IRON DEFICIENCY IN *EUCALYPTUS DIVES* SCHAUER.

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Synopsis.

A chlorosis in *Eucalyptus dives* Schauer growing at Ginninderra, A.C.T., was observed during the spring of 1956 when rainfall was excessive and soils became waterlogged. It disappeared when the soils dried out and did not reappear in 1957 or 1958 when rainfall was below normal.

Treating affected leaves with iron compounds reduced the intensity of the chlorosis.

Spectrographic analyses of chlorotic foliage in 1956 and healthy foliage in both 1956 and 1957 showed that the iron content of various portions taken from chlorotic branches was generally lower than that of corresponding parts of healthy branches from both 1956 and 1957 samples.

Introduction.

Eucalyptus dives Schauer is widespread in Australia, grows readily on poor soils and dry ridges (Ewart, 1930) and is not ordinarily found in poorly drained situations (C. W. E. Moore, private communication).

Pryor (1956) reported that this species was one of a relatively small group (Renantherae) of Eucalypts that readily developed chlorosis if grown in steam sterilized soil but was healthy in the same soil unsterilized. He concluded that this chlorosis was due to the absence of mycorrhiza on the roots following sterilization of the soil.

During the late winter of 1956, chlorotic foliage was observed on a number of adult trees of *E. dives* growing at Ginninderra in the Australian Capital Territory. The affected leaves were the younger ones occurring mostly on the northern and north-western sides of the trees.

The rainfall at Ginninderra in 1956 was nearly twice the normal amount of approximately 24″ p.a. and soils were waterlogged during the winter. Many species of trees in the Australian Capital Territory suffered from excessive wetness and some died.

Experimental Procedure.

During the spring of 1956, chlorotic leaves on an affected tree were matched for colour, labelled, and six at random were dipped into a solution of ferric potassium ethylene-diamine tetra acetate (0·2 ppm iron) containing a small amount of Tween–20 spreader.

A number of chlorotic leaves were detached, six were partly immersed in distilled water and six in a solution of ferrous sulphate (0·04 ppm iron) in petrie dishes in the laboratory.

Six branches bearing normal and six having chlorotic leaves were detached from trees and separated into current seasonal growth and previous seasonal growth as indicated by the colour and development of the main stem. The older portion was further subdivided into leaves and peduncles.

In 1957 no chlorotic leaves were evident and branches were taken at random during the spring when the trees were at the same growth stage as those sampled in 1956. These were separated into bulk fractions as in the previous year.

The samples were analysed spectrographically, standards for the analyses being prepared by adding known amounts of the elements under analysis to portions of a composite sample of dry matter. Sulphated ash of the samples and standards were

packed into cavities in graphite electrodes and arced at 15 amps d.c., the lower ash-filled electrode being the anode. The spectrograph used was a Hilger Large Quartz instrument set at the wave-length range 2450–3500 Å, the plates were Ilford Thin Film Half-tone and development was effected using ID13 developer. Analysis line intensities were computed from line densities measured on a Hilger non-recording microphotometer. The coefficient of variation associated with this method of analysis is about ± 10% for a single determination. The estimates of concentration of the elements sought were made on the means of triplicate spectrographic determinations on each ash sample.

Results.

Four weeks after treatment with Fe–K–EDTA the chlorotic leaves on the trees had developed green patches of colour in places where injury to the cuticle had occurred from various causes. The untreated leaves with similar injury to the cuticle remained chlorotic.

Table 1.

Content of Iron, Manganese and the Iron/Manganese Ratio in the Dry Matter of Healthy and Chlorotic Foliage of Eucalyptus dives *Schauer from Ginninderra, A.C.T.*

Sample.	Fe. (P.p.m.)	Mn. (P.p.m.)	Fe/Mn Ratio.
A. Current seasonal growth.			
1956 (wet year):			
Healthy foliage	95	620	0·156
Chlorotic foliage	45	870	0·053
1957 (dry year):			
Healthy foliage	70	449	0·156
B. Previous seasonal growth.			
1956 (wet year):			
Healthy leaves	85	627	0·135
Chlorotic leaves	40	404	0·099
Healthy peduncles	85	449	0·189
Chlorotic peduncles	62	888	0·070
1957 (dry year):			
Healthy leaves	155	745	0·208
Healthy peduncles	175	790	0·221

In the laboratory, the leaves immersed in the solution of ferrous sulphate became greener after about 10 days, the mid-ribs darkened and numerous dark spots developed near their apices. Those immersed in water did not change colour or develop spots.

Table 1 gives the results of spectrographic determination of the iron content of various portions taken from chlorotic and healthy branches. It will be noted that it was lower in chlorotic samples taken in 1956 than in healthy samples taken in both 1956 and 1957.

As it is known that reduced uptake of iron under waterlogged conditions is often associated with excessive uptake of manganese (Twyman, 1946), the manganese concentrations were also determined and these figures are included in Table 1.

Discussion.

Since the analyses showed that the unhealthy parts were lower in iron than the corresponding healthy ones, and the treatment of the chlorotic foliage with iron compounds caused greening to occur, it is evident that the trees were suffering from an iron chlorosis in 1956 (Karschon, 1956).

As Leeper (1935) has shown that the availability of soil manganese can be greatly increased during a wet season it is to be expected that in 1956 trees in the Australian Capital Territory had a greater opportunity for taking up an excessive amount of manganese than usual.

Smith and Specht (1953) have shown that a reduction in the Fe/Mn ratio is characteristic of iron chlorosis induced by an excessive uptake of manganese. The

ratios given in Table 1 are not inconsistent with this, but it should be noted that the manganese concentration was not in every case higher in chlorotic than in healthy foliage.

McCool (1935) has shown that manganese induced iron chlorosis is more severe in high light intensity and Wiederspahn (1957) showed that these symptoms in apples developed first on the better lighted sides of the trees. Since the iron chlorosis observed in *E. dives* at Ginninderra occurred on the northern and north-western sides of the trees, it, also, was probably dependent on incident light intensity.

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