MICROPLOT EXPERIMENTS ON THE EFFECT OF PLANT HOSTS ON POPULATIONS OF THE CEREAL CYST NEMATODE (HETERODERA AVENAE) AND ON THE SUBSEQUENT YIELD OF WHEAT

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Microplots containing soil, naturally infested with the cereal cyst nematode (Heterodera avenae) were left fallow or sown to one of nine cereal cultivars or grass species for five consecutive years. Wild oat (Avena fatua) was the most efficient host and, after three plantings, the nematode reached a potential increase ceiling of 42.2 eggs/g soil. Of the cereal cultivars tested, wheat (cv. Olympic) and barley (cv. Prior) were the most efficient hosts and levels of approximately 40 eggs/g were reached after five plantings. Barley grass (Hordeum leporinum) was less efficient than Wimmera ryegrass (Lolium rigidum) which maintained a ceiling population of about 10 eggs/g. Under fallow, populations declined to 0.5 eggs/g after 4 years. The most inefficient cereal hosts were the oat, cv. Avon, and cereal rye, cv. South Australian. The low populations maintained under continuous cropping with these cereals suggested that a rapid selection of a resistance-breaking biotype is unlikely to result from the continued use of inefficient hosts. Growth and yield of a subsequent wheat crop on all plots reflected the relative levels of nematode populations. At the low levels of infestation, grain yields were more than double those on heavily infested plots.

Severe disease symptoms in wheat crops in the southern Australian wheat belt are frequently associated with root invasion by the cereal cyst nematode (Heterodera avenae Woll.) (Meagher, 1972). Although the syndrome may often be the result of nematode-fungus interaction (Meagher & Chambers, 1971) the nematode appears to be the primary pathogen.

On nematode infested land the disease is most severe following heavy cropping with cereals on a rotation of fallow-wheat, or fallow-wheat-oats (Meagher, 1972). Improved wheat yields follow the inclusion of pasture in the rotation, especially one consisting, predominantly, of legumes (Meagher & Rooney, 1966). Experience has shown, however, that there are economic limitations to the length of the pasture phase and, as well, extended periods of ley pasture can result in increased susceptibility to moisture stress, or “haying-off” (Storrier, 1965), of the subsequent wheat crops (Meagher & Rooney, 1966).

Alternatively, wheat yields may be increased when wheat is grown after certain oat (Avena byzantina C. Koch) cultivars (Mathison, 1966). Nematode populations were not measured in these experiments, but Mathison concluded that growth and yield differences reflected the relative carry-over of H. avenae cysts produced.
on the oat cultivars tested. Unpublished data, quoted to support these observations were later published (Brown & Meagher, 1970) and showed that oat cultivars varied widely in their capacity to produce cysts and some could be classed as "moderately resistant" or inefficient hosts. Earlier, Millikan (1938) had reported the "resistance" of some oat cultivars, including Mulga, Gidgee, Guyra, and Mortgage Lifter, but these cultivars are no longer grown.

In a pot experiment Meagher (1972) grew a range of cereal and grass hosts for one season and compared nematode populations in the soil with the population under wheat (Triticum aestivum L. cv. Insignia). He concluded that the oat cvs. Avon and Mulga, were just as effective in reducing nematode carry-over as rye (Secale cereale L. cv. South Australian) or barley grass (Hordeum leporinum Link.). Wimmera ryegrass (Lolium rigidum Gaud.) was less effective, while the effect of barley (Hordeum vulgare cv. Prior) was similar to wheat. Wild oat (Avena fatua L.) was the most efficient host and caused the greatest population increase.

Further information was required on whether these population levels were maintained under successive plantings of an inefficient host without selection of resistance-breaking nematode biotypes. Also, the "ceiling population" (Jones, 1956) characteristic of several plant hosts required investigation.

The measurement of host efficiency in pots in the glasshouse is not sufficiently comparable to field conditions for their use in long-term experiments, while statistical interpretation of field experiments may be confused by variables such as soil type and initial nematode populations. In particular, the size of field plots presents problems in the exclusion of weeds and the maintenance of a pure plant stand or clean fallow. For these reasons, the microplot technique (Jones, 1955, 1956) was used in the studies described here.

**MATERIALS AND METHODS**

Preparation of Microplots (1965-66)

In 1965, fifty microplots consisting of concrete paving slabs laid on edge, were constructed at the Victorian Plant Research Institute, in Melbourne. These were installed in an area which had been excavated and equipped with tile drainage to a depth of 65 cm. Each microplot had a surface area of 0.3 m² (55 cm square) and was 55 cm deep. They were filled with a solonized brown (Mallee) soil obtained from a field site at Walpeup in the northern Mallee district of Victoria. This light-textured sandy loam, pH 7.9, had previously grown wheat and was naturally infested with H. avenae.

The soil was thoroughly mixed before the plots were filled. It was allowed to settle for several months and the plots were cultivated regularly to exclude weeds. In May 1965, and again in 1966, all plots were sown with 100 seeds of wheat (cv. Olympic) together with 50 g of complete mineral fertiliser, to increase nematode populations and provide a natural nematode profile prior to the commencement of