CALCIUM OXALATE CRYSTALS AS AN INDEX OF NUTRIENT UPTAKE IN THE TEA PLANT

D. N. BARUA

Tocklai Experimental Station, I.T.A. Scientific Department, Cinnamara, Assam

IN a previous communication[1] it was shown that the frequency of calcium oxalate crystals in the tea plant (*Camellia sinensis* L.) differs between clones and between populations raised from distinct seed sources (*jats*). A standard crystal count was called *Phloem Index*: this was considered to be indicative of the K/P balance of the tea plant. It was further shown that regeneration of shoots in response to plucking is related to phloem index.

Subsequently, leaf-stalk injection described by Roach[2] was used to study change of crystal frequency caused by nutrients injected into the vascular system. Growing shoots on unplucked bushes were used. The apex of these shoots is a compact structure from which leaves unfold at intervals. On a growing shoot, the leaf wrapped around the apex and the four unfolded leaves below this are increasing in area.

Preliminary observations were made on the movement of dye from one leaf to another. Fully expanded leaves in various positions on the stem were injected with 0·25% acid fuchin. Tea has a 2/5 phyllotaxis. The dye permeated the second and third leaves above and below the one injected. The fifth leaf above injection point was sometimes permeated, possibly when a large amount of dye was taken in by the injected leaf. The pattern of distribution of the injected dye was the same as that observed by Roach[2] in Pear (with the same phyllotaxis as tea).

Roach[2] found dye permeation to increase in proportion to reduction in size of the leaf used for injection. In our work a larger volume of solution might have been injected by using a shorter basal piece of leaf, but it was difficult to work speedily with less than one-third of the mid-rib *plus* petiole and this length (approximately 1·0"), therefore, was used throughout the experiment.

When the third, immature, leaf below the apex of a tea shoot was injected, then dye permeated only the second leaf above and below injection point, but some colouration was seen in the upper third leaf which was wrapped around the apex at the time of injection.

The third leaf below the apex was used for nutrient injection. The lamina of the basal one-third of this was trimmed and the remaining stalk immersed in solution contained in a glass vial (⅜" × 2") between 10 a.m. and 1 p.m. (local time) on 10th October 1955. Vials were removed at 10 a.m. on the following day.

Petioles of the second and third leaves above injection point were used for crystal counts. These leaves had well-developed vascular tissue on the date of injection and were respectively 20 to 25 days short of attaining their maximum area (approximately). Crystal counts were made 6 weeks after injection.

Three bushes in each of four clones were used, all the bushes being contained in an area of approximately 50′ × 50′. Ten shoots on each bush were selected for injection, two for each nutrient solution and two for controls. The nutrients, in distilled water, were as follows:

Urea	0·25%
Potassium sulphate	0·25%
Calcium chloride ($2H_2O$) ..	0·25%
Distilled water.	

Concentrations of potassium sulphate and calcium chloride higher than the foregoing caused a marginal necrosis resembling the condition commonly known as "rim blight": this is considered to be a metabolic disturbance. "Rim blight" can be induced by inorganic manures applied during early stages of shoot growth following pruning. In this connection it is to be noted that potassium sulphate used as a fertiliser can induce more rim blight than ammonium sulphate.

The analysis of variance of phloem index is given in Table I and results for treatments, clones and leaves, in Tables II to IV. In the concentrations used for injection, urea and

TABLE I

Analysis of variance of phloem index

Source of variance	D.F.	Mean square	F.
Between clones ..	3	52932·9	130·75‡
Within clones ..	8	404·8	
Bushes ..	11	14730·7	
Treatments (nutrients) ..	4	1969·4	8·03‡
Bush × treatment ..	44	245·3	
Leaf position ..	1	1230·5	4·97†
Position × treatment ..	4	317·4	
Remainder ..	165	247·7	
Total ..	229*		

* Degrees of freedom adjusted for missing values; † Significant at 5% level; ‡ Significant at 0·1% level.

potassium sulphate reduced the crystal frequency to less than that of untreated leaves. Crystal frequency did not differ between untreated leaves, leaves injected with water, and leaves injected with calcium chloride. In confirmation of previous observations, a limited range of crystal frequency was found to be characteristic of a particular clone.

TABLE II

Mean phloem index for treatments

Urea	..	69·7
Potassium sulphate	..	73·7
Calcium chloride	..	82·5
Distilled water	..	81·3
Control	..	85·5

Difference required for significance (P = 0·05) : 6·8

TABLE III

Mean phloem index for clones

Clone		Phloem Index
16/10/22	..	90·0
19/19/8	..	73·5
19/10/3	..	112·8
19/27/11	..	41·1

Difference required for significance (P = 0·05) : 8·8

TABLE IV

Mean phloem index for leaves

2nd leaf	3rd leaf
76·3	81·0

Difference required for significance (P = 0·05) : 4·1

Injected urea, and ammonium sulphate applied to the soil[1] both reduced crystal frequency, from which it can be presumed that uptake of certain nutrients by the roots will determine crystal frequency within genetical limits. Crystal frequency, therefore, appears to be a sensitive quantitative index of metabolic changes associated with nutrient uptake which could be used to investigate the relation of the tea plant to environment. When a standard clone has a constant crystal frequency in several locations then a difference between crystal frequency caused by injection and crystal frequency caused by application of the same nutrient to the soil may alter with locality, and so indicate soil variation of importance for the growth of the tea plant. The nutrients required for the cultivation of tea are likely to be those that when injected cause a reduction in crystal frequency.

The author is indebted to Dr. W. Wight and Mr. E Hainsworth for suggesting the lines of investigation, and to the Director of Tocklai and the Indian Tea Association for permission to publish this paper.

1. Wight, W. and Barua, D. N., *Curr. Sci.*, 1954, **23**, 78.
2. Roach, W. A., " Plant injections for diagnostic and curative purposes," *Imp. Bureau of Hort. and Plantation Crops Tech. Comm.* No. 10, 1938.

AN APPARATUS FOR THE DETERMINATION OF THE WATER REQUIREMENTS OF CROPS

S. PARAMESWARAN

Division of Agricultural Meteorology, Poona-5

THIS article describes how the exact measurement of the water losses by transpiration from crops, evaporation from the soil, etc., may be made, employing an electronic technique.

The amount of water required by a growing crop depends upon the soil as well as the plant itself. The plant, of course, transpires water and thus contributes to a certain extent to the loss of water. In addition, an appreciable amount of water is also lost due to evaporation, etc., from the soil and this loss depends upon the type of soil. Though the loss of water due to these two factors is large, and thus seemingly easy of exact measurement, it should be noted that this is very small compared with the weight of the soil itself, which is unavoidably large. The measurement of the change in weight represented by the loss of water from a large mass of soil presents indeed a difficult problem.

It should also be borne in mind that any method devised should also, if possible, enable the continuous recording of the loss of water during the day. An apparatus that accomplishes this without any complexity and which can be adapted for continuous recording as well, is described below.

PRINCIPLE

The underlying principle of the method is the annulling effect of the dead weight of the soil through a process of equilibrium by means of suitable counter weights and the conversion of the superimposed small changes in weight