Manganese deficiency in the cereal-growing areas

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MANGANESE deficiency in cereal growing areas of Western Australia appears to be restricted to some of the ironstone gravelly soils of certain districts. Wheat, oats and barley make poor growth on such soils unless the deficiency is remedied by applying manganese sulphate as a soil dressing or as a foliage spray.

Manganese is one of the trace elements which are essential to the healthy growth of plants. Most soils have adequate reserves of available manganese to satisfy the needs of plants. On deficient soils, however, small amounts of added manganese can give a normal crop where otherwise a complete failure would have resulted. It is, therefore, important to recognise manganese deficiency and to know the methods of controlling it.

TYPE OF SOIL AFFECTED

Within the area where cereals are normally grown for grain in Western Australia, manganese deficiency occurs only in relatively high level soils associated with lateritic outcrops. It does not follow however that all gravelly soils are deficient in manganese. Typically affected soils are very gravelly, particularly in the subsoil, and are usually very loose and powdery. The gravel is normally quite...
MAP SHOWING AREA WITHIN WHICH MANGANESE DEFICIENCY IS MAINLY FOUND IN W.A. CEREAL-GROWING AREAS.
dense and irregular in shape. Manganese deficiency does not occur on fine-textured (clay) soils nor on sandy-surfaced, non-gravelly soil types.

The main area within which manganese deficiency on cereals is of importance is shown in the accompanying map. It is seldom found, further north than Moora or further east than Kulin. Affected soils extend to the extreme western boundary of the cereal-growing zone, and in this western region the deficiency is common on the gravelly soils associated with the eastern boundary of the Darling Range.

Within the area defined, the type of soil affected is of the same general nature although there are differences in the vegetation and topographical features of the land. In the western section extending from Moora in the north to Kojonup in the south, the soils are very gravelly and are associated with trees such as wandoo (whitegum) and mallet. This is the gravel hill country which forms the eastern section of the Darling Range. A little further eastward around Narrogin, Pingelly and Wickepin, the deficiency is most common on the sharp lateritic hills and ridges which, in the virgin state, also carry mallet and whitegum. These hills often rise as sharp lateritic pinnacles or breakaways. Farther eastwards, for example in the vicinity of Corrigin, Dudinin and Kukerin, the deficiency is found on the hilltops of the more gently undulating country, and is particularly associated there with the powdery gravelly morrel soils. However, it does not occur on the calcareous morrel soils which are frequently found in the eastern wheatbelt.

CROPS AFFECTED BY MANGANESE DEFICIENCY

The cereals, wheat, oats and barley are all fairly susceptible to manganese deficiency. Of the three, however, oats are the most sensitive. Some varieties of oats are less susceptible than others, but these varietal differences may not be large enough to be of practical importance on most of our manganese deficient soils.

Cereal rye is very resistant to manganese deficiency, and for this reason has often been grown on manganese-deficient soils, where, in the absence of manganese application, other cereals have repeatedly failed.

SYMPTOMS OF MANGANESE DEFICIENCY

The general appearance of deficient crops is very characteristic. Affected crops germinate quite well and for six weeks or so appear quite normal and healthy. From this time onwards, however, patches of the crop begin to assume a pale
yellowish-green colour. As the season progresses these patches become paler and at the onset of warm weather assume a wilted, drooping appearance. The whole patch may die. These acutely-affected patches vary from a few square yards to several acres in extent. They are very irregular in shape but are clearly defined in outline. Often small clumps of healthy plants remain in the midst of wilted patches.

Wheat, oats and barley all show leaf paling which begins on the lower leaves and extends gradually to the newer growth. The pale leaves become limp and soft to the touch and ultimately die. Such affected plants often carry quantities of dead and wilted flag, particularly at the base of the plant. In severe cases the whole plant dies and no head is produced. In less severe cases a very weak head is produced.

Oats, in addition, develop a very characteristic symptom of manganese deficiency. After general paling, the lower leaves, in particular, develop dead areas in the centre portions of the blade. These dead areas which are commonly straw-coloured, cause the leaves to bend over and collapse at this point while the two extremities of the leaf are still green. Close inspection of plants will often show these leaf symptoms even though severely affected, manganese-deficient wilted patches are not apparent. Thus a considerable yield reduction can occur where no deficiency symptoms are noted on casual inspection.

Areas affected by manganese deficiency are often erroneously thought to be due to “take-all”—a fungous disease. Manganese deficiency can be easily distinguished from “take-all” by its typical appearance, and by the fact that, unlike “take-all,” it is confined to a characteristic type of gravelly soil, and by the fact that oats are severely affected. Oats are immune to the true “take-all” disease.

**CONTROL OF MANGANESE DEFICIENCY**

Manganese deficiency can be controlled by—

1. **Applied soil dressings of manganese.**
2. **Foliage sprays with manganese solutions.**

1. **Soil Application.**—Soil applications of manganese are usually applied by using superphosphate in which manganese sulphate has been incorporated. It has been found that a soil application of 14 lb. of manganese sulphate per acre is quite satisfactory for most of our manganese deficient areas. The fertiliser companies now prepare a mixture which contains 28 lb. of manganese sulphate per bag (187 lb.) of the mixture. This mixture should be used at a rate of not less than half a bag per acre. Special mixtures may be obtained by arrangement with the fertiliser companies when a different ratio of manganese to superphosphate is required, as may be the case when it is wished to use a heavy dressing of superphosphate without increasing the manganese sulphate dressing.

2. **Foliate Sprays.**—Manganese deficiency can also be cured by spraying the foliage with solutions containing manganese, which can be absorbed through the leaves. Low-volume spraying equipment suitable for this purpose can conveniently deliver about 10 gallons of solution per acre. Hitherto, this Department has recommended the use of a 2 per cent.
foliage spray (2 lb. of manganese sulphate in 10 gallons of water), but recent experiments on oats have shown that a 4 per cent. spray is more effective and does not injure the foliage. At least in the case of oats, it is therefore felt that on the more severely affected crops a 4 per cent. spray (4 lb. manganese sulphate in 10 gallons of water) at the rate of 10 gallons per acre, through a low-volume spray, should be used. Foliage sprays should not be applied when the foliage is wet from rain or dew, or when rain appears imminent.

The commercial manganese sulphate which is used for spraying has about 10 per cent. of impurities, many of which are insoluble in water. These insoluble impurities tend to block the fine nozzles of the spraying equipment. They may, however, be removed by mixing the material in a container, allowing them to settle, and then using only the upper liquid. Filtering through a fine filter such as calico before putting it into the spray equipment is an additional precaution which is well worth-while.

WHICH SHOULD BE USED—SOIL OR SPRAY APPLICATION?

Soil dressings of manganese applied with the superphosphate at seeding are very convenient and involve no extra operations. Furthermore, control by this method is very reliable and more effective than spray application. It is therefore recommended that soil dressings be used on severely affected areas when the presence of the deficiency is known prior to seeding.

Although spray applications may not effect as good a cure as soil dressings, there are occasions when this form of treatment is preferable. When the presence of the deficiency is unknown at seeding, or where affected patches are small and so scattered that large areas of unaffected land would have to be treated if soil dressings were used, foliage sprays can be very useful.

IS TREATMENT ECONOMICAL?

No matter whether soil or spray application is used, additional cropping costs will be incurred.

In the case of manganese superphosphate at 93 lb./acre the extra cost will be 12s. per acre.

For spraying a 4 per cent. solution of manganese sulphate at 10 gallons/acre, the extra cost will be about 2s. 6d. for the manganese sulphate and 6s. for application, i.e., a total cost of between 8s. and 9s. per acre.

Application of manganese superphosphate is therefore more expensive than spraying, but the extra outlay is definitely warranted.

Manganese superphosphate is easy to use, supplies manganese in the early growth stages when it is most needed, and gives greater grain yield increases than sprays.

Manganese sprays have a definite economic use where there are small isolated areas of the deficiency, or for land that only shows the deficiency in very dry years.

In conclusion it should again be emphasised that although a cost of up to 12s. per acre may be incurred in treating manganese-deficient soils, it will enable a very profitable crop to be grown in place of a complete failure. Therefore when
growing cereals on manganese deficient soils you cannot afford to omit manganese applications.

REFERENCES TO PREVIOUS WORK ON MANGANESE DEFICIENCY IN WESTERN AUSTRALIA


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