Appendix 4. COMPARATIVE TISSUE ANALYSIS FOR ACCELERATING FIELD TRIAL

The philosophy of this approach is to start field trials as soon as possible and to maximize information that can be obtained through careful monitoring using *comparative* tissue analysis.

Selection of Treatments for Field Trials

If sufficient soil analytical information from soil surveys is lacking, the technique described in Appendix 3 can fill a void in helping to determine nutrient factors that should be examined in a field trial. This approach advocates a breakaway from normal dogma concerning the collection of soil samples for fertility analysis, which usually recommends the making of an artificial composite sample from 12 to 20 subsamples in the field. Such a technique is useful for monitoring fertility characteristics of individual plots in a field trial, but is not so useful for obtaining a preliminary judgment to select treatments.

Once the treatments are chosen, field trials should be kept as simple as possible; replicated plot designs are often adequate. However, the size and number of plots are important considerations. Plots should be large enough to facilitate "splitting" of treatments. Additionally, nontreated plots should be laid down alongside the trial for further work, wherever possible.

Monitoring

Once the treatments and design of a trial are chosen, a program for monitoring the trial through soil and, especially, tissue analysis on a plot by plot basis is essential. Composite samples for both soils and tissue samples should be used to fairly represent the plot by plot treatments. Tissue analysis should be as complete as possible. Most laboratories, even in lesser developed countries, have a capacity or could easily extend their capacity to do this work. Consequently, the fertility specialist has a reading on all elements necessary for plant nutrition.

Treating Tissue Analytical Data as Yield Data

By taking plot by plot composite tissue samples, Cochrane (1979a) has shown that the need for a prior knowledge concerning tissue analytical figures is obviated. He illustrated that the analytical data for the samples can be treated and analyzed statistically in the same way as yield data, to determine any significant differences. This is a considerable break from existing practices, which center around the time consuming and costly procedures previously advocated for establishing "critical" levels for tissue analytical data. Obviously, the use of tissue analyses will be enhanced if previous work is available to obtain an idea as to possible deficiency levels.

Cochrane has emphasized that in order to take meaningful tissue samples, the trial must be monitored for *meteorological conditions,* especially moisture stress. Tissue samples are thus best collected after a suitable period of nonclimatic-induced conditions.

In the case of the plot by plot composite soil samples, these should be taken to reflect changes in soil brought about by fertilizer treatments. It is not sufficient to take "before" and "after" samples; they should be taken to fairly monitor the effect of fertilizer on soil conditions such as pH and, ideally, the transport of nutrients down the soil profile. Certainly both "topsoil" (perhaps 0-20 cm) and subsoil (21-50 cm) samples should be taken.

Implementing the Results of Monitoring

Once the trial has been laid down and monitoring has started, any results of the monitoring that suggest the need for further in-field trial treatments should be implemented as soon as possible. Comparative tissue monitoring ensures that appropriate action can be taken timely enough to investigate problems not obvious from the original soil analytical data. For example, Table A4-1, adapted from one of Cochrane's trial results, shows how the Mn concentrations in the leaves of sugarcane altered with increasing applications of $(NH4)2SO4$ This was detected soon after the trial started and led to the speedy laying down of a supplementary trial to confirm that Mn was indeed deficient. In another trial reported in the same paper (Cochrane, 1979a), the levels of Zn looked suspiciously low; again, speedy action by splitting the trial for Zn led to the finding that Zn was, in fact, deficient. The net result of this work was that fertility problems were identified and fertilizer practices formulated with a minimum of delay.

Summary

Appendix 3 describes ways and means for enhancing the soil fertility information in soil surveys with relatively little effort. Appendix 4 was prepared to emphasize that there are proven innovations for speeding the process of making field-tested, farm fertilizer recommendations. The use of tissue analysis to complement fertilizer trials on a plot by plot basis is independent of a prior knowledge of nutrient content and would have wide applicability.

Table A4-1. Effect of increasing rates of NH_4SO_4 on yield of cane and sugar and concentration of mineral constituents of the leaf on a dry matter basis.

N rate (kg/ha)	Wt. of cane per plot (kg)	Wt. of sugar per plot (kg)	Mineral concentrations in leaf						
			N (%)	P (%)	K (%)	Ca (%)	Mg (%)	S (%)	Mn (%)
0	393	30	1.14	0.16	1.00	0.18	0.10	0.10	23.8
22	453	34	1.17	0.13	0.97	0.20	0.09	0.11	26.3
44	506	38	1.26	0.16	1.14	0.20	0.12	0.12	26.3
66	532	40	1.13	0.13	1.00	0.20	0.11	0.13	28.3
88	611	49	1.38	0.14	1.01	0.19	0.12	0.13	36.3
110	701	50	1.39	0.16	1.15	0.16	0.12	0.11	41.3
LSD ($P = 0.05$)	36	4.14	0.11	–	–	–	–	–	6.8

SOURCE: Cochrane (1979a).