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Severity of Corn Seedling Disease in Iowa Soils

By A. L. HOOKER

Poor seedling stands and root injury often occur when corn is planted in cold soils. Corn stands are reduced largely as a consequence of soil inhabiting fungi invading the germinating kernel resulting in the death of the young seedling before emergence. This group of fungi, largely *Pythium* species, may also incite a rotting of the seedling root system.

This investigation concerns itself with measuring the severity of this corn seedling disease under certain greenhouse conditions in various Iowa soils of different types and cropping sequences.

MATERIALS AND METHODS

Sixty-six soil samples (Table 1) were obtained in October and November, 1952 from Howard, Hancock, and Story counties of Iowa. These represented various soil types and soils from each crop in four rotations in Howard county and from six rotations in Story county. The severity of disease was measured on seedling corn in these soils at 16°C. and at 10°C. At these temperatures, corn is very susceptible to soil fungi. A susceptible experimental corn hybrid, X9180, was used in both series.

At 16°C. three replications of 15 kernels each were planted in the various soil samples in previously washed and sterilized four inch pots and placed on a greenhouse bench at the desired temperature. Six replications of soil steamed for two hours at 15 pounds pressure were used as checks.

At 10°C. four replications of 10 kernels each were planted in the various soil samples in previously washed and sterilized three inch pots, incubated for seven days at 10°C. for disease development, and then moved to a greenhouse bench at 24°C. Sterilized quartz sand was used as a check.

The moisture levels were maintained at approximately 60 per cent of water holding capacity in each series. A randomized complete block experimental design was employed for both temperature tests. Notes were taken at the third leaf stage of the checks in each case and a disease index established for each replicate unit

by the summation of the following assigned arithmetical values to each seedling:

- 1—Seed decay or killing of plant, 2—most of the roots destroyed,
- 3—most of root tips destroyed, severe lesions on remaining portions of roots, 4—distinct lesions on root tips and remaining portions of roots,
- 5—small necrotic lesions on root tips, and 6—no infection.

EXPERIMENTAL RESULTS

A high level of seed decay and root rotting of seedling corn occurred in all soil samples at both temperatures as indicated in Table 1. Differences existing among the soil samples at both 10°C. (mean square of 146.6 for 65 degrees of freedom) and 16°C. (mean square

Table 1

Relative severity of corn seedling disease at 10°C. and 16°C. in various Iowa soils when the disease indices are compared as per cent of the sterilized checks.

Rotation and crop ^a	Treatment ^b	Soil Type ^c	10°C.	16°C.
(Story county)				
C	none	N	30.6	25.7
C	ML	N	40.9	26.1
CO	none	N	41.3	33.1
CO	ML	N	38.3	34.3
CO	none	N	46.4	46.5
CO	ML	N	41.7	30.6
COM	none	N	42.6	33.1
COM	ML	W	40.9	37.6
COM	none	N	28.9	32.7
COM	ML	N	28.9	38.4
COM	none	N	37.9	46.5
COM	ML	N	48.1	39.6
CCOM	none	N	37.4	36.3
CCOM	ML	C1	41.3	31.8
CCOM	none	C1	43.4	45.3
CCOM	ML	C1	40.4	46.5
CCOM	none	N	37.9	42.0
CCOM	ML	N	32.3	19.6
CCOM	none	N	45.1	33.9
CCOM	ML	N	46.8	34.7
CSOM	none	N	40.0	37.1
CSOM	ML	N	50.2	38.4
CSOM	none	N	37.4	33.9
CSOM	ML	C1	58.3	49.0
CSOM	none	N	30.6	33.1
CSOM	ML	N	32.3	29.4
CSOM	none	N	46.0	36.3
CSOM	ML	N	51.9	40.4
CCOMM	none	C1	37.4	39.2
CCOMM	none	C1	38.7	42.0
CCOMM	none	W	50.2	53.1

Table 1 (Continued)

Relative severity of corn seedling disease at 10°C. and 16°C. in various Iowa soils when the disease indices are compared as per cent of the sterilized checks.

Rotation and crop ^a	Treatment ^b	Soil Type ^c	10°C.	16°C.
CCOMM	none	Wa	48.5	59.2
CCOMM	none	N	40.0	37.1
CCOMM	none	N	50.6	35.5
CCOMM	none	N	36.6	40.0
CCOMM	none	W	35.7	33.5
CCOMM	none	W	34.5	37.6
CCOMM	none	W	49.8	42.9
CCOM	none	Cl	51.9	46.4
CCOM	none	W	39.1	37.6
CCOM	none	Wa	46.8	52.2
CCOM	none	H	39.1	56.3
CCOM	none	N	45.1	33.9
CCOM	none	Cl	43.4	45.3
CCOM	none	W	46.0	34.7
CCOM	none	N	48.6	40.4
CCOM	none	Wa	49.4	54.3
? M	.....	Cl	40.4	31.0
? C	.....	Cl	43.0	33.5
? O	.....	Cl	23.0	30.6
(Howard county)				
CO	none	Ca	45.5	30.2
CO	none	Ca	42.6	33.9
COM	none	Ca	48.5	36.7
COM	PK	Ca	43.0	38.4
COM	PKM	Ca	47.2	43.3
COM	none	Ca	42.1	20.0
COM	none	Ca	55.3	40.8
CCOM	none	Ca	40.9	38.4
CCOM	none	Ca	40.4	26.5
CCOM	none	Ca	42.6	34.7
CCOM	none	Ca	65.5	40.0
COMM	none	Ca	45.1	31.8
COMM	none	Ca	53.6	32.2
COMM	none	Ca	51.9	32.7
COMM	none	Ca	55.7	36.7
(Hancock county)				
? F	.....	W	43.8	33.5
? C	.....	W	49.4	35.1
? S	.....	W	.....	34.3

^aRotation and Crop; C = corn, O = oats, M = meadow, S = soybeans, and F = Flax. Italicized = crop grown in 1952.

^bFertilizer treatment; ML = manure and lime, PK = phosphorus and potassium, PKM = phosphorus, potassium and manure.

^cPredominant soil type; N = Nicollet, W = Webster, Cl = Clarion, Wa = Wabash, H = Harpster, and Ca = Carrington.

of 342.3 for 67 degrees of freedom) were statistically highly significant. The disease indices from soil tests at 10°C. and 16°C. were correlated ($r = .772$) at the one per cent level of statistical significance.

In the Howard county soils the average disease severity for rotations was in the descending order of corn-oats, corn-corn-oats-meadow, corn-oats-meadow, and corn-oats-meadow-meadow. There was progressively less injury as the proportion of meadow in the rotation increased and the proportion of corn and oats decreased. In the Story county rotations the same general condition prevailed as to rotation averages except that the corn-oats rotation samples produced less injury than the corn-oats-meadow and corn-corn-oats-meadow rotations. Continuous corn soils produced the most injury while corn-corn-oats-meadow-meadow soils produced the least. In soil samples from plots in these rotations which were in corn in 1952, the most injury occurred in continuous corn with less injury occurring in the corn-oats, corn-corn-oats-meadow, corn-oats-meadow and corn-corn-oats-meadow-meadow rotations respectively.

When crops within the various rotations are compared the highest level of disease was generally found in soils previously cropped to oats, somewhat less in corn soils, with the smallest amount in soils cropped to meadow or soybeans. Slightly less injury was found in soils from second year corn than from first year corn. If comparisons are made among crops over all rotations the same ranking prevails.

In the Story county rotation soils, parallel samples were taken from plots in high fertility receiving manure and lime and from plots receiving no fertilizer treatments. The disease severity in high fertility soils over all rotations was only slightly less than in the low fertility plots.

Within two rotations it was possible to select soil samples of different soil types. Some differences existed with more injury found in Webster and Nicollet soil types than in Harpster, Clarion and Wabash soil types.

DISCUSSION AND SUMMARY

The severity of corn seedling disease varied in soils of different types and cropping sequences. In general meadow crops reduced the severity of seed decay and root rotting of seedling corn in cold soils while oat and corn crops accentuated such injury with oats producing the greatest amount. This was true when viewing the rotation as a unit, as soils grown to corn in each rotation, as soils grown to the specific crops within each rotation, or as soils grown

to the specific crops over all rotations. Only a few soil samples were tested from plots grown to soybeans in 1952 but in these soils the disease severity was somewhat similar to the average injury in meadow cropped soils. In limited tests, differences in disease severity were found among soil types. Little effect of soil fertility on corn seedling disease was measured. On mature corn plants more root rotting is generally found in low rather than high fertility soils. The data indicate that soil fertility may exert its effect upon the host rather than upon the pathogenic flora of the soil.

The variation in corn seedling disease in these soils conceivably could be due to differences in content of pathogenic fungi, both in species and in concentration of the organisms. Variation in species content is the more plausible. Antagonistic organisms or other edaphic factors not well elucidated may also be functioning.

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BOTANY AND PLANT PATHOLOGY SECTION

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