Summary and Conclusion. In an arrowed cane there is only a slight elongation in the top joints.

Arrowed canes deteriorate after about 2½ months from the time of arrowing, while there is continuous growth and steady increase in the sucrose content of the non-arrowed canes ; consequently, there is loss due to arrowing.

Though arrowing is a distinct disadvantage in many respects, an arrowing, and quick growing variety will be found useful for early crushing by factories in November, when other varieties are not rich enough in sucrose.

Periodical sectional analysis of canes from top downwards on dead leaf samples has revealed that there is a steady improvement in sucrose content in all sections.

Arrowing involves a loss of green tops suitable for fodder purposes.

SOIL CONDITION AS AFFECTED BY CROPPING IN THE BLACK SOIL AREA OF THE TINNEVELLY DISTRICT

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The ryot of the black soil tract of the Tinnevelly and Ramnad districts adopts usually the following rotation :— Fodder cholam (*Andropogon Sorghum*), Cotton, (*G. indicum gammie*), Cumbu (*Pennisetum typhoideum*), and Cotton; whenever cotton follows cumbu, the yield is normal, but it is depressed when coming after a fodder cholam crop. Actually the figures collected from 1905 onwards show that the yield of cotton after Irungu (the variety of cholam grown) is about 15% less than that after Cumbu. The results of an investigation of this phenomenon, carried out under a scheme financed by the Indian Central Cotton Committee, showed that the growth of fodder cholam tended to alter the physical condition of the soil. After the cholam crop, the soil often turns out in clods under the plough, cracks but little, and has been observed to be considerably less permeable than after cumbu. A search for the more obvious agencies such as depletion of moisture, soil exhaustion etc., having proved futile, it was surmised that the adverse alteration of soil condition induced by cropping was responsible for the poor yield of the subsequent cotton crop.

Change of soil condition, producing profound and striking effects on crop growth, is a phenomenon with which many agriculturists will

be familiar. In fact many of the cultivation practices in vogue in different tracts have been evolved through the ryot's experience of tract, season and water supply, to promote that soil condition which is most favourable for crop growth; and when for some reason or other, an apparently meaningless departure is made from the cultivation practices, it has resulted in poorer crop-return. In the Godavari and Tanjore deltas for example, it is usual after the harvest of paddy, to leave the land fallow during summer without any preliminary cultivation whatsoever, and to take up puddling only after the receipt of rains. In Godavari, attempts on the part of the ryots to raise sugar-cane oftener than once in three years (as is the usual rotation) has entailed the crowbaring or ploughing of the soil after paddy. This has resulted in the soil becoming '*gulla*' or loose and crop growth on this kind of soil has always been poor. Similarly in Tanjore the effect of ploughing the field during summer has been to decrease the yield of paddy that season. A common feature of such phenomenon was an obvious change in soil texture which revealed itself in most cases in reduced rates of percolation or in the refractive behaviour of the soil under the plough and an explanation based on such changes appeared satisfying. The gulla soil, for example, was soft, sponge-like, cracked but little and was tenacious of moisture; so also in Tanjore, summer cultivation of the heavy illdrained soils "causes the cracks in the land to close, which stops all movement of water through the soil when the field is flooded." It should however be admitted that explanations such as these are mere records of observations and cannot be considered satisfactory and much less capable of leading to a control of the phenomena in question.

The only instance known to us for which a scientific explanation has been attempted is the one by Breazeale[1] in connection with the effect of sorghum on the succeeding crop. Breazeale was inclined to attribute the changed condition of the soil to a decrease in available carbondioxide, which again was attributed to reduced bacterial activity. It is not possible to discuss all his arguments here. It may be stated, however, that the theory advanced is not based on direct experimental facts.

In view of these observations, the work reported in this paper, should be of great interest ; for experimental work on the Koilpatti soils has thrown considerable light on the probable causes that are responsible for altering the soil condition and their mode of action.

Experimental results. The experimental investigation was mainly along two avenues, which are detailed below in brief.

(a) *Cationic composition of soils.* Samples of soil were drawn from plots cropped with cholam and cumbu, from successive depth-intervals of 6" during several stages of the growth of the crop and

1. BREAZEALE : Jour. Amer. Soc. Agronomy (1934) 16, pp. 689—700.

were analysed for exchangeable bases. The results are given in brief in table I and are examined statistically in table I-A. It will be seen from the analysis of the data that all the three interactions are definitely significant showing that changes in the exchangeable sodium occur as a result of crop growth and that the extent of such changes is different with the different crops. The soil after Irungu has more exchangeable sodium than the soil after cumbu; further, with crop growth, the exchangeable sodium rises in the soil especially in the top layers of cropped plots; in a *fallow* plot the exchangeable sodium remained more or less constant when examined at various intervals during the season; but in the cumbu and Irungu plots the soda went on increasing from October when the crops were sown to February when the Irungu fodder was cut.

(b) *Variations in the total colloid content of the soils during crop growth.* Samples of soil were also drawn from the several layers at different stages of the crop with a view to find out if there are changes in total clay content. The results are shown in Table II. Here again it will be seen that there is an increase in clay content with the growth of the crop in the top layers of the soil.

Discussion. A good friable texture in a heavy soil depends for example, upon the clay particles being generally flocculated and gathered into little aggregates promoting tilth. Clays which are rich in calcium, are easily flocculated like this, and are least retentive of water; sodium clays on the other hand are more sticky, dry less readily and are more easily dispersed, and this is in fact the type of change observed in the condition of the Koilpatti soil when they are cropped with cholam. The increase in exchangeable soda, noted above i. e. in alkalinity, would, by itself, be sufficient to explain the deteriorated condition of the soil after cropping, as it is only too well known that alkaline soils possess in general a poor texture. Also, it is easy to understand why this increase in alkalinity should follow on cropping with the cereals. The black soil area of the tract contains at a depth of about 3 feet to 4 feet a layer rich in sodium salts and it is probable that when shallow rooted crops are raised, water is lifted from the lower layers as a solution of these salts, which then interact with the calcium soils and leave them more alkaline.

This would, however, mean that cropping in general tends to produce more and more of alkalinity in the surface soils and a logical consequence of such a hypothesis should be that, in general, these black soils should be becoming increasingly alkaline with cultivation, which certainly is not the case. On the other hand even the " cholam effect " is but a temporary phase and does not last for more than one season. The soils get corrected, usually during the period of the succeeding crop; often, a simple fallow, or even a droughty summer

proves sufficient. These observations would appear to indicate the need for formulating an easily reversible mechanism, as the cause of the injurious after-effects of the cropping.

In the gentle flats of the black soil area, the processes of soil formation appear to be much the same as what obtain in other clay flats like those of Sudan and Egypt. A consistent feature of these formations is the absence of any sharp changes in the profiles down to the kunkar layer. Extensive studies of similar profiles in those countries have pointed out that, due to the intermittently moist conditions, their tropical situation, and their heavy nature, a mixing up of the soils of the whole profile is an annual feature and mass transport of soil material (upwards probably in the ascending water columns and downwards through the cracks that these soils develop during summer) should be of common occurrence; this latter is in all probability the agency that corrects the temporary aberrations in soil conditions observed as a result of cropping. The increase in the clay content of the several layers of the soil with the growth of the cholam crop is in all probability due to such movements of colloidal clay *en masse* and sodium clay being the most mobile is likely to be the predominating constituent of such moving masses. This may also be an additional cause for the increased alkalinity induced by cropping.

Again the downward transport of the clay material thus brought up to the surface depends largely on the extent of cracking developed by the soils which in turn depends on the degree of alkalinisation. The cholam crop has been found to leave the soil distinctly more alkaline and therefore less liable to crack; in such a soil, this downward transport of the clay material on which depends its restoration to the original state should suffer considerable retardation and this is exactly what is found. These soils crack poorly and the yields of the succeeding cotton raised on them are reduced by 15 to 20 per cent.

Reference to the table I on the rise of exchangeable soda during crop growth, will show that while both cumbu and Irungu soils definitely show an increase over the fallow soil, the actual difference between cumbu and Irungu is but little, being about 1 to 2 milli-equivalents only, at each stage of examination.

Ratner[2] has shown that quite small changes in exchangeable sodium of heavy soils are sufficient to bring about appreciable changes in the physical behaviour of soils and it is probable that, while with the rise of soda in it also, the " after-cumbu " soil does not show any great changes in physical condition, the slightly greater rise in the " after cholam " soil is responsible for all the faults laid at its door suggesting thereby the existence of an optimum point, which, when exceeded, affects the texture considerably.

2. RATNER E. T. Soil Science (1935). Vol. *40* pp. 462—3.

Table I.

EXCHANGEABLE SODIUM

(in milli equivalents per 100 g. of dry soil)

Time of sampling.	Top 6 inches.			Second 6 inches.			Third 6 inches.			Fourth 6 inches.			Fifth 6 inches.		
	Cumbu	Irungu	Fallow	Cumbu	Irungu	Fallow	Cumbu	Irungu	Fallow	Cumbu	Irungu	Fallow	Cumbu	Irungu	Fallow
Before sowing	3·96	3·94	2·24	3·03	3·13	2·97	3·20	4·48	3·74	14·44	14·94	15·05	14·99	17·19	15·61
Immediately after N. E. rains	6·60	7·30	3·24	8·59	10·35	4·53	9·12	9·82	4·50	10·02	12·99	13·32	15·70	20·09	17·17
At Shot Blade (Irungu)	8·71	10·78	3·89	7·74	9·85	4·70	9·50	10·37	5·12	10·74	13·84	13·67	15·82	19·53	16·89
After Harvest (Irungu)	8·96	11·14	3·96	8·14	11·26	4·91	8·97	11·02	5·64	10·68	13·86	13·94	15·86	19·78	17·21

Table I A.

Statistical Analysis of the Data in Table I.

	Degrees of Freedom.	Mean Variance	Value of Z= Found	Calculated. (P=·01)
Seasons	3	23·97		
Crops	2	51·35		
Layers	4	283·31		
Season X crops	6	3·58	1·043	0·650
Crops X layers	8	7·71	1·415	0·606
Layers X seasons.	12	9·28	1·509	0·554
Residual	24	0·454		

Table II

Clay Percentages at different stages of crop growth After Irungu set seed—soil,

	0 – 6″	6″ – 12″	12″ – 24″
Before sowing	39·17	40·46	41·55
At shot blade	41·67	41·17	41·98
After Harvest	46·83	45·59	46·54

Note: The figures are the averages of 3 samples for each at each stage.

Summary. Growing of fodder cholam in the black soil tract of the Tinnevelly District has been known to produce certain obvious changes in the physical condition of the soil which is probably the cause of the reduced yield of the cotton crop following cholam.

During the growth of the cereal crops of the tract, a rise in exchangeable soda as well as in clay content of the surface layers has been shown to take place, more in the case of cholam crop than in cumbu.

The probable cause of such rise and their relationship to the changes in the physical condition of the soil are discussed.

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FRUIT SUCKING MOTHS ON TOMATOES AND THEIR CONTROL

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Introduction. In July 1935, a crop of tomatoes was raised at the Insectary and it grew well for about 3 months in spite of occasional trouble from certain caterpillars. In October, however, with the advent of the fruits, large numbers of fruit sucking moths appeared and began to pay their attentions to the crop. Hiding by day under bushes and appearing on the scene under cover of darkness these destructive hordes of delicate creatures with pale green forewings and bright yellow hind wings became a menace to tomato culture. They pierced the fruits with their proboscis ; circular patches appeared at the place of feeding and rotting set in with the result that the fruits were utterly useless for human consumption. Taking advantage of the presence of these moths in large numbers detailed observations as to their habits were made and various remedial measures tried.

Life History and Habits of the Insect. Eggs are laid by the female moth on the leaves of a weed known as *Tinospora cordifolia* (சிந்தி கொடி.) The newly hatched cater-pillars feed on the tender