MORPHOLOGY, BIOLOGY, AND CONTROL OF *PRATYLENCHUS* SPP. ON FIELD CROPS OF WESTERN KANSAS

by 1264

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GENERAL INTRODUCTION

Relatively large populations of species of *Pratylenchus* Filipjev were recovered from soil and root samples from various crop plants in western Kansas. Since species of *Pratylenchus* have been reported to cause economic losses to field crops, research was initiated with the following objectives: 1) to identify the species of *Pratylenchus* collected from the Kansas Agricultural Experiment Station, Garden City Branch, and to compare the morphometrics of these species with original descriptions, 2) to test the suitability of selected crops as hosts for these nematodes and to study their population dynamics on these crops, and 3) to evaluate several nematicides for control of *Pratylenchus* spp. on pinto beans and corn grown on irrigated land in western Kansas.

PART I. IDENTIFICATION OF AND MORPHOLOGICAL NOTES ON PRATYLENCHUS SPP. FROM WESTERN KANSAS

Introduction

Initially, *Pratylenchus scribneri* Steiner was thought to be the primary species of *Pratylenchus* Filipjev associated with crop plants of western Kansas with some *P. neglectus* Rensch associated with wheat (*Triticum aestivum* L.). As the study progressed, it became evident that more than 2 species were involved and that the predominant species on any given host might be different. The approach taken was to work intensively with a nematode population from a relatively small area, with results to be used as a basis for further investigations.

The nematode genus *Pratylenchus* is in the phylum Nemata Chitwood, class Secernentea (von Linstow) Doughery, order Tylenchida Thorne, superfamily Tylenchoidea Chitwood and Chitwood, family Tylenchidae Oerley and subfamily Pratylenchinae Thorne (12). The main diagnostic characteristics of the genus are a robust body, broad flattened head, single outstretched anteriorly directed ovary, strong spear with massive knobs, vulva located at 75-85%, body 300 to 900 μ in length, bluntly rounded tail, lobe of basal bulb extending ventrally and laterally over intestine, and a spheroid medium bulb (4, 9, 10, 13).

There are 30 described species in the genus *Pratylenchus* (R. P. Esser, unpublished key). Eleven of these species have 2 lip annules and 5 of these 11 commonly have males present.

Materials and Methods

The origin of the populations of Pratylenchus spp. used were from the following sources: 1) Kansas Agricultural Experiment Station, Garden City Branch, containing females only, originally from pinto bean (Phaseolus vulgaris L.), and cultured in the greenhouse on 'Idaho III' pinto bean, 'K1830' corn (Zea mays L.), 'Pioneer 846' sorghum (Sorghum bicolor (L.) Moench.), and 'Bison' wheat with a mass collection cultured on 'Rutgers' tomato (Lycopersicum esculentum Mill.); 2) Kansas Agricultural Experiment Station, Garden City Branch, containing both females and males, originally from pinto bean and cultured on tomato in the greenhouse; 3) Type culture of P. scribneri from the roots of amaryllis (Amaryllis sp.) maintained in a greenhouse, Department of Entomology and Nematology, University of Florida, Gainesville; and, 4) P. scribneri (from coleus (Coleus sp.) roots) which had been heat-relaxed, fixed in FAA, and were in 2% formalin when received from the Department of Plant Pathology, South Dakota State University, Brookings.

For microscopic examination, specimens not already processed were heat-relaxed, fixed in FAA for 24 hours and processed into dehydrated glycerin by the Seinhorst glycerol-ethanol method (8).

Morphometrics were made with a compound microscope. Most measurements were made at 430 X with camera lucinda tracings at 1000 X. More detailed observations were made at 900 X with camera lucinda tracings made at about 2000 X.

Results

Four species of *Pratylenchus* were identified. The species were *P. scribneri*, *P. neglectus*, *P. hexincisus* Taylor and Jenkins and a species tentatively identified as *P. alleni* Ferris. The following key was devised to separate the 4 species.

1. Spermatheca present, males common......................alleni

   Spermatheca absent, males not observed................2

2. Lateral incisures 6....................................hexincisus

   Lateral incisures 4....................................3

3. V 80% or more, "c" 20 or more..........................neglectus

   V less than 80%, "c" less than 20......................scribneri

Measurements and ratios from western Kansas specimens are presented in Table 1. Those specimens tentatively identified as *P. alleni* varied from the original description by Ferris (2) in that western Kansas specimens were longer (490 vs. 380 μ), had a larger "b" ratio (7.2 vs. 5.4), a larger "c" ratio (23.9 vs. 20.0) and had a distinctively blunter tail (Fig. 1). Tail shapes of the other 3 species were similar to published illustrations.

The western Kansas specimens of *P. hexincisus* were longer than those originally described by Taylor and Jenkins (11), but were about the same length as given by Thorne and Malek (13). The Kansas specimens also had a longer stylet (16.2 vs. 15.0 μ) than was given by Taylor and Jenkins (11).

One species, including virtually all the specimens from wheat, were identified as *P. neglectus*. Measurements and ratios for these nematodes were very similar to the original description.

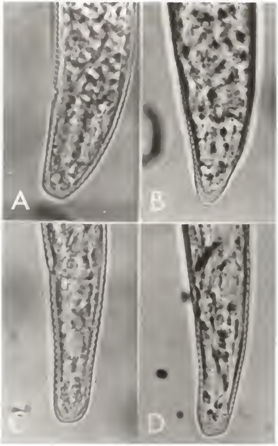
Table 1. Morphological characteristics used to identify *Pratylenchus* species from western Kansas

	P. scribneri	*P. neglectus*	*P. hexincisus*	♀ *P. alleni*	♂ *P. alleni*
Length (mm)	.508 (.458-.560)	.488 (.422-.538)	.525 (.432-.620)	.489 (.430-.560)	.488 (.430-.560)
"a"	26.1 (18.8-33.8)	24.4 (20.4-28.9)	25.1 (20.1-29.6)	25.1 (20.5-30.9)	27.6 (23.7-32.3)
"b"	6.9 (6.1-8.2)	7.0 (5.5-8.2)	7.1 (5.4-7.9)	7.2 (5.6-8.5)	6.6 (6.0-7.6)
"c"	17.6 (14.8-19.6)	22.8 (18.3-27.2)	19.8 (15.4-22.9)	23.9 (19.5-27.7)	21.2 (18.5-24.3)
V%	77.2 (73.5-78.9)	82.3 (80.3-85.7)	78.4 (76.6-81.1)	79.1 (75.8-82.0)	———
T%	———	———	———	———	38.6 (27.7-51.0)
Stylet Length (μ)	14.8 (14.0-15.9)	17.0 (15.9-18.2)	16.2 (14.9-17.3)	14.2 (13.3-15.4)	13.4 (12.6-14.5)
VA/T*	3.0 (2.2-3.5)	3.0 (2.3-3.9)	3.2 (2.5-4.0)	4.3 (3.5-5.5)	———
T/ABW**	2.3 (1.8-2.9)	1.6 (1.2-1.9)	2.2 (1.8-3.0)	1.7 (1.4-2.1)	———
Spermatheca	NO	NO	NO	YES	———
Labial Annules	2	2	2	2	2
Lateral Incisures	4	4	6	4	4
No. specimens	25	25	25	30	25

*VA/T= Distance between anus and vulva divided by the tail length.

**T/ABW= Tail length divided by the anal body width.

Fig. 1. Typical female tails of A) a species of *Pratylenchus* tentatively identified as *P. alleni*, B) *P. neglectus*, C) *P. hexincisus* and D) *P. scribneri*. Magnification 1350.


A
B
D

Pratylenchus scribneri specimens from western Kansas had a shorter stylet (14.8 vs. 16.0 μ) than described by Sher and Allen (10) and Loof (4), but other diagnostic characteristics were as described. Measurements and other morphological characteristics of the specimens from Florida and South Dakota were similiar to published descriptions of *P. scribneri* (4, 10, 13).

The presence of ovaries with 2 rows of oocytes their entire length was noted in all species of *Pratylenchus* from western Kansas. The percent occurrence of 2 rowed oocytes in each species was *P. neglectus* 15%, *P. scribneri* 50%, *P. hexincisus* 70% and *P. alleni* 75%. The remaining nematodes had either a single row of oocytes, a short region of 2 rows at the anterior end of an otherwise single row or a double row in the center of an otherwise single row (Fig. 2,3).

Fig. 2. Ovaries of *Pratylenchus* spp. A) As described for *P. alleni* and B) a double row of oocytes in *P. alleni* and C) *P. hexincisus*. Magnification 1350.

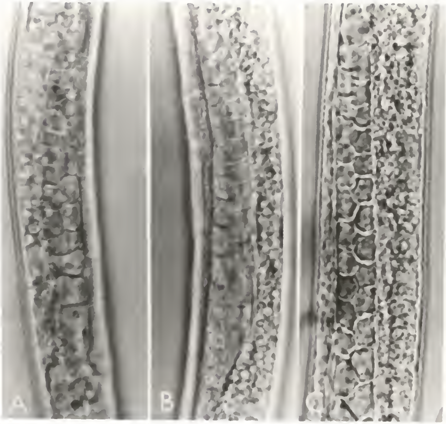
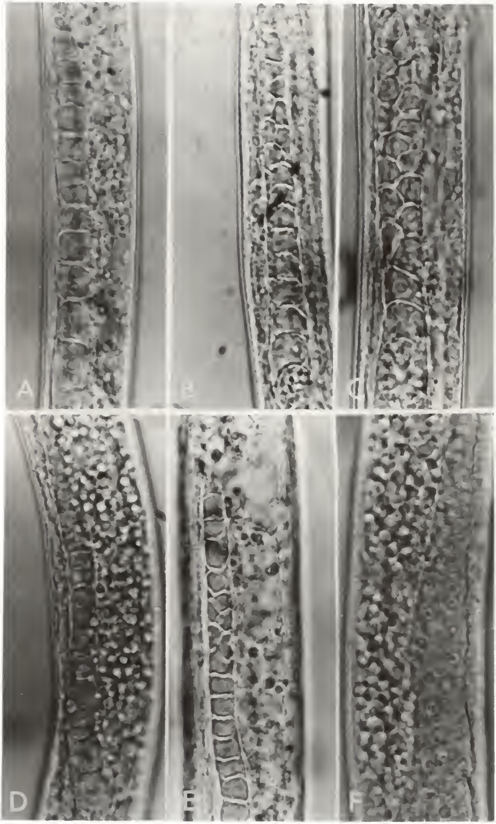


Fig. 3. Ovaries of *Pratylenchus* spp. A) A single row of oocytes for *P. scribneri*, B) as described for *P. scribneri*, and C) a double row for *P. scribneri*. D) A single row of oocytes for *P. neglectus*, E) as described for *P. neglectus*, and F) a double row of *P. neglectus*. Magnification x350.


A
B
C
D
E
F

Discussion

All species descriptions of *Pratylenchus* give a wide range of measurements and ratios. Therefore, the trend has been to establish 1 outstanding character within a group that readily identifies a species and to use morphometrics as supplementary evidence.

As stated in the Introduction, there are 11 species with 2 lip annules and 5 of these species commonly have males. All of the species from western Kansas had 2 lip annules and 1 species always had males present. Individual adult females could be distinguished by a prominent and circular spermatheca which generally contained sperm. This species tentatively was identified as *P. alleni*. The reason for tentative status was that the overall measurements deviated from the original description and the tail shape was different than that depicted by the original author (2). Observations of pure cultures reared on the host from which it was described (soybeans *Glycine max* (L.) Merr.) will be necessary before a definite decision can be made.

Another outstanding character used to separate species is the number of lateral incisures. Of the 6 species with 2 lip annules and males occurring only rarely, the only species described with 6 lateral incisures is *P. hexincisus*. One *Pratylenchus* sp. from western Kansas had this character along with measurements similiar to the description of *P. hexincisus* and was thus identified.

Of the 5 remaining species with 2 lip annules and males occurring only rarely, *P. brachyurus* Godfrey was easily eliminated by its distinctively angular lip margins. *P. tenuis* Thorne and Malek and *P. agilis* Thorne and

Malek were both excluded by their distinctively long overlapping esopheal lobes. Of the 2 remaining species, P. neglectus was then distinguished from P. scribneri by a higher V%. The V%, according to Taylor and Jenkins (11) varies less than other characters of the genus and its use as a diagnostic character is acceptable. Specimens identified as P. scribneri had a shorter stylet than given in the literature, but fit enough characters so that there was little doubt of specific designation.

A survey of literature pertaining to descriptions of Pratylenchus spp. (1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 13) revealed that only 2 species (P. brachyurus and P. zeae Graham) were described with 2 rows of oocytes the entire length of the ovary. The percentage occurrence of 2 rows of oocytes in P. scribneri from the Florida and South Dakota collections was low (2 and 4% respectively). A deviation from the normal of this magnitude might be expected. Two rows of oocytes occurred in 15% of P. neglectus. While the reasons for this are not known, a large number of old females were present. The percentage occurrence of 2 rows of oocytes in the western Kansas population of P. scribneri was 50% and for P. hexincisus it was 70%. Further observations of a pure population on hosts from which they were originally described will help answer whether this morphological variance is of significance in either speciation or reproduction or both.

Seventy five percent of the ovaries of P. alleni had oocytes in 2 rows throughout their length. As stated in Results, specimens identified from western Kansas as this species had several characters which deviated from the original description. No one variance would challenge the diagnosis, but when taken together, one must question whether the western Kansas species was P. alleni or an undescribed species. Further investigation is underway.

Summary

Pratylenchus neglectus, *P. scribneri*, *P. hexincisus* and a species tentatively identified as *P. alleni* were identified from field crops in western Kansas. A high percentage of the population of *P. scribneri* (50%), *P. hexincisus* (70%) and *P. alleni* (75%) had ovaries with 2 rows of oocytes throughout their length. This represents a departure from published descriptions.

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PART II. POPULATION DYNAMICS OF PRATYLENCHUS SPP. FROM WESTERN KANSAS UNDER GREENHOUSE CONDITIONS

Introduction

A greenhouse experiment was designed to evaluate the population dynamics of species of Pratylenchus Filipjev from western Kansas. The purpose of the experiment was to gain some insight into possible rotation sequences for reduction of damage caused by this nematode genus to pinto bean (Phaseolus vulgaris L.), sorghum (Sorghum bicolor (L.) Moench.), corn (Zea mays L.), and wheat (Triticum aestivum L.). These crops were used because they are commonly grown in western Kansas. Pratylenchus scribneri Steiner, P. hexincisus Taylor and Jenkins, and P. neglectus Rensch were the main nematode species in the soil used. No information pertaining to populations of these species, in or about pinto bean roots, was found in the literature.

Young (11) tested several genera of plant parasitic nematodes against sorghum and corn and found that sorghum was generally resistant to nematodes and that corn was very susceptible. Norton (5) found that P. hexincisus caused significant damage to sorghum under dry soil conditions and his data demonstrated that the population increased during the tenure of his experiment.

Taylor and Schleder (9) noted P. hexincisus, P. scribneri, and P. neglectus present in the soil of corn fields in Minnesota. Mixed populations of P. hexincisus and P. scribneri were recovered from soil of several corn fields in Illinois (2).

Benedict and Mountain (1) found *P. neglectus* (syn. *P. minyus* Sher and Allen) in the roots of winter wheat in Ontario. Ferris and Bernard (2) found that *P. neglectus* increased in the soil about winter wheat roots in Illinois. *P. scribneri* and *P. hexincisus* were detected in the soil about wheat roots in Minnesota (9).

Materials and Methods

Pratylenchus spp. infested loam soil (3) was obtained from the Kansas Agricultural Experiment Station, Garden City Branch. The soil was thoroughly mixed and sampled for *Pratylenchus* spp. using Perry's variation of the Baermann funnel technique (10). The average population/pint of soil was 145. Sixty-four 7 inch plastic pots were filled with soil and randomly divided into 4 groups of 16 pots each. Each group of pots was planted to 1 of 4 species of plants commonly grown in the Garden City area; 'K1830' corn, 'Pioneer 846' grain sorghum, 'Bison' wheat, and 'Idaho III' pinto beans. In each pot 5 seeds of corn, sorghum or pinto beans, or 10 seeds of wheat were planted. After 10 days the pots with corn, sorghum, or pinto beans were thinned to 3 plants/pot and wheat to 5/pot by cutting the excessive plants off at the soil line. Four weeks after planting, the wheat was placed at 10° C for 50 days for vernalization. At maturity of each crop, the 16 pots were randomly divided into 4 equal groups. The roots and soil were removed intact from each pot and the roots growing next to the pot discarded. Representative samples from the remaining roots were then washed and placed on wire screens in a mist chamber (6) for 7 days for removal of *Pratylenchus* spp. The number of *Pratylenchus* spp./g dry wt of roots was then determined by dividing the number of *Pratylenchus* spp. obtained by the dry wt of each host's roots. To determine the number of *Pratylenchus* spp. in the soil around the roots of a host, the soil from each group of 4 pots was thoroughly mixed and a 1 pint sample removed. The nematodes were then separated from the soil as described above.

One pint of autoclaved field soil was added to regain the original volume, fertilized with 1 tablespoon of 5-10-5 granular fertilizer and repotted. One group was replanted with the same host while the other groups were each planted to a different one of the remaining 3 hosts. Planting, thinning, and vernalization were done as before. At each crops maturity, nematode counts of roots and soil were made as before. Analysis of variance and LSD tests were calculated from the data obtained. All nematode counts were transformed to their square root plus 1 for statistical analysis to reduce the variation of count data (4).

Results

Differences were found at host maturity in the mean number of a mixed population of *P. hexincisus*, *P. neglectus*, and *P. scribneri*/g dry wt of pinto beans, corn, sorghum and wheat roots, (Table 1). Larger numbers of these nematodes generally were recovered from the corn and pinto bean roots than from the wheat and sorghum roots. The average population of *Pratylenchus* spp./g dry wt of roots increased in all cases when pinto beans were the second crop and decreased in all cases when sorghum was the second crop. A significant reduction was found when wheat followed pinto beans or corn and a significant increase was found when wheat followed wheat.

At maturity of the first crop, significantly higher numbers of *Pratylenchus* spp. were recovered from the soil surrounding the corn and sorghum roots than from the soil about the roots of pinto beans or wheat (Table 2). This trend continued through the second crop regardless of which host was the second crop (Table 3).

Table 1. The average population of Pratylenchus spp. recovered from the roots of four hosts and the average population of Pratylenchus spp. recovered from each host's roots when grown following itself and the other three hosts.

	Second host				
First host	Pinto beans	Corn	Sorghum	Wheat	Mean of first host
Pinto beans[1]	4160[2]	13841	7691	26399	10133 ab[3]
	21149*	21428	1970*	1870***	
Corn	8447	8646	14557	36850	17312 a
	68151**	4941	725***	2318***	
Sorghum	5563	5020	6392	5356	5632 bc
	20482**	3710	1008***	4299	
Wheat	4069	1789	2583	3781	2881 c
	56618***	8191**	1359**	25197***	

[1]The population averages from the first host are in horizontal rows. Population averages from the second host are in vertical rows and underlined. Figures represent the average number of Pratylenchus spp. from four replicates of each host at its maturity.

[2]Significant differences indicated were found by using square root of nematode counts plus one.

[3]Unlike letters indicate significant differences.

*Indicates significance at the 10% level.

**Indicates significance at the 5% level.

***Indicates significance at the 1% level.

Table 2. *Pratylenchus* spp. per pint of soil about roots of four hosts at maturity.

	Host			
Nematode	Pinto beans	Corn	Sorghum	Wheat
Pratylenchus spp.	112 a[1,2]	1554 b	1378 b	41 a

[1]Unlike letters indicate significant difference at 5% level.

[2]Significant differences indicated were found by using square root of nematode counts plus one.

Table 3. Pratylenchus spp. per pint of soil about roots of four hosts at maturity, each which had followed itself and each of the other three.

	First host			
Second host	Pinto beans	Corn	Sorghum	Wheat
Pinto beans	94[1]	1783	1283	590
Corn	3086	2225	2425	1025
Sorghum	1075	1050	1475	1300
Wheat	72	470	100	1775

[1]Each number represents counts for one composite sample from four replications.

Discussion

Both corn and pinto beans proved to be very good hosts for *Pratylenchus hexincisus*, *P. scribneri* and *P. neglectus*, whereas sorghum seemed to be a fair host. For the 3 species present, wheat was a good host only for *P. neglectus* which is in agreement with work by Ferris and Bernard (2).

Of special interest was the decrease in the number of *Pratylenchus* spp./g dry wt of root when wheat followed pinto beans and the increases when pinto beans followed wheat and pinto beans and when wheat followed wheat (Table 1). The probably reason for these phenomenon was that *P. neglectus* was the only *Pratylenchus* spp. of the 3 that reproduced extensively on wheat. *Pratylenchus neglectus* also reproduced well on pinto beans as indicated by the population on pinto beans growing after wheat, but did not compete well when the other species were present as indicated by the drop in population on wheat when wheat followed pinto beans and corn.

When evaluating the data obtained in relation to population dynamics, it became apparent that the data was not sufficient to fully measure the total nematode populations actually present. It would have been more meaningful to have calculated the total population/pot. Generally, *Pratylenchus* spp. attained a higher population/g dry wt in pinto bean and corn roots than in roots of sorghum or wheat. There were less g of roots/ pot for pinto beans than for corn and sorghum. This means that the total population of *Pratylenchus* spp. in corn and sorghum was probably greater than that for pinto beans.

The populations of *Pratylenchus* spp./pint of soil (Table 2) were lower for pinto beans and wheat than for sorghum and corn after the first crop. This trend continued with few exceptions after the second crop (Table 3). These population differences could have been caused by any one or a combination of variables, such as: 1) variable time required for host maturity, 2) nature of root anatomy for the different hosts, 3) migratory habits of the different *Pratylenchus* spp. on a given host, 4) variations in population density or 5) environmental variations inherent in greenhouse culture.

The roots in some pots contained very high populations of *Pratylenchus* spp./g dry wt. Even with these high populations in the roots, the population/pint of soil remained relatively low (Tables 1 and 3). This suggests that if the *Pratylenchus* spp. followed the logistic curve for reproduction (7,8) it had not reached a peak population in the roots.

Because of a mixed population of *Pratylenchus* spp. in the soils at the Kansas Agricultural Experiment Station, Garden City Branch, no rotation sequences can be recommended. Pinto beans will apparently have a large population per wt unit of roots regardless of the crop it follows. However, the pathogenic potential of the 3 individual *Pratylenchus* spp. to pinto beans is not known.

Pratylenchus neglectus is the only species of the 3 that will reproduce significantly on wheat. When wheat follows wheat, the population reaches relatively high numbers. This suggests that economic losses of wheat could be sustained under a continuous cropping sequence, but no loss data has been presented.

Populations on corn and sorghum did not change enough to suggest a pattern that would be helpful in a rotation sequence with the other crops studied.

Summary

Higher numbers of mixed populations of *Pratylenchus hexincisus*, *P. scribneri* and *P. neglectus* generally were recovered/wt unit of corn and pinto bean roots than from wheat and sorghum roots. The population of *Pratylenchus* spp./g of dry wt of roots increased in all cases when pinto beans were the second crop and decreased in all cases when sorghum was the second crop. A significant population reduction was found when wheat followed pinto beans or corn and a significant increase was found when wheat followed wheat.

No rotation sequences involving pinto beans, corn, sorghum, and wheat could be recommended from the data obtained.

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PART III. CONTROL OF *PRATYLENCHUS* SPP. ON PINTO BEANS AND CORN IN WESTERN KANSAS

Introduction

High populations of species of *Pratylenchus* Filipjev were found associated with unexplained yield losses of pinto beans (*Phaseolus vulgaris* L.) and corn (*Zea mays* L.) in western Kansas. It had been reported that plants could tolerate some *Pratylenchus* spp. without economic loss (14, 15). Therefore, experiments were designed to 1) find if actual losses were being incurred, 2) determine the approximate level of kill needed to significantly increase yield and 3) find economically feasible nematicides. Data were obtained in 1966 and 1968 on pinto beans and in 1968 on corn.

No references to economic losses for pinto beans by *Pratylenchus* spp. was found in the literature.

Young (18) found a *Pratylenchus* sp. to severely stunt corn plants in Texas. He found that the nematodes damaged the root cortex, caused brown lesions to form, and girdled and amputated roots. Dickerson, et al. (3) reported reductions in corn roots, stalks and stalk diameters caused by infections of *P. penetrans* Cobb, Filipjev and Stekhoven in corn plants in the greenhouse. Edmunds, et al. (4) attained an 85% kill of *P. penetrans* with D-D injected into the soil at 32 gal/acre, but did not increase yield of corn in New York State. He did report that the fumigant was phytotoxic under his experimental conditions. Ferris (5) found Vorlex, Telone, and D-D drastically reduced *P. penetrans* populations on several crops, including corn, in muck soil when applied at 45-50 gal/A. He presented no yield data for any of the crops.

Materials and Methods

Pinto beans-1966.- Twenty-four plots were established at the Kansas Agricultural Experiment Station, Garden City Branch, on May 5, 1966. The land used in the experiment was Keith loam with a 0 to 1% slope. It was deep, loamy, and had a high moisture holding capacity (8). A randomized complete block design with 6 treatments in each of 4 replicated blocks was used. This design was chosen to eliminate some of the variation inherent with furrow irrigation. The plots were 50 ft long with 10 ft alleys between blocks. Each plot consisted of 4 rows, 2 on each of 2 beds having 56 inch centers. The rows on each bed were 24 inches apart. Soil samples were taken from all plots and the number of *Pratylenchus* spp./pint of soil determined by Perry's (17) variation of the Baermann funnel technique. There were approximately 117 *Pratylenchus* spp. and 28 *Tylenchorhynchus acutus* Allen/pint of soil with no significant differences between plots.

The treatments and rates were as follows: 1) Vidden-D (1,3-dichloropropene, 1,2-dichloropropane and related chlorinated hydrocarbons) 35-40 gal/Acre (A); 2) Vorlex (methyl isothiocyanate 20% plus chlorinated C_3 hydrocarbons including dichloropropenes, dichloropropane and related chlorinated hydrocarbons 80%) 35-40 gal/A; 3) Telone PBC (dichloropropenes 80%, chloropicrin 15%, and propargyl bromide 5%) 35-40 gal/A; 4) Dasanit-10G (O,O-diethyl O- [p-(methylsulfinyl) phenyl] phosphorothioate) 17.7 lb. actual/Acre (A/A); 5) Dowfume MC-2 (methyl bromide 98%, chloropicrin 2%) 1 lb./100 ft^2; and 6) untreated control. All rates were on an overall basis, not the amount actually applied.

The liquid fumigants Vidden-D, Vorlex, and Telone PBC were applied by chisels 8 inches deep with 3 chisels/bed on 12 inch centers. A drag was pulled directly behind the applicator to fill furrows left by chisels. The granular nematicide Dasanit-10G was broadcast on the surface of the beds with a 3-ft Gandy lawn fertilizer applicator and rototilled 4 inches deep. Dowfume MC-2 was applied to the entire plot under a polyethylene tarp. Soil temperature 8 inches deep was 18° C. Plots were planted on May 26 (21 days after treatment) to 'Idaho III' pinto beans.

Representative soil and root samples were taken with a spade from the outer rows of each plot July 27 (62 days after planting) and September 7 (104 days after planting). Each sample contained 4 sets of roots and adjacent soil. Roots from each sample were removed, washed, weighed, and placed in a mist chamber for removal of nematodes (13). Nematodes were collected daily for 7 days and the number of *Pratylenchus* spp./g dry wt of roots calculated for each sample. The soil from each sample was thoroughly mixed and 1 pint was processed for nematodes as described above.

The pinto beans were harvested at maturity on September 12 (109 days after planting). The middle 30 ft of the 2 middle rows of each plot were pulled, threshed, and yields of seeds at 0% moisture recorded. An additional 10 plants/plot were harvested and their number of pods and dry wt determined. Analysis of variance and LSD statistical tests were performed with the data. The technique of transforming the data by using the square root of the nematode counts plus 1 was used in the statistical analysis to reduce variation (11).

Pinto beans-1968.- Methods of plot design, sampling, nematode separation from soil and roots, yield data and statistical analysis were the same as in 1966. Nematode populations/g dry wt of roots were calculated. Plots were adjacent to the 1966 experimental area and contained approximately 89 *Pratylenchus* spp. and 15 *T. acutus*/pint of soil with no significant differences between plots. There was an uneven distribution of small numbers of *Xiphinema americanum* Cobb in the field. Application of nematicides was the same as in 1966 with the exception that liquids were applied through 2 chisels, one each 10 inches to left and right of center of the beds.

Treatments were: 1) Dasanit-10G, 7.5 lb. A/A; 2) Dasanit-10G, 15.0 lb. A/A; 3) Vorlex, 40 gal/A; 4) Vorlex, 20 gal/A; 5) D-D (1,3-dichloropropene, 1,2-dichloropropane and related chlorinated hydrocarbons), 40 gal/A; 6) D-D, 20 gal/A; and 7) untreated control. Dasanit-10G was applied May 2, and the liquid fumigants May 3, 1968. At the time of application, soil temperature was 16° C 8 inches deep.

'Idaho III' pinto beans were planted May 27 (25 days after treatment). Root and soil samples were taken on June 3 (7 days after seeding), July 2 (36 days after seeding), August 1 (66 days after seeding), and August 28 (93 days after seeding).

At maturity, October 11 (107 days after seeding), the pinto beans were harvested by pulling the center 20 ft of the 2 middle rows of each plot. They were then dried and later threshed to obtain yield.

Corn-1968.- Corn plots were located at the Kansas Agricultural Experiment Station, Garden City Branch. Plot design, techniques of taking samples, nematode separation from soil and roots, soil type and statistical analysis were the same as for pinto beans, 1968. Only the older corn roots were used to obtain nematode counts. There were approximately 104 *Pratylenchus* spp. and 28 *Xiphinema americanum*/pint of soil with no significant differences between plots. A very small number of a species of *Tylenchorhynchus* Cobb and a species of *Helicotylenchus* Steiner occurred erradically and were not considered a factor in this experiment.

Treatments and rates were: 1) Dasanit-10G, 7.5 lb. A/A; 2) Dasanit-10G, 15.0 lb. A/A; 3) Bay 68138-10G (Ethyl 4-(methylithio)-m-tolyl isopropylphosphoramidate), 5.0 lb. A/A; 4) Bay 68138-10G, 10.0 lb. A/A; 5) Di-Syston-10G (O,O-Diethyl S-[2-(ethylthio) ethyl] phosphorodithioate), 10.0 lb. A/A; 6) Di-Syston-10G, 20.0 lb. A/A; and 7) untreated control. Chemicals were spread evenly over the beds with a 3-ft Gandy lawn fertilizer applicator and rototilled 4 inches deep on May 2. Soil temperature 8 inches deep at the time of treatment was 16° C.

Corn ('Funk 711AA') was planted May 17 (15 days after treatment), but due to poor germination the plants were destroyed by undercutting and replanted on June 12 (41 days after treatment). Samples for nematode counts were taken at approximately 30 day intervals on June 3, July 2, August 1, August 28 and October 3.

The entire 50 ft of each of the 2 center rows of each plot was harvested on either October 31 or November 1. Yield was determined as the weight of the shelled corn at 0% moisture.

Results

Pinto beans-1966.- There were significant differences in the mean number of *Pratylenchus* spp. recovered/10 g fresh wt of pinto bean roots both sampling dates (Table 1). The population was significantly lower for the Dowfume MC-2 treatments than for all others. Root populations from Vorlex and Telone PBC treatments were significantly lower than those from the Vidden-D and the controls on both dates. Dasanit-10G resulted in a significantly lower population than recorded for control and Vidden-D the first sampling period, while in the second sampling period it was different from plots treated with Vidden-D but not from the control.

Populations of *Pratylenchus* spp./pint of soil from Dowfume MC-2, Vorlex and Telone PBC treatments were significantly lower than those for the control on both sampling dates. The Dasanit-10G treatment soil populations were significantly lower than the control on September 7, while no differences were found on July 27. Differences were found in the soil population between Vidden-D and the control on September 7 but no differences were detected on July 27.

All nematicides gave significantly greater yields than did the control, but no significant differences occurred between nematicides. No significant differences were found in the number of pods or total dry wt for 10 randomly selected pinto bean plants.

Table 1. The average number of *Pratylenchus* spp. recovered per 10 grams fresh weight of pinto bean roots, per pint of soil surrounding the pinto bean roots, and yield of the pinto beans after treatment with five nematicides in 1966.

Treatment and dosage	*Pratylenchus* spp./10 g of fresh roots		*Pratylenchus* spp./ pint of soil		Yield in lb./acre
	July 27	Sept. 7	July 27	Sept. 7	
Vidden-D 35-40 gal/A	9,775 a[1,2,3]	24,888 a	181 ab	393 b	1,030.3 a[4]
Dowfume MC-2 1 lb./100 ft^2	10 c	15 d	0 c	0 d	1,148.5 a
Vorlex 35-40 gal/A	2,997 b	13,513 c	57 bc	95 c	1,131.4 a
Dasanit-10G 17.7 lb. A/A	2,450 b	16,350 bc	81 ab	207 bc	1,133.7 a
Telone PBC 35-40 gal/A	3,783 b	13,163 c	40 bc	137 c	972.7 a
Control-untreated	10,919 a	21,688 ab	288 a	636 a	737.4 b

[1] Each number represents the average of four replications.

[2] Significant differences indicated were found by using square root of nematode counts plus one.

[3] Unlike letters indicate significant differences.

[4] LSD .05 = 227.8

Pinto bean-1968.- All treatments resulted in significantly fewer *Pratylenchus* spp./g dry wt of pinto bean roots than did the control on June 3 (Table 2). The lowest number of nematodes was found the first sampling (June 3). Significant differences were found between treatments on June 3 and August 28. The control had the highest nematode numbers/g dry wt of roots for the first 3 samplings, while D-D at 20 gal/A had a slightly larger number than the control on the last.

The average number of *Pratylenchus* spp. recovered/pint of soil remained low until near maturity when a sharp increase occurred in all treatments (Table 3). In the control there was a decrease in the number of *Pratylenchus* spp./pint of soil in mid-growing season.

All treatments except Dasanit-10G at 7.5 lb. A/A resulted in significantly fewer *Tylenchorhynchus acutus* when compared to the control on June 3 (Table 4). The pre-treatment sampling had significantly greater numbers of *T. acutus* than the first 2 samplings after treatment, but fewer than the last 2. No significant differences were found among the other genera of plant parasitic nematodes.

Yields (Table 2) resulting from treatment with Dasanit-10G at 7.5 lb. A/A, Vorlex at 40 gal/A and Vorlex at 20 gal/A were significantly higher than those from the control. No significant yield differences were detected between Dasanit-10G at 15 lb. A/A, D-D at 40 gal/A, D-D at 20 gal/A and the control.

Table 2. The average number of *Pratylenchus* spp. recovered per gram dry weight of pinto bean roots and the average yield of pinto beans after treatment with 3 nematicides, each at 2 rates, in 1968.

Treatment and dosage	*Pratylenchus* spp./g dry wt of roots				Bean yield in lb./acre
	June 3	July 2	Aug. 1	Aug. 28	
Dasanit-10G 7.5 lb. A/A	174 bc[1,2,3]	3,544 a	12,406 a	9,383 abc	1,170.5 a[4]
Dasanit-10G 15 lb. A/A	187 bc	3,432 a	13,590 a	3,950 d	811.6 bc
Vorlex 40 gal/A	158 c	914 a	6,036 a	8,094 bc	1,217.4 a
Vorlex 20 gal/A	327 bc	968 a	10,104 a	7,822 cd	1,045.5 ab
D-D 40 gal/A	306 bc	1,438 a	8,935 a	6,288 cd	836.8 bc
D-D 20 gal/A	448 b	1,377 a	8,240 a	14,331 a	751.8 c
Control-untreated	1088 a	4,562 a	15,201 a	12,521 ab	677.7 c

[1]Each number represents the average of 4 replications.

[2]Significant differences indicated were found by using square root of nematode counts plus one.

[3]Unlike letters indicate significant differences.

[4]LSD .05 = 289.0

Table 3. The average number of Pratylenchus spp. recovered per pint of soil about roots of pinto beans, 1968.

Treatment and dosage	Date of sampling				
	May 1[1]	June 3	July 2	Aug. 1	Aug. 28
Dasanit-10G 7.5 lb. A/A	62[2]	43	65	273	1,721
Dasanit-10G 15.0 lb. A/A	110	39	51	201	1,032
Vorlex 40 gal/A	125	12	17	71	1,814
Vorlex 20 gal/A	123	16	46	168	1,675
D-D 40 gal/A	91	22	20	47	1,778
D-D 20 gal/A	118	33	31	92	3,150
Control-untreated	97	45	16	181	2,832

[1] Population per pint of soil at time of treatment.

[2] Each number represents average of four replications.

Table 4. The average number of _Tylenchorhynchus acutus_ recovered per pint of soil surrounding the pinto bean roots after treatment with 3 nematicides, each at 2 rates, in 1968.

Treatment and dosage	_Tylenchorhynchus acutus_/pint of soil				
	May 1	June 3	July 2	Aug. 1	Aug. 28
Dasanit-10G 7.5 lb. A/A	9 a[1,2,3]	7.50 ab	8 a	22 ab	155 a
Dasanit-10G 15 lb. A/A	10 a	3.50 b	9 a	25 ab	95 a
Vorlex 40 gal/A	12 a	1.25 cd	1 a	9 b	59 a
Vorlex 20 gal/A	14 a	0.75 d	4 a	10 b	51 a
D-D 40 gal/A	18 a	0.25 e	2 a	22 ab	24 a
D-D 20 gal/A	12 a	4.75 bc	5 a	39 ab	97 a
Control-untreated	31 a	10.00 a	7 a	99 a	287 a

[1]Each number represents the average of 4 replications.

[2]Significant differences indicated were found by using square root of nematode counts plus one.

[3]Unlike letters indicate significant differences.

Corn-1968.- The smallest average population of *Pratylenchus* spp./g dry wt was detected from the June 3 sampling and the largest from the July 2 sampling (Table 5). Changes in populations were slight for the last 3 sampling periods. The Dasanit-10G treatments (7.5 and 15.0 lb. A/A) gave the most complete control of the *Pratylenchus* spp./g dry wt of roots on June 3. Bay 68138-10G at 10.0 lb. A/A also gave significant nematode control on this date. No nematode control could be detected by the remaining treatments at this time. In later samplings, no significant nematode control was detected for any of the treatments.

The average number of *Pratylenchus* spp./pint of soil on the control and Di-Syston-10G treatments increased the last 3 sampling periods (Table 6).

The Xiphinema americanumm population did not significantly change during the growing season (Table 7).

Differences in treatment yields were not significant. Bay-10G 68138 was phytotoxic at the rates used.

Table 5. The average number of Pratylenchus spp. recovered per gram dry weight of corn roots after treatment with 3 nematicides, each at 2 rates, and the corn yield in 1968.

Treatment and dosage	June 3[4]	Pratylenchus spp./g of dry roots July 2[4]	Aug. 1	Aug. 28	Oct. 3	Yield in bu./A
Dasanit-10G 7.5 lb. A/A	290 d[1,2,3]	2,671 a	2,053 a	2,534 a	2,227 a	99.8 a
Dasanit-10G 15.0 lb. A/A	159 d	607 a	597 a	681 a	1,515 a	94.5 a
Bay 68138-10G 5.0 lb. A/A	780 bc	5,780 a	1,484 a	1,206 a	1,784 a	75.3 a
Bay 68138-10G 10.0 lb. A/A	459 cd	1,656 a	577 a	404 a	900 a	82.4 a
Disyston-10G 10.0 lb. A/A	1,946 a	3,243 a	1,369 a	1,423 a	2,759 a	92.9 a
Disyston-10G 20.0 lb. A/A	779 bc	6,827 a	2,619 a	2,665 a	3,397 a	96.5 a
Control-untreated	1,026 b	5,908 a	3,881 a	3,128 a	3,954 a	89.0 a

[1]Each number represents average of 4 replications.

[2]Significant differences indicated were found by using square root of nematode counts plus one.

[3]Unlike letters indicate significant differences.

[4]Because of replanting, count data was from plants of approximately the same age.

Table 6. The average number of Pratylenchus spp. recovered per pint of soil about roots of corn, 1968.

Treatment and dosage	Date of sampling May 1[1]	June 3	July 2	Aug. 1	Aug. 28	Oct. 3
Dasanit-10G 7.5 lb. A/A	87[2]	14	19	30	105	145
Dasanit-10G 15.0 lb. A/A	77	15	9	73	50	73
Bay 68138-10G 5.0 lb. A/A	142	21	8	92	84	113
Bay 68138-10G 10.0 lb. A/A	130	54	6	18	28	38
Di-Syston-10G 10.0 lb. A/A	49	65	16	48	184	252
Di-Syston-10G 20.0 lb. A/A	70	70	26	137	188	169
Control-untreated	65	61	35	112	269	168

[1]Population per pint of soil at time of treatment.

[2]Each number represents average of four replications.

Table 7. The average number of *Xiphinema americanum* recovered per pint of soil about roots of corn, 1968.

Treatment and dosage	Date of sampling					
	May 1[1]	June 3	July 2	Aug. 1	Aug. 28	Oct. 3
Dasanit-10G 7.5 lb. A/A	19[2]	12	8	47	24	112
Dasanit-10G 15.0 lb. A/A	35	4	5	43	57	48
Bay 68138-10G 5.0 lb. A/A	49	16	1	48	67	57
Bay 68138-10G 10.0 lb. A/A	32	35	4	32	86	86
Di-Syston-10G 10.0 lb. A/A	28	19	5	38	116	46
Di-Syston-10G 20.0 lb. A/A	25	15	10	47	72	41
Control-untreated	8	19	10	50	78	114

[1]Population per pint of soil at time of treatment.

[2]Each number represents average of four replications.

Discussion

Dowfume MC-2 (9), Vorlex and propargyl bromide containing fumigants (9) and 1-3 dichloropropene, 1-2 dichloropropane mixture (1) have been reported to have fungicidal properties when used as soil fumigants. Since significant yield differences were not detected between these chemicals and the strictly nematicide Dasanit in 1966 it was assumed that soil pathogens other than nematodes were not a factor in this experiment. As expected, Dowfume MC-2 treatment gave excellent control of Pratylenchus spp. for the entire 1966 growing season. However, this treatment did not significantly increase yields more than Vidden-D.

More sampling periods for the 1968 field experiments gave a more complete view of the Pratylenchus spp. control on pinto beans than did the 2 sampling periods of 1966. The first samples were taken 7 days after planting. There was a correlation between the resulting yields and the number of Pratylenchus spp./g of dry wt of roots at this time for the 3 significantly different population levels. Control, with the highest nematode population, had the lowest yield. D-D treatment at 20 gal/A had a lower population than the control and a higher yield. Vorlex treatment at 40 gal/A had the lowest population from which the highest yields were obtained.

In 1968, the 15 lb./A rate of Dasanit-10G seemed to be phytotoxic because of a lower yield than that obtained for the 7.5 lb./A rate. The 15 lb./A rate showed a significant reduction of the nematode population through Aug. 28, which indicated residual nematicidal effects.

The number of Pratylenchus spp. recovered by the Perry method of separating nematodes from soil in the pinto bean-1968 experiment was 89. This number of nematodes was able to cause significant damage.

In both 1966 and 1968, the final Pratylenchus spp. populations/g dry wt of roots were higher in some treatments than in control even though yields for the treatments were significantly higher. According to Steiner (16) this phenomenon is common. He postulated that fumigation treatment controlled the pest well enough to permit the young crop plants to establish a good root system. A residual population of the nematodes was then able to rebuild a larger population on these roots than on the untreated plant roots toward the end of the season.

It has been reported that the population of Pratylenchus spp. drops in the middle of the growing season and then builds up rapidly at the end (5, 6, 7). Chang and Rhode (2) reported that the necrotic effect produced by P. penetrans repelled rather than attracted individual nematodes and Young (18) reported that meadow nematodes (Pratylenchus spp.) left decaying roots. Taking this into account, a larger soil population at or near the end of the growing season would be expected in those treatments with the earliest infection of relatively large numbers of nematodes. This was the case in the 1966 and 1968 pinto bean and the 1968 corn experiments.

Because the corn plots had to be replanted, the experiment was not a good test of the nematicides potential to increase yields by controlling Pratylenchus spp. However, some aspects of the effects of the different nematicides on the nematode population dynamics were noted.

Pratylenchus spp. populations/g dry wt of roots in corn were not as great as they were in pinto beans. This means that the population density in pinto bean roots was greater, but the total population may be lower because pinto bean root systems do not attain the volume that corn roots do. A higher population density would indicate a greater degree of damage. Yield results for pinto beans and corn suggested this was the case for these experiments.

Numbers of Pratylenchus spp./g dry wt of roots can be misleading. For corn, the primary root would make up the bulk of the sample 7 days after planting. Primary roots may persist for the life of the plant, but frequently decay and are of little importance after the establishment of the adventitious root system. Seminal roots next develop above the scutellar node and later adventitious roots develop in the basal intercalary meristems of higher internodes (10). Miller et al. (12) and Edmunds et al. (4) reported that P. penetrans populations infecting corn had 2 peaks in numbers/unit of root during the growing season which is contrary to the results of this experiment. The above authors used a random sample for all types of roots. If at any sampling period a large portion of the sample consisted of relatively new adventitious roots, the count/unit wt would be low, but the total population would not be lower than for any previous sampling. Pinto bean root systems consist of a main tap root with numerous laterals. If the young tap root becomes heavily infected early and is damaged by Pratylenchus spp., it would have a greater ultimate effect on the plant than an early infection of corn roots.

Summary

Vidden-D, Vorlex and Telone PBC at 35-40 gal/A, Dowfume MC-2 at 1 lb./100 ft^2 and Dasanit at 17.7 lb. A/A all gave significantly greater pinto bean yields in 1966 than did the untreated control. No significant yield differences occurred between nematicides.

Dasanit-10G at 7.5 lb. A/A, Vorlex at 40 gal/A and Vorlex at 20 gal/A soil treatments gave significantly higher pinto bean yields in 1968 than those in the untreated controls. No significant yield differences were detected between treatments with Dasanit-10G at 15 lb. A/A, D-D at 40 gal/A, and D-D at 20 gal/A and the untreated control, although all 3 treatments did result in higher yields. One-third less of the liquid fumigants were used in the 1968 experiments. All treatments had significantly fewer *Pratylenchus* spp./g dry wt of pinto bean roots than did the control 7 days after seeding. The untreated control had the highest nematode numbers/g dry wt of roots on the first 3 sampling dates (7, 36, and 66 days after seeding).

Fewer *Pratylenchus* spp./g dry wt of corn roots were present in the Dasanit-10G, Bay 68138-10G and Di-Syston-10G at 20 lb. A/A treatments than in the untreated control 17 days after seeding. No further comparisons could be made because the experiment had to be replanted. Bay 68138-10G was phytotoxic at 5 and 10 lb. A/A. Differences in treatment yields were not significant, but all treatments except Bay 68138-10G had higher yields than the untreated controls.

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GENERAL CONCLUSIONS

Pratylenchus neglectus, *P. scribneri*, *P. hexincisus* and a species tentatively identified as *P. alleni* were all present in western Kansas soil. A high percentage of the 4 species had ovaries with double row of oocytes throughout their length. This represents a departure from published descriptions. The significance of double rowed oocytes in either speciation or reproduction is not known.

When *P. neglectus*, *P. scribneri*, and *P. hexincisus* were tested for population response on pinto beans, corn, sorghum and wheat, it was evident that both pinto beans and corn were good host for all 3 species. Sorghum was a fair host for the 3 species. Wheat was a good host only for *P. neglectus*. Interspecific competition between *P. neglectus* and 1 or more of the other species was indicated when there was a decrease in the number of *Pratylenchus* spp./g dry wt of root population when wheat followed pinto beans, but an increase when pinto beans followed wheat and pinto beans and when wheat followed wheat. Because of the mixed population of *Pratylenchus* spp. in the soils of western Kansas, no rotation sequences could be recommended with confidence of increasing yields of any of the hosts studied. The pathogenic potential of each of the 3 *Pratylenchus* spp. studied will need to be determined on each host before specific recommendations can be made.

Control of Pratylenchus spp. increased yields of pinto beans. Early control is the most important as populations later in the season appear to have little effect on the yield.

The 1966 nematicide rates were too high for economic control of *Pratylenchus* spp. on pinto beans. Even with a one-third reduction in the fumigants in 1968, the value of the increased yield was not great enough to justify their use on pinto beans or most other field crops.

New uninfected adventitious corn roots dilute the number of *Pratylenchus* spp./unit of root. This makes the comparison of *Pratylenchus* spp./unit of corn roots from different sampling dates difficult.

Vita

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He entered Kansas State University in the fall of 1958 with an athletic scholarship for football. He obtained his B. S. in biological science, secondary education in the spring of 1963.

He then taught science in the junior high public school at Spring Hill, Kansas, for three years. In 1966 he accepted a Graduate Research Assistantship for study in nematology in the Department of Plant Pathology, Kansas State University. During his studies he was initiated into Gamma Sigma Delta.

He was married on June 5, 1965, to Carolyn Louise Hunt at the First United Presbyterian Church, Olathe, Kansas.

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MORPHOLOGY, BIOLOGY, AND CONTROL OF <u>PRATYLENCHUS</u> SPP. ON FIELD CROPS OF WESTERN KANSAS

by

ROBERT THOMAS ROBBINS

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Relatively large populations of species of *Pratylenchus* Filipjev were recovered from soil and root samples from various crop plants in western Kansas. These nematodes have been reported to cause economic losses to field crops, but virtually no information was available relative to the crops grown and *Pratylenchus* spp. present in western Kansas.

The objectives of this study were 1) to identify the *Pratylenchus* spp. in soil on the Kansas Agricultural Experiment Station, Garden City Branch, and to compare their morphometrics to original descriptions, 2) to determine the suitability of pinto beans, corn, sorghum and wheat as hosts and 3) to evaluate several nematicides for control of *Pratylenchus* spp. on pinto beans and corn grown on irrigated land in western Kansas.

Pratylenchus neglectus Rensch, *P. scribneri* Steiner, *P. hexincisus* Taylor and Jenkins and a species tentatively identified as *P. alleni* Ferris were identified from field crops in western Kansas. One morphological variance from published descriptions found for all 4 species was that a high percentage of the Kansas specimens had ovaries with 2 rows of oocytes throughout their length; *P. neglectus* (15%), *P. scribneri* (50%), *P. hexincisus* (70%) and *P. alleni* (75%). Otherwise *P. neglectus* and *P. hexincisus* agreed very closely with published descriptions. The stylet of *P. scribneri* averaged 1 μ shorter than described. In addition to ovaries with 2 rows of oocytes, the species tentatively identified as *P. alleni* varied from the original description in that they were longer (490 vs 380 μ), had a larger "b" ratio (7.2 vs. 5.4), a larger "c" ratio (23.9 vs. 20.0) and had a distinctively blunter tail.

Differences were found at host maturity in the mean number of a mixed population of P. scribneri, P. hexincisus, and P. neglectus/g dry wt of pinto bean, corn, sorshum and wheat roots. Larger numbers of nematodes generally were recovered/g dry wt from the corn and pinto bean roots than from the wheat and sorghum roots. The average population of Pratylenchus spp./g dry wt of roots increased in all cases in pinto beans when they were the second crop and decreased in all cases when sorghum was the second crop. A significant reduction was found when wheat followed pinto beans or corn, while there was a significant increase when wheat followed wheat.

Because of the mixed population of Pratylenchus spp. in the soils at the Kansas Agricultural Experiment Station, Garden City Branch, no rotational sequences can be recommended. Pinto beans will apparently have a large population/wt unit of roots regardless of which of the 4 crops it follows. However, the pathogénic potential of the individual 3 species of Pratylenchus studied are not known. Pratylenchus neglectus is the only species of the 3 studied that will reproduce significantly on wheat. When wheat follows wheat, the population reaches numbers which suggests that economic losses of wheat would be sustained under a continuous cropping sequence, but no data attributing yield reductions to P. neglectus has been presented.

In 1966, applications of Vidden-D, Vorlex, and Telone PBC at 35-40 gal/A, Dowfume MC-2 at 1 lb./100 ft^2, and Dasanit-10G at 17.7 lb. A/A resulted in significantly greater pinto bean yields than the untreated controls when 3-ft beds were treated on an overall basis. No significant yield differences occurred between nematicides.

Dasanit-10G at 7.5 lb. A/A applied to a 3-ft bed and Vorlex at 40 and 20 gal/A on an overall basis, but applied through a single chisel 2 inches off center of the rows, resulted in significantly higher pinto bean yields in 1968 than the untreated control. Dasanit-10G at 15.0 lb. A/A applied to a 3-ft bed and D-D at 40 and 20 gal/A on an overall basis, applied as Vorlex above, did not result in significantly greater yields than the untreated controls. Although only 3 treatments resulted in significantly greater yields, all treatments had significantly fewer Pratylenchus spp./g dry wt of pinto bean roots than did the control 7 days after seeding. The untreated control had the highest nematode populations/g dry wt of roots for the first 3 sampling periods (7, 36, 66 days after seeding).

Fewer Pratylenchus spp./g dry wt of corn roots were present in plots treated with Dasanit-10G at 15 and 7.5 lb. A/A, Bay 68138-10G at 10 and 5 lb. A/A and Di-Syston-10G at 20 lb. A/A than in the untreated control 17 days after seeding. No further nematicidal comparisons could be made because the experiment had to be replanted. Bay 68138-10G was phytotoxic at 5 and 10 lb. A/A. Differences in treatment yields were not significant, but all treatments except Bay 68138-10G produced higher hields than did the untreated control.