

1953

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Recommended Citation

Hooker, A. L. (1953) "Relative Pathogenicity of Pythium Species Attacking Seedling Com," *Proceedings of the Iowa Academy of Science*, 60(1), 163-166.

Available at: <https://scholarworks.uni.edu/pias/vol60/iss1/22>

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Relative Pathogenicity of Pythium Species Attacking Seedling Corn

By A. L. HOOKER

Several species of *Pythium* have been isolated and identified as inciting a root rot and blight of seedling corn. In view of the over-all importance of this group of fungi, a comparative study of the relative pathogenicity of a selected number of *Pythium* species is justified.

MATERIALS AND METHODS

Nine species of *Pythium* (*Pythium graminicolum* Subr., *P. debaryanum* Hesse, *P. irregulare* Buisman, *P. arrhenomanes* Drechs., *P. rostratum* Butler, *P. aphanidermatum* (Edson) Fitz., *P. splendens* Braun, *P. acanthicum*¹ Drechs., and *P. paroecandrum*¹ Drechs.) and two strains of corn (X9180 and X5171²) were selected for this study.

Five methods of evaluating the pathogenicity of each species with each strain of corn were employed. They were as follows:

1. Two day old fungus cultures on potato dextrose agar were crushed and uniformly mixed with quartz sand. Seed was planted between one-half inch layers of this mixture over soil in four inch pots. Twelve Petri dish cultures were used for the required 18 pots. Pots were incubated at 10°C. for seven days and then moved to a greenhouse bench at approximately 24°C.
2. Same as above incubated at 16°C. for seven days, then at 24°C.
3. Same as above but at 24°C. continuously.
4. Fungus established in freshly steamed soil (one part peat: one part sand) for two days before planting seed. Pots placed on greenhouse bench at about 16°C.
5. Same as above but at about 24°C.

Pots, sand, and soil were all steamed for two hours at 15 pounds pressure before inoculation with the cultures. Check plantings employing sterile plates of potato dextrose agar were made in each method. Three replications of 15 kernels each were employed. Moisture contents were maintained at approximately 60 per cent of water holding capacity.

Notes were taken at the third leaf stage of the check plantings.

¹Tentatively identified.

²Susceptible and resistant experimental hybrids respectively, courtesy S. F. Goodsell, Pioneer Hi-Bred Corn Company, Johnston, Iowa.

Journal Paper No. 2297 of the Iowa Agricultural Experiment Station, Ames, Iowa. Project No. 1140.

Table 1

Relative disease indices as per cent of the uninoculated checks of nine species of *Pythium* for two strains of corn and five methods of evaluation.

	X9180 (Susceptible)						X5171 (Resistant)					
	Methods						Methods					
	1	2	3	4	5	Ave.	1	2	3	4	5	Ave.
<i>P. graminicolum</i>	18.4	17.7	31.3	37.0	42.7	29.4	24.1	33.3	41.1	41.5	40.0	36.0
<i>P. debaryanum</i>	19.2	17.7	32.2	17.0	20.4	21.5	44.1	54.8	78.5	24.4	38.1	48.0
<i>P. paroecandrum</i>	18.4	21.9	37.0	19.2	30.8	25.5	34.8	53.0	48.9	36.7	51.5	45.0
<i>P. irregulare</i>	18.4	24.9	37.7	20.4	33.8	27.0	36.7	51.5	51.5	33.7	45.6	43.8
<i>P. splendens</i>	24.5	31.7	38.5	17.0	25.8	27.5	35.2	58.9	64.1	30.7	58.1	49.4
<i>P. aphanidermatum</i>	31.4	26.4	36.6	24.2	27.7	29.3	29.6	67.0	65.2	34.8	64.1	52.1
<i>P. arrhenomanes</i>	18.8	25.3	44.2	37.7	53.5	35.9	42.2	44.8	49.3	67.8	51.5	51.1
<i>P. rostratum</i>	49.4	46.8	82.3	61.5	78.1	63.6	98.1	74.8	98.1	80.7	100.0	90.3
<i>P. acanthicum</i>	100.0	99.2	84.5	69.1	87.7	88.1	100.0	100.0	100.0	99.6	100.0	99.9
Average	32.2	34.6	47.3	33.7	44.5	49.4	59.8	66.3	50.0	61.0

Table 2

Summary of analyses of variance of data pertaining to the relative pathogenicity of nine species of *Pythium* involving two strains of corn and five methods of evaluation.

Source of variation	df	MS	F
Cultures	9	16,324.85	475.25**
Strains	1	20,484.80	596.36**
Methods	4	1,941.01	56.51**
Cultures X strains	9	402.34	11.71**
Cultures X methods	36	268.04	7.80**
Strains X methods	4	111.86	3.26*
Cultures X strains X methods	36	154.66	4.50**
Cultures within method 1.	9	4,395.88	89.91**
Strains within method 1.	1	4,001.66	81.85**
Cultures X strains within method 1.	9	268.70	5.50**
Cultures within method 2.	9	3,358.23	86.06**
Strains within method 2.	1	6,657.07	170.61**
Cultures X strains within method 2.	9	216.33	5.54**
Cultures within method 3.	9	2,640.89	280.05**
Strains within method 3.	1	3,985.35	422.62**
Cultures X strains within method 3.	9	200.24	21.23**
Cultures within method 4.	9	3,801.71	175.19**
Strains within method 4.	1	2,898.15	133.56**
Cultures X strains within method 4.	9	122.22	5.63**
Cultures within method 5.	9	3,200.30	65.33**
Strains within method 5.	1	3,390.01	69.20**
Cultures X strains within method 5.	9	213.50	4.36**

*Significant at 5% level.

**Significant at 1% level.

Disease indices were obtained by the summation of the following assigned arithmetical values to each seedling for each replicate unit: 1-Seed decay or killing of plant; 2-most of 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 AND DISCUSSION

Relatively large differences exist in pathogenicity among the nine species of *Pythium* when the disease indices are compared as per cent of the check for each strain of corn and method of evaluation (Table 1). Statistically the differences were highly significant (Table 2.) All species except *P. rostratum* and *P. acanthicum* were highly pathogenic. On the average most species of *Pythium* were most injurious at 10°C. and least at 24°C. Seed decay was the common form of injury at 10°C. while at 24°C. less seed decay occurred and root rotting was prevalent. The highly significant

culture X strain interaction may be due in part to the fact that with X5171 (resistant) *P. graminicolum* was more pathogenic than *P. debaryanum*, while with X9180 (susceptible) the reverse was true. Hybrid X5171 expressed somewhat greater resistance to some species than to others. *P. irregulare*, and *P. splendens* seemed to establish themselves readily in soil and were more injurious in evaluation methods 4 and 5 than in methods 1, 2, and 3; while several other species were more injurious in the mycelium sand mix methods of evaluation than in soil.

Within each method of evaluation, the pathogenic differences among species were always highly significant (Table 2). The culture X strain interactions within each method of evaluation were significant at the one per cent level. An inspection of Table 1 reveals that the ranking of relative pathogenicity of the species with X9180 differs slightly from X5171. However these differences are small in comparison to the pathogenic differences among species as indicated by a comparison of their respective mean square values (Table 2).

P. debaryanum and *P. splendens* produced a high percentage of seed decay while *P. graminicolum*, *P. paroecandrum*, and *P. arrhenomanes* produced their greatest injury through a rotting of the seedling roots.

SUMMARY

The relative pathogenicity of nine species of *Pythium* was measured with two strains of corn and five methods of evaluation involving three temperatures.

1. Large differences existed among the nine *Pythium* species in pathogenic capabilities.
2. Most species were more injurious to seedling corn at low temperatures than at the high temperatures.
3. At 10°C. seed decay was prevalent while at 24°C. more of the injury was in the form of root rotting.
4. Highly significant fungus culture X corn strain and fungus culture X method of evaluation interactions were measured.
5. Seed decay was common with *P. debaryanum* and *P. splendens* while root rotting was the common form of injury produced by *P. graminicolum*, *P. paroecandrum*, and *P. arrhenomanes*.

Appreciation is given to the Iowa State College Seed Laboratory for the use of their 10°C. temperature chambers.

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