*Istituto di Nematologia Agraria, C.N.R. - 70126, Bari, Italy*

# RACE AND RESISTANCE STUDIES ON TWO ITALIAN POPULATIONS OF *HETERODERA AVENAE*

by
T. D'ADDABBO and N. SASANELLI

**Summary**. Twenty five near-isogenic lines of wheat, oat and barley were tested for their resistance to two Italian populations of *Heterodera avenae* in a glasshouse experiment. All of the lines were resistant to both populations, which were identified as pathotype *Ha51* (from Basilicata) and *Ha41* (from Sardinia), with the possibility that the latter might be one of the Spanish pathotypes *Ha71* or *Ha 81*.

The development of resistant cultivars is the most promising control method against the cereal cyst nematode *Heterodera avenae* Woll., for which the use of chemicals is economically unacceptable. Different sources of resistance, associated with single dominant genes, are present in cereals (Andersen and Andersen, 1970), but breeding is complicated because of the presence of different pathotypes of *H. avenae*, characterized by different levels of virulence.

This paper reports the screening of 5 near-isogenic lines of wheat, 7 of oat, and 13 of barley (all with some resistance to *H. avenae*) against two Italian populations of the cyst nematode. The two populations were tested on some of the discriminating cereal cultivars of the International Test Collection to identify the pathotype (s) to which they belong.

## Materials and methods

Soil naturally infested by *H. avenae* was collected from a field at Genzano (province of Potenza, Basilicata) and a field at Guasila (province of Cagliari, Sardinia) in both of which durum wheat (*Triticum durum* L.) had been cultivated for many years. The initial nematode population density (27 and 33 eggs/g soil, respectively) was adjusted to 7 eggs/g soil, which is considered to be above the tolerance limit of wheat to *H. avenae* (Greco and Brandonisio, 1987), by adding appropriate amounts of sterilized sandy soil.

The 25 near-isogenic lines were: 5 of durum wheat, 7 of oat (*Avena sativa* L.) and 13 of barley (*Hordeum vulgare* L.) (Table I).

Pots (12 cm diam) were filled with infested soil and each sown with four seeds of each cereal. There were four replicates for each line or test cultivar in each of the two soils. The pots were arranged in a randomized block design on benches in a glasshouse at 17±2 °C. Irrigation, fertilization, disease and pest control measures were applied as required. Plants were cut at the soil level three months after sowing and cysts were extracted from a 200 g soil sample with the Fenwick can. Cysts were then crushed (Seinhorst and Den Ouden, 1966) and eggs and juveniles were counted to calculate the numbers per g of soil.

The lines and the cultivars tested were considered resistant if the final nematode density in the soil was lower than the initial, i.e. if the nematode did not reproduce. Numbers of eggs of each nematode population on different lines were compared by analysis of variance and Duncan's multiple range test, while for each line the comparison between the two populations was made by the Student's *t* test.

In the pathotype identification test reproduction of the two nematode populations was challenged on 7 cultivars of barley (Dalmatische, Emir, Harlan 43, Herta, Morocco, Ortolan and Varde), 2 cultivars of oat (Silva and Sun II) and one cultivar of rye (*Secale cereale* L.) (Petkus Spring), belonging to the International Test Collection for the identification of the pathotypes of *H. avenae* (Nielsen, 1972). The choice was limited to these nine cultivars because of their immediate availability at the Istituto del Germoplasma-C.N.R., Bari, Italy.

## Results

The final nematode density of the population from Basilicata on all the 25 lines was lower than the initial

TABLE I - *Final density (eggs and juveniles/g soil) of two Italian populations of* Heterodera avenae *on 25 near-isogenic lines (Pf = final population; Pi = initial population of the nematode in the soil).*

| Line code | Lines | Nematode population | | | | *t* test between populations |
|---|---|---|---|---|---|---|
| | | Basilicata | | Sardinia | | |
| | | *Pf* | *t* test of *Pf* vs *Pi* | *Pf* | *t* test of *Pf* vs *Pi* | |
| *Wheat* | | | | | | |
| IGV 1-2824 | Prins (receptor) | 0.9 a | ** | 3.1 a | – | – |
| IGV 1-701 | Loros x Prins | 2.5 a | * | 1.9 a | ** | – |
| IGV 1-702 | Australia 10894 x Prins | 1;9 a | ** | 1.5 a | ** | – |
| IGV 1-703 | Iskamish x Prins | 1.8 a | ** | 2.5 a | ** | – |
| IGV 1-704 | Red Egyptian X Prins | 1.7 a | ** | 1.5 a | ** | – |
| *Oat* | | | | | | |
| IGV 5-1050 | Sun II (receptor) | 2.8 a | ** | 4.3 a A | * | – |
| IGV 5-301 | A. sterilis GHb x Sun II | 2.5 a | ** | 1.8 b B | ** | – |
| IGV 5-302 | A. sterilis Rouda x Sun II | 2.4 a | * | 2.0 b B | ** | – |
| IGV 5-303 | US 1625-4575 x Sun II | 1.7 a | ** | 1.7 b B | ** | – |
| IGV 5-304 | Grise de Houdan x Sun II | 2.9 a | * | 2.9 ab AB | * | – |
| IGV 5-305 | CI 2095, Calcutta x Sun II | 2.9 a | – | 3.2 ab AB | ** | – |
| IGV 5-306 | Pusa Hybrid G x Sun II | 3.9 a | * | 2.6 b AB | * | – |
| *Barley* | | | | | | |
| IGV 3-2027 | Ingrid (receptor) | 1.6 bc AB | ** | 5.0 a A | – | – |
| IGV 3-401 | Barley 191 x Ingrid | 1.1 bc AB | ** | 4.6 ab AB | – | – |
| IGV 3-402 | Morocco x Ingrid | 2.0 abc AB | * | 4.7 a A | – | * |
| IGV 3-405 | Ogalitsee x Ingrid | 1.2 bc AB | ** | 2.6 abc ABC | ** | – |
| IGV 3-406 | Kron x Ingrid | 3.6 a A | ** | 5.0 a A | – | – |
| IGV 3-408 | Goldfoil x Ingrid | 2.3 abc AB | ** | 1.0 c C | ** | – |
| IGV 3-409 | Osiris x Ingrid | 3.0 ab AB | * | 3.4 abc ABC | * | – |
| IGV 3-410 | Drost x Ingrid | 1.5 bc AB | ** | 2.0 bc ABC | ** | – |
| IGV 3-413 | CI 4226 x Ingrid | 2.3 abc AB | ** | 3.6 abc ABC | ** | * |
| IGV 3-414 | Ariana x Ingrid | 0.6 c B | ** | 2.6 abc ABC | ** | – |
| IGV 3-415 | CI 3725 x Ingrid | 2.4 abc AB | * | 1.2 c BC | ** | – |
| IGV 3-416 | Martin 403-2 x Ingrid | 2.5 abc AB | * | 2.8 abc ABC | * | – |
| IGV 3-417 | Bajo-Aragon 1-1 x Ingrid | 2.7 abc AB | * | 2.9 abc ABC | * | – |

Data flanked in any column by the same letters are not statistically different according to Duncan's multiple range test (small letters for P = 0.05; capital letters for P = 0.01).
Statistically different according to Student's *t* test: * for P = 0.05; ** = for P = 0.01.

population and the reduction was always statistically significant, except on the oat line IGV 5-305 (Table I). No significant difference was found in the reproduction of *H. avenae* on the lines of wheat or oat. In the pots sown with the barley line IGV 3-414 the final nematode density was significantly (P = 0.01) lower than on the line IGV 3-406, but there was no statistical difference among the other barley lines.

Europe (Kort *et al.*, 1964; Lücke, 1976). The similar environmental conditions, the closer proximity of cropping areas and the history itself of the island suggest that the population from Sardinia could be attributable to pathotype *Ha41* or to the Spanish pathotypes *Ha71* or *Ha81*.

## Discussion

All the near-isogenic lines tested in the first experiment were resistant to both the *H. avenae* populations, with no particularly significant difference between them. The test with the nematode population from Basilicata must, however, take into account that under field conditions this population seems to be strongly suppressed by parasitic fungi; so the experiment should be repeated in steamed or autoclaved soil to verify if the lack of nematode reproduction was due to the resistance of lines or to the fungal parasitism. Interference of fungi parasitic to nematode eggs may have affected also the results obtained with this population in the pathotype identification test.

The attribution of the two *H. avenae* populations to different pathotypes could also explain their different impact on the cereal crop as the Sardinia population appears to be more virulent and causes greater yield losses than that from Basilicata. However, this should be considered as a preliminary study and its results need confirmation using the whole International Collection of test cultivars, and populations of the nematode free of egg parasites.

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