **Linum.**

Four-o'clock, see **Mirabilis.**

Foxtail, see **Setaria.**

Gaillardia sp. **(C, N)**

GOFF 1936 (*96*): No infestation found (60 plants, 2 tests). Florida.
STEINER, G. (Division of Nematology, Bureau of Plant Industry. 1939): Small field infestation found in Maryland.
TYLER, J. (Division of Nematology, Bureau of Plant Industry. 1938): Not all roots remained entirely free in greenhouse test. District of Co umbia.
WATKINS 1929 (*248*): Rated as "resistant." Florida.
WHITTLE and DRAIN 1935 (*263*): Listed as seldom infested or highly resistant. Tennessee (?).

Galinsoga parviflora, quickweed. **(N)**

CUBONI 1892 (*50*): Specimens showing numerous galls were presented, following a paper on another subject. Italy.
FRANK 1885 (*68*): Absolutely free; other hosts preferred (one planting). Germany.
HÖSTERMANN 1922 (*111*): Infestation very light. Germany (experimental).
MUSZYNSKI and STRAZEWICZ 1932 (*174*): Found infested. Poland.
TARNANI 1898 (*225*): Infestation heavy but little injury. Poland.

Gardenia thunbergi (*Warneria thunbergi*). **(M, N)**

ANONYMOUS 1936 (*1*): Not subject to attack; used as a stock for *G. veitchi*. Florida.
TYLER, J. (Division of Nematology, Bureau of Plant Industry. 1938): Galls very small and sometimes not numerous; root growth relatively very healthy (experimental, in greenhouse). District of Columbia.

Garlic, see **Allium.**

Geranium, see **Pelargonium.**

Gerbera jamesoni, flame-ray gerbera, gerbera daisy. **(N, S)**

GOFF 1936 (*96*): Infestation 0 to heavy (33 plants, 2 winter tests); average rating "very lightly infested." Florida.

Heavy infestations on gerbera have been reported from California, Florida, Hawaii, and Russia. Christie (*36*) reports that galls are sometimes small and inconspicuous.

Globe-amaranth, see **Gomphrena.**

Glycine, see **Soja.**

Gnaphalium luteo-album.

GODFREY 1935: [52] Infestation commonly observed to be light. Hawaii.

Gnaphalium purpureum.

BESSEY 1911 (*16*): No infestation found.

Goldenrod, see **Solidago.**

Gomphrena globosa, globe-amaranth. (C)

CEYLON DEPARTMENT OF AGRICULTURE 1936 (*33*): Infestation recorded in Ceylon.

GOFF 1936 (*96*): Infestation 0 to heavy (25 plants, 1 test); average rating "very lightly infested." Florida.

An unidentified species of *Gomphrena* has been found infested in Palestine (unpublished data of G. Minz, research station, Rehovot, Palestine; in letter, 1940).

Gonya grass, see **Urochloa.**

Gooseberry, see **Ribes.**

Goosegrass, see **Eleusine.**

Gossypium barbadense, Egyptian cotton and sea-island cotton. (N, S)

KING, C. J. (Division of Cotton and Other Fiber Crops and Diseases, Bureau of Plant Industry; in letter, 1939): Var. Sakellaridis (Sakel) slightly "resistant" as compared with Var. Pima, but often seriously injured. Arizona.

MILES 1939 (*165*): Sea Island 13B3 (Seabrook strain) averaged slightly fewer infested plants (44.5 percent) than any of the 17 upland varieties tested [see **G. hirsutum**]. Mississippi.

There are many reports of injury to this species of cotton.

Gossypium hirsutum, upland cotton [called also American upland]. (N)

BARKER 1938 (*10*): Upland cottons in general are tolerant of nematodes under average field conditions.

BESSEY 1911 (*16*): Nematodes abundant, injury apparently not great.

GEORGIA COASTAL PLAIN EXPERIMENT STATION 1928 (*78*): Infestation increased after two crops of Var. Petty-Toole.

——— 1938 (*85*): Cotton has only slight value in control rotations with tobacco.

KING 1938 (*126*): Little injury in soils having a moisture equivalent above 18; at 16 or less the stands are often reduced; yields 3.25 to 1 compared with Var. Pima (*G. barbadense*) on infested soil, 1.8 to 1 on noninfested soil. [Data in letter, 1939: Var. Miller is unusually susceptible as compared to such upland varieties as Acala, Coker Clevewilt, and Missdel; other upland varieties show slight differences in resistance, e. g. Vars. Delfos, Durango, Hartsville, King, Lone Star, and Mebane Triumph.] Arizona. [Cf. report of Miles, below.]

——— and HOPE 1934 (*127*): Readily attacked, but yields are much higher than from Var. Pima (*G. barbadense*) in infested areas continuously cropped to cotton; infestations remain active. Upland plants seldom die from root knot under Arizona conditions.

KRISHNA AYYAR 1933 (*132*): No infestation found in pot experiment, Var. Cambodia. India (Madras).

MILES 1939 (*165*): Average 59.5 percent of plants infested in Var. Dixie 14–5, 64.72 percent in Missdel Wilt Resistant, 74.76 percent in Miller 610, and 100 percent in a selfed line of Missdel No. 4; averages from 45.63 percent to 75.25 percent in Vars. Carolina-del No. 2, Clevewilt 6, Coker 100, Cook 144–68 and 307, Delta & Pine Lands 11A, Dixie-Triumph 12 and 55–85, Half and Half, Perry-Toole, Rowden 2088, Sikes Wilt Resistant, and Washington; in all but three varieties there was less wilt than root knot (1 season). Mississippi.

[52] See footnote 10, p. 11.

SHERBAKOFF 1939:[53] No galls found nor symptoms of injury on a number of varieties and crosses in a plot where root knot had become severe on tomatoes, grown continuously for 12 to 14 years; considerable root knot injury on 12 varieties in a plot planted continuously to cotton for an even longer time. Tennessee.

TAUBENHAUS and EZEKIEL 1933 (*226*): Losses rarely serious. Texas.

UNITED STATES BUREAU OF PLANT INDUSTRY 1919:[54] Root knot was especially prevalent in 1918 on Var. Dixie.

Var. ACALA.

CALIFORNIA NEMATODE COMMITTEE 1925:[55] Infested but profitable.

KING, C. J. (Division of Cotton and Other Fiber Crops and Diseases, Bureau of Plant Industry; in letter, 1939): Resistance medium; serious injury under certain conditions, e. g., sandy soils in the San Joaquin Valley, California.

——— and HOPE 1934 (*127*): Only 25 percent of the roots were galled and there was little decay in the tissues. Arizona.

MACKIE, W. W. (California station; in letter, 1939): Shows much injury in California.

SCOTT, LINDSAY, and HARRISON 1939 (*209*): Infestation serious in the San Joaquin Valley, California. [Ms. data: Plants die in heavily infested spots; major damage to seedlings, complicated by other seedling diseases; roots of older plants sometimes heavily galled.]

Gossypium hybrids.

KING 1937:[56] Hybrids between Acala and Sakellaridis (imported Egyptian cotton, *G. barbadense*) proved resistant and vigorous in the F_1, but with few exceptions F_2 plants revert to type. [Data in letter, 1939: All F_1 hybrids between upland (*G. hirsutum*) and American-Egyptian varieties (*G. barbadense*) appear highly resistant, though some galls may be found. "Interspecific hybridization was undertaken to determine if the factor for relative resistance in the upland might be transmitted to some of the Pimalike progenies that segregated in the F_2. With such a wide cross we had little hope of obtaining anything valuable." In the interspecific hybrids Pima × Acala, F_1 plants may show as many galls as Acala, the more resistant parent, but they grow and fruit vigorously in areas so heavily infested that even Acala shows above-ground symptoms; in the F_2 segregates, the Pimalike plants show most galls, Acalalike plants fewest galls.] Arizona.

Gram, see **Cajanus** and **Phaseolus.**

Grape, see **Vitis.**

Grass, see **Agropyron, Agrostis, Andropogon, Arrhenatherum, Bromus, Chloris, Cynodon, Dactylis, Digitaria, Echinochloa, Eleusine, Eragrostis, Euchlaena, Eustachys, Festuca, Lolium, Panicum, Paspalum, Pennisetum, Phleum, Poa Sorghum, Tricholaena,** and **Urochloa;** see also millet and **Gramineae.**

Guar, see **Cyamopsis.**

Guava, see **Psidium.**

Guizotia abyssinica, nigerseed. (C)

KRISHNA AYYAR 1933 (*132*): No infestation found in pot experiment. India (Madras).

Hedysarum coronarium, sulla. (C)

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.

Helenium tenuifolium, bitterweed.

BESSEY 1911 (*16*): No infestation found.

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[53] SHERBAKOFF, C. D. ROOT-KNOT NEMATODES ON COTTON AND TOMATOES IN TENNESSEE. Cotton Dis. Council Proc. Ann. Mtg. 4: 15. 1939. [Mimeographed.]

——— ROOT-KNOT ON TOMATOES AND COTTON IN TENNESSEE. Cotton Dis. Council Proc. Ann. Mtg. 4: 15–17. 1939. [Mimeographed.]

——— RECENT FIELD OBSERVATIONS ON TOMATO AND COTTON ROOT-KNOT NEMATODES. U. S. Bur. Plant Indus., Plant Dis. Rptr. Sup. 124: 146. 1940. [Mimeographed.] (Additional data, not cited above.)

[54] See p. 163 of reference given in footnote 17, p. 16.

[55] See footnote 6, p. 8.

[56] See report of King on p. 115 of reference given in footnote 3, p. 6.

Helianthus annuus, common sunflower. (N, S)

ATKINSON 1889 (*4*): "Badly affected" in Alabama.
COLLINS 1938 (*41*): Sunflower readily attacked, suggested for a trap crop. Rhodesia.
GOFF 1936 (*96*): Infestation light to very heavy (131 plants, 3 tests). Florida.
HÖSTERMANN 1922 (*111*): Infestation moderate. Germany (experimental).
SANDGROUND 1922 (*207*): Parasitized more or less severely in South Africa.
TAUBENHAUS and EZEKIEL 1933 (*226*): Losses rarely serious. Texas.
WATSON 1921 (*251*): Sunflowers seem more or less tolerant; good yield, although roots are badly knotted. Florida.
——— 1923 (*253*): Infestation heavy; used for indicator. Florida.

Helianthus debilis, cucumber-leaved sunflower.

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.

Helichrysum argyrosphaerum. (C)

COLLINS 1937 (*41*): No signs of nematode attack. Rhodesia.

Helichrysum pachyrhizum.

COLLINS 1937 (*41*): No signs of nematode attack. Rhodesia.

Helichrysum spp., everlasting, strawflower.

BESSEY 1911 (*16*): On "*H. bracteatum,* Immortelle," nematodes abundant, injury apparently not great.
COLLINS 1937 (*41*): "No signs of nematode attack" in two additional unidentified species. Rhodesia.
GOFF 1936 (*96*): Infestation very heavy, some plants stunted (two tests). Florida.
WATKINS 1929 (*248*): Annual helichrysum rated as "resistant." Florida.

Hemerocallis hybrid, daylily. (C, N)

GROWER: Some hybrid varieties have been grown without galls in heavily infested soil, but infestation has been found on Var. Aureole. Florida.
HUME 1938:[57] In handling many hundreds of plants, of many varieties, only one sample has been found infested. Florida.

The California State Department of Agriculture has a record of infestation in this genus.

Hemp, sunn-, see **Crotalaria.**

Herdsgrass, see **Agrostis.**

Hevea brasiliensis, Para rubbertree. (C)

BALLY and REYDON 1931 (*8*): Host plant. Java.
BEELEY 1939 (*14*): Apparently resistant to attack; considerable injury to other plants grown for cover in rubber plantations. Malaya.
GHESQUIÈRE 1921 (*86*): Infestation found. Belgian Congo.

Hicoria spp. (C)

UNITED STATES DIVISION OF POMOLOGY 1896 (*240*): "Pecan and other hickories . . . are known to be free from injury or but slightly affected." [See also **Carya.**]

Hippeastrum spp. (C)

GROWER: Apparently "immune" or nearly so. Florida.

Holcus, see **Sorghum.**

Honeysuckle, see **Lonicera.**

Hordeum vulgare (*H. sativum*), barley.

BALACHOWSKY and MESNIL 1935 (*6*): Vars. Chevalier, Primus, Svanhals ("Cou de Cygne"), "etc.," appear resistant. [These varieties are not found in the literature on root knot; they were named by Nilsson-Ehle (*180*) as resistant to the sugar-beet nematode, *Heterodera schachtii.* See **Gramineae.**]
BESSEY 1911 (*16*): No infestation found ("some varieties").
GONFREY 1928 (*92*): Infestation abundant (one test). Hawaii.
GOFFART 1934 (*97*): Negative results. [See **Gramineae.**]

[57] See remarks of Hume on p. 142 of reference given in footnote 4, p. 6.

SCOTT, LINDSAY, and HARRISON 1939 (*209*): No longer effective for control rotation in San Joaquin Valley, California. [Ms. data: Builds up nematode populations even in winter.]

WHITTLE and DRAIN 1935 (*263*): Listed as seldom infested or highly resistant. Tennessee.

Houndstongue, see **Cynoglossum.**

Houseleek, see **Sempervivum.**

Hyacinth-bean, see **Dolichos.**

Iberis umbellata, common annual candytuft, purple candytuft. (C, S)

GOFF 1936 (*96*): Infestation 0 to very heavy (55 plants, 2 tests); average rating "lightly infested." Some of the variation "may have been due to the degree of infestation of the nematodes in the soil, as there seemed to be a great variation in numbers even in small areas." Florida.

NEAL 1889 (*176*): "Badly affected." Florida.

WATKINS 1929 (*248*): Candytuft rated as "resistant." Florida.

Ilima, see **Sida.**

Ilysanthes dubia. (C)

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.

Ipomoea batatas, sweetpotato. (M, N, S)

BESSEY 1911 (*16*): Nematodes abundant, injury apparently not great.

CHRISTIE, J. R. (Division of Nematology, Bureau of Plant Industry. 1939): Galls inconspicuous even on heavily infested roots; little above-ground indication of infested areas (Var. Nancy Hall). Virginia.

ELLIOTT 1918 (*57*): An unusual instance of severe injury. Arkansas.

FAJARDO and PALO 1933 (*60*): Infestation moderate. Philippine Islands.

GEORGIA COASTAL PLAIN EXPERIMENT STATION 1935 (*81*): Unsafe for a control rotation.

HARTER and WEIMER 1929 (*105*): The greatest loss is not to the sweetpotato itself but to susceptible crops that follow.

MILBRATH 1923 (*162*): Susceptible; suggested for indicator plant. California.

PITTMAN 1929 (*192*): Not usually attacked to such an extent as other market-garden plants. Western Australia.

POOLE 1933:[58] Has been an important means of dissemination. North Carolina.

——— and SCHMIDT 1929 (*195*): Yields small if attacked early; plants not killed; even the most resistant varieties would increase the soil infestation. North Carolina.

TAUBENHAUS and EZEKIEL 1933 (*226*): Infested occasionally, little loss. Texas.

UNITED STATES BUREAU OF PLANT INDUSTRY 1926:[59] Infestation said to be often serious in Arkansas.

WATSON and GOFF 1937 (*258*): Rather tolerant; rated as No. 29 in order of susceptibility [from okra, No. 1, to corn, No. 46]. Florida.

ZIMMERLEY and SPENCER 1923 (*267*): Listed as "practically immune." Virginia. [Question: What variety?]

The following reports, which analyze varietal differences in susceptibility, are more significant than the preceding, which judge all sweetpotatoes alike, or generalize a limited experience without reporting the variety. To balance the reports on resistant varieties it should be remembered that the same authors report severe infestations on many varieties, especially on Nancy Hall (*195, 261, 263*), Red Bermuda (*195*), and Red Brazil (*195, 261*). The susceptible variety Southern Queen is listed below because of conflicting reports.

Var. BIO-STEM JERSEY.

POOLE and SCHMIDT 1929 (*195*): Resistant; slight infestation in roots, sometimes also in potatoes (1.2 percent; 2 seasons). North Carolina.

WEIMER and HARTER 1925 (*261*): Highly resistant, not immune; a few galls seen in two of the three tests (1 season). California.

WHITTLE and DRAIN 1935 (*263*): Listed as seldom infested or highly resistant.

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[58] WOOD, JESSIE I., STEVENS, NEIL E., and MILLER, PAUL R. DISEASES OF PLANTS IN THE UNITED STATES IN 1932. U. S. Bur. Plant Indus., Plant Dis. Rptr. Sup. 85, pp. 1–82. 1933. [Mimeographed.] See report by R. F. Poole, Root Knot in North Carolina in 1932, p. 22.

[59] See p. 56 of reference given in footnote 23, p. 19.

Var. "California" [meaning Var. Shanghai?].

Burtch 1930 (*27*): Seems to be fairly free. California.

Var. Creola.

Poole and Schmidt 1929 (*195*): Resistant; potatoes infested (3 percent) in cracks and lenticels (1 season). North Carolina.

Var. Dixie "Yam."

Poole and Schmidt 1929 (*195*): As resistant and as productive as Var. Porto Rico on infested soils; rootlets infested at tips, potatoes slightly scabbed (2.3 percent; 2 seasons). North Carolina.

Var. Enormous.

Poole and Schmidt 1929 (*195*): Resistant; roots slightly infested, also potatoes (3.5 percent; 1 season). North Carolina.

Var. Gold Skin.

Poole and Schmidt 1929 (*195*): Resistant; very slight infestation of potatoes (0.2 percent; 1 season). North Carolina.

Whittle and Drain 1935 (*263*): Listed as seldom infested or highly resistant.

Var. Japan Brown.

Poole and Schmidt 1929 (*195*): Resistant; rootlets infested at tips, potatoes scabbed (3 percent; 1 season). North Carolina.

Var. "New Gem."

Poole and Schmidt 1929 (*195*): As resistant and as productive as Porto Rico; slight infestation in roots, 2.1 percent in potatoes (2 seasons). North Carolina.

Var. "Old Long Red."

Poole and Schmidt 1929 (*195*): Resistant; slight infestation in rootlet tips, scablike lesions on a few potatoes (1.2 percent; 2 seasons). North Carolina.

Var. Porto Rico.

Poole and Schmidt 1929 (*195*): The Porto Rico strains and varieties have been very resistant throughout the infested areas; infestation slight in rootlets and in cracked potatoes (1 to 1.8 percent; 3 seasons); Var. "Golden Porto Rico" resistant also (1 season); potatoes slighty infested (2.1 percent) through cracks and lenticels. North Carolina. Porto Rico roots and potatoes sent by R. C. Thomas from Tifton, Ga., showed slightly greater infestation than was observed in North Carolina.

Tyler, J. (Divison of Nematology, Bureau of Plant Industry. 1939): Heavy infestation observed on one planting, with fewer salable potatoes than from the Nancy Hall, supposedly a much more susceptible variety, in adjacent rows. Grower said the severe splitting and the irregularities of size and shape in both varieties were directly connected with root knot infestation. Virginia.

United States Bureau of Plant Industry 1927: [60] Reported as very resistant by the assistant farm adviser in Los Angeles County, California.

Weimer and Harter 1925 (*261*): Highly resistant, not immune; yield better than other varieties tested; a dozen galls found in one test, no galls seen in two other tests (1 season). California.

Whittle and Drain 1935 (*263*): Listed as slightly infested.

Var. Red Jersey.

Poole and Schmidt 1929 (*195*): Resistant; infestation 0 to slight in rootlets, 0 to 0.8 percent in potatoes (3 seasons). North Carolina.

Weimer and Harter 1925 (*261*): Highly resistant, not immune; "no galls seen" in seedbed nor in three tests (1 season). California.

Whittle and Drain 1935 (*263*): Listed as seldom infested or highly resistant.

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[60] Haskell, R. J., and Woon, Jessie I. Diseases of vegetable and field crops other than cereals in the United States in 1926. U. S. Bur. Plant Indus., Plant Dis. Rptr. Sup. 54, pp. 209–333, illus. 1927. [Mimeographed.] See p. 270.

Var. SOUTHERN QUEEN.

POOLE and SCHMIDT 1929 (*195*): Badly infested, but less than Nancy Hall; uniform but slight infestation of roots, 35–45 percent potato infestation (2 seasons). North Carolina.

WEIMER and HARTER 1925 (*261*): Highly resistant, not immune; a few small galls in seedbed but none seen in three tests of plants from this bed (1 season). California.

WHITTLE and DRAIN 1935 (*263*): Listed as badly infested.

Var. TRIUMPH.

POOLE and SCHMIDT 1929 (*195*): Infestation slight to moderate in rootlets, 6 to 10.5 percent in potatoes (3 seasons). North Carolina.

WHITTLE and DRAIN 1935 (*263*): Listed as slightly infested.

Var. YELLOW JERSEY (Early Carolina; Little-Stem Jersey).

BURTCH 1930 (*27*): Jersey seems to be fairly free. California.

CALIFORNIA NEMATODE COMMITTEE 1925:[61] Jersey infested but profitable.

POOLE and SCHMIDT 1929 (*195*): Resistant; infestation slight in rootlets, 0 to 1 percent in potatoes, with a few scablike lesions (3 seasons); ditto Var. "Yellow Jersey Vineless" (1 season); the Jersey varieties produce a very high percentage of salable potatoes. North Carolina.

PORTER 1931 (*196*): Very satisfactory crops of most varieties of the Jersey group can be grown in soils so thoroughly infested that it is impossible to grow tomatoes, eggplants, or melons with profit; serve as hosts for nematodes in rotation. California.

WEIMER and HARTER 1925 (*261*): Highly resistant, not immune; a few galls seen in one of the three tests, slight stem infestation in another test (1 season). California.

WHITTLE and DRAIN 1935 (*263*): Listed as seldom infested or highly resistant.

Var. YELLOW "YAM" (Yellow Belmont).

POOLE and SCHMIDT 1929 (*195*): Infestation of roots moderate to severe, of potatoes "scab markings" to severe (3 seasons); Var. Belmont, however, was heavily infested. North Carolina.

WEIMER and HARTER 1925 (*261*): Highly resistant, not immune; a few small galls in seedbed but none seen on plants from this bed grown in three different localities (1 season). California.

Ivy, ground-, see **Nepeta.**

Jackbean, see **Canavalia.**

Japonica, see **Camellia.**

Jasminum grandiflorum, Spanish jasmine. (M)

BODENHEIMER 1930 (*19*): Almost no infestation (one planting). Palestine.

Jatropha, see **Manihot.**

Johnson grass, see **Sorghum.**

Juglans cinerea, butternut, "white walnut." (M)

NEAL 1889 (*176*): "Slightly affected." Florida.

No further published reports on this species have been found.

Jujube, see **Zizyphus.**

Juniperus spp., juniper. (C)

BLATTNÝ 1930 (*18*): Infested by root knot. [Data from title. Czechoslovakia.]

HUME 1937:[62] No harmful infestation ever seen. Florida.

Kafir, see **Sorghum.**

Kaki, see **Diospyros.**

Kale, see **Brassica.**

Knotweed, see **Polygonum.**

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[61] See footnote 6, p. 8.

[62] See footnote 5, p. 8.

Koniga, see **Lobularia.**

Kraunhia, see **Wisteria.**

Kudzu-bean, see **Pueraria.**

Lablab, see **Dolichos.**

Laceflower, see **Trachymene.**

Lactuca sativa, garden lettuce. **(N, S)**

BESSEY 1911 (*16*): Injury severe.
BOSHER 1933: [63] Severe outdoors infestation discovered in British Columbia; plants considerably weakened.
FOSTER 1923: [64] Heavy infestations in seedbeds; total loss in some cases. Florida (Sanford).
FRANK 1885 (*68*): Favored host; infestation heavy. Germany.
GOFFART 1934 (*97*): Growth of young plants arrested; outdoors infestation. Germany (Pomerania).
HÖSTERMANN 1922 (*111*): Infestation heavy. Germany (experimental).
HUME 1901 (*113*): Badly infested. Florida.
NEWHALL 1934: [65] Infestation threatened to handicap lettuce production on mucklands. New York.
POOLE and SCHMIDT 1927 (*194*): Badly diseased. North Carolina.
STONE and SMITH 1898 (*224*): Occasional heavy infestations are unusual; often grown in infested soil without finding galls. [Question: At low soil temperatures?]
TARNANI 1898 (*225*): Infestation heavy but little njury. Poland.
TAUBENHAUS and EZEKIEL 1933 (*226*): May cause serious losses. Texas.
WAID 1921 (*246*): Injury generally not serious; may considerably retard development.
WATSON and GOFF 1937 (*258*): Rated as No. 17 in order of susceptibility [from okra, No. 1, to corn, No. 46]. Florida.
——— GOFF, and BRATLEY 1937 (*259*): Progress is being made with resistant strains. Florida.

Lambsquarters, see **Chenopodium.**

Lantana camara, common lantana. **(N)**

BUHRER, E. M. (Division of Nematology, Bureau of Plant Industry. 1934): No galls found on the two plants in a mixed border otherwise heavily infested. District of Columbia.
GARDNER 1926 (*75*): Found to be a host. California.
TYLER, J. (Division of Nematology, Bureau of Plant Industry. 1936): Galls very few and very small in greenhouse experiment. District of Columbia.

Larkspur, see **Delphinium.**

Leek, see **Allium**; houseleek, see **Sempervivum.**

Lemon, see **Citrus.**

Lepidium sativum, garden cress.

HÖSTERMANN 1922 (*111*): Infestation moderate, galls small. Germany (experimental).
WHITTLE and DRAIN 1935 (*263*): Listed as slightly infested. Tennessee.

One or two other infestations have been reported from Europe.

Leptosyne, see **Coreopsis.**

Lespedeza bicolor, shrub bushclover. **(C, N)**

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.

Lespedeza sericea, Chinese lespedeza, perennial lespedeza, sericea. **(N)**

STEINER and BUHREB 1933: [66] Infestation found. Maryland.
WHITTLE and DRAIN 1935 (*263*): Sericea slightly infested. Tennessee.

[63] BOSHER, J. E. AN OUTDOORS INFESTATION OF ROOT-KNOT NEMATODE IN BRITISH COLUMBIA. U. S. Bur. Plant Indus., Plant Dis. Rptr. 17: 105–106. 1933. [Mimeographed.]
[64] CHUPP, CHARLES. DISEASES OF FIELD AND VEGETABLE CROPS IN THE UNITED STATES IN 1922. U. S. Bur. Plant Indus., Plant Dis. Bul., Sup. 26, pp. 1–163. 1923. [Mimeographed.] See information from Foster, p. 154.
[65] See footnote 12, p. 12.
[66] STEINER, G., and BUHRER, Edna M. RECENT OBSERVATIONS ON DISEASES CAUSED BY NEMATODES. U. S. Bur. Plant Indus., Plant Dis. Rptr. 17: 172–173. 1933. [Mimeographed.]

Lespedeza striata, common lespedeza, Japanese-clover.

ATKINSON 1889 (*4*): "Slightly affected" near Auburn, Ala.
BESSEY 1911 (*16*): Practically if not entirely immune.
NEAL 1889 (*176*): A fine substitute for susceptible cowpeas. Florida.
SHAW 1940 (*213a*): Tobacco in enclosure units showed no severe infestation following 2 years' bare fallow, 83.7 percent following 2 years' lespedeza Var. Tennessee 76, and 100 percent following 2 years' tobacco. [North Carolina.]

Lespedeza spp., lespedeza. **(N, S)**

BEELEY 1939 (*14*): "Bush and shrubclovers" considerably weakened by infestation. Malaya.
CHRISTIE, J. R. (Division of Nematology, Bureau of Plant Industry. 1939): Korean lespedeza, *L. stipulacea*, found heavily infested; plants yellow and stunted, a good field indicator. Virginia.
GEORGIA COASTAL PLAIN EXPERIMENT STATION 1936 (*83*): Both annual and perennial lespedezas are too susceptible for tobacco rotations; "not always seriously affected."
WATSON and GOFF 1937 (*258*): Rated as No. 27 in order of susceptibility [from okra, No. 1, to corn, No. 46]. Florida.
WHITTLE and DRAIN 1935 (*263*): Annual lespedeza "seldom infested or highly resistant." Tennessee (?).

Lettuce, see **Lactuca.**

Leucas martinicensis. **(C)**

COLLINS 1937 (*41*): No signs of nematode attack. Rhodesia.

Ligustrum ovalifolium, California privet. **(M, N, S)**

BARKER and NEAL 1924 (*11*): Infestation apparently general on California privet throughout Mississippi; "other varieties in the same nursery have not been found to be affected."
BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.
HUME 1937: [67] Extremely susceptible. Florida.
WHITTLE and DRAIN 1935 (*263*): Infestation heavy (4 seasons). Tennessee.

Ligustrum quihoui, Quihou privet.

HUME 1937: [68] The only resistant species. Florida.

Lilium spp., lily. **(C)**

WEBER 1925: [69] Many plants of Easter lily, *L. longiflorum*, killed before blooming. Florida.
WHITTLE and DRAIN 1935 (*263*): Lily listed as slightly infested. Tennessee (?).

Lily, see **Lilium**; see also calla and daylily.

Lima bean, see **Phaseolus.**

Limonium sinuatum, notchleaf sea-lavender, notchleaf statice. **(C)**

GOFF 1936 (*96*): Infestation 0 to very light on 19 plants, light to moderate on 6 plants (1 winter test). Florida.

Linum usitatissimum, flax, linseed.

OREGON AGRICULTURAL EXPERIMENT STATION 1938 (*185*): Tests with seed flax have given yields such as to make it a strong possibility for use in future rotations. [Although this report was included under the heading of "Control methods for nematodes," the particular crop test was made, according to A. E. Gross, the investigator, for purely agronomic considerations and not in nematode-infested land.]

Infestation has been reported by Krishna Ayyar (*132*) and injury by Bessey (*16*).

Lobularia maritima (*Koniga maritima*), sweet alyssum. **(C, N)**

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.
GOFF 1936 (*96*): No infestation found (50 plants, 2 winter tests); infestation 0 to light (25 plants, 1 spring test). Florida.

[67] [68] See footnote 5, p. 8.
[69] MARTIN, G. HAMILTON. DISEASES OF FOREST AND SHADE TREES, ORNAMENTAL AND MISCELLANEOUS PLANTS IN THE UNITED STATES IN 1924. U. S. Bur. Plant Indus., Plant Dis. Rptr. Sup. 42, pp. 313-380, illus. 1925. [Mimeographed.] See report of Weber, p. 355.

NEAL 1889 (*176*): "Badly affected." Florida.
WATKINS 1929 (*248*): Alyssum rated as "resistant." Florida.

Loganberry, see **Rubus.**

Lolium perenne, perennial ryegrass. (C)

BESSEY 1911 (*16*): No infestation found.
WHITTLE and DRAIN 1935 (*263*): Ryegrass listed as highly resistant. Tennessee (?).

Lonicera japonica, Japanese honeysuckle. (C)

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.
FLORIDA STATE PLANT BOARD 1919 (*66*): Three infested shipments of honeysuckle intercepted (from Ohio).

The Mississippi station has a record of infestation on plants from Ohio.

Lonicera nitida.

GARDNER 1926 (*75*): Observed to be a host. California.

Loquat, see **Eriobotrya.**

Lucerne, see **Medicago.**

Lucuma nervosa (*L. rivicoa angustifolia*), canistel, ty-ess. (C)

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.

Lupinus angustifolius. (M)

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.

Lupinus hartwegii, Hartweg lupine.

LYON 1911 (*144*): Seemed to be entirely free (one test). Hawaii.

Lupinus spp. (N, S)

FRANK 1885 (*68*): No infestation found; other hosts preferred (one planting). Germany.
GOFF 1936 (*96*): Infestation found on only 1 plant, very light (annual ornamental; 15 plants, 1 winter test). Florida.
ZIMMERMANN 1903 (*269*): Galls numerous, plants very unhealthy. Tanganyika (German East Africa).

Lycopersicon esculentum, tomato. (N, S)

FAJARDO and PALO 1933 (*60*): 49 varieties were grown 35 days from seed, in greenhouse pots; the highly susceptible varieties showed only 9 to 26 galls per plant. Seedlings of the following made good growth, although all plants showed some galls: Vars. June Pink, Penn State Earliana, and the Philippine native varieties "San Isidro No. 1," "Wild Cherry (Lemery)," and "Pasig No. 1." Vars. Columbia and (Livingston) Globe were rated as "resistant" in 1 test in spite of poor growth, presumably because of rather low gall counts; other lots of these same varieties were rated as susceptible. The small-fruited, wild types were rated as "more resistant" than those with fleshy fruits, on the basis of their very small galls. Varieties noted below appeared somewhat "resistant." Philippine Islands.
FICHT 1939 (*63*): Field tests with Vars. Baltimore, Marglobe, Pride of Illinois, and Pritchard demonstrated considerable decrease in number of fruits set on infested plants, in size of fruits and plants, and in yield of fruits of each grade. Indiana.
LI and LEI 1938 (*138*): 32 varieties tested in the experimental plots at Lingnan University, China; all plants were infested except a few individual plants of the varieties noted below.
YOUNG 1939 (*266*): Root knot infestation caused a decrease of 8 percent in the wilt resistance of Var. Early Baltimore, 23 percent in (Livingston) Globe, 20 percent in Marglobe (4 selections), and from 0 to 39 percent in 45 other selections; the different percentages were probably caused by differences in the severity of root knot. Only 3 of the 54 selections tested gave opposite results, and these were wilt-susceptible varieties. Texas.

Occasional references to tolerance in tomato have been omitted because no varieties were named and because the reports were not otherwise sufficiently definite; much more numerous are the reports of crop losses, which also lack variety names in most cases.

Var. Chalk Early Jewel.
Fajardo and Palo 1933 (*60*): Good growth, relatively few galls; 65 seedlings infested, 6 free.
Li and Lei 1938 (*138*): Nine plants infested, one free.
Malloch 1923 (*154*): Susceptible in greenhouse. California.

Var. Red Cherry.
Fajardo and Palo 1933 (*60*): Good growth, galls very small and relatively few; 57 seedlings, all infested.
Li and Lei 1938 (*138*): 10 plants, all infested.
Malloch 1923 (*154*): Susceptible in greenhouse (Red Cherry No. 81). California.

Var. Red Pear.
Fajardo and Palo 1933 (*60*): Good growth, relatively few galls; 24 seedlings infested, 26 free.
Li and Lei 1938 (*138*): Five plants infested, five plants free.
Malloch 1923 (*154*): Susceptible in greenhouse (seed from three sources). California.

Var. Red Rock.
Barrons 1938:[70] Galls smaller, root system better developed than in other common varieties; reasonably tolerant unless heavily infested when young (four tests). Alabama.
Malloch 1923 (*154*): Susceptible in greenhouse (seed from two sources). California.

Var. Stone.
Barrons 1938:[71] Reasonably tolerant. [Same description as for Var. Red Rock, q. v.]
Malloch 1923 (*154*): Susceptible in greenhouse. California.
Young 1939 (*266*): Wilt resistance decreased 6 percent by root knot attack. Texas.

Var. Yellow Pear.
Li and Lei 1938 (*138*): Nine plants infested, one plant free.
Malloch 1923 (*154*): Susceptible in greenhouse. California.

Var. Yellow Plum.
Fajardo and Palo 1933 (*60*): Good growth, galls very small and relatively few; 38 seedlings infested, 7 free.
Li and Lei 1938 (*138*): Eight plants infested, two free.
Malloch 1923 (*154*): Susceptible in greenhouse (seed from three sources). California.

Magnolia grandiflora, southern magnolia. **(N)**
Boyd 1927:[72] A "large infection" in Georgia.
Hume 1937:[73] Never seen "affected." Florida.

Maize, see **Sorghum** and **Zea.**

Malus sylvestris (*Pyrus malus*), apple. **(C)**
Archer 1926:[74] In one heavily infested locality "apples had been planted repeatedly but most of them are killed or else remain stunted." Missouri. [Question: Were roots dissected?]
Bodenheimer 1930 (*19*): Galls occasionally found on seedlings. Palestine.
Florida State Plant Board 1919–25 (*66*): Infested shipments intercepted from Alabama, Georgia, and North Carolina (one each).

[70] [71] Barrons, Keith C. Varietal differences in resistance to root-knot in economic plants. U. S. Bur. Plant Indus., Plant Dis. Rptr. Sup. 109: 143–151. 1938. [Mimeographed.]
[72] Martin, G. Hamilton. Diseases of forest and shade trees, ornamental and miscellaneous plants in the United States in 1926. U. S. Bur. Plant Indus., Plant Dis. Rptr. Sup. 55, pp. 334–393. 1927. [Mimeographed.] See report of Boyd, p. 351.
[73] See footnote 5, p. 8.
[74] U. S. Bureau of Plant Industry. A severe infestation of the root knot nematode (caconema radicicola). U. S. Bur. Plant Indus., Plant Dis. Rptr. 10: 111–112. 1926. [Mimeographed.] (Reported by W. A. Archer.)

McClintock 1927 (*148*): Nematodes never found in suspected knots, previous records questioned; woolly aphis causes knots; total absence of knots on apple seedling grown near infested fig. Tennessee.
Milbrath 1923 (*162*): Root knot found on several varieties of apple. California.
Selby 1897 (*210, 211*): "Eelworms" were found on apple in connection with crown gall and aphid galls. Ohio. [In his 1910 Handbook Selby (*212*) described crown gall on apple, "probably *Bacterium tumefaciens*," without mentioning nematodes. See also **Rubus.**]
Tarnani 1898 (*225*): Lindemann assumed root knot to be the cause of galls on apple and pear roots in Russia; Tarnani did not find *Heterodera marioni*, but found other nematodes on the surface of these galls. [Question: Did Tarnani examine Lindemann's actual specimens? His statement is not clear. Lindemann's paper (1896) has not been found.]
Taubenhaus and Ezekiel 1933 (*226*): Losses rarely serious. Texas.
Tufts and Day 1934 (*234*): Seedlings, Var. Rainier, not attacked (one small test). [Data in letter, 1939: Var. Delicious free from knots (nursery test, 1 year).] California.
United States Bureau of Plant Industry 1928:[75] Occasionally collected by nursery inspectors in Utah; very minor.
——— 1935:[76] Generally distributed in Mississippi.
——— 1936:[77] Root knot reported from Mississippi and Texas.
Whittle and Drain 1935 (*263*): Not seriously affected, though subject to attack. Tennessee.

The Mississippi station has records of infestations on apple from six States. G. Minz (research station, Rehovot, Palestine; in letter, 1940) reports infestation on "*M. mitis*" in Palestine; this name cannot be checked.

Mangifera indica, mango. **(C)**

No reports whatever have been found for this plant.

Manihot esculenta (*Jatropha manihot; M. utilissima*), cassava. **(N)**

Bessey 1911 (*16*): Nematodes not abundant and no injury observed.
Neal 1889 (*176*): "Slightly affected." Florida.

Marguerite, see **Chrysanthemum** and **Dianthus.**

Marigold, see **Tagetes;** figmarigold, see **Mesembryanthemum;** pot-marigold, see **Calendula.**

Matthiola sp., stock.

Goff 1936 (*96*): Infestation 0 and very light in 1 winter test (33 plants), very light to very heavy in a second winter test (25 plants); average rating "very lightly infested." Florida.
Höstermann 1922 (*111*): Infestation moderate. Germany (experimental).
Taubenhaus and Ezekiel 1933 (*226*): Losses rarely serious. Texas.

Mazzard, see **Prunus.**

Medicago arabica, spotted bur-clover.

Neal 1940 (*175a*): Bur-clover and Southern Giant bur-clover are resistant; may be used successfully in rotations. Louisiana (?).
Smee 1928 (*214*): Infestation very slight. Nyasaland.

Farmers in Louisiana are said to disagree on the resistance of the bur-clovers named above. Severe infestations have been reported on related species: on [*M. hispida*, toothed] bur-clover by Gilbert (*88, 89*) and on *M. rigidula*, Tifton bur-clover, by A. L. Taylor, of the Division of Nematology, working in Georgia.

Medicago sativa, alfalfa (lucerne). **(N, S)**

Atkinson 1889 (*4*): Insusceptible, so far as observed here. Alabama.
Bessey 1911 (*16*): Nematodes abundant, injury apparently not great.
California Nematode Committee 1925:[78] Common or Chilean alfalfa infested but profitable.
Frank 1896 (*69*): Preferred host; plant development may be injured. Germany.

[75] Linford, Maurice B. Plant diseases in Utah in 1927. U. S. Bur. Plant Indus., Plant Dis. Rptr. Sup. 59, pp. 65–117, illus. 1928. [Mimeographed.] See p. 105.
[76] Edson, H. A., Miller, Paul R., and Wood, Jessie I. Diseases of plants in the United States in 1934. U. S. Bur. Plant Indus., Plant Dis. Rptr. Sup. 90, pp. 1–135, illus. 1935. [Mimeographed.] See p. 42.
[77] Edson, H. A., and Wood, Jessie I. Diseases of plants in the United States in 1935. U. S. Bur. Plant Indus., Plant Dis. Rptr. Sup. 96, pp. [114]–289, illus. 1936. [Mimeographed.] See p. 172.
[78] See footnote 6, p. 8.

GOFFART 1934 (*97*): Heavy field infestation. Germany (Berlin-Dahlem).
KENNEDY and MACKIE 1925 (*123*): Carries nematodes in limited numbers. California (?).
KINO 1940 (*126a*): Alfalfa rotation appears as effective as fallow for control of root knot; satisfactory yields of American-Egyptian cotton could be maintained if the intervals between alfalfa were not greater than 2 years (rotation practiced for 20 years). [Arizona.]
———and HOPE 1934 (*127*): Injuries practically negligible in Arizona and southern California; rotation maintains cotton yields in infested areas, but without eradication. [Data in letter, 1939: No reduction in yield of common or Chilean alfalfa in heavily infested land.]
KRISHNA AYYAR 1933 (*132*): "Abundantly infected" in pot experiment. India (Madras).
NAUDE 1939 (*175*): Helpful in control rotations with tobacco; no signs of infestation could be discovered on year-old lucerne on land where certain weeds were "heavily affected." South Africa (Oudtshoorn).
SANDOROUND 1922 (*207*): Parasitized more or less severely in South Africa (Basutoland, Natal, or Transvaal).
SCOTT, LINDSAY, and HARRISON 1939 (*209*): Does not control root knot in the San Joaquin Valley; was formerly regarded favorably for rotation with cotton. California.

Var. HAIRY PERUVIAN.
KING, C. J. (Division of Cotton and Other Fiber Crops and Diseases, Bureau of Plant Industry; in letter, 1939): Tolerant, no reduction in yield. Arizona and southern California.
TAUBENHAUS 1923:[79] Highly resistant. Texas.

Meibomia, see **Desmodium.**

Melandrium album. (C)
MUSZYNSKI and STRAZEWICZ 1932 (*174*): No infestation found. Poland.

Melia azedarach, chinaberry, "umbrella-tree."
BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.

Melilotus indica. (M)
BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.
NEAL 1940 (*175a*): Resistant; may be used successfully in rotations. Louisiana (?).

Mesembryanthemum spp., figmarigold. (C, N)
GROWER: Common species "seem untroubled" by infestation. California.
NEAL 1889 (*176*): "Various spp. . . . slightly affected." Florida.

Six species are known as hosts, each from a single report, without estimate of the amount of injury.

Mesquite, see **Prosopis.**

Mexican-clover, see **Richardia.**

Michaelmas-daisy, see **Aster.**

Millet, see **Echinochloa, Eleusine, Panicum, Pennisetum,** and **Setaria.**

Milo, see **Sorghum.**

Mirabilis jalapa, common four-o'clock. (C)
GOFF 1936 (*96*): No infestation found in 1 winter test (23 plants); infestation 0 to very light in 2 spring tests (65 plants). Florida.
WATKINS 1929 (*248*): Mirabilis rated as "resistant." Florida.

Morus spp., mulberry. (N)
BESSEY 1911 (*16*): Included among the trees "most generally affected seriously" in the south; the four species recorded were given the rating "nematodes abundant, but injury apparently not great."
HUME 1937:[80] Not much injury although heavily infested. Florida.
NEAL 1889 (*176*): "Slightly affected." Florida.

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[79] HASKELL, R. J., and WOOD, JESSIE I. DISEASES OF CEREAL AND FORAGE CROPS IN THE UNITED STATES IN 1922. U. S. Bur. Plant Indus., Plant Dis. Bul. Sup. 27, pp. 164–266, illus. 1923. [Mimeographed.] See report of Taubenhaus, p. 249.
[80] See footnote 5, p. 8.

STEINER 1938: [81] Seedlings tolerant of infestation; roots beaded with galls, growth apparently normal.

WATSON and GOFF 1937 (*258*): Flourishes in spite of the infestation. Florida.

Mucuna, see **Stizolobium.**

Mulberry, see **Morus.**

Musa paradisiaca subsp. **sapientum** (*M. sapientum*), common banana. (M, S)

FAHMY 1924 (*59*): Susceptible, but injury less apparent than on *M. cavendishii*. Egypt.

TAUBENHAUS and EZEKIEL 1933 (*226*): Banana infested occasionally, little loss. Texas.

WATSON and GOFF 1937 (*258*): Banana rated as No. 43 in order of susceptibility [from okra, No. 1, to corn, No. 46]; plants "at the bottom of the list are little affected and for all practical purposes can be considered as immune." Florida.

Musa spp., banana. (N)

Severe infestations have been reported on *M. paradisiaca* var. *champa*, Lady-finger banana (Fuller 1913 (*70*). South Africa) and on *M. paradisiaca* var. *dacca* (Müller 1884 (*173*). Germany, in greenhouse). Partial wilting of Cavendish banana, *M. cavendishii* (*M. chinensis*, Chinese or dwarf banana) has been reported from Florida. [82] In Egypt, where severe injuries to "banana" (mostly *M. cavendishii*) have been reported in several papers, the cause of the decay that ultimately destroys the roots has not been established. Severe infestations have also been reported on three other species of *Musa*.

Mustard, see **Brassica.**

Myrobalan, see **Prunus.**

Napier grass, see **Pennisetum.**

Narcissus spp., narcissus. (C)

STEINER, G. (Division of Nematology, Bureau of Plant Industry. 1939): Never found infested.

Narcissus has never been reported as a host plant; Whittle and Drain (*263*) listed it on authority of Tyler (*236*), whose table heading permitted this misunderstanding.

Nasturtium, see **Tropaeolum.**

Natal grass, see **Tricholaena.**

Nectarine, see **Amygdalus.**

Nepeta hederacea, ground-ivy. (C)

BOSHER and NEWTON 1933: [83] No root knots nor other symptoms. Canada.

The California State Department of Agriculture has a record of infestation in this genus.

Nicotiana glauca, tree tobacco.

CLAYTON and FOSTER 1940 (*38*): Highly resistant (experimental).

KOSTOFF and KENDALL 1930 (*129*): Infestation less heavy than on *N. tabacum*. Bulgaria.

MINZ, G. (Research station, Rehovot, Palestine; in letter, 1940): Found infested in Palestine.

Nicotiana longiflora.

CLAYTON 1940 (*37a*): Highly resistant or immune.

Nicotiana megalosiphon.

CLAYTON 1940 (*37a*): Highly resistant or immune.

Nicotiana nesophila.

CLAYTON 1940 (*37a*): Highly resistant or immune.

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[81] See discussion by Steiner on p. 139 of reference given in footnote 4, p. 6.

[82] FULTON, H. R. DISEASES OF SUB-TROPICAL FRUITS. U. S. Bur. Plant Indus., Plant Dis. Rptr. Sup. 39: 89–102. 1925. [Mimeographed.] See report of Weber, p. 99.

[83] See footnote 31, p. 23.

Nicotiana nudicaulis.

CLAYTON 1940 (*37a*): Highly resistant or immune.

Nicotiana repanda.

CLAYTON and FOSTER 1940 (*38*): Highly resistant (experimental).

Nicotiana rusbyi, see **N. tomentosiformis.**

Nicotiana rustica, Aztec tobacco.

FERRARI 1939 (*62*): Var. Brasilia (?: "Brasile del Grappa") observed to be relatively resistant at Scafati (tested 1 year). Italy.

Nicotiana tabacum, common tobacco. **(N, S)**

CLAYTON 1938: [84] Resistant varieties from Central America used in breeding program; several types show little evidence of infestation, other types show abundant galls which seem not to injure the plant because they are small and do not decay.

——— 1940 (*37a*): Varying degrees of resistance found; in certain lines, like White Honduras, nematode resistance is linked closely with undesirable growth characters; other lines, apparently homozygous, with a marked degree of resistance, have been established after repeated selfing.

——— and FOSTER 1940 (*38*): Only moderate to slight resistance has been found—more than 1,000 collections tested; resistance was recessive and conditioned by multiple factors.

FERRARI 1939 (*62*): Vars. Round Tip and the Turkish Xanthi ("Xanty Yaka") were observed to be relatively resistant at Scafati (tested 1 year). Italy.

GARNER, ALLARD, and CLAYTON 1936 (*76*): All domestic varieties tried so far are susceptible except a strain of Orinoco known as Faucette Special, which shows moderate resistance; one foreign variety, "White Honduras," also moderately resistant.

KINCAID 1938 (*125*): Crosses have been made between a resistant variety and commercial varieties. Florida.

OGLOBLIN 1934 (*184*): Var. "Chileno Colorado" sometimes tolerates infestation much better than do other varieties, though young plants may be killed. Argentina (Misiones). [Heavy infestations observed on this variety by Kerzman [85] in Argentina.]

POOLE 1937: [86] "Blistering" of leaves is magnified by decay of the galls. North Carolina.

SHAMEL and COBEY 1907 (*213*): Promising selections made; development of a resistant strain anticipated. [Nothing materialized from this project; Bessey's (*16*) citation of the report is still quoted.]

TISDALE 1923 (*230*): Selections made from a desirable strain, Ew–22–17, of the Var. Big Cuban; some infestation on all plants. Florida.

UNITED STATES BUREAU OF PLANT INDUSTRY 1938 (*239*): Seed collections from Central America tested in Georgia, North Carolina, and South Carolina; the better resistant strains suffered no damage; F_2 progenies from selections crossed with Orinoco varieties show segregation for resistance and susceptibility. [See report of Clayton, above.]

Nicotiana tomentosa, giant tobacco.

KOSTOFF and KENDALL 1930 (*129*): No infestation obtainable; plants contain a high percentage of alkaloids. Bulgaria.

Nicotiana tomentosiformis [collected in 1921 from Ama on Basin; erroneously identified as *N. rusbyi;* see Goodspeed (*100*)].

KOSTOFF and KENDALL 1930 (*129*): No infestation obtainable on "*N. rusbyi*"; plants contain a high percentage of alkaloids. Bulgaria.

Nicotiana hybrid.

CLAYTON and FOSTER 1940 (*38*): "Smiths allo-polyploid (*N. tabacum* × *N. glauca*—n=36) shows resistance" (experimental).

Nolana sp., nolana.

NEAL 1889 (*176*): "Slightly affected." Florida. **(C)**

[84] See report of Clayton on p. 140 of reference given in footnote 4, p. 6.

[85] [KERZMAN, I. N.] ROOT KNOT DEL TABACO. Argentina Min. de Agr. Bol. Tabacalero 2 (4): 27–31. 1938. [Mimeographed.]

[86] See remark by Poole on p. 119 of reference given in footnote 3, p. 6.

Oak, see **Quercus.**

Oat, see **Avena.**

Oatgrass, see **Arrhenatherum.**

Oenothera lamarckiana, lamarck evening-primrose.

GOFF 1936 (*96*): No infestation found (25 plants, 1 test). Florida.

Onion, see **Allium.**

Opuntia spp., pricklypear. (N)

GROWER: Vigorous; not injured by infestation. California.

Orange, see **Citrus** and **Poncirus.**

Orchard grass, see **Dactylis.**

Ornithopus sativus, serradella. (C)

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.
FRANK 1885 (*68*): Galls numerous. Germany.

Orthosiphon bracteosus.

COLLINS (*41*): No signs of nematode attack (1937); weed host (1938). Rhodesia.

Oryza sativa, rice. (C, N)

BARBER 1901 (*9*): Paddy recommended as an "immune crop." India (Madras).

FAJARDO and PALO 1933 (*60*): Rice fields kept under water for 2 to 4 months are usually free. An upland variety, "Dumali" (native name), was rated as resistant; 10 plants infested, 30 plants free. Philippine Islands.

KRISHNA AYYAR 1933 (*132*): No infestation found in pot experiment. India (Madras).

ROLFS 1907 (*201*): "Almost quite immune."

STEINER 1934 (*222*): The rice plant (Var. Supreme Blue Rose) suffers more than numerous other hosts because root tips are blinded and infested tissues break open. Arkansas.

TULLIS 1934 (*235*): Plants yellow and dwarfed in the field; heavy experimental infestation on Var. Supreme Blue Rose; infested roots reduced in number and in length; more nematodes in the submerged than in the nonsubmerged roots. Arkansas.

Pachyrhizus angulatus.

BEELEY 1939 (*14*): Infestation apparently not observed [Malaya?] nor reported [in literature?]; experiments projected.

Pachyrhizus erosus, yam-bean. (N)

FAJARDO and PALO 1933 (*60*): Rated as "resistant"; 45 plants infested, 20 plants free. Philippine Islands.

Paeonia hybrids, peony. (N, S)

BROWN 1929 (*25*): Infested roots received for examination have not included any of the *officinalis* group.

BUHRER 1938:[87] *P. officinalis* listed as a host plant. [Data from Bureau of Entomology and Plant Quarantine; infested shipments intercepted from three different European countries.]

NELSON 1926:[88] *P. officinalis* Var. "Rosea" especially "affected." Michigan (in nursery).

——— 1931 (*177*): There appears to be little if any varietal resistance in *P. albiflora,* Chinese peony. Michigan.

S., 1928 (*206*): Heavy-growing varieties with big roots, like Festiva Maxima, seem to thrive in spite of the nematodes; less vigorous varieties suffer severely. Missouri. [Bailey's Standard Cyclopedia of Horticulture (1935) names Var. Festiva under both common species, *P. albiflora* and *P. officinalis.*]

[87] BUHRER, EDNA M. ADDITIONS TO THE LIST OF PLANTS ATTACKED BY THE ROOT-KNOT NEMATODE (HETERODERA MARIONI). U. S. Bur. Plant Indus., Plant Dis. Rptr. 22: 216–234. 1938. [Mimeographed.]

[88] MARTIN, G. HAMILTON. DISEASES OF FOREST AND SHADE TREES, ORNAMENTAL AND MISCELLANEOUS PLANTS IN THE UNITED STATES IN 1925. U. S. Bur. Plant Indus., Plant Dis. Rptr. Sup. 50, pp. 413–478, illus. 1926. [Mimeographed.] See report of Nelson, p. 461.

In certain manuals the horticultural varieties of peonies are listed under definite species or groups. There are numerous reports of severe infestations referring merely to peony or else to varieties commonly listed under *P. albiflora*. It is the opinion of the Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry, that the pedigrees of most varieties are too complex and usually too obscure for accurate botanical classification.

Palm, date, see **Phoenix.**

Panicum hirsutissimum (name supplied), buffel. (C)

COLLINS 1938 (*41*): Buffel not attacked (1 season). Rhodesia. [The common name buffel is used in Africa for this grass and also for *Penniselum cenchroides;* there are no other nematode reports for either plant.]

Panicum maximum (name supplied), guinea grass, purpletop buffel grass.

COLLINS 1938 (*41*): Purpletop not attacked (1 season). Rhodesia. [Question: Was this the plant tested?]

Panicum miliaceum, broomcorn millet, proso.

BESSEY 1911 (*16*): No infestation found.

KRISHNA AYYAR 1933 (*132*): No infestation found in pot experiment. India (Madras).

Panicum miliare.

KRISHNA AYYAR 1933 (*132*): No infestation found in pot experiment. India (Madras).

Panicum purpurascens (*P. barbinode*), Para grass.

GODFREY 1927 (*90*): "A root-knot nematode-eliminating rotation crop" if it is grown in a pure stand. Hawaii.

LINFORD 1939 (*142*): Appears highly resistant under Hawaiian field conditions; roots highly attractive to larvae *in vitro.*

Panicum sp. (N)

HAUSER 1937 (*106*): Weed attacked in greenhouse.

STEINER, G. (Division of Nematology, Bureau of Plant Industry. 1927): Found infested in greenhouse. District of Columbia.

Panicum, see also **Digitaria.**

Para grass, see **Panicum.**

Paspalum scrobiculatum. (M)

KRISHNA AYYAR 1933 (*132*): No infestation found in pot experiment. India (Madras).

Paspalum urvillei (*P. larranagai*), Vasey grass.

GODFREY 1935:[89] Infestation commonly observed to be light. Hawaii.

Paternoster-bean, see **Abrus.**

Pea, see **Pisum;** cowpea, see **Vigna;** pigeonpea, see **Cajanus;** rosary-pea, see **Abrus.**

Peach, see **Amygdalus.**

Peanut, see **Arachis.**

Pear, see **Pyrus.**

Pecan, see **Carya.**

Pelargonium peltatum, ivyleaf geranium.

BOSHER and NEWTON 1933:[90] No root knots nor other symptoms. Canada.

Pelargonium, geranium. (N)

BOSHER and NEWTON 1933:[91] No root knots nor other symptoms found on "common geranium, *P. hortorum.*" Canada.

COMPTON 1930 (*44*): "Eelworms" often attack geranium as in greenhouses.

FLORIDA STATE PLANT BOARD 1919–21 (*66*): Infested shipments of geranium intercepted—1 from New York, 2 from Florida, 48 from Ohio.

HÖSTERMANN 1922 (*111*): Infestation light. Germany (experimental).

STEINER and BUHRER 1936:[92] "*P. hortorum*, Fish geranium," a new host, from Ohio greenhouse. [Infestation heavy; considered unusual.]

[89] See footnote 10, p. 11.
[90] [91] See footnote 31, p. 23.
[92] See footnote 42, p. 30.

Infestations have been reported on *P. zonale*, on Hort. Var. Roseum, and on unspecified geranium in a few other instances. Members of the Division of Nematology (Buhrer, Steiner, Tyler) have found resistance the usual situation, however, in the common hybrid bedding geraniums.

Pennisetum cenchroides (name supplied), buffel. (C)

COLLINS 1938 (*41*): Buffel not attacked (1 season). Rhodesia. [See also **Panicum hirsutissimum.**]

Pennisetum glaucum (*P. typhoideum*), pearl millet.

BESSEY 1911 (*16*): No infestation found.
GODFREY 1928 (*92*): No infestation found (one test). Hawaii.
KRISHNA AYYAR 1933 (*132*): No infestation found in pot experiment. India (Madras).

Pennisetum purpureum, elephant grass, Napier grass.

GODFREY 1935:[93] Infestation commonly observed to be light. Hawaii.

Peony, see **Paeonia.**

Pepper, see **Piper.**

Periwinkle, see **Vinca.**

Persea americana (*P. gratissima*), avocado. (C, N)

BESSEY 1911 (*16*): No infestation found.
CALIFORNIA NEMATODE COMMITTEE 1925: [94] Avocado resistant. [In California both *P. americana* and *P. americana drymifolia* are used as rootstocks.]
GHESQUIÈRE 1921 (*86*): Infestation found. Belgian Congo.
LAVERONE 1901 (*136*): Trees died. Chile. [Roots apparently not examined. See **Citrus** for a partial explanation of this confused study.]

Persimmon, see **Diospyros.**

Peruvian-bark, see **Cinchona.**

Petunia, common petunia. (N, S)

BESSEY 1911 (*16*): Injury severe.
GODFREY 1935: [95] Infestation heavy. California and Hawaii.
GOFF 1936 (*96*): Infestation very light to very heavy (80 plants, 3 tests); average rating "lightly infested." Florida.
SANDGROUND 1922 (*207*): Parasitized more or less severely in South Africa.
TAUBENHAUS and EZEKIEL 1933 (*226*): Losses rarely serious. Texas.
WATKINS 1929 (*248*): Both common and giant-flowered petunias rated as "resistant." Florida.

Phaseolus aureus (*P. max*), green gram, mung bean. (S)

COLLINS 1938 (*41*): "Munga" was not attacked in test (1 season) but was attacked and dwarfed on one farm. Rhodesia.

Very susceptible according to other reports.

Phaseolus lunatus, lima bean. (N, S)

BEELEY 1939 (*14*): Found attacked, but somewhat "resistant." Malaya (?).
CALIFORNIA AGRICULTURAL EXPERIMENT STATION 1936 (*29*): A large lima obtained from Peru; highly resistant but poor quality, no commercial value except for breeding.
MACKIE, W. W. (California station; in letter, 1939): A small lima, "black-seeded hybrid," secured through United States Department of Agriculture explorers, was almost immune (only 3 small galls found on more than 100 plants) in 2 heavily infested areas in California where other resistant beans entirely died out; by crossing and back-crossing with his best resistant Hopis and with large limas, Mackie hopes to produce large and small limas of superior resistance.
TOWNSEND 1934 (*231*): "A collection of Fordhook lima beans probably resistant to nematodes has been made." Florida.

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[93] See footnote 10, p. 11.
[94] See footnote 6, p. 8.
[95] See footnote 15, p. 16.

Var. HOPI.

BARRONS 1938 (*12*): Hopi 155 was partially resistant in the field, occasional plants susceptible; definitely susceptible in greenhouse seedling test, occasional plants partially resistant. Alabama.

——— 1938:[96] California station strains Nos. 5987, 5988, and 5922 more resistant at Auburn than Hopi 155 (1 season). Alabama.

——— 1939 (*13*): Numerous larvae entered root tips of seedlings and of "adult plants" (Hopi 155) heavily inoculated in greenhouse; young roots of seedlings and of plants 2, 4, and 8 weeks old "developed root knot to the same degree" as the susceptible Henderson Bush lima; 8 weeks later galls on Hopi 155 were "for the most part . . . nothing more than slight swellings . . . There were no signs of decay." Alabama.

CALIFORNIA AGRICULTURAL EXPERIMENT STATION 1936 (*29*): Hopi 155 is rapidly replacing other small-lima-bean varieties; high yield; more resistant to heat, nematodes, and other pests than varieties formerly planted. Hopi No. 5989 is superior to No. 155 in yield, quality, and nematode resistance. [Calapproved[97] seed of No. 5989 is distributed by A. Milani, Tracy, Calif., according to the Stockton, Calif., "Record" for January 22, 1938.]

ISBELL and BARRONS 1938 (*117*): Hopi No. 155 and other California station Hopis (tested 5 years) are heavy yielders and notably more resistant than common varieties, but less resistant in Alabama than is Alabama No. 1 (*P. vulgaris*).

KING 1937:[98] Many limas collected from the Hopi country, some much more resistant than No. 155, but not wanted by the trade because mottled. Arizona.

MACKIE, W. W. (quoted in California station Circular 330 (*236, p. 12*), 1933): Hopi No. 155, bred by W. W. Mackie, is highly resistant to root knot, fusarium wilt, charcoal rot, and heat, but its nematode resistance is not yet fixed; some vines, reverting, may even be killed. Hopi No. 2000 is somewhat less resistant to root knot.

——— (in letter, 1939): Nematode-resistant Hopis now occupy much of the lima-bean area in California; a recent infestation is being checked with Hopi, No. 5989; Hopis yield up to 40 or more sacks per acre; Hopis died out, however, in 2 heavily infested areas.

——— and SMITH 1935 (*153*): Small lima grown for centuries by the Hopi Indians of Arizona shows heterozygosity from constant field crossing. [No reference to nematode resistance.]

TENNESSEE AGRICULTURAL EXPERIMENT STATION 1936 (*227*): Showed high resistance to nematode injury.

Phaseolus vulgaris, common bean. **(N, S)**

FRANK 1885 (*68*): No infestation found; other hosts preferred (one planting). Germany. [In 1896 Frank (*69*) listed *Phaseolus* as a preferred host.]

ISBELL and BARRONS 1938 (*117*): Snap beans not seriously affected because grown during the cooler months Alabama.

WATSON, GOFF, and BRATLEY 1937 (*259*): Selections for greater resistance are being made in a "resistant" strain of Kentucky Wonder from the Alabama station. Florida.

Vars. ALABAMA No. 1 [now preferred] and No. 2, pole snap bean.

BARRONS 1939 (*13*): Numerous larvae entered root tips of seedlings and of "adult plants" heavily inoculated in greenhouse; some 90 larvae entered 1 rootlet. [No report on later development of galls or of nematodes.] Alabama.

——— 1940 (*13a*): Resistance in Alabama No. 1 is probably inherited as a double recessive character. All the F_1 hybrids between this bean and Var. Kentucky Wonder showed characters of both parents—the anthocyanin pigmentation of the Alabama No. 1 and the susceptibility of the Kentucky Wonder (14 seeds grown in greenhouse 22 days; 5 seeds in field grown to maturity). In the F_2 and F_3 generations, grown in large numbers, "intermediate" plants were not easily distinguished from the completely susceptible segregates. Alabama.

[96] See footnote 70, p. 44.

[97] California Approved Seed Plan, under the supervision of the California Farm Bureau Federation and the College of Agriculture.

[98] See report of King on p. 116 of reference given in footnote 3, p. 6.

ISBELL and BARRONS 1938 (*117*): No. 1 is highly resistant but not immune; outstanding for home gardens. On a few occasions in badly infested soil galls have been found, never large nor numerous, on old plants only. Reselected strains introduced in 1938 (tested 8 years); continued breeding with hybridization and selection promises further improvement. Alabama.

MACKIE, W. W. (California station; in letter, 1939): Only slightly resistant where tested in California; dies under severe attack, and succumbs also to scab and dry rot. Mackie has recently selected more resistant types from heterozygous lots of Alabama material.

TAYLOR, A. L. (Division of Nematology, Bureau of Plant Industry. 1937): Little or no early infestation was found in the field, but a large proportion of the smaller roots were infested by the end of the season (No. 1 and No. 2, at least 50 plants each). Georgia.

TENNESSEE AGRICULTURAL EXPERIMENT STATION 1936 (*227*): "Resistant to nematode injury," but lacked commercial quality.

Phleum pratense, timothy. (C)

BESSEY 1911 (*16*): No infestation found.

WHITTLE and DRAIN 1935 (*263*): Listed as seldom infested or highly resistant. Tennessee(?).

Phlox drummondi, Drummond phlox. (N)

GOFF 1936 (*96*): Infestation 0 to very heavy; majority of plants only lightly infested (Var. Big Drummond. 133 plants, 4 tests); infestation 0 to heavy (*P. drummondi* var. *stellaris*. 25 plants, 1 test); average rating "very lightly infested." Florida.

STEINER and BUHRER 1933:[99] First host record. District of Columbia.

WATKINS 1929 (*248*): Rated as "resistant." Florida.

Phlox nana compacta.

GOFF 1936 (*96*): Infestation 0 to heavy (25 plants, 1 test); average rating "very lightly infested." Florida.

Phoenix dactylifera, date palm. (N)

CALIFORNIA NEMATODE COMMITTEE 1925:[1] Resistant.

HEALD 1933 (*109*): Listed as "especially subject." [Date palm is Heald's only addition to the list of hosts from U. S. Farmers' Bulletin 1345.]

THORNE, G. (Division of Nematology, Bureau of Plant Industry. 1938): Many young palms appeared to be retarded in growth by heavy infestation when visited in 1925; by 1938 these plantings had apparently largely recovered and were growing normally. California.

Pigeonpea, see **Cajanus.**

Pigweed, see **Amaranthus.**

Pilea serpyllifolia, artilleryplant. (C)

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.

WATSON and GOFF 1937 (*258*): Wild host. Florida.

Pimpernel, see **Anagallis.**

Pineapple, see **Ananas.**

Pink, see **Dianthus.**

Pinus spp., pine. (C, N)

BUHRER 1938:[2] *P. caribaea*, slash pine, and *P. palustris*, longleaf pine, are listed as hosts. [Infestation of seedlings was recorded once, from Florida.]

HUME 1937:[3] No harmful infestation ever seen; heavily infested nursery land may be freed of nematodes in 6 or 7 years, possibly less, by setting pine trees near enough together to keep out green weeds. Florida.

LINFORD 1939 (*142*): Small pieces from fresh boards of commercial sugar-pine lumber showed distinct but mild attractiveness to larvae *in vitro* in repeated tests. Hawaii.

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[99] See footnote 66, p. 41.
[1] See footnote 6, p. 8.
[2] See footnote 87, p. 49.
[3] See footnote 5, p. 8.

UNITED STATES BUREAU OF PLANT INDUSTRY (unpublished data in files of Division of Nematology; material collected by H. N. Hansen, California station. 1939): Seedlings of *P. lambertiana*, sugar pine, heavily infested; grown on a garbage dump at 6,000 feet elevation in Tuolumne County, California.

Piper nigrum, black pepper. (S)

RUTGERS 1916 (*202*): Infestation "practically harmless," found in the best pepper plantations of Java and Sumatra; heavy infestation may destroy some of the roots, but injuries occur only when cultural conditions are unfavorable for new root growth; Van Breda de Haan, Soltwedel, and Zimmermann convinced people that nematodes were responsible for the sudden death of plantations.

Pistacia vera, pistache. (C)

MILBRATH 1928 (*164*): Infestation found for the first time; "of uncommon occurrence in California."

Pisum sativum (*P. arvense*), pea. (N, S)

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed ("field pea, *P. arvense*"); nematodes abundant, injury apparently not great ("garden pea, *P. sativum*").

FRANK 1885 (*68*): No infestation found; other hosts preferred (one planting). Germany.

PITTMAN 1929 (*192*): Peas not usually attacked to such an extent as other market-garden crops. [Illustration shows numerous small galls on garden pea.] Western Australia.

All other references agree that infestation is serious on field pea (including Austrian Winter pea) and on garden pea.

Plantago major, common or greater plantain. (M)

FRANK 1885 (*68*): Original host record. Germany.

HÖSTERMANN 1922 (*111*): No infestation found in pot experiment. Germany.

TISCHLER 1902 (*229*): Infestation abundant; somewhat less than on coleus. Germany (experimental).

Plantago media.

HÖSTERMANN 1922 (*111*): No infestation found in pot experiment. Germany.

Plum, see **Prunus.**

Poa annua, annual bluegrass. (C, N)

HAUSER 1937 (*106*): No infestation found in greenhouse. Netherlands.

HÖSTERMANN 1922 (*111*): Infestation very light. Germany (experimental).

STEINER, G. (Division of Nematology, Bureau of Plant Industry. 1939): Infested plants show practically no gall development.

WHITTLE and DRAIN 1935 (*263*): Bluegrass listed as seldom infested or highly resistant. Tennessee.

Poa pratensis, Kentucky bluegrass. (N)

STEINER, G. (Division of Nematology, Bureau of Plant Industry. 1939): Infested plants show practically no gall development.

Poinsettia, see **Euphorbia.**

Polycarpaea corymbosa. (C)

COLLINS 1937 (*41*): No signs of nematode attack. Rhodesia.

Polygonum convolvulus, cornbind. (M)

HÖSTERMANN 1922 (*111*): Infestation very light; roots very resistant, early lignified. Germany (experimental).

LINFORD and VAUGHAN 1927:[4] Found infested in Wisconsin.

Polygonum persicaria, knotweed, ladysthumb. (N)

MUSZYNSKI and STRAZEWICZ 1932 (*174*): No infestation found. Poland.

This weed has been found infested in greenhouses in the District of Columbia, England, and the Netherlands.

Polygonum tomentosum.

COLLINS 1937 (*41*): No signs of nematode attack. Rhodesia.

[4] See report of Linford and Vaughan on p. 306 of reference given in footnote 60, p. 39.

Pomegranate, see **Punica.**

Poncirus trifoliata (*Citrus trifoliata*), hardy orange. (C)

NEAL 1889 (*176*): Seems resistant, but the trial has been brief. Florida.

Poppy, California–, see **Eschscholtzia**; pricklepoppy, see **Argemone.**

Portulaca spp., portulaca. (S)

GOFF 1936 (*96*): Infestation 0 to light in 1 planting where the infestation on other plants also was relatively light (50 plants); infestation very light to heavy in a second test (25 plants); average rating "lightly infested." Florida.

WATKINS 1929 (*248*): Rated as "resistant." Florida.

Of the two commonly cultivated annual species, *P. grandiflora* and *P. oleracea*, Bessey (*16*) wrote "nematodes abundant, but injury apparently not great"; the latter is given as a wild host by Watson and Goff (*258*) and by others, whereas Neal (*176*) reported it "badly affected."

Potato, see **Solanum**; sweetpotato, see **Ipomoea.**

Pot-marigold, see **Calendula.**

Pricklepoppy, see **Argemone.**

Pricklypear, see **Opuntia.**

Primrose, evening-, see **Oenothera.**

Privet, see **Ligustrum.**

Prosopis chilensis (*P. juliflora*), algaroba, kiabe, mesquite. (C)

GODFREY 1935:[5] Infestation commonly observed to be light. Hawaii.

Prunus angustifolia, chickasaw plum.

HUTCHINS, L. M. (Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry. 1939): No infestation observed in Georgia.

Prunus armeniaca, apricot.[6]

BROWN 1924:[7] Six trees killed near Tucson, Ariz. [Question: On what root? Cf. report of George, below.]

CALIFORNIA NEMATODE COMMITTEE 1925:[8] Apricot resistant "on some types of root."

FIKRY 1939 (*64*): No infestation found on native apricot (47 roots tested 2 to 5 years); seedlings in nursery always healthy. Egypt.

GARDNER 1926 (*75*): Observed to be a host. California.

GEORGE 1924:[9] Practically all apricot trees in the Salt River Valley, Ariz., are budded on peach roots; no known case of nematodes attacking apricots on their own roots; recent plantings on apricot roots uninjured (the majority of these, however, in soil only lightly infested).

HUTCHINS 1937 (*114*): Seedlings of Var. Blenheim (seed from California) were completely resistant in all tests. Georgia.

MILBRATH 1923 (*162*): Certain varieties of apricot roots have been found free in infested soil; no conclusive evidence for pronouncing resistance.

——— 1924:[10] Apricot rootstock has been found resistant. California.

NEAL 1889 (*176*): "Badly affected." Florida.

SANDGROUND 1922 (*207*): Parasitized more or less severely in South Africa.

TAUBENHAUS and EZEKIEL 1933 (*226*): Losses rarely serious. Texas.

TUFTS 1930 (*233*): "The apricot root has generally been accepted as immune"; H. R. Keller, of Fresno, Calif., has recently reported an infestation.

——— and DAY 1934 (*234*): Apricot root has long been reputed uninjured, though sometimes lightly infested. Seedlings of 48 varieties (including *P. armeniaca*, *P. dasycarpa*, and *P. mume*) have stood in the Delhi nursery for 2 to 3 years without infestation. California.

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[5] See footnote 10, p. 11.

[6] All available citations on apricot are given.

[7] ORTON, C. R., and WOOD, JESSIE I. DISEASES OF FRUIT AND NUT CROPS IN THE UNITED STATES IN 1923. U. S. Bur. Plant Indus., Plant Dis. Rptr. Sup. 33, pp. 35–147, illus. 1924. [Mimeographed.] See report of J. G. Brown, p. 112.

[8] See footnote 6, p. 8.

[9] See report of D. C. George on pp. 112–113 of reference given in footnote 7, above.

[10] See reports by Milbratb on pp. 104 and 113 of reference given in footnote 7, above.

Prunus avium, mazzard, sweet cherry.

MINZ 1936 (*166*): Reported infested in Palestine.
TUFTS and DAY 1934 (*234*): Seedlings not infested (2-year test). California.

Prunus bokhariensis, plum.

TUFTS and DAY 1934 (*234*): Infestation moderate to heavy; some seedlings of P. I. No. 40224 were free from knots (Delhi nursery 1 season, 1934). California.

Prunus cerasifera (*P. myrobalana*), myrobalan plum. (S)

FIKRY 1939 (*64*): No infestation found (71 roots, grown 4 years). Egypt.
MILBRATH 1923 (*162*): Roots destroyed by nematodes; illustration. California.
NEAL 1889 (*176*): "Slightly affected." Florida.
TUFTS and DAY 1934 (*234*): Infestation 0 to heavy on 11 strains tested 1 to 3 seasons in Delhi nursery: No infestation found on rooted cuttings of Myrobalan 2–7 (2 seasons), Myrobalan 8–10, a vigorous grower (3 seasons), or Myrobalan B, "perhaps a type of Marianna" (3 seasons), nor on 3 vigorous trees of Myrobalan B in heavily infested orchard (2 years). Infestation light on Myrobalan 2500, some individuals free from knots (1 season, 1934). Some cuttings or seedlings of 4 susceptible selections remained free from knots 1 season (1934), whereas 3 other selections showed no sign of resistance. California.
WHITTLE and DRAIN 1935 (*263*): Susceptible stock. Tennessee.

Var. MARIANNA.[11]

FIKRY 1939 (*64*): No infestation found (110 roots, grown 4 years). Egypt.
HUME 1937:[12] Never found infested. Florida.
MCCLINTOCK 1922 (*145*): No knots found (1 season). Georgia.
NEAL 1889 (*176*): Free from knots 3 years. Florida.
TUFTS and DAY 1934 (*234*): "Rooted cuttings of 25 seedlings, selected for their vigor, were free from infestation during the 2 years they were under test"; neither was there visible infestation on "(English?)" Marianna (1 season in Delhi nursery). California.
WHITTLE and DRAIN 1935 (*263*): Marianna stock is seldom attacked. Tennessee.

Prunus cerasus (*P. vulgaris*), sour cherry.

NEAL 1889 (*176*): Roots of *P. vulgaris* are "badly affected," whereas those of *P. cerasus* are unhurt. Florida. [This statement is not a contradiction, because Neal listed *P. vulgaris* as peach.]
TUFTS and DAY 1934 (*234*): Seedlings of Vars. English Morello and Montmorency Monarch free from attack (1 season, 1934); Var. Stockton Morello [vegetatively produced by suckers] not infested in 2-year test. California.

No host report has been found for this species.

Prunus dasycarpa, purple apricot.

TUFTS and DAY 1934 (*234*): No infestation found on seedlings in nursery. California.

Prunus demissa, western chokecherry.

TUFTS and DAY 1934 (*234*): Free from infestation (1 season, 1934, in nursery). California.

Prunus domestica, common plum.

Var. GRAND DUKE.

TUFTS and DAY 1934 (*234*): Infestation moderate; some seedlings free from knots (1 season, 1934). California (Delhi).

Prunus hortulana, hortulan plum.

HUTCHINS 1937 (*114*): Highly resistant in tests. Georgia.
TUFTS and DAY 1934 (*234*): No visible infestation (seedlings 1 season, 1934, in Delhi nursery). California.

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[11] Possibly a hybrid; ancestry uncertain.
[12] See footnote 5, p. 8.

Prunus insititia, damson plum.

TUFTS and DAY 1934 (*234*): No visible infestation in nursery on rooted cuttings of Vars. Damson (reported as "Black Damas C"—meaning Black Damascene (?)—tested 2 seasons), St. Julien E (1 season), nor St. Julien G (2 seasons), but infestation very heavy on St. Julien 3–P. California.

Prunus mume, Japanese apricot.

HUTCHINS 1937 (*114*): Roots free in all Georgia tests (seeds from commercial seedsmen in the United States in different years, and from the University of Nanking, China).

TUFTS and DAY 1934 (*234*): No infestation found on seedlings in nursery. California.

Prunus munsoniana, wildgoose plum.

NEAL 1889 (*176*): A valuable rootstock for susceptible scions. Florida.

TUFTS and DAY 1934 (*234*): No visible infestation on seedlings ("Improved Wild Goose"; 1 season, 1934, in Delhi nursery). California.

Prunus salicina (*P. triflora*), Japanese plum.

NEAL 1889 (*176*): Vars. Kelsey, Ogon ("Ogru"), and Satsuma are "valuable" rootstocks for susceptible scions; but even the native plums suffered when peach died. Florida.

Prunus virginiana, common chokecherry.

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.

Prunus spp., plum.

BESSEY and BYARS 1915 (*17*): Native wild plum is resistant. Florida.

HUME 1937:[13] Infestation not sufficiently serious on any plum to damage its growth. Florida.

HUTCHINS, L. M. (Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry. 1939): No infestation observed on any native plums in Georgia.

MCCLINTOCK 1922 (*145*): No knots found on wild and cultivated plum seedlings (1 season). Georgia.

TAUBENHAUS and EZEKIEL 1933 (*226*): Losses rarely serious. Texas.

TUFTS and DAY 1934 (*234*): In Vars. "Methley (*P. cerasifera* × *P. salicina*)" and Cheresoto (*P. besseyi*, Bessey cherry, "western sand-cherry" × *P. americana*, Var. Desoto), classed as moderately or heavily infested, some seedlings were found free from knots (1 season, 1934). California.

WATSON and GOFF 1937 (*258*): Native plums resistant. Florida.

Prunus, see also **Amygdalus**.

Pseudarthria hookeri. (C)

COLLINS 1937 (*41*): No signs of nematode attack. Rhodesia.

Psidium guajava, guava. (C)

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.

FLORIDA STATE PLANT BOARD 1925 (*66*): Two infested shipments intercepted; grown in Florida.

Psophocarpus tetragonolobus, seguidilla. (C)

FAJARDO and PALO 1933 (*60*): Rated as "resistant" (judged by growth); six plants infested, one free. Philippine Islands.

Pueraria hirsuta (*Dolichos japonica*; *P. thunbergiana*), kudzu-bean. (N)

BOYD 1927:[14] Loss 1 percent for Georgia; 50 percent infestation in one field, developed apparently during the winter months.

COLLINS 1938 (*41*): Kudzu-vine listed among plants not attacked (1 season). Rhodesia.

WATSON 1929 (*255*): Kudzu rated as No. 41 in order of susceptibility [from okra, No. 1, to peanut, No. 43]. Florida.

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[13] See footnote 5, p. 8.

[14] ARCHER, W. A. DISEASES OF FORAGE CROPS. U. S. Bur. Plant Indus., Plant Dis. Rptr. Sup. 53: 192–208, illus. 1927. [Mimeographed.] See report of Boyd, p. 204.

Punica granatum, pomegranate.

BARKER 1925: [16] Infestation reported from one locality in Mississippi.
BESSEY 1911 (*16*): Injury severe.
CALIFORNIA NEMATODE COMMITTEE 1925: [16] Infested but profitable.
GILBERT 1914 (*88*): Listed as "most severely attacked." [Omitted from the 1921 bulletin (*89*).]
TAUBENHAUS and EZEKIEL 1933 (*226*): Infested occasionally; little loss. Texas.

Pursley, see **Richardia.**

Pyrus communis, common pear.

DAY (quoted by Currie (*52*)): Seedlings not entirely resistant, but seem to prosper in spite of the infestation. California.
FRANK 1885 (*68*): Galls numerous outdoors; plot used for experimental infestation of other plants. Germany.
TARNANI 1898 (*225*): Lindemann was probably wrong in attributing galls to root knot. [See explanation under **Malus.**]
TUFTS and DAY 1934 (*234*): Seedlings of 10 varieties tested 2 years in nursery, none resistant; infestation moderate on 7 varieties, light on Vars. Beurre Hardy, Easter Beurre, P. Barry. California.
WATSON and GOFF 1937 (*258*): Pear attacked to some extent but not so seriously injured; can usually be raised successfully in heavily infested soil. Florida.

Pyrus pashia (*P. variolosa*), Pashi pear.

TUFTS and DAY 1934 (*234*): Seedlings free from infestation (1 season, 1934, in Delhi nursery). California.

Pyrus, pear (hybrids?).

HUME 1937: [17] No damage to the growth of pears in the "Chinese section." Florida.

Pyrus, see also **Malus.**

Quackgrass, see **Agropyron.**

Quercus spp., oak. (C)

DUCOMET 1908 (*56*): Galls numerous on surface roots of the cork oak, *Q. suber*, especially in young plantings; fungus invasion later apparently kills the infested roots; evidence of defense reactions by the plant. France.
GARDNER 1926 (*75*): Both *Q. agrifolia*, California live oak, and *Q. suber*, cork oak, were found to be hosts. California.
HUME 1937: [18] No species has been seen "affected." Florida.

Quince, see **Cydonia.**

Quinine tree, see **Cinchona.**

Radicula waiteri. (M)

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.

Ragi, see **Eleusine.**

Raspberry, see **Rubus.**

Redtop grass, see **Agrostis** and **Tricholaena.**

Rescue grass, see **Bromus.**

Rhodes grass, see **Chloris.**

Rhododendron spp., azalea. (C)

HUME 1937: [19] All azaleas, American and oriental, are free from injury year after year. Florida.

Rhynchosia intermedia (*Dolicholus intermedius*). (C)

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.

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[16] See report of Barker on p. 102 of reference given in footnote 82, p. 47.
[16] See footnote 5, p. 8.
[17] [18] [19] See footnote 5, p. 8.

Ribes spp. (C)

BUHRER, COOPER, and STEINER 1933:[20] Listing of red currant as a host was probably a misinterpretation, unfortunately copied by later authors.
WHITTLE and DRAIN 1935 (*263*): Currant and gooseberry listed as seldom infested or highly resistant. Tennessee.

The California State Department of Agriculture has an unpublished record of infestation on *R. grossularia*, gooseberry.

Rice, see **Oryza.**

Richardia scabra (*Richardsonia scabra*), "Florida pursley," "Mexican-clover."

GEORGIA COASTAL PLAIN EXPERIMENT STATION 1935 (*81*): More resistant than crabgrass.
——— 1936 (*83*): Can be used successfully for control rotation.
GILBERT 1921 (*89*): Mexican-clover a susceptible weed.
GODFREY 1935:[21] Infestations distinctly heavy. Hawaii.
NEAL 1889 (*176*): A fine substitute for susceptible cowpeas. Florida.
WATSON, GOFF, and BRATLEY 1937 (*259*): One of the most seriously infested weeds in watermelon fields. Florida.

Ricinus communis, common castor-bean, castor-oil tree. (C)

COLLINS 1937 (*41*): No signs of nematode attack. Rhodesia.
KRISHNA AYYAR 1933 (*132*): No infestation found in pot experiment. India (Madras).
NAUDE 1939 (*175*): Castor-oil plants were found heavily infested. South Africa (Oudtshoorn).
SANDGROUND 1922 (*207*): Parasitized more or less severely in South Africa (Basutoland, Natal, or Transvaal).

Roquette, see **Eruca.**

Rosa spp., and hybrids, rose. (N, S)

HUME 1937:[22] All roses are attacked, but show much variation in the extent of damage; Var. Mme. Plantier does not suffer seriously. Florida.
MCCLINTOCK 1930 (*149*): None resistant; marked differences in vigor; two vigorous growers which might be used in selecting for tolerance are *R. multiflora* and P. I. No. 22449 (*R. banksiae;* called "U. S. D. A. Odorata 22449"). Tennessee.
WATSON and GOFF 1937 (*258*): For Florida conditions, roses should be grafted on a resistant stock, such as the "Texas Wax" rose.

There are numerous reports of injury to roses; some of these possibly refer to the varieties named above. Reh (*198*) mentioned rose as tolerant because of its capacity for new root growth; the source of his quotation has not been found.

Rosary-pea, see **Abrus.**

Royal sweet-sultan, see **Centaurea.**

Rubbertree, see **Hevea.**

Rubus spp. (C)

FLORIDA STATE PLANT BOARD 1921 (*66*): Infested shipments intercepted, one of blackberry from North Carolina and two of raspberry from Florida.
GARDNER 1926 (*75*): *R. idaeus*, European raspberry, and *R. subuniflorus*, "blackberry," observed to be hosts. California.
MORRIS 1934 (*167*): Blackberry selection Halls Lawton shows little susceptibility to attack; all late-maturing varieties, e. g., Alfred, Blowers, Eldorado, and others, have proved more susceptible to infestation than the earlier maturing varieties. Texas.
NEAL 1889 (*176*): *R. subuniflorus* (*R. villosus*), "blackberry," and *R. trivialis*, southern dewberry, "slightly affected." Florida.
SELBY 1897 (*210, 211*): Galls ½ to 1½ inches in diameter on blackberry and raspberry roots and stems; "eelworms . . . on the outer portion of the galls below ground." Ohio. [These "eelworms" were not identified, though "referred to *Heterodera*." In his 1910 handbook (*212*) Selby described crown gall on raspberry, but did not mention nematodes.]
WHITTLE and DRAIN 1935 (*263*): Blackberry, dewberry, and raspberry listed as slightly infested. Tennessee.

[20] See footnote 20, p. 17.
[21] See footnote 10, p. 11.
[22] See footnote 5, p. 8.

The Mississippi station has records of infestation on blackberry from Illinois and Mississippi, and on raspberry from Illinois, Kentucky, Mississippi, and Pennsylvania. No reports whatever have been found for loganberry.

Rudbeckia bicolor, rudbeckia.

GOFF 1936 (*96*): No infestation found (25 plants; 1 test). Florida.

Rumex acetosella, sheep sorrel. (N)

COURTNEY, W. D. (Division of Nematology, Bureau of Plant Industry. 1937): Found infested in Oregon and Washington.

MUSZYNSKI and STRAZEWICZ 1932 (*174*): No infestation found. Poland.

Rutabaga, see **Brassica.**

Rye, see **Secale.**

Ryegrass, see **Lolium.**

Saccharum officinarum, sugarcane. (N)

BESSEY 1911 (*16*): Nematodes abundant, injury apparently not great.

BOYD 1925: [23] Var. Louisiana Purple ("Red" cane) showed marked stunting, total loss in one field; galls minute on fine roots, but up to one-fourth inch in diameter on the larger roots. Georgia.

COBB 1918: [24] Usually considered not serious; specimens from Florida "extremely heavily affected"; some of the young stalks had died, mainly or entirely because of root knot.

COOK 1925 (*46*): Root knot is of little importance on sugarcane in Puerto Rico.

FAJARDO and PALO 1933 (*60*): Rated as "resistant." [No data.] Philippine Islands.

FLOR 1930 (*65*): Infestation found very sparingly in scattered regions in Louisiana; inoculated plants (Var. Louisiana Purple) showed principal injury to be the blinding of root tips; "results indicate that injury due to root knot increases as the water content of the soil decreases." [This conclusion is apparent in only one of the two tests; the averages tabulated show no consistent moisture relations in the stunting of top growth, whereas galls were more abundant at the intermediate moistures.]

KRÜGER 1899 (*133*): Galls as large as hazel nuts; only one field heavily infested; root knot does not, as formerly thought, cause the sereh disease. Java.

MARTIN 1938 (*157*): Normal growth not affected until root injury, which may invite fungus invasion also, exceeds the "safety limit" of the apparently superabundant root production. Hawaii.

MATZ 1925 (*158*): Infestations have undoubtedly caused the lack of growth in older cane as well as the death of young cane in a number of fields; root-tip decay is commonly associated with nematode infestation. Puerto Rico.

MOSSERI 1904 (*170*): Complete destruction by root knot was recently reported from Upper Egypt.

MUIR 1926 (*172*): Infestation may destroy a whole root when severe, but if the root does not break down it appears to function fairly well. In Var. Yellow Caledonia the galls are small and do not break down quickly, but in Vars. Lahaina and H–109 the galls are much larger and break down very quickly. Hawaii.

SPENCER 1919 (*219*): Infestations have caused serious loss; estimated injury in one region this year will reduce the sirup output about one-third. Florida.

TAUBENHAUS and EZEKIEL 1933 (*226*): Infested occasionally, little loss. Texas.

UNITED STATES BUREAU OF PLANT INDUSTRY 1920: [25] Crop injuries to sugarcane ranged from 0 to 50 percent; estimated loss averaged about 1 percent. Georgia.

VAN ZWALUWENBURG 1931 (*243*): In 1926 it appeared as if severe infestations, which occurred on cane roots in certain fields, were responsible for the growth failure in spots; it now seems probable that *Heterodera* was only a contributing factor. Hawaii.

[23] BOYD, O. C. SUGARCANE DISEASES IN GEORGIA. U. S. Bur. Plant Indus., Plant Dis. Rptr. 9: 122–123. 1925. [Mimeographed.]

[24] COBB, N. A. SUGAR CANE: NEMATODE INJURY CAUSED BY HETERODERA RADICICOLA. U. S. Bur. Plant Indus., Plant Dis. Bul. 2: 237–238. 1918. [Mimeographed.]

[25] MARTIN, G. HAMILTON, JR. DISEASES OF COTTON, SUGAR CANE, FOREST TREES, ORNAMENTALS, AND MISCELLANEOUS PLANTS IN THE UNITED STATES IN 1919. U. S. Bur. Plant Indus., Plant Dis. Bul. Sup. 11, pp. 274–306. 1920. [Mimeographed.] See p. 286.

WATSON 1919 (*250*): Serious infestation recently found on cane in some sections of Florida.

——— and GOFF 1937 (*258*): Sugarcane rated as No. 41 in order of susceptibility [from okra, No. 1, to corn, No. 46]. Florida.

Saccharum sinense.

Var. CAYANA.

BOYD 1925:[26] Numerous hills of Cayana 10 scattered throughout the field attained nearly normal height, where *S. officinarum* Var. Louisiana Purple ("Red" cane) was severely stunted. Georgia.

RANDS, R. D. (Division of Sugar Plant Investigations, Bureau of Plant Industry. 1939): Commercially resistant.

Var. JAPANESE CANE.

RANDS, R. D. (Division of Sugar Plant Investigations, Bureau of Plant Industry. 1939): Commercially resistant.

WATSON 1929 (*255*): Usually "immune" or only slightly infested. Florida.

Saccharum spp., and hybrids. (N)

RANDS and ABBOTT 1939 (*197*): Serious curtailment of root growth and losses to the noble varieties (*S. officinarum*) in sandy soils; the more vigorous hybrid varieties now grown rarely suffer serious damage. [According to unpublished records of R. D. Rands, some root knot has been found on hybrid P. O. J. 213, a cross between *S. officinarum* Var. Louisiana Purple, susceptible, and *S. barberi* Var. Chunnee, somewhat resistant. On susceptible roots galls may be relatively large. No serious root knot has been observed on hybrids Co. 290 and C. P. 29/116, with complex inheritance from *S. officinarum*, susceptible, *S. barberi*, somewhat resistant, and *S. spontaneum*, apparently highly resistant—resistance judged largely by growth.]

Safflower, see **Carthamus.**

Sage, see **Salvia.**

St. Johnsbread, see **Ceratonia.**

Salad-rocket, see **Eruca.**

Salvia farinacea, blue sage, mealycup sage. (C)

GOFF 1936 (*96*): Five plants free, five very lightly infested (one test). Florida.

Salvia splendens, scarlet sage. (N)

GOFF 1936 (*96*): Infestation very light on all plants (20 plants, one test). Florida.

Salvia spp., sage. (N)

There are several reports of infestation on unidentified species of salvia, without indication of severity. Frank (*69*) includes salvia among the Labiatae infested "sometimes in great numbers." There is one host record for *S. leucantha* (*75*) and one for *S. triloba* (G. Minz, research station, Rehovot, Palestine; in letter, 1940).

Var. "ZURICH," "dwarf sage."

MELCHERS 1915 (*159*): Apparently "unaffected." Kansas (in greenhouse).

Sasanqua-tea, see **Camellia.**

Sawbrier, see **Smilax.**

Scabiosa atropurpurea (*S. maritima*), sweet scabiosa.

COTTE 1912 (*48*): Galls as large as chickpeas; assigned to *Heterodera schachtii* because of the external position of the nematode. France (Provence). [The Imperial Bureau of Agricultural Parasitology (*115*) considers this almost certainly an infestation by *H. marioni*.]

HÖSTERMANN 1922 (*111*): Infestation very light. Germany (experimental).

Secale cereale, rye. (C)

BARRONS 1939 (*13*): Numerous larvae entered root tips of seedlings (Var. Abruzzi) heavily inoculated in greenhouse; 7 weeks later this series showed only "a few very slight swellings." Alabama.

BESSEY 1911 (*16*): No infestation found; Var. Abruzzi was used for winter rotations. South Carolina.

[26] See footnote 23, p. 60.

CUNNINGHAM 1936 (*51*): No sign of infestation; successful for control rotation. New York (Long Island).
FULTON and WINSTON 1919 (*71*): Nonsusceptible crop for control rotation, Var. Abruzzi. Florida.
GEORGIA COASTAL PLAIN EXPERIMENT STATION 1936 (*82*): Winter cover of rye slightly increased the yield of tobacco, with corresponding decreases in root knot.
GOFFART 1934 (*97*): Negative results. [See **Gramineae.**]
MACKIE, W. W. (California station; in letter, 1939): No infestation ever observed.
POOLE 1933:[27] Winter rye has been seen infested ["heavily"?] in North Carolina.
SMEE 1928 (*214*): Rye for rotation has given good results in Nyasaland.
WATSON and GOFF 1937 (*258*): Harbors some root knot, which does not materially interfere with growth. Florida.
WHITTLE and DRAIN 1935 (*263*): Rye listed as highly resistant. Tennessee (?).

Seguidilla, see **Psophocarpus.**

Sempervivum tectorum, roof houseleek.

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.
LICOPOLI 1875 (*139*): Large and small galls on all root branches. Italy.

Senecio cineraria, "dusty-miller," silver cineraria. (C, N)
STEINER, G. (Division of Nematology, Bureau of Plant Industry. 1939): Highly resistant.
TYLER, J. (Division of Nematology, Bureau of Plant Industry. 1936): Galls very few and very small (experimental; in greenhouse). District of Columbia.

Senecio, see also **Erechtites.**

Senna, wild, see **Cassia.**

Scricea, see **Lespedeza.**

Serradella, see **Ornithopus.**

Sesamum orientale (*S. indicum*), sesame. (C)
KRISHNA AYYAR 1933 (*132*): Infestation slight in pot experiment. India (Madras).

Sesbania macrocarpa (*S. emerus*), sesbania. (M, N)
BESSEY 1911 (*16*): Nematodes abundant, injury apparently not great.
KENNEDY and MACKIE 1925 (*123*): Carries over nematodes in abundance. California.
MCKEE 1931:[28] Little or no damage; plants with nematodes are often strong and vigorous.

Sesbania sp., sesbania.

KING and HOPE 1934 (*127*): Used with onions and vetch in a profitable 2-year rotation. Arizona.
WATSON and GOFF 1937 (*258*): Rated as No. 35 in order of susceptibility [from okra, No. 1, to corn, No. 46]. Florida.

Setaria italica (*Chaetochloa italica*), foxtail millet, German millet.

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.
GODFREY 1928 (*92*): No infestation found ("golden millet," one test). Hawaii.
KRISHNA AYYAR 1933 (*132*): No infestation found in pot experiment. India (Madras).

Setaria verticillata (*Chaetochloa verticillata*), bristly foxtail, bur bristlegrass, prickly foxtail.

GODFREY 1935:[29] Infestation commonly observed to be light. Hawaii.

Sida meyeniana, ilima.

GODFREY 1935:[30] Infestation commonly observed to be light. Hawaii.

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[27] See footnote 58, p. 38.
[28] MCKEE, ROLAND. SESBANIA. A LEGUME FOR GREEN MANURE. U. S. Bur. Plant Indus. 3 numb. leaves. May 28, 1931. [Mimeographed.]
[29] [30] See footnote 10, p. 11.

Sida rhombifolia.

BARBER 1901 (*9*): Weed host in south India.
BESSEY 1911 (*16*): Nematodes abundant, injury apparently not great.
COLLINS 1937 (*41*): No signs of nematode attack. Rhodesia.
COSTA NETO 1937 (*47*): Weed host in Brazil.

Sinapis, see **Brassica.**

Smilax glauca, sawbrier. (C)

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.

Smilo, see **Sorghum.**

Snapdragon, see **Antirrhinum.**

Soja max (*Glycine hispida*), soybean. (N, S)

MACKIE, W. W. (California station; in letter, 1939): The Laredo soybean and many others, and soy hybrids from W. J. Morse, have shown high resistance.

Var. ACME.

LYON 1911 (*144*): Relatively free from galls. Hawaii.

Var. BILOXI.

BARRONS 1938: [31] Almost free from galls, even in artificially inoculated soil. Alabama.
GEORGIA COASTAL PLAIN EXPERIMENT STATION 1938 (*85*): Of only slight value for control rotation.
GODFREY 1928 (*93*): Root knot developed from month to month until practically all plants were "affected." Hawaii.
MCCLINTOCK 1922 (*145*): Considerable resistance, some infested plants found (3-year tests). Georgia.
WHITTLE and DRAIN 1935 (*263*): Listed as slightly infested. Tennessee (?).

Var. HABERLANDT.

ERNST 1924 (*58*): Resistant cover crop. [The source of this information has not been found.] California (?).

Var. LAREDO.

COLLINS 1938 (*41*): Not attacked (1 season). Rhodesia.
FENNE 1940 (*61a*): Found heavily infested just before cutting time, with some roots an inch or more in diameter. Virginia (Caroline County).
GEORGIA COASTAL PLAIN EXPERIMENT STATION 1938 (*85*): Of only slight value for control rotation.
GODFREY 1928 (*93*): Resistance held as compared with susceptible varieties. Hawaii.
MCCLINTOCK 1922 (*145*): Considerable resistance; some infested plants found (3-year tests). Georgia.
MACKIE, W. W. (California station; in letter, 1939): Highly resistant.
MORSE 1927 (*169*): Thus far shows the greatest resistance.
PIPER and MORSE 1923 (*190*): Laredo and three unnamed varieties showed high resistance; tested in Florida, Georgia, and South Carolina. [The unnamed varieties are no longer grown. Kornfeld (*128*) reported that one variety called resistant by Piper and Morse was attacked in Rumania.]
SHAW 1940 (*213a*): Tobacco in enclosure units showed less than 10 percent severe infestation following bare fallow or certain highly resistant crops, 69.8 percent following Laredo soybeans, and 100 percent following tobacco or other susceptible crops. [North Carolina.]
WHITTLE and DRAIN 1935 (*263*): Listed as highly resistant. Tennessee (?).

Var. OTOOTAN.

GEORGIA COASTAL PLAIN EXPERIMENT STATION 1936 (*83*): Moderately susceptible, not adequate for control rotation.
GODFREY 1928 (*93*): Growth vigorous; root knot developed from month to month until practically all plants were "affected." Hawaii.
MCCLINTOCK 1922 (*145*): Considerable resistance, some infested plants found (3-year tests). Georgia.

Solanum tuberosum, potato. (N, S)

FRANK 1885 (*68*): Infestation conspicuously absent; other hosts preferred (one planting). Germany. [Listed as a host plant by Frank in 1896 (*69*).]
WATSON and GOFF 1937 (*258*): Grows well, but infested tubers are unsalable and do not keep well. Florida.

[31] See footnote 70, p. 44.

Experiments indicating nematode resistance in Var. "Roode Star" were reported by Dorst (*55*). The nematode in question was not named and no clue to its identity can be found in the paper. In the Netherlands it is often the bulb-and-stem nematode, *Ditylenchus dipsaci*, that causes trouble in potatoes; in other parts of Europe potatoes are injured by the sugar-beet nematode, *Heterodera schachtii;* these two nematodes are probably more important than root knot in the Netherlands.

Var. BURBANK.

HEADLEY 1918 (*108*): Russet Burbank is supposed to be more resistant than the smooth Burbank.

Var. IRISH COBBLER.

CUNNINGHAM 1936 (*51*): Tuber infestation fairly light, and later than in other varieties (moderate in Var. Bliss Triumph, severe in Green Mountain); roots of all three varieties heavily infested. New York (Long Island).

Solidago spp., goldenrod. (C)

BESSEY 1911 (*16*): "Species of *Solidago* also free."

No reports of infestation in this genus have been found; possibly the roots are seldom examined. See **Weeds.**

Sorghum halepense (*Andropogon halepensis*), Johnson grass. (C)

BARRONS 1939 (*13*): Numerous larvae entered root tips of seedlings heavily inoculated in greenhouse. Alabama.

BESSEY 1911 (*16*): No infestation found.

SMEE 1928 (*214*): "Johnston grass . . . immune . . . (South Africa)." [No authority can be found for this statement except Fuller (*70*), who had acknowledged, in a general way, his use of Bessey's (*16*) material.]

Sorghum vulgare (*Andropogon sorghum; Holcus sorghum*), sorghum.

BARRONS 1939 (*13*): Numerous larvae entered root tips of seedlings (Var. Sagrain) heavily inoculated in greenhouse. Alabama.

BESSEY 1911 (*16*): No infestation found on the various forms of sorghums, milos, kafir, etc.

CALIFORNIA NEMATODE COMMITTEE 1925:[32] Resistant.

COLLINS 1938 (*41*): Kafir not attacked (1 season). Rhodesia.

GODFREY 1928 (*92*): Infestation light on "Smilo" [Question: What plant was meant?]; infestation extreme on "Red milo maize" [meaning Dwarf Yellow Milo?] and on "Sorghum amber cane" [meaning Amber sorgo?] (one test each). Hawaii.

KING and HOPE 1934 (*127*): Sorghums beneficial in rotation for control. Arizona.

KRISHNA AYYAR 1933 (*131, 132*): Always found free and soil population reduced; no infestation found in pot experiment. India (Madras).

WATSON 1929 (*255*): Sorghum usually "immune" or only slightly infested. Florida.

Sorghum vulgare var. **sudanense,** Sudan grass. (N)

COLLINS 1938 (*41*): Rhodesian Sudan grass not attacked (1 season). Rhodesia.

GEORGIA COASTAL PLAIN EXPERIMENT STATION 1936 (*83*): Somewhat susceptible.

TYLER 1938 (*237*): Viable eggs found in greenhouse experiment. [Infestation light.] District of Columbia.

Sorrel, see **Rumex.**

Soybean, see **Soja.**

Speedwell, see **Veronica.**

Spider-flower, see **Cleome.**

Sprouts, see **Brassica.**

Spurge, see **Euphorbia.**

Squash, see **Cucurbita.**

Statice, see **Limonium.**

Stick-tight, see **Bidens.**

[32] See footnote 6, p. 8.

Stizolobium aterrimum, Bengal or Mauritius velvetbean. (C)

COLLINS 1930 (*42*): Black Mauritius only very slightly subject to attack. Hawaii.

GODFREY 1928 (*93*): Very slight infestation found on Mauritius velvetbean, on only 2 out of 50 plants examined; "can be safely considered as immune." Hawaii.

LYON 1911 (*144*): Has not in the least suffered from nematode attacks. Hawaii.

SMEE 1928 (*214*): Attacked in Nyasaland; should not be used for a starvation rotation. ["Indigenous velvetbean." Specific name, as above, given by Smee with a question mark.]

Stizolobium cochinchinensis (*Mucuna lyoni*; *S. niveum*), Chinese velvetbean, Lyon velvetbean.

BESSEY 1911 (*16*): Grown in infested land without the slightest infestation.

LYON 1911 (*144*): Has not in the least suffered from nematode attacks. Hawaii.

Stizolobium deeringianum, Deering velvetbean [erroneously called *Mucuna utilis* in the United States until 1909, when it was described as a distinct species].

BESSEY 1911 (*16*): Grown in infested land without the slightest infestation.

MCCLINTOCK 1922 (*145*): All climbing and Bunch varieties were resistant in field tests. Georgia.

——— 1927 (*148*): The most exempt plant. Tennessee.

MALLOCH 1923 (*154*): Field infestation found. California (Fresno County).

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION 1934 (*181*): Found highly resistant under a variety of conditions.

SHAW 1940 (*213a*): Tobacco in enclosure units showed less than 10 percent severe infestation following velvetbean or other highly resistant crops and 100 percent following tobacco or other susceptible crops. [North Carolina.]

TAUBENHAUS and EZEKIEL 1933 (*226*): Infested occasionally; little loss. Texas.

WATSON and GOFF 1937 (*258*): Velvetbean has generally been "absolutely immune"; only one infestation has been found in Florida.

Var. ALABAMA [Early Speckled or Hundred-Day; these names used also for Var. Georgia].

COLLINS 1930 (*42*): More nematodes on Early Speckled and on Hundred-Day than on Black Mauritius. Hawaii.

GODFREY 1928 (*93*): Hundred-Day definitely somewhat susceptible. Hawaii.

Var. BUSH [or BUNCH; a sport from Var. Florida].

ARIZONA AGRICULTURAL EXPERIMENT STATION 1936 (*3*): More resistant than the Iron or Brabham cowpeas tested.

GEORGIA COASTAL PLAIN EXPERIMENT STATION 1936 (*83*): Infestation on tobacco averaged 12 percent to 15 percent after velvetbeans compared with 2 percent to 45 percent after other rotations. [Var. Bunch was named in the 1927 report (*78*).]

MCCLINTOCK 1922 (*145*): All Bunch varieties were resistant in field tests. Georgia.

SMEE 1928 (*214*): Rotation with Bunch velvetbeans has given good results in Nyasaland.

WATSON and GOFF 1937 (*258*): "Absolutely immune." Florida.

Var. FLORIDA.[33]

GODFREY 1928 (*93*): Almost completely free. Hawaii.

LYON 1911 (*144*): Has not in the least suffered from nematode attacks Hawaii.

ORTON 1903 (*187*): Velvetbeans recommended for starvation rotation.

ROLFS 1907 (*201*): Velvetbeans "almost quite immune." [In 1898 Rolfs (*200*) made the following general statement, which has been cited as a host record for velvetbean and for beggarweed: "Nearly every one is familiar with the fact that plants belonging to the bean and pea family are more or less subject to its attack. The cow-pea, velvet bean, and beggar weed are our best nitrogen-gathering plants, and these at the same time are often attacked . . . ; crab grass or possibly . . . beggar weed" were suggested for rotation; "velvet bean or cow-pea had better not be used."]

[33] The only velvetbean grown in the United States before 1906.

WATSON 1922 (*252*): "Practically immune." Florida.
WEBBER and ORTON 1902 (*260*): Galls fairly abundant on P. I. Nos. 4333 and 5066 ("*Mucuna utilis*"). South Carolina.

Var. Georgia, see Var. ALABAMA.

Stizolobium hirsutum.

BESSEY 1911 (*16*): Grown in infested land without the slightest infestation.

Stizolobium pachylobium, "Brazilian-bean," fleshypod-bean.

BESSEY 1911 (*16*): Nematodes abundant, injury apparently not great.
LYON 1911 (*144*): Has not in the least suffered from nematode attacks. Hawaii.

Stizolobium pruriens (*Mucuna pruriens*).

BESSEY 1911 (*16*): Grown in infested land without the slightest infestation.
PIPER (quoted by Bessey 1911 (*16*)): Abundant infestation found on P. I. No. 21566 in greenhouse. District of Columbia.

Stizolobium hybrid.

Var. OSCEOLA [flowers *S. deeringianum* Var. Florida × pollen *S. cochinchinensis*, Lyon velvetbean; developed at Florida station].
COLLINS 1930 (*42*): More nematodes than Black Mauritius. Hawaii.
GODFREY 1928 (*93*): Very slightly susceptible. Hawaii.

Stizolobium spp., velvetbean.

BESSEY 1911 (*16*): One or more additional species grown in infested land without the slightest infestation.
COLLINS 1938 (*41*): "Somerset" velvetbean not attacked (1 season). Rhodesia.
GODFREY 1928 (*93*): Infestation slight on Var. "Brazilian" (one test; growth poor from other causes). Hawaii.
PIPER and MORSE 1938 (*191*): "Affected" only under very unusual conditions.

Stock, see **Matthiola.**

Strawflower, see **Helichrysum.**

Sudan grass, see **Sorghum.**

Sugarcane, see **Saccharum.**

Sulla, see **Hedysarum.**

Sunflower, see **Helianthus.**

Sunn-hemp, see **Crotalaria.**

Sweetpotato, see **Ipomoea.**

Sweet-sultan, see **Centaurea.**

Sweet-william, see **Dianthus.**

Syncarpia glomulifera. (C)

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.

Syntherisma, see **Digitaria.**

Tagetes erecta, African marigold, Aztec marigold. (C, N)

GEORGIA COASTAL PLAIN EXPERIMENT STATION 1938 (*84*): Marigolds are very nearly immune.
GOFF 1936 (*96*): No infestation found (140 plants, 3 tests). Florida.
MELCHERS 1915 (*159*). [The resistant "pot-marigold," Var. Eldorado, is assumed to belong here; see report of Melchers under **Calendula.**]
TYLER 1938:[34] Relatively resistant; no variety remained entirely free under greenhouse conditions (1 prolonged season). [On 10 varieties galls were very few and very small; a moderately heavy infestation was found on Var. "Gigantea Sunset Giants." *T. lucida* and *T. signata* Var. Pumila were also infested, the latter more or less abundantly.] District of Columbia.

[34] See report of Tyler on p. 140 of reference given in footnote 4, p. 6.

Tagetes minuta.

COLLINS 1937 (*41*): No signs of nematode attack. Rhodesia.

Tagetes patula, French marigold. (N)

BUHRER, E. M. (Division of Nematology, Bureau of Plant Industry. 1934): No galls found on the two plants in a mixed border otherwise heavily infested. District of Columbia.

GOFF 1936 (*96*): No infestation found (25 plants, 1 test). Florida.

TYLER 1938:[35] Infestation heavy on some plants under greenhouse conditions (1 prolonged season). [Slight infestation was found on occasional plants of 5 varieties; in each of the other 10 varieties tested a few plants showed moderate to heavy infestation.] District of Columbia.

Tamarindus indica, tamarind. (C)

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.

Tea, see **Thea;** sasanqua-tea, see **Camellia.**

Teff, see **Eragrostis.**

Teosinte, see **Euchlaena.**

Tephrosia toxicaria (*Cracca toxicaria*). (M)

BEELEY 1939 (*14*): Infestation apparently not observed [Malaya?] nor reported [in literature?]; experiments projected.

Tephrosia vogelii (*Cracca vogelii*).

BALLY and REYDON 1931 (*8*): Frequently found infested, may be killed. Java.

GADD 1937 (*73*): Seedlings injured or killed; older plants appear to grow normally, even when heavily infested, but may die after lopping. Ceylon.

SMEE 1928 (*214*): Found attacked in Nyasaland.

Thea sinensis, tea.

BARBER 1901 (*9*): Very destructive for seedlings; close search showed no galls on plants 1 to 3 years old in the same nurseries, nor on mature plants in four other infested areas. India (Madras).

CEYLON GOVERNMENT ENTOMOLOGIST 1920 (*34*): Sometimes occurs in tea nurseries, and on one occasion "had thoroughly infested the roots of a number of fairly old bushes."

GADD 1928 (*72*): Nurseries have been partially or wholly destroyed; occurrence on mature bushes has been recorded in isolated cases. Ceylon.

——— 1937 (*73*): Infestation disastrous to seedlings; old plants become "largely immune." Ceylon.

LIGHT 1928 (*141*): Capable of exterminating a whole nursery; "the roots, especially at the base, are noticeably swollen into galls." Ceylon.

MENZEL 1929 (*161*): Young nursery plants often killed; no significant injury found on plants more than 3 or 4 years old. East Indies.

RUTHERFORD 1914 (*203*): Chief injury above or below the collar, which is swollen and corrugated; "the root did not show any very conspicuous swellings"; several seedlings died. Ceylon.

Thunbergia spp., clockvine, thunbergia. (C, N)

GOFF 1936 (*96*): Rated as "very lightly infested"; no infestation found (14 plants) in 1 test where the infestation on other species also was relatively light; infestation 0 to moderate in a second test (25 plants). Florida.

Giant stem galls were reported on *T. grandiflora* and on *T. laurifolia* by Steiner, Buhrer, and Rhoads (*223*), with the remark that the plants did not seem to suffer much; severe injury was reported on *T. fragrans* by Bessey (*16*).

Timothy, see **Phleum.**

Tobacco, see **Nicotiana.**

Tomato, see **Lycopersicon.**

Torenia fournieri, blue torenia. (C, N)

GOFF 1936 (*96*): Infestation 0 to light (47 plants, 2 tests). Florida.

STEINER and BUHRER 1933:[36] Infestation found. District of Columbia.

[35] See report of Tyler on p. 140 of reference given in footnote 4, p. 6.

[36] See footnote 66, p. 41.

Var. ALBA (name supplied), white torenia.
GOFF 1936 (*96*): Infestation 0 (4 plants) and very light (21 plants). Florida.

Toxicophlaea, see **Acokanthera.**

Trachymene caerulea (*Didiscus caerulea*), blue laceflower. (C)
GOFF 1936 (*96*): Very heavily infested, plants very badly stunted. Florida.
WATKINS 1929 (*248*): Didiscus rated as "resistant." Florida.

Trachyspermum copticum (*Ammi copticum*). (C)
BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.

Trichloaena rosea, Natal grass. (C)
COLLINS 1938 (*41*): "Natal redtop" not attacked (1 season). Rhodesia.
FULTON and WINSTON 1919 (*71*): Nonsusceptible crop, for control rotation. Florida.
GODFREY 1935:[37] Infestation commonly observed to be light. Hawaii.
VOSBURY and WINSTON 1921 (*244*): After 2 years or more in Natal grass it was found that the nematodes had practically disappeared. Florida.
WATSON and GOFF 1937 (*258*): Wild host. Florida.

Trifolium alexandrinum, berseem, Egyptian clover. (M)
BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.
CALIFORNIA NEMATODE COMMITTEE 1925:[38] Resistant.
KENNEDY and MACKIE 1925 (*123*): "Carries nematodes in limited numbers." California.
MALLOCH 1923 (*154*): Field infestation found. California (Imperial Valley).

Triticum aestivum (*T. sativum*), wheat. (C, N)
BALACHOWSKY and MESNIL 1935 (*6*): Infestation observed on wheat in southern France following tobacco. [See **Gramineae.**]
BARRONS 1939 (*13*): Numerous larvae entered root tips of seedlings of Var. Purplestraw ("Alabama Bluestem") heavily inoculated in greenhouse. Alabama.
BESSEY 1911 (*16*): No infestation found.
GODFREY 1928 (*92*): Infestation abundant (one test). Hawaii.
GOFFART 1934 (*97*): Not infested in greenhouse experiment (alfalfa inoculum; 8-week test). [See also **Gramineae.**]
REH 1906 (*198*): Infested in Sweden. [This is a mistaken citation of papers by Nilsson-Ehle (*179*) on the sugar-beet nematode; see **Avena.**]
TYLER 1938 (*237*): Viable eggs found in greenhouse experiment. [Infestation light.] District of Columbia.

The wheat nematode is *Anguina tritici* (Steinbueh) Filipjev, parasitic in the flower parts and grain.

Triticum repens, see **Agropyron.**

Tropaeolum majus, common nasturtium. (N, S)
BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.
GODFREY 1935:[39] Infestation heavy. Hawaii.
GOFF 1936 (*96*): Infestation light (1 plant) to very heavy; wilts when dry (70 plants, 2 tests). Florida.
HARRIS 1938 (*104*): Nasturtium supports a moderate infestation without showing ill effect. Tanganyika (?).
TAUBENHAUS and EZEKIEL 1933 (*226*): Infested occasionally, little loss. Texas.
WATKINS 1929 (*248*): Nasturtium rated as "resistant." Florida.

Tropaeolum minus, bush nasturtium.
BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.

Tulipa sp., tulip. (C)
STEINER, G. (Division of Nematology, Bureau of Plant Industry. 1939): Never found infested.

No report of infestation on tulip is known. Whittle and Drain (*263*) listed it as "slightly infested" on authority of Tyler (*236*), whose table heading permitted this misunderstanding.

[37] See footnote 10, p. 11.
[38] See footnote 6, p. 8.
[39] See footnote 15, p. 16.

Tung, see **Aleurites.**

Turnip, see **Brassica.**

Ty-ess, see **Lucuma.**

Urochloa trichopus (name supplied), gonya grass. (C)

COLLINS 1938 (*41*): Gonya grass not attacked (1 season). Rhodesia.

Vasey grass, see **Paspalum.**

Velvetbean, see **Stizolobium.**

Verbena bonariensis. (M)

GODFREY 1935:[40] Infestation commonly observed to be light. Hawaii.

Verbesina virginica (*V. sinuata*), "crownbeard."

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.
NEAL 1889 (*176*): Badly "affected." Florida.

Vernonia ieptolepis.

COLLINS 1937 (*41*): No signs of nematode attack. Rhodesia.

Veronica peregrina, speedwell.

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.

Veronica tournefortii, speedwell.

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.

Vetch, see **Vicia.**

Vicia atropurpurea, purple vetch. (M)

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.

Vicia fuigens, scarlet vetch.

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.

Vicia pseudocracca.

BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.

Vicia spp., vetch. (N)

FRANK 1885 (*68*): No infestation found; other hosts preferred (one planting). Germany.
KING and HOPE 1934 (*127*): Used with onions and sesbania in a profitable 2-year rotation. Arizona.

V. sativa, common vetch, and other species are sometimes reported heavily infested.

Vigna cylindrica (*Dolichos catjang*), catjang-pea. (S)

COLLINS 1938 (*41*): Highly susceptible; suggested for a trap crop. Rhodesia.
KENDRICK 1929 (*121*): "No evidence of disease" (wilt and root knot; 1 season). California.
KRISHNA AYYAR 1933 (*132*): Infestation "mild" in pot experiment. India.
MACKIE, W. W. (California station; in letter, 1939): All varieties tested in badly infested soils died.

Atkinson (*4*) and Neal (*176*) reported severe injury to "*Dolichos catjang,* cowpea." [Question: What plant was meant? Possibly common cowpea, below?]

Vigna lutea.

MACKIE, W. W. (California station; in letter, 1939): Completely free from root knot and other diseases and insects (tested 5 years).

Vigna sinensis (*V. unguiculata*), common cowpea. (N, S)

GEORGIA COASTAL PLAIN EXPERIMENT STATION 1935 (*79*): No variety is entirely immune.
WATSON 1924 (*254*): No cowpea is so resistant as velvetbean. Florida.
—— GOFF, and BRATLEY 1938 (*259*): A cowpea of Australian origin, seems very resistant; large vine, very long season. Florida.

[40] See footnote 10, p. 11.

Var. BRABHAM [Vars. Iron × Whippoorwill; natural cross].

ARIZONA AGRICULTURAL EXPERIMENT STATION 1936 (*3*): Less resistant than velvetbean.

ARZBERGER, E. G. (unpublished manuscript in files of Division of Nematology, Bureau of Plant Industry, 1913): Suberized and other protective tissues better developed than in susceptible varieties. Virginia.

BARRONS 1937:[41] Less resistant than Var. Iron. Alabama.

——— 1939 (*13*): Numerous larvae entered root tips of seedlings heavily inoculated in greenhouse. Alabama.

BESSEY and BYARS 1915 (*17*): Highly resistant, but subject to injury in certain parts of Florida.

CLAYTON 1940 (*37a*): Sufficiently parasitized to carry over large nematode populations.

COLLINS 1938 (*41*): Not attacked (1 season). Rhodesia.

GEORGIA COASTAL PLAIN EXPERIMENT STATION 1938 (*85*): Of only slight value for control rotation with tobacco.

GODFREY 1928 (*93*): Comparative freedom from infestation during early growth, galls prominent after 3 months; plants long outlived susceptible varieties; illustration. Hawaii.

KENDRICK 1929 (*121*): "No evidence of disease" (wilt and root knot; 1 season). California.

KIME 1937:[42] Iron and Brabham have shown more tolerance than other varieties. North Carolina.

MCCLINTOCK 1922 (*145*): Resistant in tests. Georgia.

MACKIE, W. W. (California station; in letter, 1939): Many highly susceptible types have proved to be field hybrids.

MORSE 1920 (*168*): "Immune."

POOLE and SCHMIDT 1929 (*195*): Generally more resistant than other varieties, but sometimes severely attacked. North Carolina.

TAYLOR 1937:[43] 10 to 15 percent infested; commercial seed may have become mixed. Georgia.

WARNER 1937 (*247*): Highly resistant. Florida.

WATSON and GOFF 1937 (*258*): Harbors some root knot, which does not materially interfere with growth. Florida.

Var. CALIFORNIA BLACKEYE.

ISBELL 1934 (*116*): Infestation 0 to very light; almost no injury (159 plants, 4 percent infested; 2 seasons). Alabama.

KENDRICK 1936 (*122*): Susceptible. California.

MACKIE, W. W. (California station; in letter, 1939): Root knot attacks appear to vary with soil and climatic conditions, possibly due to biological differences or to complications with fungus diseases.

Var. CALVA BLACKEYE [California Blackeye × Virginia Blackeye; developed at California station].

CALIFORNIA AGRICULTURAL EXPERIMENT STATION 1938 (*31*): Seems somewhat tolerant; strains escape serious injury in all but the most severely infested parts of a field.

KENDRICK 1936 (*122*): Several strains highly resistant to fusarium wilt and to root knot. California.

MACKIE, W. W. (California station; in letter, 1939): Was grown primarily for wilt resistance; has not proved very resistant to nematodes.

Var. COLUMBIA [Blackeye variety × Red Whippoorwill; developed by Bureau of Plant Industry].

KENDRICK 1929 (*121*): "No evidence of disease" (wilt and root knot; 1 season). California.

Var. CONCH.[44]

BARRONS 1937:[45] A strain tested in Alabama seems "almost immune in the adult stage."

——— 1938 (*12*): The most resistant of the edible cowpea varieties; class 3 in seedling test, with a few medium-sized galls; as free in the field as are Alabama beans. Alabama.

——— 1939 (*13*): Numerous larvae entered root tips of seedlings heavily inoculated in greenhouse; 7 weeks later this series showed "a few very small galls." Alabama.

[41] See data on resistant varieties of crop plants by K. C. Barrons on pp. 115-116 of reference given in footnote 3, p. 6.
[42] See remarks by Kime on p. 117 of reference given in footnote 3, p. 6.
[43] See report of Taylor on pp. 116-117 of reference given in footnote 3, p. 6.
[44] Sometimes erroneously spelled "Couch."
[45] See footnote 41, above.

ISBELL 1934 (*116*): Extremely resistant, even more so than Victor (304 plants, 0.33 percent infested; 2 seasons). Alabama.
KENDRICK 1929 (*121*): "No evidence of disease" (wilt and root knot; 1 season). California.
WATSON 1937:[46] Some strains susceptible. Florida.
——— and BRATLEY 1936 (*257*): An extremely resistant strain discovered. Florida.

Var. EARLY BLACK.

KENDRICK 1929 (*121*): "No evidence of disease" (wilt and root knot; 1 season). California.

Black cowpea, the group to which this variety belongs, was suggested by Godfrey (*93*) for use as a trap crop in Hawaii. Orton (*186*) found it "much affected" in South Carolina.

Var. EXTRA EARLY BLACKEYE.

ISBELL 1934 ((*116*): Infestation 0 to light (110 plants, 22.4 percent infested; 2 seasons). Alabama.

Orton (*188*) mentioned that early cowpeas might escape injury by maturing before infestations became heavy.

Var. IRON.

ARIZONA AGRICULTURAL EXPERIMENT STATION 1936 (*3*): Iron No. 762 was less resistant than velvetbean.
ARZBERGER, E. G. (unpublished manuscript in files of Division of Nematology, Bureau of Plant Industry. 1913): Suberized and other protective tissues better developed than in susceptible varieties; roots deep, with minimum exposure of laterals. Virginia.
BARRONS 1938:[47] Samples from different seed sources showed variation in habit of growth and date of maturity, indicating that there are definite strains now in commerce; two samples were resistant, two lightly infested, and one was moderately susceptible. Alabama.
——— 1939 (*13*): Numerous larvae entered root tips of seedlings heavily inoculated in greenhouse. Alabama.
BESSEY 1911 (*16*): Apparently free under most conditions; usually sufficiently resistant for a starvation rotation.
——— and BYARS 1915 (*17*): Highly resistant, but subject to injury in certain parts of Florida.
CARNS 1937 (*32*): Valuable for its "immunity" to root knot and wilt; vigorous growth. South Carolina.
COLLINS 1938 (*41*): Not attacked (1 s[illegible]). Rhodesia.
GEORGIA COASTAL PLAIN EXPERIMENT STATION 1938 (*85*): Of only slight value for control rotation with tobacco.
GODFREY 1928 (*93*): Comparatively free from infestation during early growth, galls prominent after 3 months; plants long outlived susceptible varieties. Hawaii.
KENDRICK 1929 (*121*): "No evidence of disease" (wilt and root knot; 1 season). California.
KIME 1937:[48] Iron and Brabham have shown more tolerance than other varieties. Nematode resistance seems to be related to fusarium-wilt resistance. North Carolina.
——— OWENS, and POOLE 1937 (*124*): A strain obtained several years ago in Wilson County, North Carolina, has remained highly resistant under severe testing.
MCCLINTOCK 1922 (*145*): Resistant in tests. Georgia.
MACKIE 1934 (*151*): Resistance dominant; may probably be explained by the occurrence of suberin in the root cortex. [Data in letter, 1938: Highly resistant to root knot and to wilt; many highly susceptible types have proved to be field hybrids; K890–3 is still the most resistant Iron strain. (Strain K890–3 was selected by P. B. Kennedy and is now widely sold in California.)] California.
MALLOCH 1923 (*154*): Infested at Berkeley, and also in the Imperial Valley. California.
MORSE 1920 (*168*): "Immune."

[46] See comment by Watson on p. 116 of reference given in footnote 3, p. 6
[47] See footnote 70, p. 44.
[48] See remarks of Kime on p. 117 of reference given in footnote 3, p. 6.

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION 1934 (*181*): Several strains found highly resistant under a variety of conditions.
ORTON 1903 (*187*): "Somewhat affected" at the Florida station, but remained free in all trials in South Carolina.
——— 1913 (*188*): "Practically immune"; has preserved its vigor and resistance perfectly, 11 years; resistance dominant.
POOLE 1933 (*193*): High resistance in a strain found near Wilson, N. C.
——— and SCHMIDT 1929 (*195*): Generally more resistant than other varieties but sometimes severely attacked. North Carolina.
ROLFS 1907 (*201*): "Fairly immune"; has been "severely affected . . . under certain conditions."
SHAMEL and COBEY 1907 (*213*): Found resistant in infested tobacco fields and recommended for rotation.
TAYLOR 1937:[49] One field about 50 percent infested; commercial seed may have become mixed. Georgia.
WARNER 1937 (*247*): Highly resistant. Florida.
WATSON 1921 (*251*): True Iron is usually highly resistant; sometimes harbors nematodes.
——— and GOFF 1937 (*258*): Harbors some root knot, which does not materially interfere with growth. Florida.
WEBBER and ORTON 1902 (*260*): Seems to be "almost absolutely immune" under existing conditions. South Carolina.

The divergence of opinions on the resistance of the Iron cowpea seems to be due to differences in the purity of the seed used. This subject was discussed at the Nashville meeting.[50] Webber and Orton (*260*) [illegible] such a difficulty and wrote: "It could probably be brought back to its full degree of immunity by a few generations of seed selection." In this connection note (above) the experiences of Barrons and of Taylor, and the recent selection of strains in North Carolina and other States. Mackie and Smith (*153*) explain how field hybridization occurs in cowpeas.

Var. MONETTA [Whippoorwill × Iron].[51]
COLLINS 1938 (*41*): Almost invariably resistant. Rhodesia.
GILBERT 1917 (*88*): Listed as "largely immune."

Var. "PURPLE HULL (white)."
ISBELL 1934 (*116*): Infestation 0 to very light (92 plants, 29.7 percent infested; 2 seasons). Alabama.

Var. "SIX WEEKS."
ISBELL 1934 (*116*): "Free except area" (247 plants, 9.2 percent infested; 2 seasons). Alabama.

Var. SUWANNEE.
MINZ 1936 (*166*): Listed as "resistant." Palestine (?).
WARNER 1937 (*247*): Has much resistance to root knot but is not immune. Florida.

Var. VICTOR ([Vars. Brabham × Groit; developed by Bureau of Plant Industry]).
BARRONS 1937:[52] Less resistant than Iron. Alabama.
——— 1939 (*13*): Numerous larvae entered root tips of seedlings heavily inoculated in greenhouse. Alabama.
CARNS 1937 (*32*): "Immune" to wilt and root knot; probably the most valuable variety tested. South Carolina.
COLLINS 1938 (*41*): Not attacked (1 season). Rhodesia.
ISBELL 1934 (*116*): Infestation 0 to heavy (157 plants, 46 percent infested; 2 seasons). Alabama.
KENDRICK 1929 (*121*): 2 to 15 percent diseased (wilt and root knot; 1 season). California.
McCLINTOCK 1922 (*145*): Resistant in tests. Georgia.
MACKIE 1934 (*151*): Vigorous and resistant. California.
MORSE 1920 (*168*): As highly resistant as Iron and Brabham.
WATSON 1929 (*256*): Found heavily infested "under Florida conditions."

[49] See report of Taylor on pp. 116–117 of reference given in footnote 3, p. 6.
[50] See discussion on pp. 116–117 of reference given in footnote 3, p. 6.
[51] No longer grown in the United States.
[52] See footnote 41, p. 70.

Var. VIRGINIA BLACKEYE.

ISBELL 1934 (*116*): Infestation very light to medium; injury medium (182 plants, 58 percent infested; 2 seasons). Alabama.

KENDRICK 1929 (*121*): "No evidence of disease" (wilt and root knot; 1 season). California.

MACKIE, W. W. (California station; in letter, 1938): Frequently killed by root knot, though more resistant than the common Blackeye.

Vigna sinensis crosses.

GONFREY 1928 (*93*): A Department of Agriculture "hybrid" (seed from Federal Experiment Station, Honolulu) was comparatively free from infestation during early growth; galls prominent after 3 months; plants long outlived susceptible varieties; illustration. Hawaii.

MACKIE 1939 (*152*): A number of varieties of superior quality, resistance, and yield created by crossing California Blackeye with Iron, followed by repeated back-crossing to the Blackeye, and by plant selection. [Data in letter: Placed with bean farmers; will soon be grown exclusively in many areas.] California.

Vinca spp., periwinkle. (S)

GOFF 1936 (*96*): Infestation 0 to heavy on *V. rosea* (75 plants, 2 tests); average rating "very lightly infested." Florida.

MELCHERS 1915 (*159*): *V. rosea* infested in greenhouse. Kansas.

WATKINS 1929 (*248*): Vinca rated as "resistant." Florida. [Possibly *V. minor;* the United States Bureau of Entomology and Plant Quarantine has a record of infestation on this species.]

Vitis champinii, Champin grape.

Var. BARNES.

NOUGARET 1923 (*182*): Medium-small galls on all plants; rating [53] 15 (100 cuttings, 1 year).

SNYDER 1936 (*216*): Infestation very slight; rating 5 (58 vines, 4 years).

Var. DE GRASSET.

SNYNER 1936 (*216*): Infestation very slight, rating 10 (14 vines, 1 year).

Var. DOG RIDGE.

NOUGARET 1923 (*182*): Infestation found on only one-fourth of the plants—"trace"; rating 5 (50 cuttings, 1 year).

SNYDER 1936 (*216*): Infestation very slight, rating 5 (45 vines, 4 years).

Var. RAMSEY.

SNYDER 1936 (*216*): Infestation slight, rating 25 (4 vines, 1 year).

Var. VERMOREL.

SNYNER 1936 (*216*): Infestation slight, rating 25 (20 vines, 1 year).

Vitis cordifolia, frost grape.

NEAL 1889 (*176*): Certain races, for rootstocks, are free from the disease. Florida.

Vitis doaniana, Doan grape.

Var. SALT CREEK.

NOUGARET 1923 (*182*): No infestation found (50 cuttings, 1 year).

SNYDER 1936 (*216*): Infestation very slight, rating 5 (55 vines, 4 years).

Vitis labrusca, fox grape.

Var. ISABELLA.

HUERGO 1903 (*112*): Var. "Isabel," cultivated in North America, has been found more resistant than *V. vinifera* in Argentina at different times; on roots more than 1 year old infestation is lighter and less frequent than on *V. vinifera,* and decay of old galls is somewhat less severe.

LICOPOLI 1877 (*140*): Growth sufficiently vigorous in spite of infestation. Italy. [The original publication cannot be found in this country; the above citation is taken from Bellati and Saccardo (*15*).]

[53] Grape roots tested in California by Nougaret (*182*) in Orange County and by Snyder (*216*) in Kern County were given ratings from 0, no infestation found, to 100, infestation very heavy.

Vitis linsecomii, pinewoods grape.
Var. NEOSHO.
SNYDER 1936 (*216*): Infestation slight, rating 25 (10 vines, 1 year).

Vitis longii (*V. solonis*), Longs grape.

Var. AUSTRALIS.
SNYDER 1936 (*216*): Infestation slight, rating 25 (63 vines, 4 years).

Vitis riparia, see **V. vulpina.**

Vitis rupestris, sand grape.
LAVERGNE 1901 (*136*): No galls nor root degeneration, several years in infested vineyard. Chile.
MANUEL 1924 (*156*): Var. Du Lot "has been mentioned as immune."
SNYDER 1936 (*216*): Infestation very severe, rating 85, on Vars. "des Semis No. 81–2" and "Pillans."

Var. ST. GEORGE.
BESSEY 1911 (*16*): Resistant; showed no root knot (tested by a nurseryman in California).
SNYDER 1936 (*216*): Infestation very severe, ratings 75 and 80.

Vitis vinifera, European grape. (N, S)

Var. SULTANINA (Thompson seedless).
BESSEY 1911 (*16*): Apparently not so easily injured as other varieties of *V. vinifera.*
BROWN 1931:[54] Infestation abundant on a vine in Arizona, which produced a crop 3 years previously but none since.
MILBRATH 1923 (*162*): Illustration of severely infested root. California.
NOUGARET 1923 (*182*): Infestation severe, though less than on several other varieties of *V. vinifera;* rating 50.
SNYDER 1936 (*216*): Infestation very heavy, roots badly rotted; illustration.

Vitis vulpina (*V. riparia*), riverbank grape.
HUERGO 1903 (*112*): Infestation found only on young rootlets; said to cause less decay than on other grape roots. Argentina.
LAVERGNE 1901 (*136*): No galls nor root degeneration, several years in infested vineyard. Chile.
NEAL 1889 (*176*): Certain races, for rootstocks, are free from the disease. Florida.
SNYDER 1936 (*216*): Infestation medium on Var. Gloire ("Riparia Gloire"); rating 55 (49 vines, 4 years).

Vitis spp., and hybrids. (N)
BESSEY 1911 (*16*): "Some of the phylloxera-resistant hybrids and pure American sorts are practically immune" but some "quite badly affected."
WHITTLE and DRAIN 1935 (*263*): No nematodes found on the common eastern bunch varieties at Knoxville, Tenn.

Var. MUENCH [*V. aestivalis bourquiniana* × *V. linsecomii*].
SNYDER 1936 (*216*): Infestation slight, rating 25 (11 vines, 1 year).

No. 101–14: *V. vulpina* × *V. rupestris.*
MANUEL 1924 (*156*): Seen "affected." New South Wales.
NOUGARET 1923 (*182*): Galls, very small, found on 7 percent of the plants; rating 5 (50 cuttings, 1 year).
SNYDER 1936 (*216*): Infestation medium, rating 45 (56 vines, 4 years).

No. 106–8: *V. vulpina* × (*V. cordifolia* × *V. rupestris*).
NOUGARET 1923 (*182*): Infestation found on 4 percent of the plants; rating 5 (50 cuttings, 1 year).
SNYDER 1936 (*216*): Infestation "mild," rating 30 (78 vines, 4 years).

No. 108–16: *V. rupestris* × *V. vulpina* (*V. riparia*).
SNYDER 1936 (*216*): Infestation slight, rating 20 (30 vines, 4 years).

No. 120A: *V. vulpina* × *V. rupestris.*
NOUGARET 1923 (*182*): Galls, very small, found on 25 percent of the plants; rating 5 (100 cuttings, 1 year).

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[54] BROWN, J. G. ROOT KNOT IN ARIZONA. U. S. Bur. Plant Indus., Plant Dis. Rptr. 15: 148. 1931. [Mimeographed.]

No. 1613: *V. longii*, "Solonis" × Othello [complex hybrid, with inheritance including *V. labrusca*, *V. vinifera*, and *V. vulpina*].
NOUGARET 1923 (*182*): Infestation found on 20 percent of the plants; galls very small; rating 5 (100 cuttings, 1 year).
SNYDER 1936 (*216*): Infestation very slight, rating 5 (70 vines, 5 years).

No. 1616: *V. longii*, "Solonis" × *V. vulpina* (*V. riparia*).
NOUGARET 1923 (*182*): No infestation found (100 cuttings, 1 year).
SNYDER 1936 (*216*): Infestation very slight, rating 10 (79 vines, 5 years).

V. rupestris × *V. cinerea*.
SNYDER 1936 (*216*): Infestation slight, rating 15 (65 vines, 4 years).

Waltheria americana. (C)
COLLINS 1937 (*41*): No signs of nematode attack. Rhodesia.

Warneria, see **Gardenia.**

Watermelon, see **Citrullus.**

Wheat, see **Triticum.**

Wisteria sinensis (*Kraunhia sinensis*), Chinese wisteria. (C)
BESSEY 1911 (*16*): Nematodes not abundant and no injury observed.
FLORIDA STATE PLANT BOARD 1919–25 (*66*): Infested shipments of wisteria [species not named] intercepted from Georgia and Ohio.
WHITTLE and DRAIN 1935 (*263*): Listed as slightly infested. Tennessee.

Wormskioldia longipedunculata. (C)
COLLINS 1937 (*41*): No signs of nematode attack. Rhodesia.

Yam-bean, see **Pachyrhizus.**

Zantedeschia aethiopica, calla. (N)
GROWER: Not much injury. California.

Zea mays, Indian corn, maize, "mealie." (N)
BARRONS 1939 (*13*): Numerous larvae entered root tips of seedlings and of "adult plants" (Vars. Golden Bantam and Trucker's Favorite) heavily inoculated in greenhouse; 7 weeks later one series showed "a few very small galls." Alabama.
BESSEY 1911 (*16*): No infestation found.
BUHRER, COOPER, and STEINER 1933: [55] Infestation found on Var. Golden Bantam.
CALIFORNIA NEMATODE COMMITTEE 1925: [56] Infested but profitable.
CLAYTON 1940 (*37a*): Sufficiently parasitized to carry over large nematode populations.
COBB 1890 (*39*): Maize "but little affected." New South Wales.
COLLINS, A. D. 1938 (*40*): Practically no yield on infested part of field "has again been noticed"; no galls found (but no systematic search). Rhodesia.
COLLINS, J. C. 1938 (*41*): Not attacked in experiment (1 season), but was attacked on one farm and stunted, cobs few or small, galls not easy to detect; first record in Rhodesia. [This report and the preceding, published in the same issue of the journal but by different observers, refer to separate instances of infestation.]
CUNNINGHAM 1936 (*51*): Sweet corn was very slightly "affected." New York (Long Island).
FAJARDO and PALO 1933 (*60*): Rated as "resistant"; white corn and "Lagkitan" were infested (20 plants each); in Yellow Flint 14 plants were infested, 8 plants free. Philippine Islands.
FRANDSEN 1916 (*67*): "We have succeeded in getting a marked infestation." California.
GEORGIA COASTAL PLAIN EXPERIMENT STATION 1938 (*85*): Of only slight value for control rotation with tobacco.
HUME 1901 (*113*): Infestation does not interfere seriously with the crop. Florida.
JACK 1920 (*119*): Not attacked. Rhodesia.

[55] See footnote 20, p. 17.
[56] See footnote 6, p. 8.

KERZMAN 1938:[57] Some varieties appear susceptible to attack. Argentina.
KING and HOPE 1934 (*127*): Corn in rotation increases cotton yield. Arizona.
KRISHNA AYYAR 1933 (*131, 132*): No infestation found in pot experiment nor in infested plot, and soil population reduced. India (Madras).
LUNN and MATTISON 1937 (*143*): Infestation on tobacco following corn is moderate to severe, showing no better control than following cotton. South Carolina.
MELCHERS 1915 (*159*): Galls found on Var. Burbank Rainbow in greenhouse. Kansas.
NEAL 1889 (*176*): "Slightly affected." Florida.
OREGON AGRICULTURAL EXPERIMENT STATION 1938 (*185*): Corn as an alternate cultivated crop greatly reduced the nematode population in the field.
ORTON 1903 (*187*): Corn ("immune") recommended for a starvation rotation.
POOLE 1933:[58] Infestation prominent in North Carolina in 1932. [Poole also reported a case of stunting in 1930.][59]
ROLFS 1907 (*201*): "Almost quite immune."
SANDGROUND 1922 (*207*): Found susceptible to some degree, in a heavily infested orchard, but can often be grown profitably. South Africa.
SHAW 1940 (*213a*): Tobacco in enclosure units showed less than 10 percent severe infestation following bare fallow or certain highly resistant crops and 100 percent following corn, cotton, sweetpotatoes, or tobacco. In field plots, tobacco showed 11 percent severe infestation following peanuts, 67.3 percent following corn, and 93.3 percent following tobacco (2-year averages); in 3-year rotations, tobacco showed less than 10 percent severe infestation following oats and weeds after peanuts, less than 25 percent following oats and weeds after corn, 28 percent following corn-cotton, and 93 percent following continuous tobacco (1 year's results). [North Carolina.]
SMEE 1928 (*214*): Maize for rotation has given good results in Nyasaland.
STEINER, G. (Division of Nematology, Bureau of Plant Industry. 1939): Very heavy infestations have been submitted from Georgia, South Carolina, and North Carolina.
TAYLOR, A. L. (Division of Nematology, Bureau of Plant Industry. 1939): Two or three instances of severe damage in Georgia, showing as isolated stunted patches.
TOWNSEND 1935 (*232*): Beans following corn were not sevcrely injured, but were an almost complete loss following two bean crops. Florida.
WATSON and GOFF 1937 (*258*): Usually highly resistant on well drained land; often rather heavily infested on poorly drained land. Florida.
WHITTLE and DRAIN 1935 (*263*): Field corn and sweet corn listed as seldom infested or highly resistant. Tennessee (?).
WILSON 1936 (*265*): Grown for rotation where a root knot population had been built up on onions. Ohio.

The differences in susceptibility of corn may be due to differences in host strains of the nematode or to external conditions, but careful records of the behavior of corn varieties might prove of valuc.

Zinnia elegans, common zinnia. **(C, N, S)**

BUHRER, COOPER, and STEINER 1933:[60] Infestation found. [District of Columbia.]
GOFF 1936 (*96*): Infestation 0 to light (0 or very light on most; 144 plants, small and giant; 4 tests). Florida.
KRISHNA AYYAR 1933 (*131*): Host in south India.
TYLER 1938:[61] Infestation very heavy on 33 horticultural varieties under greenhouse conditions; tolcrance not determined. District of Columbia.

Zinnia spp., zinnia.

BESSEY 1911 (*16*): No infestation found.
CEYLON DEPARTMENT OF AGRICULTURE 1936 (*33*): Infestation recorded in Ceylon.

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[57] See footnote 85, p. 48.
[58] See footnote 58, p. 38.
[59] See report of Poole on p. 64 of reference given in footnote 16, p. 16.
[60] See footnote 20, p. 17.
[61] See report of Tyler on p. 140 of reference given in footnote 4, p. 6.

TYLER 1938: [62] Mexican zinnias possibly somewhat resistant (experimental, in greenhouse). District of Columbia.
WATKINS 1929 (*248*): Zinnia rated as "resistant." Florida.

Zizyphus jujuba, common jujube. (C)
CALIFORNIA NEMATODE COMMITTEE 1925: [63] Resistant.
GEORGIA COASTAL PLAIN EXPERIMENT STATION 1935 (*80*): "Jujubes have been growing in the trial grounds 12 years, have produced 11 consecutive crops of fruit, are as yet free from insect and disease attack" [nematodes not mentioned].

SUMMARY

It is impossible at present to draw lines between high resistance, moderate resistance, and tolerance. All possible gradations and combinations of qualities are found; there are even occasional instances of heavy and conspicuous infestation on some of the most resistant plants. For the benefit of growers the following tentative list of plants that now appear most highly resistant is given. Even this carefully culled selection is arbitrary and subject to revision as additional information becomes available. A comparative testing of all these plants would be of great value. The reports cited in this compilation are in no way considered final.

PLANTS USUALLY RECOMMENDED TO GROWERS AS RESISTANT TO ROOT KNOT

Amygdalus persica: certain selections of Shalil and Yunnan peaches and P. I. No. 61302 (peach × nectarine).
Avena sativa, oat.
Citrus spp., grapefruit, lemon, orange.
Crotalaria spectabilis.
Desmodium tortuosum, Florida beggarweed.
Lantana camara, common lantana.
Malus sylvestris, apple.
Narcissus spp., narcissus.
Panicum miliaceum, broomcorn millet.
Panicum purpurascens, Para grass.
Pennisetum glaucum, pearl millet.
Phleum pratense, timothy.
Prunus armeniaca, apricot.
Prunus cerasus, sour cherry.
Prunus hortulana, hortulan plum.
Prunus mume, Japanese apricot.
Prunus munsoniana, wildgoose plum.
Prunus hybrid, Marianna plum.
Rhododendron spp., azalea and rhododendron.
Ribes spp., currant and gooseberry.
Secale cereale, rye.
Senecio cineraria, dusty-miller.
Sorghum vulgare, sorghum.
Stizolobium deeringianum, velvetbean.
Tagetes erecta, African marigold and other species.
Tulipa spp., tulip.
Vitis champinii, Var. Dog Ridge (Champin grape).
Vitis doaniana, Var. Salt Creek (Doan grape).
Ferns are assumed to be highly resistant.

[62] See report of Tyler on p. 140 of reference given in footnote 4, p. 6.
[63] See footnote 6, p. 8.

Plants Recommended Only With Reservations

Arachis hypogaea, peanut (harvested).
Fagopyrum vulgare, buckwheat.
Gardenia thunbergi.
Ligustrum quihoui, Quihou privet.
Oryza sativa, rice.
Pelargonium, geranium.
Persea americana, avocado.
Phaseolus lunatus: certain selections of Hopi lima bean.
Quercus spp., oak.
Setaria italica, foxtail millet.
Soja max: Laredo soybean (?).
Triticum aestivum, wheat.
Vigna sinensis: Iron cowpea selection K890–3.
Vitis: grape hybrids Nos. 1613 and 1616.
Zea mays, Indian corn.
Coniferous trees and many grasses are usually resistant, but conspicuous exceptions are known.

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