A SURVEY OF SOIL AND PLANT LEVELS OF TRACE ELEMENTS IN NSW COTTON AREAS

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Questions are often raised about whether trace elements are required on cotton. Zinc deficiency has been confirmed in areas where topsoil has been removed, and zinc application is common in many areas, despite a lack of evidence for a general zinc response. More recently, copper has been proposed as deficient in some areas.

With this background it was decided to sample soil and plants from a number of cotton fields from Warren to Boggabilla. The soil was sampled to 30 cm depth as near to planting time as possible. Leaf and whole plant samples were taken from the same fields during flowering. These samples were analysed for zinc, copper, iron and manganese. In addition plant samples were taken at regular intervals from experiments at Narrabri to determine the pattern and extent of uptake of each trace element.

The precise aims of the project were to determine the timing and amount of trace element uptake by cotton and to measure the range of trace element levels in soils. The extent of any deficiency and methods of correcting the deficiency can then be approached in a scientific fashion. For example, timing of uptake could indicate the best application times, and the survey may indicate the most responsive sites.

Samples were taken during the 1984/85 season, and other than slow emergence at some sites, the climate was ideal for high cotton yields.

The location of fields by region is shown in the following table:

Region	Number of fields sampled
Macintyre	4
Eastern Gwydir	6
Western Gwydir/Moomin	8
Namoi	9
Macquarie	6
Breeza	2
Total	35

It must be emphasised that this was not a random sample of fields. On most occasions, the owner/manager/agronomist was asked to nominate some field(s) from which samples could be taken. Most people nominated fields which they had an interest in, or a suspicion about.

A summary of soil and plant results from the 35 fields is shown in Table 1. There were only two instances where soil test values were less than the corresponding nominal critical value. There were no occasions when plant tissue levels indicated deficiency.

Table 1. Summary of survey of 35 cotton fields

		Nominal Crital value	Survey results Minimum	Mean	Maximum
Soil tests					
pH in $Cacl_2$		-	6.9	7.3	7.6
EDTA extraction	Zinc	4	2.1	6.2	15.5
(ppm)	Copper	2	2.3	5.6	9.2
	Iron	80	27.8	166.3	354.2
	Manganese	-	.5	1.1	2.1
DTPA extraction	Zinc	.5	1.2	2.5	4.8
(ppm)	Copper	.3	1.8	2.2	2.9
	Iron	2	4.0	7.6	17.4
	Manganese	2	15.5	23.7	48.5
Plant tests					
Leaf blade	Zinc	11	11.6	23.0	37.2
(ppm)	Copper	2	4.8	7.1	9.5
	Iron	30	90.0	162.0	264.7
	Manganese	15	43.1	148.6	404.0
Plant uptake	Zinc	-	22.0	61.9	113.8
(g/ha)	Copper	-	9.1	19.6	49.5
	Iron	-	209.5	594.4	1122.5
	Manganese	-	55.9	449.2	1574.1

In terms of total uptake of trace elements, iron was taken up in greater amounts (600 g/ha), followed by manganese (450 g/ha), zinc (60 g/ha) and least for copper (20 g/ha). To put these values into perspective, the desired uptake of nitrogen by cotton is about 110 kg/ha; or more than five thousand times the copper uptake.

Of equal interest was the relationship between soil test and plant test: at best there were only slight correlations for zinc, iron and manganese. The DTPA (eg CFL test) extraction was best for zinc and iron; the EDTA (eg Quantum test) extraction was best for manganese. There were no statistical correlations between copper soil tests and copper levels in the plant.

The best relationships for zinc, iron and manganese were between soil test and trace element uptake rather than the content in the leaf blade. In fact the site with the lowest zinc content in the leaf blade, actually had large plants and a very high yield.

The timing of uptake presented some surprising trends. Copper and zinc appeared to be taken up throughout the season. By contrast, iron was taken up early in growth with the peak iron uptake occurring before flowering. The timing of manganese uptake was intermediate. These data are summarised in the following table.

Element	Maximum rate of uptake g/ha/day	Time of maximum uptake day degrees from sowing
Zinc	2.8	1000
Copper	1.1	1280
Iron	35.0	720
Manganese	3.9	860

It must be concluded that the sites sampled in this season were not deficient in any of the trace elements measured. Zinc status was relatively lower than copper, iron or manganese. It is therefore impossible to suggest that the nominal critical values for soil and plant tests are adequate, or even whether soil or plant tests are adequate. The survey indicated lowest soil and plant zinc levels in the Garah area of the Gwydir Valley. This would appear to be the most likely area to experiment with zinc.

Application strategies

Studies elsewhere (Weir and Holland on corn at Breeza) on zinc have shown that application timing is critical. Zinc must be applied at soil preparation and thoroughly incorporated. Rates of up to 20 kg zinc ha were shown to last for seven years. Form of zinc was not as important as timing and extent of incorporation. These soil applications were superior to foliar sprays; but where foliar sprays were used, they had to be applied before flowering to be effective.