INFLUENCE OF THREE ASCOCHYTA DISEASES OF PEAS ON PLANT DEVELOPMENT AND YIELD[1]

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Abstract

Yield losses of up to 50% were recorded in pea (Pisum sativum) plots inoculated with Ascochyta pinodes and Ascochyta pinodella. Six weeks after planting, reductions in stand of 24% and 14%. caused primarily by a foot rot, were recorded for A. pinodella and A. pinodes, respectively: As well, severe leaf infection and early defoliation were followed by a reduction in the number and weight of pods on plants affected by the two fungi. Only a slight yield reduction occurred in plots inoculated with Ascochtya pisi.

Résumé

On a enregistré des baisses de rendement pouvant atteindre 50% dans des parcelles de pois (Pisum sativum) inoculées avec Ascochyta pinodes et Ascochyta pinodella. Six semaines après le semis, on a signalé des reductions de densité de 24 et de 14%respectivement pour A. pinodella et A. pinodes, surtout attribuables au pourridié aschochytique. De plus, une infection grave des feuilles et une defoliation précoce ont été suivies par une reduction du nombre et du poids des cosses des plants attaqués. On n'a signalé qu'une faible baisse de rendement dans les parcelles inoculées avec Ascochyta pisi.

In an extensive survey of processing peas, Pisum sativum L., conducted in seven provinces of Canada in 1970 and 1971 (1), it was found that the ascochyta diseases leaf and pod spot caused by Ascochyta pisi Lib.; blight caused by Mycosphaerella pinodes (Berk. & Blox.) Vestgrn., imperfect state Ascochyta pinodes L.K. Jones; and foot rot caused by Phoma medicaginis var. pinodella (L.K. Jones) Boerema, syn. Ascochyta pinodella L.K. Jones, were second in prevalence only to fusarium root rot.

The three Ascochyta pathogens are seed-borne (7) and A. pinodes and A. pinodella are also soil-borne (10). Seed-borne A. pinodes and A. pisi are effectively controlled by treatment with chemical seed treatments (5, 6, 9).

In an earlier study in Canada (7), more samples of processing pea seed were internally infected with Ascochyta pisi than with the other two ascochytas, and similarly the average infection within the samples was higher with A. pisi. A. pisi was also the most prevalent species affecting field pea (P. arvense Poir.) seed until the variety Century with specific resistance to Ascochyta pisi was introduced in 1961 (2). Century is now the predominant field pea variety in Canada.

A. pisi causes lesions on leaves, stems and pods; in young seedlings the stems may be girdled and occasionally such plants are killed. A. pinodes and A. pinodella also affect leaves, stems, and pods and, in addition, cause a foot-rot symptom which is not present on plants affected by A. pisi. In view of this, it would be suspected that the blight and foot-rot diseases may be more important from a yield loss aspect because of the death of many plants affected by the foot-rot phase. In the United States, it has been stated that blight is the most destructive of the three organisms (3, 4), and in preliminary trials at Ottawa blight. foot rot, and leaf and pod spot reduced yields by 45%, 25% and 11%, respectively (8).

The purpose of this work was to determine the yield losses, as expressed in green pod weight. caused by the three organisms under field conditions and to follow the progress of the epiphytotics in the field by weekly disease assessments.

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Materials and methods

The experiment was carried out in 1971 and 1972, using the same experiment procedures each year. The design was a randomized block consisting of four treatments, a non-inoculated control plot and plots inoculated with one of the three ascochyta pathogens. Each treatment was replicated four times. Plots were isolated from one another by a 20 ft strip that was kept harrowed throughout the growing season. Twenty-one rows were seeded on May 29 with Pisum sativum L. 'Improved Laxton's Progress* in each 25 x 15 ft plot. Seeds were sown 2 inches apart in the rows. At harvest, July 27, the outside three rows of each plot and 2.5 ft at each end of the rows were discarded. Harvesting of the pods was done when the pods were green and full. Yields were recorded in pod weight. Green pod weights were used instead of dry seed weight because it is impossible to grow peas to maturity in this area because of bird damage.

Epiphytotics in the plots were produced using the method previously described (7) except that the inoculum was distributed over the rows of peas just prior to emergence.

Detailed assessments were made during the growinq season to give an indication of the rate of disease development and to provide information on the amount of damage to the leaves, stems, and pods. Assessments were made on 10 tagged plants chosen at random in each plot when the disease was first noted and at weekly intervals thereafter until harvest. The number of nodes per plant and at each node the number of infected leaflets, the percent defoliation, and the percent leaf area affected were recorded at each assessment. Assessments of foot rot were made at harvest.

Emergence counts were made 3 weeks after sowing, and at harvest plant counts were made for both the harvested area and the total area of each plot.

Results and discussion

The development of the diseases varied between the 2 years. Environmental conditions were more favorable for epiphytotics of ascochyta diseases in 1972, and losses were proportionately greater in 1972 although similar trends were apparent each year. For this reason, the results of the first year are regarded as preliminary and only the 1972 results are reported here.

Severe yield losses of up to 50% were recorded in the plots inoculated with A. pinodes and A. pinodella. Only a slight yield reduction occurred in the A. pisi affected plots (Table 1). With A. pinodes and A. pinodella, yield losses were influenced by 1) a reduction in stand initially: 2) a progressive reduction in stand throughout the growing season, caused in particular by the foot-rot type of infection in the A. pinodella affected plots and to a lesser extent in the A. pinodes affected plots (Fig. 1): 3) a reduction in the number of pods produced (Figs. 1, 4); and 4) leaf infection (Fig. 3) causing subsequent early defoliation (Fig. 2).

Stand counts recorded 6 weeks after planting were lower than in the control by almost 24% and 14% for A. pinodella and A. pinodes respectively. A. pisi did not affect the overall stand.

The stand reductions in the A. pinodella plots and to a lesser degree in the A. pinodes plots is understandable with the nature of the diseases. severe foot rot

Table 1. Effects of *A. pisi*, *A. pinodes*, and *A. pinodella* on stand, yield, and plant development

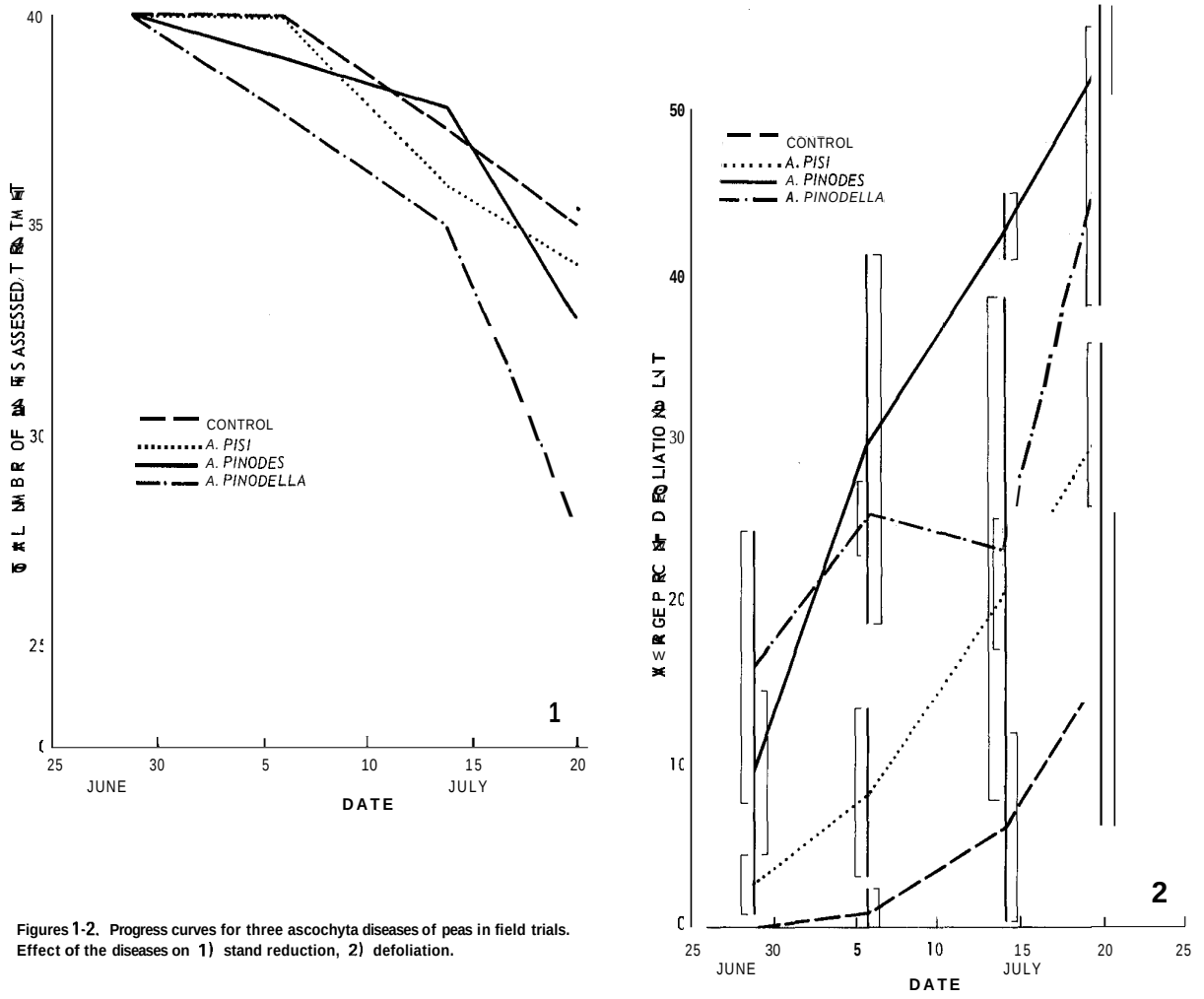
Pathogen	Percent stand*	Average no. pods affected per plant**	Avg yield*** (kg)	Pod yield per plant (g)	Avg pod weight (g)
Control	100	0.0	8.53	37.25	5.46
A. pisi	106	1.0	7.84	29.71"	5.76
A. pinodes	86	4.1	3.97†	21.66†	4.83
A. pinodella	76	4.6	3.22†	19.16"	3.39

* Percent stand is based on the total plant count in the harvested areas of the plots for the various treatments, expressed as a percentage of the count in the control plots.

** Based upon the number of pods at harvest on the 40 tagged plants for each treatment used for disease assessment.

*** Average pod yield per replicate of all plants within the harvested area for each treatment of four replicates.

† Significant at the 5%level.



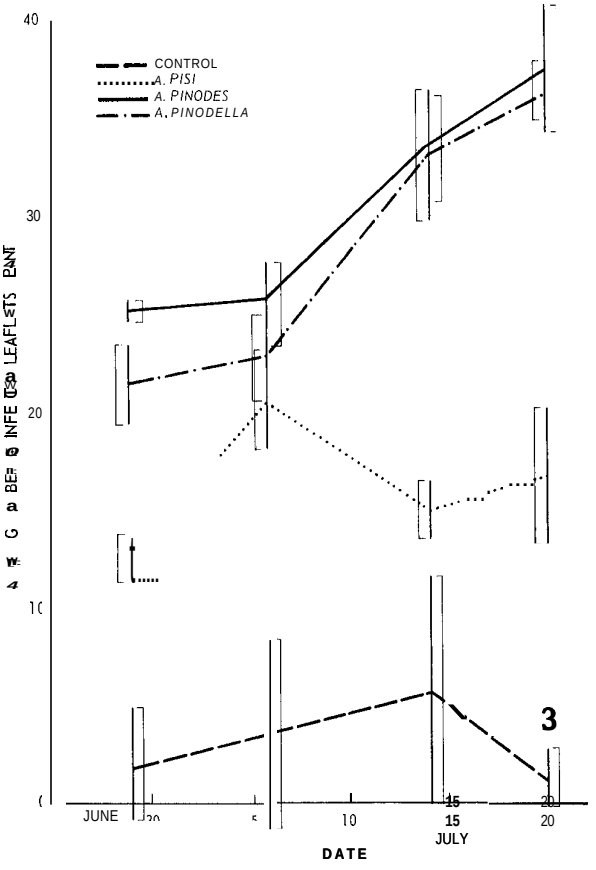
Figures 1-2. Progress curves for three ascochyta diseases of peas in field trials. Effect of the diseases on 1) stand reduction, 2) defoliation.

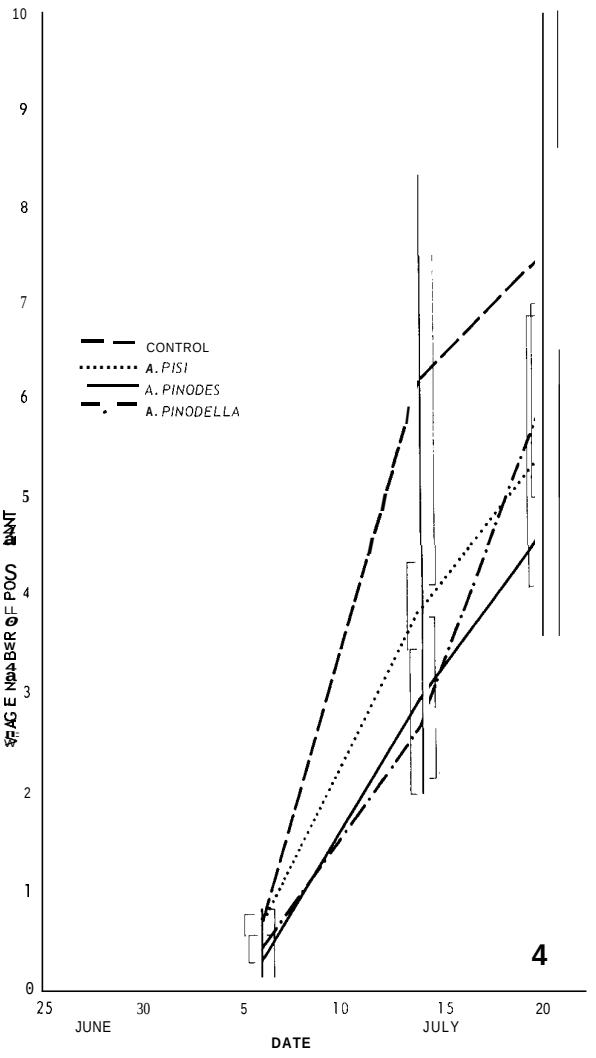
developed and killed a considerable number of the plants in all plots (Fig. 1). Of the original 40 plants assessed in the A. pinodella affected plots, only 8 remained on the last assessment date. Assessment of the remaining plants at harvest did not reveal any significant differences in the amount of foot rot among the plots affected with the three diseases.

Plant development was affected by all three diseases as expressed by a trend toward decreased pod production. Control plots developed on the average 1.5 more pods per plant than did any of the affected plots (Table 1).

Between 30 and 40 leaflets per plant became infected with A. pinodella and A. pinodes. From the onset of infection until harvest, the progress of these diseases was similar. Considerably fewer leaflets became infected in the A. pisi plots (Fig. 3). premature defoliation occurred in all affected plots but was more severe in the A. pinodes and A. pinodella plots and closely paralleled the intensity of leaf infection with these two diseases (Fig. 2). Almost 50% defoliation had occurred just prior to harvest in these plots. By July 1 more defoliation had occurred in these plots than was evident in the control plots by July 20. The amount of defoliation at harvest was closely correlated with the number of infected leaflets per plant.

Pod assessments for diseases were recorded 1 and 2 weeks prior to harvest. Pod infection was prevalent in the three treatments but in surprisingly low percentages. A. pinodella plots had the highest number of pods infected per plant, 4.6, and the greatest average pod area infected, slightly over 4%. Lower pod infection levels were recorded with A. pinodes and A. pisi (Table 1). Despite the relatively low amount of pod infection at this stage of growth, yield losses were high. It is apparent that early infection of leaves and stems was the principal factor





Figures 3-4. Progress curves for three ascochyta diseases of peas in field trials. Effect of the diseases on 3) number of infected leaflets, and 4) pod production.

influencing plant development and subsequent yield losses in these experiments, and that pod infection occurred too late to influence yield.

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