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CEREAL EELWORM

A new disease of cereal crops in the Geraldton area

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CEREAL eelworm (Heterodera avenae) is a potentially serious disease of crops which was seen in the Geraldton area for the first time in the 1966-67 season. It was first identified in this State at Beverley in 1958 and later near Northam in 1963. The Geraldton region has been the only area found to be affected since. The disease was identified on eight properties in 1966-67, and a further ten properties in 1967-68. There are indications that many more properties could be affected in varying degrees.

Cereal eelworm (or nematode) is a disease of considerable economic importance in South Australia and Victoria, Canada and Europe. Eelworms are minute worm-like animals which live in soil and attack the roots of plants. They could become a problem in the Geraldton area if precautionary measures are not taken.

Where the disease has occurred

Outbreaks in the Geraldton area have been up to 80 miles apart. A small area of infestation was discovered north of Nabawa in 1966. This was followed by three further discoveries. The first was at Dongara (where a total of 200 acres was involved), and the second was in the Narngulu-Moonyoonooka area just east of Geraldton. The total area over which infestations were found was about 600 acres. Soil types ranged from sandy loams to clay loams. The third area (of 100 to 200 acres) was discovered west of Northampton. This infestation was on brown sandy loam to brown clay loam.

In each of these areas, farming has been practised for 70 to 100 years.

In 1967 further suspect paddocks in the same general localities were inspected. The inspection showed that a far greater area was infested with eelworm than was previously thought. About 700 acres in the west Northampton area, 1,000 acres in the Narngulu-Moonyoonooka area and a further 100 acres at Dongara were found to be affected. About 200 acres were found to be affected along the Greenough flats.

In all, a total of about 3,000 acres has been shown to be positively affected to a moderate to severe degree. Above ground symptoms do not occur in the early stages of infestation. It is only when multiplication of the worms has taken place and conditions do not favour vigorous plant growth that symptoms appear. Depending on the farming practice this could take many years. Hence, it is possible that the actual area infested is many times greater than that already confirmed. In fact, the area which could have some degree of eelworm infestation might be well in excess of 10,000 acres.

The surrounding areas, of course, are subject to infestation and the total area over which eelworm could become a problem may be well in excess of 50,000 acres.

The present infestation areas, known, probable and potential, are outlined in Figure 1. The soils at Dongara are strongly alkaline. All others are slightly acid.
Fig. 1.—Cereal eelworm areas in districts near Geraldton
What an affected crop looks like

Affected crops show patches of poor growth which resemble waterlogging and nitrogen deficiency. Infestation shows up as irregular pale patches, or as isolated roughly circular areas. Depending on the severity of the infestation, the crop may be stunted only slightly, or may be so badly affected that it does not exceed 6 to 7 in. in height.

The pale colour of the affected areas is often plainly visible from a distance, but, at the same time, is hard to find when walking through the crop. The patchiness has been observed in crops as early as the seedling stage. Unless aware that eelworm could be a cause, these patches can be often passed over as being of no consequence.

Points to look for in an infected crop:—
- Pale patches within an otherwise normal crop.
- Apparent nitrogen deficiency on areas which have received adequate nitrogen.
- Takeover of weeds such as cape-weed and doublegees to the almost complete exclusion of the crop.
- An uneven crop with very obvious areas of stunted growth.
- Malformed, stubby roots of either the seedling root system or the main root system.

Degree of damage

As a result of obvious stunting in growth and malformation of the roots, eelworms can cause severe yield reduction. Sampling at Dongara in 1966 showed that a severe attack could reduce wheat yields to only 20 per cent. of that from unaffected areas. Estimates taken in 1966 indicated that eelworms reduced the overall yield of a wheat paddock by 40 to 50 per cent. Yield losses of this order were also estimated to have occurred in a barley crop at Northampton and paddocks of oats have been affected to an even greater extent.

These are the most severe attacks but severe infestations accounted for some 30 to 40 per cent. of the areas found to have cereal eelworm.

The disease can be readily identified

The best means of identification in the field is to look for malformed roots. They can be recognised very early in the crop's life, even before the main root system has properly formed. Where infestation is severe, the seminal roots (or feeder roots from the seed) will develop the malformations. (See Fig. 2).

The roots appear stubby and clumped. Instead of branching freely the branches appear deformed and thickened. A small swelling also occurs at the point of branching.

Cereal eelworms form cysts which are often seen on the affected root system (Fig. 3). However, such cysts are often difficult to see by eye and can be confused with particles of sand. No other stage of the life history of cereal eelworm is visible to the naked eye. The above symptoms are characteristic and offer a quick and accurate means of identifying the disease in the field.

Conditions that favour the build-up of eelworm

Cereal eelworms take a considerable time to build up to serious proportions.
They have obviously been present in the Geraldton area for some time, but until 1966 were never in sufficient numbers to cause heavy crop losses. The following factors could account for the recent rapid build-up.

**ROTATION**

Very rapid build-up of eelworm occurs under a system of successive cropping and omission of fallow. With the exception of one area at Dongara, all seriously affected paddocks of the last two seasons have been under second or third successive crops.

There are two main reasons for the increase in successive cropping:

- The large increase in soil fertility following clover ley.
- The increasing use of nitrogen fertilisers.

The same reasons have been responsible for the omission of fallow. A bare fallow is a useful means of reducing the number of eelworms in the soil.

**SEASONAL CONDITIONS**

Although seasonal conditions have little affect on actual numbers of eelworms in the soil, they can be important for symptom manifestation. Very heavy rains early in the season leach soil nutrients—late opening rains delay germination until weather conditions are too cool for rapid crop growth. Under such circumstances the rate of growth of the cereal is slowed and eelworm damage enhanced.

**NUTRITION**

Any nutrient deficiency which reduces crop vigour and root growth could increase the severity of eelworm attack.

**Cereals affected**

All the cereals commonly grown in W.A.—wheat, oats and barley—can be seriously affected. Severe infestations have been observed on wheat at Dongara; oats and wheat at Moonyoonooka; and wheat, oats and barley at Northampton.

Victorian workers (J. Meagher & R. Brown*) have screened all commercial cereal varieties without finding any resistance in wheat. Variations in resistance occur with the oat and barley varieties. Some source of resistance has been recorded in some oat varieties in South Australia (Mathison 1966†). In the coming season (1968-1969) a large number of cereal varieties will be grown on affected areas at Geraldton to look for possible resistance.

**Grasses affected**

A number of grasses also harbour the disease. In the Geraldton area, wild oats (*Avena fatua*), Brome grass (*Bromus rigidus*), barley grass (*Hordeum leporinum*) and Wimmera rye grass (*Lolium rigidum*) all showed signs of infestation. Wimmera rye grass however, showed very little attack and was by far the least affected of the grasses examined.

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* Personal communication.
Control measures to be taken

Control measures should have two aims, both of which are extremely important.
1. Preventing a serious build-up of eelworm on already infested areas.
2. Preventing or minimising the risk of spread to uninfested areas.

PREVENTING BUILD-UP

Although soil fumigation can be used to control eelworm infestation, treatments at present are far too costly for use in broad-acre agriculture. Hence, cultural methods are the only means of keeping eelworms at low levels. Cultural treatments include:

- Reducing the number of crops grown on infested land.
- Keeping the density of grass to a minimum in pasture years.

The most serious outbreaks have been on second or third successive crops. The small outbreak at Nabawa occurred on a fourth successive crop. Any successive cropping, or a tight crop rotation on land where eelworm is present, will lead to a rapid build-up of eelworm numbers (Meagher & Rooney 1966*). This includes sowing oats as a cover crop when sowing clover after cropping.

It may be necessary to leave a paddock down to clover pastures for three or more years before taking off another cereal crop.

In view of the poor economics of growing oats as a grain crop, compared with wheat and barley, and since oats appear to suffer most damage from cereal eelworm, it is recommended that oats be excluded altogether from infected areas.

Barley is a good substitute for oats for grazing purposes and may be expected to suffer less from eelworm attack. However, it is likely that varieties differ markedly in their susceptibility.

Where cereal root rot disease and eelworm occur together, fallow might have to be incorporated in the rotation if successful cereal crops are to be grown.

During the pasture phase, the same practices of grazing pressure as currently recommended for the district, should be observed. These are:

- Graze to minimise the density of grasses such as barley grass, wild oats and brome grass in the pasture.
- Where grazing has been light, mow paddocks to reduce the seed set of these grasses.

MINIMISING SPREAD

It was mentioned earlier that the infestations have appeared in Geraldton's oldest farming areas and that build-up has taken place over a long period. It has been suggested that a possible source of introduction was the farm machinery brought in by early settlers.

As cereal eelworm is a cyst forming nematode (the cyst is a female packed with eggs) it is very resistant to desiccation. Carriage of these cysts by soil movement on vehicles or implements aids the spread of the disease.

Ploughing can spread eelworm within a paddock, and spread can be minimised only by adoption of the grazing practices mentioned above. Before moving to "clean" parts of the farm (or other farms if applicable), machinery should be hosed down to remove soil which could be harbouring cysts.

Soil conservation practices can reduce risk of spread of eelworm by reducing water erosion and hence soil loss to other paddocks, and indeed, other farms.

Summary

- The map on page 117 outlines a huge area which is potentially liable to infestation. If the control recommendations are followed in the already infested areas, it is hoped that this potential hazard will never eventuate.
- Farmers in the infected and suspect areas should learn to recognise the disease. Samples of malformed roots compared with healthy roots can be examined at the Department of Agriculture in Geraldton.
- Do not hesitate to call for assistance in identifying and controlling this pest of cereal crops.