ZOOSPORIC FUNGI ASSOCIATED WITH WHEAT SPINDLE STREAK MOSAIC IN ONTARIO[1]

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Abstract

Polymyxa graminis Led. has been found frequently in Ontario on wheat plants infected with wheat spindle streak mosaic. Other wheat: parasites, *Olpidium brassicae* (Wor.) Dang., *Rhizophydium graminis* Led., and *Lagena radicicola* Vanterpool and Led., have also been found in Ontario and they are being investigated as possible vectors of the virus.

Introduction

Wheat spindle streak mosaic caused by a soil-borne virus (WSSMV) has been common on winter wheat in Ontario most years since it was first observed in 1957. It has been prevalent only in fields in which three or more preceding crops of winter wheat were grown at intervals of 5 years or less (5).

The soil relationships of WSSMV appear to be similar to those for wheat soil-borne mosaic: virus (WMV). Infectivity is retained in soil stored dry at room temperature for several years, in fractions of soil that pass through sieves with 44 μ openings, and in organic fractions from soil. However, infectivity can be destroyed by heating at 52C or by treating with any of a number of fungicidal chemicals.

These characteristics are consistent with the possibility that the virus is harbored and transmitted by a root-invading zoosporic fungus, several of which have been observed on roots of Gramineae in Ontario:

Polymyxa graminis Led. (Plasmodiophorales) was discovered in 1929 during an investigation of certain root rots of wheat occurring in Ontario (3). There is good evidence that it is a vector of WMV in the U.S.A. (1,4).

Olpidium brassicae (Wor.) Dang. (Chytridiales) is a vector of several plant viruses, including tobacco necrosis, tobacco stunt, and lettuce big vein (7). It occurs in the roots of many plants in Ontario.

Rhizophydium graminis Led. (Chytridiales) was first described from material found in 1932 in roots of wheat grown in soil from the Central Experimental Farm, Ottawa (2). Unlike the other zoosporic fungi considered here, which are endobiotic, this fungus produces epibiotic zoosporangia and resting spores on root hairs and epidermal cells. Only delicate rhizoids penetrate the host cells. The epibiotic resting spores soon become separated from the roots leaving no observable bodies in the roots. Although this fungus has seldom been observed, it may be very common and possibly a vector.

Lagena radicicola Vanterpool and Led. (Lagenidiales) was reported to be a parasite of wheat, barley, and Zea *mays* in Western Canada (9) and Ontario where it was also found on wild grasses (8). It produces endobiotic zoosporangia and resting spores.

Root examinations were made to determine if any of these fungi were commonly associated with wheat spindle streak mosaic in Ontario, and if they occurred on certain other common grasses.

Methods

Wheat (*Triticum aestivum* L.) plants showing symptoms of spindle streak mosaic were collected from the main winter wheat producing districts of Ontario during surveys in May and June 1969 (6), from field plots at Ottawa, and from growth rooms operated at 8-12C. Roots of various grasses, principally from the vicinity of Ottawa, were also examined.

The roots were washed and small portions mounted in water and examined with a phase contrast microscope. Fungi were identified by their characteristic zoosporangia or resting spores. As a further check on the presence of fungi, the plants were potted in washed white sand and incubated for 3-4 weeks by a south-facing window in a laboratory, or at 15-20C in growth chambers. These conditions encouraged rapid spread of *P.*

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graminis, O. brassicae and L. radicicola and, in the absence of soil particles, the fungi were easily seen. This technique was not satisfactory for R. graminis which was seen only on roots of plants from soil.

Results

Zoosporangia and resting spores of P. graminis were found in the roots of spindle streak mosaic diseased wheat plants from 12 of 13 fields sampled in the counties of Carleton, Elgin, Kent, Middlesex, Simcoe, and Welland. P. graminis was also found in wheat seeded in infested soils from these counties and grown at 8–12C in a growth room. However, it was also found in mosaic–free wheat grown on land at Ottawa for which there was no record of a previous crop of wheat.

In host range tests, Hordeum vulgare L. 'Vantage', Bromus inermis Leyss. 'Lincoln', and Agropyron repens (L.) Beauv., which appear to be immune to WSSMV, became infected with P. graminis.

Olpidium brassicae was detected in roots of wheat from 5 of the 13 fields of WSSM-diseased wheat sampled, including fields in Carleton, Elgin, Kent, and Simcoe counties. It was also found in roots of mosaic–free wheat grown in soil collected from fields in which wheat has probably never been grown previously, and in roots of the grasses Poa pratensis L., Hordeum jubatum L., Phleum pratense L., Agrostis palustris Huds., and Agropyron repens.

Rhizophydium graminis was found on wheat that developed wheat spindle streak mosaic while growing at 8–12C in soil collected from a field in Brant county in which the disease was severe in 1968. The resting spores of this fungus were abundant on the surface of roots and root hairs 6 to 8 weeks after seeding, but later they were difficult to find. R. graminis was not found on roots of plants collected from the field but since the resting spores do not persist on the roots, failure to find them does not necessarily indicate that the fungus had not been present.

Lagena radicicola was found on Agropyron repens at Ottawa, but it was not detected in roots of wheat infected with WSSMV.

Discussion

The similarities in transmission in soil and factors involved in the persistence and elimination of infectivity of soil indicate that WSSMV and WMV may have a similar vector and vector relations. The evidence that WMV is transmitted by P. graminis (1,4) and the frequent finding of this fungus in roots of wheat infected with WSSMV indicate that it may be a vector of WSSMV. Proof that P. graminis is a vector may be achieved from experiments with unifungal cultures of this fungus grown on wheat roots in association with the virus, but the slow development of wheat spindle streak mosaic prevents rapid results. In the meantime, each of the zoosporic fungi known to infect wheat must be considered as potentially a vector.

Literature cited

1. Estes, Alice P. and M.K. Brakke. 1966. Correlation of Polymyxa graminis with transmission of soil-borne wheat mosaic virus. Virology 28:772-774.
2. Ledingham, G. A. 1936. Rhizophidium graminis n. sp., a parasite of wheat roots. Can. J. Res., C, 14:117-121.
3. Ledingham, G.A. 1939. Studies on Polymyxa graminis, n. gen. n. sp., a plasmodiophoraceous root parasite of wheat. Can. J. Res., C, 17:38-51.
4. Rao, A.S. and M.K. Brakke. 1969. Relation of soil–borne wheat mosaic virus and its fungal vector, Polymyxa graminis. Phytopathology 59:581-587.
5. Slykhuis, J.T. 1970. Factors determining the development of wheat spindle streak mosaic caused by a soil–borne virus in Ontario. Phytopathology 60:319-331.
6. Slykhuis, J.T. 1970. Verification of wheat spindle streak mosaic as a cause of mosaic of wheat in Ontario in 1969. Can. Plant Dis. Surv. (in press).
7. Teakle, D.S. 1969. Fungi as vectors and hosts of viruses, p. 23 to 54. In K. Maramorosch [ed.] Viruses, vectors and vegetation. John Wiley & Son:;, New York.
8. Truscott, J.H.L. 1933. Observations on Lagena radicicola. Mycologia 25:263-265.
9. Vanterpool, T.C. and G.A. Ledingham. 1930. Studies on "Browning" Root Rot of cereals, the association of Lagena radicicola n. gen.; n. sp., with root injury of wheat. Can. J. Res. 2:171-194.