PYTHIUM ROOT ROT SEVERITY IN WHEAT AND CORN AT DIFFERENT TEMPERATURES

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In greenhouse assessments of Pythium isolates for virulence to wheat (*Triticum aestivum* L., cv. Selkirk) and corn (*Zea mays* L, inbred M14) in potted, steamed soil a difference was noted between tests conducted in winter and those conducted in summer. Isolates generally were more virulent on wheat tested in summer than in winter while the reverse was true on corn. An example of

Figure 1. Wheat and corn seedlings grown mid-summer in the greenhouse at high and low temperatures in steamed soil non-infested and infested with *Pythium arrhenomanes:* paired pots on left, wheat, those on right, corn; within paired pots, non-infested soil on left, infested soil on right; seedlings in top row at high temperature (18-37 C), those in bottom row at low temperature (18-24 C).

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this difference is shown in Fig. 1 in which a set of pots with *P. arrhenomanes*-infested steamed soil was planted to wheat and corn and held from mid-July to early August 1966, in a closed, cooled greenhouse room whose side and apical vents respectively, similar pots was held over the same time span in an open, non-cooled greenhouse room whose side and apical vents respectively, were manually and thermostatically operated for outdoor ambient coolness. The glass roof and sides of both rooms were coated with a lime:wheat-flour mixture to reduce incoming solar heat. Soil temperatures in the cooled room fluctuated between 20 and 23° C; those in the vented room fluctuated from 18 C at night to 30 C by mid-morning, late afternoon, and evening, with mid-day highs of 37 C.

Another example of this difference is shown in Fig. 2. In this test, wheat and corn grew in steamed soil infested with four Pythium isolates[2] (one each of *P. arrhenomanes*, *P. debaryanum*, *P. graminicola*, and *P. ultimum*) from late December to early January (1966-1967) within a thermostatically-controlled, steam-heated

Figure 2. Wheat and corn seedlings grown in mid-winter in the greenhouse at 18-22 C in steamed soil non-infested (CK) and infested with *Pythium ultimum* (75), *P. debaryanum* (108), *P. graminicola* (134), and *P. arrhenomanes* (142). Top row of seedlings shows wheat; bottom row shows corn.

[2]Personally identified as to morphology and cultural growth rate, and for pathogenicity to alfalfa, (**Medicago sativa** L., cv, Ranger), corn, and wheat seedlings.

greenhouse room at 18-22 C. In both examples the soil used was a local black loam:sand mixture (2:1) that had been moistautoclaved 3 h in cotton sacks at 120 C along with 12.5 cm wide clay pots into which the soil was transferred on cooling. In the transfer, 8-10 carrot agar squares (1 cm^2), plain or supporting a growing Pythium colony in Petri plates, were placed within each pot 2 cm below seed level. Seed used (10 corn or 15 wheat seeds/pot) was soaked beforehand 7 min in a 1:10,000 Hg solution of Ceresan L (2.89% methyl mercury 2, 3 hydroxypropyl mercaplide, 0.62% methyl mercury acetate 96.49% inert material), rinsed in flowing tap water, and air dried.

Because both examples recalled to mind a previously reported (Dickson, 1925) temperature-related difference between wheat and corn in disease severity from *Gibberella saubinetii*, a further test of the difference with the same four Pythium isolates was made in 2 trials, previously briefly reported (Semeniuk, 1968), using a set of 6 water-circulating tanks for soil temperature control. Soil containers used were 2.9 L cylindrical metal cans (15 cm wide x 17.5 cm deep) fitted inside with polyethylene bags into which autoclaved soil, such as that used in the above, was added. As in the above, inoculum of these pathogens consisted of plain carrot agar or Pythium-colonized carrot agar squares positioned in each can at 3 levels below the seed: 2, 4, and 8 cm, with 6 agar squares at each level. Each can received 10 treated corn seeds or 20 treated wheat seeds (treated as in the above) and covered with 3 cm of topsoil. Cans were weighed and watered by weight to make soil moisture near 90% of field capacity after which they were held covered under a polyethylene sheet in the laboratory at 20 C. When wheat plumules began to emerge within 5 da, cans were immersed in tank water to within 3 cm of their tops, after which the soil in each can was watered to initial weight each day at the 3 highest temperatures and every second day at the 3 lowest temperatures. Three wk later seedlings from each can were washed free of soil, scored for root rot severity (Fig. 3A), measured for average seedling length (Fig. 3B), and weighed free of surface moisture (Fig. 3C).

Root rot severity scores were measured on a scale of 1-5:0 = no root loss, roots white; 0.5 = no root loss, ¼ of root mass light brown; 1 = no root loss, ½ of root mass light brown; 2= 10% root loss, most root mass brown; 3 = 11% − 35% root loss, most roots brown; 4 = 36 − 75% root loss, all roots brown; 5 = 76% − 95% root loss, all roots brown. Seedling number/can over all treatments in each of the two trials respectively averaged 17.0±0.6 and 16.7±0.9 for wheat and 7.5 ± 0.6 and 8.5 ± 0.4 for corn. Similarly, seedling numbers between duplicate cans respectively differed by 1.7 ± 1.5 and 2.1 ± 0.4 for wheat and 1.7 ± 1.6 and 1.0 ± 0, 3 for corn; seedling

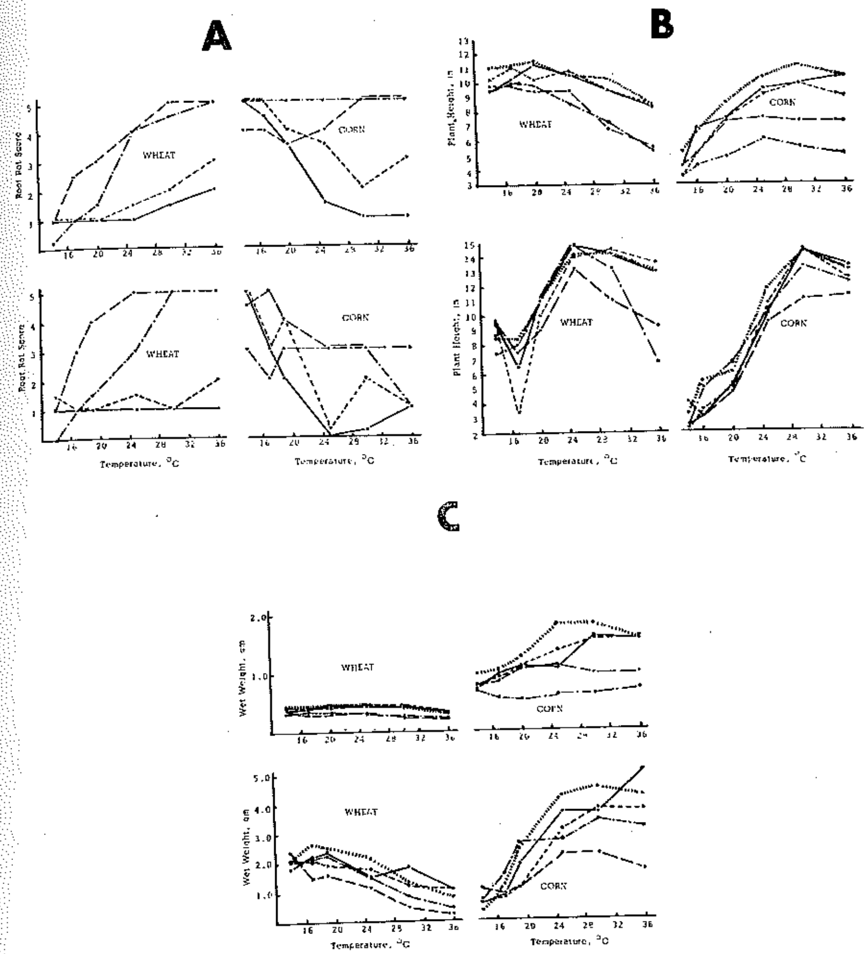

Figure 3 (A-C). Effect of temperature on root rot severity in wheat and corn seedlings grown in two trials (upper and lower charts) in steamed soil non-infested (///// /////) and infested with 4 Pythium species: *P. ultimum* (————), *P. arrhenomanes* (—— ——————), *P. debaryanum* (— — — — — —), and *P. graminicola* (—.—.—). A = root rot scores; B = plant height; C = wet weight/plant. Root rot scores for wheat and corn in both trials in non-infested soil were zero at temperatures of 25 C and less, and 0.5 and 1, respectively, at temperatures of 30 C and 35 C.

length (in) differed by 1.7 ± 1.4 and 0.6 ± 0.5 for wheat and 0.7 ± 0.2 and 0.8 ± 0.6 for corn; and fresh weight (gm) of seedlings differed by 0.3 ± 0.3 and 0.04 ± 0.001 for wheat and 0.4 ± 0.5 and 0.2 ± 0.1 for corn. Root rot severity scores between duplicate cans were alike for 90% of the cans; the remainder (12/120) differed by a score of 1 or 2.

Temperature-related differences between wheat and corn in disease severity from each of the four Pythium species did not wholely conform to the difference Dickson (1925) reported with *Gibberella saubinetii;* namely that wheat is damaged by this pathogen more at high (>10 C) than at low temperatures, and corn is damaged more at low (24 C) than at high temperatures. Root rot severity scores (Fig. 3A) from the four Pythium species showed some of this difference while reductions in seedling lengths (Fig. 3B) or seedling fresh weights (Fig. 3C) did not. The low virulence of *P. debaryanum* and *P. ultimum* to wheat and the high virulence of *P. arrhenomanes* and *P. graminicola* to corn over all temperatures may have obscured expected differences. Seedling lengths and seedling fresh weights were depressed about equally over the full range of temperatures on both wheat and corn by *P. debaryanum* and *P. ultimum* while they were depressed more at high than at low temperatures on both plants by *P. arrhenomanes* and *P. graminicola.*

LITERATURE CITED

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