RESISTANCE TO PRE-EMERGENCE DAMPING-OFF IN GARDEN PEAS[1]

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Abstract

The resistance of 450 introductions or varieties of peas to pre-emergence damping-off incited by Pythium ultimum Trow. was tested in naturally infested soil and artificially infested sand. In preliminary screening tests 83 per cent of 105 strains with colored flowers and 7 per cent of 345 strains with white flowers were rated resistant. Seventeen colored and 68 white-flowered strains were re-tested in sand culture against a virulent isolate of the pathogen and of these 15 and 7 respectively were significantly more resistant than the check variety Lincoln.

Introduction

Control by chemical seed treatment of pre-emergence damping-off of garden peas, incited by Pythium ultimum Trow., is usually successful and thus little emphasis has been placed on the production of varieties resistant to this disease. Resistant varieties would be valuable to the grower, however, as fungicidal seed treatments are an added expense and inconvenience in the production of this crop. In 1958 a program was undertaken to screen a large number of pea introductions for sources of resistance to P. ultimum to determine whether any might be useful for breeding purposes. This paper presents the results of tests conducted at Brandon, Man. in naturally infested field soil and at Winnipeg, Man. in artificially infested sand.

Materials and Methods

local varieties. The samples of seed of introduced strains were obtained from Dr. D.D. Dolan, New York State Experimental Station, Geneva, New York. Samples which appeared to be mixtures of strains were re-selected on the basis of seed Characteristics and the entire collection was increased

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Each test contained a group of 76 samples. Three replicates, each consisting of 10 seeds of a single strain, were planted. Emerged seedlings were counted 2 weeks after planting. To provide a range of reaction from resistant to susceptible each group contained at least 2 resistant introductions with colored flowers and the variety Lincoln., Lincoln has shown less susceptibility to damping-off than any of the other common varieties of garden peas grown at Brandon and it was used as the check variety in all the tests.

The soil used in the initial tests contained organisms other than P. ultimum so, to prove that the strains selected were resistant to that pathogen, it was necessary to re-test the more promising strains against pure cultures of it, For this purpose the jelly glass technique (1) was employed. Inoculum was prepared from comminuted mycelial cultures grown in 200 ml of 1 per cent pea meal liquid medium for 5 days at 70°F. Five seeds in each glass were inoculated with 40 ml of inoculum diluted 1:74 with distilled water, Four replicates of each strain were planted. Ten days after planting the seedlings were washed free of sand and rated for disease on the following basis: healthy = 100; slight lesioning = 75; tap root firm, side roots rotted = 50; germinated, but root soft = 25; not germinated, decayed = 0. The ratings were totalled for each replicate and divided by the number of seeds planted (excluding hard, not germinated seeds) to obtain a disease index in per cent. Angular transformations were applied to the percentages obtained and an analysis of variance calculated.

Results

In each of the greenhouse tests in naturally infested soil many of the strains appeared to be more resistant than Lincoln. Table 1 shows the occurrence of resistant strains in relation to their geographical origin and flower color. Most of the resistant strains originated in southern Asia or Africa and the majority of them had colored flowers. Many had primitive characteristics such as small, mottled brown seeds, A high proportion of the more susceptible strains with white flowers originated in North America or Australia and undoubtedly trace back to English varieties.

Sixty-four of the most resistant strains with white flowers and 20 of the 87 resistant strains with colored flowers, selected in the preliminary screening, were re-tested with pure cultures of P. ultimum. Of these strains, 22 had significantly greater resistance to P. ultimum than Lincoln' (Table 2). The 13 strains with the greatest resistance had colored flowers and brown or purple seed coats. P.I. 180702 was selected previously by Lockwood (2) for partial resistance to Aphanomyces root rot. Of the remainder in Table 2, all but P.I. 196032 (Sel. A) and Vavilov Brown had white flowers and white seed. The high level of resistance in P.I. 180702 as compared to Vavilov Brown, P.I. 167363 (Sel. B) and the Lincoln check is shown in Fig. 1. The tests in artificially infested sand were much more severe than those in natural soil and many of the promising strains selected earlier were as suscpetible as Lincoln in later tests. The resistance shown by the white-flowered strains listed in Table 2 appears to be much greater than that of the variety White Brunswick which Saksena (3) reports to be resistant. That variety did not differ significantly in resistance from Lincoln in these tests.

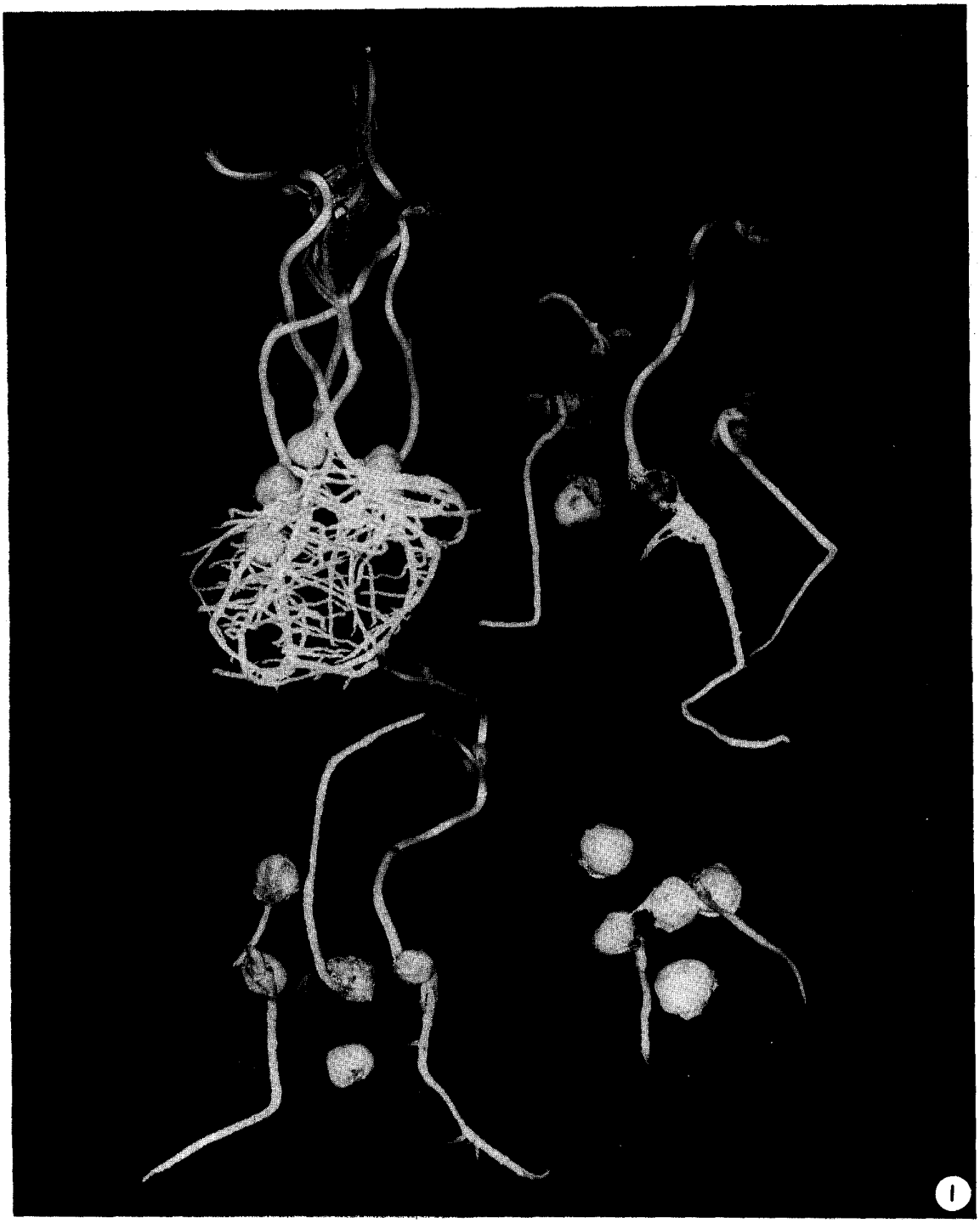

Figure 1. Comparison of pea strains: resistant (upper left, P.I. 180702); moderately resistant (upper right, Vavilov Brown, lower left, P.I. 167363 Sel. B); and susceptible (lower right, Lincoln).

Table 1. Pythium-resistant peas in relation to their place of origin and flower color.

Place of origin[1]	Colored Flowers R[2]	MR	S	Total	White Flowers R	MR	S	Total
South Asia	23	1	1	25	5	10	a9	34
S.W. Asia	28	7	2	37	4	9	29	42
Africa	15	2	1	18	1	5	4	10
N. & E. Asia	0	1	0	1	0	2	7	9
Europe	10	1	0	11	0	4	18	22
S. America	4	0	0	4	2	11	11	24
N. Amer. & Aust.	7	2	0	9	13	46	145	204
Total	87	14	4	105	25	87	233	345
Percent Resistant		83				7		

1/ South Asia - India, Pakistan
South-west Asia - Afghanistan, Iran, Turkey
Africa - Ethiopia
North and East Asia - China, Manchuria, Russia
Europe - Austria, England, Finland, Germany, Netherlands, Sweden
South America - Mexico, Costa Rica, Guatemala, Honduras, Peru, Argentina
North America, Australia - Canada, U.S.A.

2/ R - resistant, MR - moderately resistant, S - susceptible,

Table 2. Disease indices for the most resistant pea strains selected from 86 tested to pure cultures of P. ultimum.

P.I. Number or Variety	Disease Index[1]	P.I. Number or Variety	Disease Index
P.I. 183910	100 **	P.I. 206808 (Sel. C)	79 **
Capuchin type	99 **	P.I. 196032 (Sel. A)	70 *
P.I. 171812 (Sel. B)	97 **	P.I. 123246 (sea. A)	65 *
P.I. 169606 (Sel. A)	97 **	P.I. 206852	63 *
P.I. 164612 (Sel. A)	96 **	P.I. 195024 (Sel. C)	62 *
P.I. 193843 (Sel. A)	94 **	P.I. 210618	59 *
P.I. 170669 (Sel. A)	90 **	P.I. 206781	58 *
P.I. 234263	90 **	P.I. 210624	57 *
P.I. 180702	87 **	Vavilov Brown	56 *
P.I. 170669 (Sel. B)	85 **	P.I. 167363 (Sel, B)	56 *
P.I. 174922 (Sel. A)	82 **	Lincoln	23
P.I. 210587	82 **		

1/ Mean of 1 to 6 tests

** Significantly better at 1 per cent level than Lincoln in individual tests

* Significantly better at 5 per cent level than Lincoln in individual tests.

Discussion

The predominance of pea strains with colored flowers and grey, brown or purple seed color, in those rated resistant to **P.** ultimum in the preliminary screening, suggests that resistance may be associated with these characteristics in a manner similar to that found by Sorgel **(4)** in the relationship between anthocyanin development and resistance to Asochyta diseases of pea. He reported that the resistance in a variety of sugar pea with variegated flowers and red seed to the root rots caused by A. pisi Lib., A. pinodella L, K. Jones, and Mycosphaerella pinodes (Berk. & Blox.) Stone was due to the presence of an anthocyanin in the testa. The strains with colored flowers selected by Lockwood (2) as partially resistant to Aphanomyces root rot also fall into this group. Resistance conditioned by factors contained in colored seed coats would be of little value in producing white-seeded garden varieties. Some of the strains with white flowers and seeds, however, have shown a satisfactory degree of resistance in these tests and may contain factors for resistance different from those conditioning seed color. It is this latter group that should provide adequate sources of resistance to P. ultimum.

Literature Cited

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