# Screening Brassicas for resistance to clubroot, Ptasmodiophora brassicae Wor.[1]

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A total of 109 Brassica accessions obtained from the Plant Introduction Station, Geneva, N.Y. were evaluated for germplasm resistance to clubroot, ***Plasmodiophora brassicae*** Wor. race 6, E.C.D. code number 16/02/30. All the lines were severely infected with clubroot; the least infection (about 50%) was observed in two ***Brassica rapa*** L. lines.

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Un total de 109 lignees de Brassica ont ete evaluees pour leur resistance a la hernie, ***Plasmodiophora brassicae*** Wor. race 6, E.C.D. numero 16/02/30. Toutes ces lignees ont ete severement infectees, excepte deux lignees de ***Brassica rapa*** L. ou la severite d'infection était d'environ 50%.

## Introduction

Clubroot, ***Plasmodiophora brassicae*** Wor., a major disease of cruciferae causes appreciable crop losses in many parts of the world.

There are few effective means of controlling this disease. Of all the chemicals tested to control clubroot, certain systemic benzimidazole derived fungicides and derivatives of dithiocarbamic acid have shown promise, Colhoun 1958, Karling 1968 and Buczacki ***et al***. 1976, but these are not always reliable, practical and economical to use. Success in the control of clubroot could be best achieved by the development of disease-resistant varieties. Attempts have been made to locate possible sources of resistance (Catovic-Catani and Rich 1964; Crbte and Chiang 1967 and Chiang and Crête 1972). This paper reports screening test results of Brassica lines of different origin in search of clubroot resistant germplasm which could be used in our breeding program.

## Materials and methods

One hundred and nine (109) Brassica accessions were obtained from the NE-9 Regional Plant Introduction Station, Geneva, N.Y. (Table 1). The tests were conducted in a glasshouse with a temperature of 21°C ± 1"and a mean relative humidity of 50%. A combination of fluorescent and incandescent lamps were used to extend the period of illumination to 14 hours. The supplemental light had an intensity of 50 ± lux at plant level.

Resting spores of P. ***brassicae*** race 6, E.C.D.* code number 16/02/30 (Buczacki ***et al.*** 1975) were extracted from infected cabbage roots and the inoculum prepared according to Williams' 1965 method. Pasteurized organic soil, pH 5.8 was inoculated by thoroughly mixing the spore suspension to obtain 30 x $10^9$ spores per 100 g of dry soil. Handi-Pot modules containing 36 pots with a volume of approximately 140 $cm^3$ were filled with the inoculated soil. Four seeds of each line were sown per pot and the treatments replicated 9 times. Thirty-five (35) days after inoculation all the plants were uprooted, washed and evaluated for clubroot infection. The grades of infection and the disease index were scored and calculated according to the method of Crête ***et al***. 1963 with a slight modification (Crbte 1975).

## Results and discussion

The distribution of the plants evaluated for clubroot resistance into four grades and the disease index for each entry are presented in Table 1.

One hundred and seven (107) of the 109 Brassicas tested for resistance, against clubroot P. ***brassicae*** race 6, E.C.D. code number 16/02/30 showed a disease severity index ranging from 62 to 100. Two ***Brassica rapa*** L. lines had a disease index of 52 and 55 which is greater than our "cut-off point" of 25. However these lines will be retested and the search for germplasm resistant to P. ***brassicae*** should continue with other species in the Brassica family.

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*European Clubroot Differential set

**Table 1. Brassica lines tested for clubroot resistance.**

| Scientific name and plant introduction number | Origin | Disease grade | | | | |
|---|---|---|---|---|---|---|
| | | 0 | 1 | 2 | 3 | Disease Index |
| *Brassica oleracea* L. var. *capitata* L. | | | | | | |
| P.I. 391555 | China | 1 | 3 | 1 | 31 | 91 |
| 391556 | China | 0 | 4 | 2 | 30 | 91 |
| 391557 | China | 0 | 1 | 0 | 35 | 98 |
| *Brassica campestris* L. | | | | | | |
| 390962 | China | 0 | 0 | 0 | 36 | 100 |
| 390963 | China | 0 | 0 | 0 | 36 | 100 |
| 390964 | China | 0 | 0 | 0 | 36 | 100 |
| 391547 | China | 0 | 0 | 4 | 32 | 96 |
| 391548 | China | 0 | 8 | 7 | 21 | 79 |
| 391549 | China | 0 | 5 | 4 | 27 | 87 |
| 391550 | China | 0 | 0 | 0 | 36 | 100 |
| 391551 | China | 0 | 0 | 0 | 36 | 100 |
| *Brassica pekinensis* Rupr. | | | | | | |
| 391558 | China | 0 | 0 | 0 | 36 | 100 |
| 391559 | China | 0 | 0 | 0 | 36 | 100 |
| 391560 | China | 0 | 0 | 0 | 36 | 100 |
| *Brassica rapa* L. | | | | | | |
| 391561 | China | 3 | 16 | 5 | 8 | 52 |
| 391562 | China | 4 | 15 | 6 | 11 | 55 |
| *Brassica oleracea* L. var. *botrytis* L. | | | | | | |
| 277273 | India | 0 | 1 | 0 | 34 | 98 |
| 277274 | India | 0 | 1 | 0 | 35 | 98 |
| 277275 | India | 0 | 0 | 1 | 33 | 99 |
| 277276 | India | 0 | 1 | 0 | 31 | 98 |
| 277277 | India | 0 | 1 | 6 | 29 | 93 |
| 284594 | Sweden | 0 | 0 | 0 | 36 | 100 |
| 284697 | Sweden | 2 | 2 | 0 | 4 | 58* |
| 284698 | Sweden | 0 | 0 | 0 | 35 | 100 |
| 285061 | Denmark | 0 | 0 | 0 | 36 | 100 |
| 285062 | Denmark | 0 | 0 | 0 | 36 | 100 |
| 285275 | Denmark | 0 | 1 | 1 | 34 | 97 |
| 285276 | Denmark | 0 | 0 | 0 | 36 | 100 |
| 285596 | Poland | 0 | 0 | 0 | 10 | 100* |
| 289693 | Australia | 0 | 0 | 0 | 36 | 100 |
| 289694 | Australia | 0 | 0 | 0 | 36 | 100 |
| 289695 | Australia | 0 | 0 | 0 | 36 | 100 |
| 289696 | Australia | 0 | 0 | 0 | 36 | 100 |
| 291565 | Egypt | 0 | 1 | 0 | 35 | 98 |
| 291566 | Egypt | 0 | 0 | 0 | 35 | 100 |
| 291567 | Egypt | 0 | 0 | 0 | 36 | 100 |
| 291992 | Israel | 0 | 0 | 2 | 34 | 98 |
| 291993 | Israel | 0 | 0 | 2 | 34 | 98 |
| 291995 | Israel | 0 | 0 | 0 | 36 | 100 |
| 291996 | Israel | 0 | 0 | 2 | 34 | 98 |
| 291997 | Israel | 0 | 0 | 1 | 35 | 99 |
| 296130 | USA | 0 | 0 | 1 | 35 | 99 |
| 320999 | Taiwan | 0 | 0 | 0 | 36 | 100 |
| 321000 | Taiwan | 0 | 1 | 0 | 35 | 98 |
| 321001 | Taiwan | 1 | 3 | 2 | 30 | 90 |
| 343474 | USSR | 0 | 1 | 0 | 35 | 98 |
| 343475 | USSR | 3 | 7 | 5 | 21 | 74 |
| 343476 | USSR | 0 | 1 | 0 | 35 | 98 |
| 343477 | USSR | 0 | 2 | 2 | 32 | 94 |
| 343478 | USSR | 0 | 3 | 1 | 32 | 93 |
| 343479 | USSR | 0 | 3 | 1 | 32 | 93 |
| 343480 | USSR | 0 | 0 | 0 | 36 | 100 |
| 343481 | USSR | 0 | 0 | 0 | 36 | 100 |
| 343482 | USSR | 0 | 0 | 0 | 36 | 100 |
| 343483 | USSR | 3 | 2 | 0 | 31 | 88 |
| 344268 | Turkey | 0 | 0 | 0 | 36 | 100 |
| 344269 | Turkey | 2 | 1 | 4 | 29 | 89 |
| 344270 | Turkey | 0 | 0 | 1 | 35 | 99 |
| 344271 | Turkey | 0 | 0 | 0 | 36 | 100 |
| 344272 | Turkey | 0 | 0 | 0 | 36 | 100 |
| 344273 | Turkey | 0 | 0 | 0 | 36 | 100 |
| 345541 | USSR | 0 | 0 | 0 | 36 | 100 |
| 345542 | USSR | 0 | 0 | 0 | 36 | 100 |
| 372585 | Netherlands | 0 | 0 | 5 | 31 | 95 |
| 372590 | Denmark | 0 | 0 | 0 | 36 | 100 |

*Poor germination

**Table 1.** (Continued)

| Scientific name and plant introduction number | Origin | Disease grade | | | | |
|---|---|---|---|---|---|---|
| | | 0 | 1 | 2 | 3 | Disease Index |
| 372591 | Denmark | 0 | 0 | 6 | 30 | 94 |
| 372592 | Denmark | 0 | 2 | 0 | 34 | 96 |
| 372856 | Netherlands | 0 | 0 | 2 | 34 | 98 |
| 372857 | Netherlands | 0 | 0 | 0 | 36 | 100 |
| 372858 | Netherlands | 0 | 0 | 0 | 36 | 100 |
| 372860 | Netherlands | 0 | 0 | 3 | 33 | 97 |
| 372862 | Denmark | 0 | 0 | 2 | 34 | 98 |
| 372863 | Denmark | 0 | 0 | 5 | 31 | 95 |
| 372864 | Denmark | 0 | 7 | 4 | 25 | 83 |
| 372865 | Denmark | 0 | 2 | 2 | 32 | 94 |
| 372885 | Netherlands | 0 | 1 | 1 | 34 | 97 |
| 372886 | Netherlands | 0 | 2 | 3 | 31 | 93 |
| 372887 | Netherlands | 2 | 1 | 0 | 33 | 93 |
| 372888 | Netherlands | 0 | 1 | 0 | 35 | 98 |
| 372889 | Netherlands | 0 | 0 | 0 | 36 | 100 |
| 372890 | Netherlands | 0 | 0 | 0 | 36 | 100 |
| 372897 | Netherlands | 0 | 0 | 1 | 35 | 99 |
| 372901 | Netherlands | 0 | 0 | 1 | 35 | 99 |
| 372902 | Netherlands | 0 | 0 | 0 | 36 | 100 |
| 373906 | Netherlands | 0 | 1 | 0 | 35 | 98 |
| 373907 | Netherlands | 0 | 0 | 0 | 36 | 100 |
| 373908 | Netherlands | 0 | 2 | 4 | 30 | 93 |
| 373909 | Netherlands | 0 | 0 | 0 | 36 | 100 |
| 373910 | Netherlands | 0 | 0 | 0 | 36 | 100 |
| 373919 | Netherlands | 0 | 10 | 10 | 16 | 72 |
| 373920 | Netherlands | 2 | 13 | 9 | 12 | 62 |
| 373921 | Netherlands | 1 | 18 | 7 | 12 | 63 |
| 373922 | Netherlands | 2 | 9 | 8 | 17 | 70 |
| 373923 | Netherlands | 1 | 7 | 3 | 25 | 78 |
| 374224 | India | 1 | 14 | 5 | 16 | 67 |
| 374225 | India | 2 | 5 | 10 | 19 | 76 |
| 374226 | India | 1 | 1 | 0 | 6 | 79* |
| 374227 | India | 1 | 3 | 4 | 28 | 88 |
| 374228 | India | 2 | 3 | 10 | 21 | 80 |
| 384428 | India | 2 | 0 | 2 | 32 | 93 |
| 385951 | Kenya | 0 | 5 | 8 | 23 | 83 |
| 385952 | Kenya | 4 | 3 | 0 | 29 | 83 |
| 385953 | Kenya | 0 | 1 | 4 | 31 | 94 |
| 385954 | Kenya | 0 | 0 | 1 | 35 | 99 |
| 385955 | Kenya | 0 | 0 | 0 | 36 | 100 |
| 385956 | Kenya | 0 | 1 | 0 | 33 | 93 |
| 390967 | Israel | 0 | 6 | 5 | 25 | 84 |
| 390968 | Israel | 1 | 3 | 3 | 29 | 89 |
| 390969 | Israel | 0 | 4 | 1 | 31 | 92 |

*Poor germination

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