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## EDITORIAL

**The Madras Agriculturists Relief Act.** Among recent legislative enactments of the Madras Government calculated to ameliorate the economic conditions of the vast agricultural population, the Madras Agriculturists Relief Act 1938, takes prime place. For sometime past the Government of the province had realised that following several years of continuous agricultural depression, the lot of the small land holders and tenant-farmers was far from enviable. Bereft of other sources of income than the interest in their land, the small cultivators who form the real back-bone of the country, were drifting year after year into a state of indebtedness and consequent ruin. The proverbially usurious rates of interest they had to pay on their borrowings and the exorbitant rent the tenants had to pay to the big landlords began to result in the inevitable transfer of the land which formed practically their sole earthly possessions. It was at such a critical period, when nothing short of a colossal endeavour and a bold and statesmanlike policy could rescue the small farmer from the clutches of the ubiquitous money-lender or the exacting land-lord, that the Government of Madras introduced in 1937 a bill called the Madras Agriculturists Relief Act. Though the bill was hotly opposed at every stage by the vested interests in the country, it was ably steered through by the popular Government and become law in 1938. As a piece of statesmanlike legislation the Act revealed a commendable insight on the part of the Government into the actual conditions of the small land-holders and tenant-farmers and an earnest desire to help them. While the Act contemplated giving relief to the agriculturists, adequate provision has been made to ensure that none but deserving agriculturists benefit by an arbitrary scaling down of debts. One of the outstanding provisions of the Act is that such debtors as have paid back twice the amount of the principal, would be deemed to have cleared their debts irrespective of any renewed documents executed by them. Again, in the case of debts contracted after 1st October 1932, no debtor is obliged to pay a rate of interest higher than 5 per cent simple interest. In the matter of accumulated arrears of rent, such arrears up to Fasli 1345 (1935-36) will be deemed to be discharged provided the tenant pays the rent due for two years within a specified period. It may be recalled that at the time the bill was on the anvil several doubts and fears were expressed about the propriety of such a legislation and grave consequences were predicted as

the after-effects of such a measure. It was freely expressed that the little money which the agriculturists could hitherto borrow, would not be forthcoming, for the moneyed classes would be shy of investing their capital in such form. The experience gained in the working of the Act during the last two years has, however, belied such fears and it may now be asserted without contradiction that the Act has worked as a boon to a very important section of the population. The extent of benefits accrued can be gleaned from a recent Press communique issued by the Development department. During the 25 months ending with March 1940, 1,32,790 cases were disposed of involving a total of four crores and ninety lakhs of rupees which does not cover innumerable cases voluntarily settled outside law courts. If further proof were needed about the success of this legislation it is afforded in the rapid introduction of very similar measures in some of the provinces and states in India.

**The late Maharaja of Mysore.** The passing away of Col. H. H. Maharaja Sri Krishnaraja Wadiyar Bahadur, the Maharaja of Mysore on the 3rd of August at Bangalore, marks the close of a long period of 38 years of beneficent and progressive rule of an Indian state by an enlightened prince, saintly ruler and great administrator, of whose achievements India may well be proud. His Highness's administration marks an era of great agricultural and industrial progress in the state, which was the direct result of a wise and progressive policy initiated and fostered by His Highness. It was the ruler's aim in life to spread education, to diffuse knowledge and to further industrial enterprise and it may well be claimed that this aim was realised in a measure yet unattained in several parts of India. It was the continued policy of the ruler to carry the fruits of research in modern sciences to the doors of the farmers. His Highness's Government made it a policy to understand the needs of the farmer and to extend their cooperation to him. Bulletins and leaflets in the Kannada language on various agricultural and industrial subjects form a great feature of the activities of the Mysore Government. In the formation of cooperative societies, issue of agricultural loans and establishment of agricultural colonies, the state has attained remarkable success. Various industrial enterprises such as the soap factory, sandal wood oil factory, sericultural development, the Badravati iron works, the Mandya sugar factory, the Krishnaraja Sagara power and irrigation projects and the Mysore Paper Mills are but a few of the many enterprises which were initiated by His Highness and which he lived to see in full fruition. Mysore today moans the loss of her beloved ruler and the *Madras Agricultural Journal* joins her in paying its last tributes to a prince among princes.

# Relative Efficiency of Roots and Tops of Plants in Protecting the Soil from Erosion

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**Introduction.** Since a plant cover, either natural or grown, is the main single controllable factor in erosion, an exact understanding of its effects is very valuable. Attempts to ascertain the rate of erosion of soil protected by both tops and roots of cultivated plants as compared with similar soil free from vegetation, are meagre. An immediate application of this knowledge is found in crop-growing. In the black-cotton soil tract of the Deccan where erosion of soil has become a serious proposition, it is important to know the erosion resistance efficiency of the several crops and crop-mixtures, growing in this zone.

In this tract only *mungari*<sup>1</sup> crops experience rains during their growing period. After the sowing of *hingari*<sup>2</sup> crops usually no further rains are received. These studies were made during the two seasons 1938—39 and 1939—40. As these pertain only to erosion, only crops which receive rain during their growth are included. Such of those *hingari* crops as figure in *mungari* mixtures only have been included in these experiments. In Section I a general survey of the relative efficiency of crops and crop-mixtures in protecting the soil from erosion is detailed. Section II deals with their relative efficiency at different stages of growth.

**Technique.** The technique adopted in these studies was that developed by Kramer and Weaver (1936) at the University of Nebraska, Lincoln, Nebraska, U. S. A. Stout frames 40 inches long and 20 inches wide inside and 4 inches deep were made of teak wood one inch thick. The corners were firmly reinforced outside, by angle irons held in place by screws. The frames were taken to the field and placed over samples carefully selected as representative of the area. Pairs of samples were taken only a few feet apart. Care was taken that the tops of all plants rooted inside the frame were included and those rooted outside excluded. Tops of plants immediately surrounding the frames were then removed. Care was exercised not to damage the plants within the frame. With a sharp mason's trowel the core of soil was cut to a depth of 4 inches around the frame in such a manner that the frame could be forced to this depth in the soil, holding firmly the enclosed sample. Laths nailed to the edges of the frame and between the rows of plants, were used to hold the soil in the frame when it was tilted. The frame was next undermined by digging the soil from the

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\* Paper read at the Twenty-ninth college day and conference, July 1940.

1. *Mungari* = *Kharif* = Early South west monsoon.

2. *Hingari* = *Rabi* = North east monsoon.

ends and, especially, from both sides in such a manner that a blunt wedge was formed from the soil core protruding beneath the frame. The frame was then carefully tipped on its side, but only after a sufficient excavation had been made so that the tops of plants like *setaria* or *sorghum* would not be crushed against the soil. The excess soil was removed and the bottom very carefully fastened in place while the frame lay on its side. The whole process, apparently so simple, was successfully accomplished after some experience. After the sample was secured, it was transplanted in a normal, erect position.

Since each sample contained 1.85 c.ft. of soil of approximately 175 - 200 lbs. in weight, securing it was arduous and painstaking work. The samples were lightly watered so that no dry soil remained. The frame was then placed lengthwise on a washing rack with a slope of 10°. A second frame of the same size but 12 inches deep was placed upon the first. It was held by a number of braces fitting over the frame beneath. A strip of wood  $\frac{3}{4}$  inch wide was permanently fastened within the frame, one on the lower side of each wall, so that its edge protected the soil in the lower frame. Thus in eroding the soil no water came directly in contact with the sides of the lower frame until at least the upper 2 or 3 inches of soil were removed. A strip one inch wide had been removed from the lower end of the upper frame to permit surface soil to escape during this process, and 4 one-inch holes were bored in the lower end of the lower frame to furnish an exit for the water and eroded soil after the top of the soil had been worn away. Water was supplied from a 800 gallon tank on the top of a 40 feet tower, with the same hose and shower-bath nozzle and at a uniform distance of 2 feet from the surface of the soil. Care was taken to move the hose slowly back and forth in a regular manner so that the stream played for only an instant on any one portion of the soil. Two gallons of water were delivered from the nozzle per minute in 35 streams. Throughout the period of washing the soil, the head of water was maintained at practically the same level by two men operating continuously the hand pump connecting the tank.

The objective sought was to erode the whole surface of the soil as uniformly as possible until the entire sample disappeared. This was especially difficult to accomplish where the soil was protected by a plant cover. If all the soil had been eroded in places, obviously additional water on the bottom of the box would have merely prolonged the erosion time. Consequently, before this point was attained, a helper determined where ridges and columns of soil were holding longest and the operator directed the stream of water upon them. The necessary uniformity of method, essential to consistent results, was attained by the same investigator directing where the stream should fall.

Roots and other underground plant materials were caught upon a large copper screen with close meshes, attached near the end of the box and through which all of the water and eroded soil had to pass. The duplicate samples gave fairly similar results showing the accuracy of sampling. The

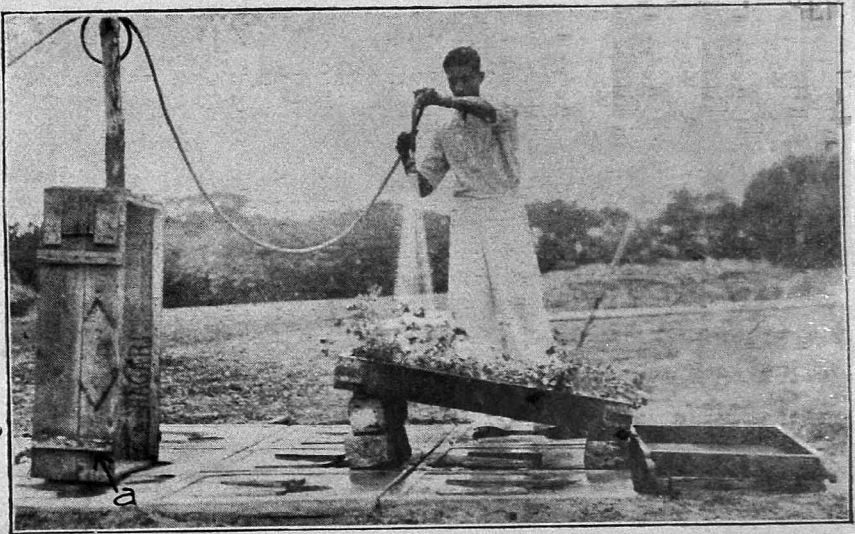


Illustration showing the technique adopted in studying the relative efficiency of crops in protecting the soil from erosion.

The second frame (a) is placed on the frame with the soil and crop while washing and is of the same size.

tops and roots of plants so secured were again carefully washed and each secured separately. The volume of roots in each sample was determined by displacement of water in a cylindrical graduate. The tops and roots were separately dried in a steam oven and the dry weights recorded after cooling in a desiccator.

### I. Relative Efficiency of Crops and Crop mixtures in protecting the Soil from Erosion.

(a) *Sorghum—groundnut mixtures.* Sorghum and bunch variety of groundnut (*Arachis hypogea*) were sown in the following proportions: (1) sorghum—groundnut (1:1): (2) sorghum in between rows of groundnut. The groundnut crop was sown in August and sorghum in October and at the time of sampling the former was 90 days old and the plants 16 cm tall. The sorghum crop was 45 days old with a height of 23 cm. In the mixture in which sorghum was sown between rows of groundnut the time taken for completely washing the soil in the frames was 67 minutes. The erosion ratio for this mixture was 1:2\*. In the mixture in which sorghum lines alternated with those of groundnut, the time taken was 63 minutes, the erosion ratio being 1:1.9. The effect of these mixtures in protecting the soil from erosion is similar.

(b) *Groundnut-pure (bunch):—* In the pure crops, groundnut grew to a height of 30 cm. and the plants were very bushy. This bushy growth, however, did not prevent water from reaching the ground through the interstices of leaves and branches. The soil was easily eroded as the root-system did not ramify the soil well enough to bind it. But for the soil protected by the lodged leaves and branches, the rest of it was easily eroded. All the soil was completely washed away in 112 minutes, the erosion ratio being 1:3.4.

(c) *Sorghum-pure:—* The plants were in shot blade with a height of 100 cm. Though the broad, swaying leaves considerably checked the beat of the water, the thin stand of the grain crop could not effectively prevent water from reaching the soil surface. Erosion occurred fairly quickly, though the thick crown roots held the soil for some time. The lodged leaves also protected the soil. All the soil in the box was washed away in 123 minutes, the erosion ratio working out to 1:3.7.

It will be seen that pure crops of sorghum and groundnut are more effective in protecting the soil than mixtures of these. This is so because pure crops are better and more vigorously grown than the crops sown mixed, and between the two pure crops there is not much to choose.

(d) *Setaria—cotton mixtures (1:1).* At the time of examination, the plants were 60–80 days old. *Setaria (Setaria italica)* plants had finished flowering, had 2–3 tillers per plant and were about 80 cm. in height.

\* The time taken for completely eroding bare soil was 33 minutes. Assuming this time to be unity, erosion ratio for the several crops was calculated. For each set, paired samples were taken. The data are presented in the table I appended. These studies were made in 1938–39.

Cotton (*Gossypium herbaceum*) had just started flowering and the plants were 43 cm tall. Under the impact of water, the *Setaria* plants began to lodge. Gradually the plant cover settled closer to the earth as the hold of the roots was slowly weakened, but the process was slow. The mass of *Setaria* roots held firmly since the force of water was broken and erosion proceeded slowly. By the end of an hour the soil had been removed to the bottom of the box in only a few of the least protected places. Finally the soil between the rows gave way but the rows themselves held, each as a separate unit, and only after a long time was all the soil eroded. Though the cotton roots constituted a fourth of the weight and volume in the mixture, they were not so efficient in protecting the soil as they were stout and had sparse lateral branches; but the broad leaves of cotton were effective. In *Setaria*, the innumerable tillers and flowing leaves, combined with thick stand intercept a great deal of the falling water, thus breaking the force of the impact. This action is effectively reinforced by the dense crown roots at stem bases with their well ramified fine branch roots. The time taken for completely washing the soil was 108 minutes, the erosion ratio being 1:3'3.

(e) *Setaria*—horsegram mixtures (2 *Setaria*:1 horsegram). The *Setaria* plants were of the same size as those in the above mixture. Horsegram (*Dolichos biflorus*) plants attained a height of 18 cm. In this mixture, the soil was completely eroded in 2 hours and 32 minutes, with an erosion ratio of 1:4'6.

(f) *Setaria*—groundnut (spreading) mixtures (1:1). In these mixtures, the groundnut plants had foliage with a lateral spread of 32 cm. The *Setaria* plants were of the same size as those in the above mixtures. The lodged plants settled down on the spread haulms of groundnut forming such an efficient cover that erosion occurred very slowly. It took 3 hours and 38 minutes for all the soil to wash, the erosion ratio being 1:6'6. In this mixture, the efficiency of *Setaria* as a crop in protecting the soil against erosion, was greatly strengthened by the spread foliage of groundnut.

(g) *Setaria*—pure. The pure crop of *Setaria* had a very vigorous growth and it took 188 minutes of washing to completely erode the soil, with an erosion ratio of 1:5'7.

(h) Cotton—pure. The soil was completely washed away in 55 minutes, with an erosion ratio of 1:1'6. It will be seen that this is practically no better than bare soil. But in mixtures with *Setaria*, the erosion ratio rises to 3'3.

(i) Groundnut (spreading)—pure. In pure plots with spreading groundnut, all the soil was completely washed away in 164 minutes, with an erosion ratio of 1:5'0. In mixtures with *Setaria*, this ratio rises to 6'6, increasing the efficiency of the mixture. In the pure plots the stand was not so good. In spite of this, the spreading foliage protected the soil for a long time. If the stand were good, it is doubtful if the soil would have been eroded even after hours of washing. The leaflets afforded complete protection to the soil beneath them. The impact of the continuous beating

TABLE I. Relative efficiency of tops and roots of crop mixtures in protecting the soil from erosion.

	Age of plants.	No. of plants.	Height of plants.	Spread of plants.	Number of tillers.	Weight of shoot (dry)	Volume of roots.	Weight of roots (dry)	Erosion time.	Erosion ratio (bare soil=1).	Remarks.
	days.	cm.	cm.	cm.		gm.	cc.	gm.	min.		
Bare soil	84	—	—	—	—	—	—	—	33	—	
Cotton pure	84	12.0	54.0	—	—	110.2	19	8.12	55	1:1.6	Flowering.
Sorghum-groundnut (1:1)											
groundnut (Bunch)	90	11.0	16.0	—	—	66.18	21	3.75	63	1:1.9	Pod stage.
sorghum	45	7.0	23.0	—	—	3.81	13	2.15			
Sorghum in between groundnut lines: groundnut (Bunch)	90	11.0	17.0	—	—	63.32	15	2.87	67	1:2.0	Pod stage.
sorghum	45	16.0	21.0	—	—	5.35	15	1.80			
Setaria-cotton (1:1)											
setaria	73	7.5	85.0	—	24	30.23	39	11.36	108	1:3.3	Flowered.
cotton	73	8.0	43.0	—	—	20.64	10	2.97			
Groundnut (Bunch) pure	90	18.0	30.0	—	—	106.87	20	4.59	112	1:3.4	Pod stage.
Sorghum-pure	66	9.0	100.0	—	—	216.17	127	31.72	123	1:3.7	Boot stage.
Setaria-horsegram (2:1)											
setaria	63	13.0	60.0	—	28	42.16	39	7.53	152	1:4.6	Pre-flowering.
horsegram	63	4.0	18.0	—	—	6.56	8	1.04			
Groundnut (spreading) pure	50	13.0	—	19	—	29.90	25	3.25	164	1:5.0	Pod stage.
Setaria-pure	83	26.0	84.0	—	38	174.10	66	21.16	188	1:5.7	Dough stage.
Setaria-groundnut (spr.) (1:1)											
setaria	63	7.5	66.0	—	20	35.24	38	7.35	218	1:6.6	Pre-flowering.
groundnut (spreading)	63	7.5	—	32	—	26.80	18	2.54			
Phillipesara ( <i>Phaseolus trilobus</i> )-pure	—	—	—	—	—	127.95	70	12.75	390	1:11.8	Flowered.

water on the leaflets could be noticed in the etching on the leaf surfaces. Most of the upper epidermis was damaged and chlorophyll in places washed off, giving the leaf a patchy appearance. In spite of this, the soil protected by them was not eroded. Because of the poor stand, water gradually worked through the uncovered portions of the soil and undermined the protected soil.

(j) *Pillipesara*—(*Phaseolus trilobus*) pure:—The almost complete protection afforded to the soil by a spread plant cover is graphically demonstrated in this crop whose vines and leaves get inextricably tangled and clothe the surface of the soil. As in the case of groundnut, the chlorophyll was scoured from the leaf surfaces in patches by the beating water but the leaves and vines effectively protected the soil beneath them. As a consequence, very little soil was eroded even after six hours of washing, the water percolating through the holes being fairly clear, instead of being muddy. At this stage, the cover was disturbed to hasten the washing. After this, the soil was quickly eroded. The time taken for completely washing the soil was 390 minutes, the erosion ratio being 1:11'8. This would have been considerably longer were the plant cover not disturbed (Table I).

These studies reveal that mixtures of sorghum with bunch groundnut are not effective in controlling soil erosion. In fact they are as ineffective as a pure crop of cotton in affording protection to the soil among the crops studied. Mixtures of *Setaria* and cotton improve the situation slightly. *Setaria*-horsegram mixtures are considerably better than these. *Setaria*-groundnut (spreading) combination is the best among the crop mixtures. Pure spreading crops are clearly of advantage. Of the cereals, *Setaria* with its thick stand, numerous tillers, swaying leaves and panicles and the extensively branched root-system is a very efficient crop in conserving the soil. Though the broad flowing leaves of the single-stalked sorghum intercept and break the force of the falling water their thin stand is ineffective in protecting the soil. A pure crop of cotton protects the soil least. Naturally the loss due to erosion is highest in cotton fields. Sowing strips of cotton alternating with strips of *Setaria* reduces the severe root competition that exists under the present method of sowing and also helps in the conservation of the soil.

## II. Relative efficiency of crops at different stages of growth in protecting the soil from erosion.

As it is common to receive rain at intervals during the growth of the crop in the *mungari* season, a knowledge of the relative efficiency of shoot and root at these stages will give accurate information regarding the damage done to the soil due to erosion were such plant cover not existent and also the protection afforded by the various crops at those stages of growth. The technique adopted was the same as in Section I. Paired samples were taken after each rain. Detailed data are presented in Table II. The respective ages of the crops after each rain together with rainfall data are given below:—



TABLE III.

Age of Plants. (Days)	Rainfall received in the interval. (inches)	Rainfall received prior to sampling. (inches)
35	2.66	0.54
50	0.43	0.42
68	7.18	2.76
89	0.49	0.33
	<u>Total.</u> 10.76	

(a) *Cotton pure*. Erosion time and erosion ratio at each stage are given below : -

TABLE IV.

Age of plants. days.	Erosion time. minutes.	Erosion ratio *
35	49	1:1.09
50	55	1:1.20
68	83	1:1.84
89	73	1:1.60

Though with the growth of the plant there is a slight increase in the erosion ratio, it is negligible. This is practically no better than bare soil. Thus at any stage of growth, cotton affords very little protection to the soil against soil loss.

(b) *Setaria-Cotton mixtures* (1:1). In spite of the reduced growth due to severe root competition, the *Setaria*-cotton mixtures afford better protection, to the soil than a pure cotton crop. Below are given the erosion time and erosion ratios :—

TABLE V.

Age of plants. days.	Erosion time. (minutes).	Erosion ratio.
35	84.5	1:1.9
50	100.0	1:2.2
67	140.0	1:3.1
57	135.0	1:3.0

The crops in this mixture afford increasing protection with progressive growth in them. This increased efficiency at each stage is not due to the cotton but to the *Setaria* crop in the mixture. The extensive and dense root system in the soil and the numerous tillers with swaying leaves, break the force of falling water, reducing the soil loss. In the early stages of crop growth, the *Setaria* roots particularly bind the soil well.

(c) *Setaria—pure*. Because of its earliness, this crop develops and expands its vegetative organs quickly. In the early stages of the crop, the

\* These studies were made in 1939-40. The time taken for completely eroding bare soil was 45 minutes. Assuming this time to be unity, erosion ratios have been calculated,

roots are very efficient soil binders, but in later stages the gradually expanding shoot also plays a dominant role. The numerous leaves and tillers break the force of falling water and what little water that reaches the ground is further arrested and spread by the closely situated root crowns (as this crop is usually sown thick). The barriers that these rows of root crowns create are such that they remain intact even after all the soil is washed away. From the erosion ratios given below it will be seen that a pure *Setaria* crop protects the soil efficiently.

TABLE VI.

Age of plants. days.	Erosion time. (minutes).	Erosion ratio.
35	121.5	1:2.7
50	165.0	1:3.7
68	197.5	1:4.4
80	225.0	1:5.0

(d) *Groundnut (spreading) - pure.* Due to the spreading habit the leaflets almost lie on the ground and afford complete protection to the soil. Naturally, as the plant grows and puts on more foliage, its efficiency in protecting the soil increases. The impact of the continuous beating water on the leaves could be noticed in the etching on the leaf surfaces. Most of the upper epidermis was damaged and chlorophyll in places washed off, giving the leaf a patchy appearance. In spite of its good spread on the ground, small portions of the soil were exposed. Erosion occurred due to the water working through the uncovered portions of the soil and undermining the protected soil. Data showing the increasing efficiency are given below:—

TABLE VII.

Age of plants. days.	Erosion time. (minutes).	Erosion ratio.
35	109.5	1:2.4
50	129.0	1:2.9
68	163.5	1:3.6
90	240.0	1:5.3

**Summary.** In the 'Black Cotton' soil of the Bellary District, where sheet erosion of the soil has become a serious proposition, it is important to know the erosion resistance efficiency of the several crops and crop-mixtures grown in this tract. A special technique developed by Dr. J. E. Weaver of the University of Nebraska, U. S. A., was adopted in these studies. This consists in washing *undisturbed* soil taken out in a wooden frame (40" × 20" × 4") under different plant cover with a steady jet of water delivered in a fine spray simulating rain and noting the relative time taken to erode the soil completely.

From these studies it is clear that spreading crops like *Pillipesara (Phaseolus trilobus)* sown pure or the spreading varieties of groundnut are clearly of very great advantage. The bunch variety of groundnut, though it has a

bushy top, is not efficient as the foliage is at some height from the ground and not spreading over it. Of the cereals, *Setaria* with its thick stand, numerous tillers and swaying leaves and panicles, is a very efficient crop in conserving the soil. In *Setaria* an extensively branched and dense root system also contributes a great deal in reducing the soil loss. Sorghum is generally sown thin when raised as a grain crop. Though the broad, swaying leaves intercept and break the force of falling water, the thin stand operates against their efficiency and, consequently, the sorghum crop affords poor protection to the soil. Cotton with its stout tap-root and sparse lateral root system protects the soil least. Naturally the loss due to erosion is highest in cotton fields. It is obvious from these studies that a farmer, who has the interest of his land at heart and who does not want to face the inevitable ruin, should not sow cotton pure in any of his fields. It should be sown along with a soil-binding crop, preferably a spreading one. Since a food crop is to find a place in this mixture, *Setaria* may meet the situation. But the present mode of sowing this mixture has to be modified since it is not economical. Strip cropping may be done to reduce the severe competition in the root-systems and at the same time protect the soil against erosion. These studies also show that when pure crops which do not afford efficient protection to the soil are grown, a suitable mixed cropping which will be economically, ecologically and agronomically advantageous should be resorted to.

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### Soil Erosion and the Coffee Industry.\*

By W. W. MAYNE, B. Sc.,

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**Introduction.** I make no apology for addressing you today on the ecological conditions of coffee cultivation in South India, as they afford several interesting points on the management of hill lands under conditions of heavy rainfall; such areas, in fact, on which soil erosion is commonly seen in its most serious and spectacular form.

**History of coffee industry.** Coffee must be regarded as the oldest of the three main plantation crops in South India, its history as a plantation crop extending back to about 1840. Although many areas planted with coffee have been abandoned or given over to tea, there are considerable areas still producing satisfactory crops, which have been under cultivation for well over half a century. At least one estate in Mysore is known to me

\* Paper read at the Twenty-ninth College day and conference of the M. A. S. U. July 1940.

which has been under coffee for a hundred years and which still exists as a productive agricultural unit.

**Permanence of plantation crops.** This feature of coffee cultivation in South India is perhaps more remarkable than appears at first sight. If we glance at the history of the great tropical 'permanent crops', we find that 'permanent' is perhaps hardly the right term. The coffee industry of Ceylon started and ended within half a century and left the succeeding tea industry with little more than a subsoil over considerable areas of the hills of Ceylon. In Brazil, the coffee industry has been based on the exploitation of fresh lands as the earlier plantations declined. Recent reports indicate that the great coffee industry which has grown up in Colombia in the last thirty or forty years is faced with declining production.

The other perennial crop industries in the wet tropics have hardly had time to show what degree of permanence they possess. The dangers inherent in such forms of agriculture are, however, sufficiently obvious now and there are clear signs of a realization of their importance in agricultural practice. There still remains much to be done, not only in applying conservation methods already known, but in investigating the means of ensuring a stable agriculture in the large areas of evergreen and monsoon forest which have been opened up for the increased production of tropical commodities during the last half century.

**System of coffee cultivation and the problem of soil erosion.** I believe that the system of coffee cultivation in South India represents one solution of the problem of a stable agriculture under the topographical, pedological and climatic conditions of the coffee growing areas. It is, of course, a particular solution applicable only to coffee (and also to cardamoms) but an examination of one solution may not be without interest in considering the general problem of soil erosion. Further, the solution is only a partial one and there are many ways in which the situation ought to be improved. The fact that the system is one which greatly minimizes soil losses must not be allowed to obscure the existence of danger points which demand special measures.

Although the first essential of an enduring agriculture must be a stable surface soil, protected against the dangers of soil erosion, it is an interesting paradox that the measures, which in a high degree provide this protection for coffee, were not introduced for this purpose at all. The result is that a considerable degree of protection against soil erosion has been incidental and the coffee planter is less alive to the dangers that still exist in certain areas and under certain conditions than he should be.

The system of cultivation in general use in South Indian coffee areas is, shortly, the culture of the crop plant under a continuous shade canopy, composed of a mixture of trees, many of which were constituents of the original plant association which had developed on the area prior to its cultivation. The mode of opening such land varies widely from a complete

clearing of the original jungle and planting shade along with the coffee to the simple undergrowth and light thinning of the taller trees to permit the development of the young plants. Nowadays, the debris is normally burnt, but in the early days of coffee planting, a number of estates were opened without burning. It is perhaps not without significance that several estates opened in this way in the early days of coffee planting still exist as sound productive units, with no visible signs of serious soil deterioration.

**Undergrowth cultivation.** The cultural treatment of coffee is normally conditioned by this system of what might be described as undergrowth cultivation. Coffee planters place great store by the preservation of the surface mulch which is built up from the leaf fall from the shade canopy. Soil cultivation with implements is comparatively restricted after the establishment of the young plants, though in this respect there is much variation in estate practice, depending to a considerable degree on the slope of the land.

**Shade canopy and soil erosion.** Under the shade, the coffee itself is planted closely, very much more closely than is normally the practice in other coffee growing countries, and the ground is covered by the coffee plants from a comparatively early age. From the point of view of soil erosion, this continuous shade canopy affords a very valuable protection against the beating action of the rain on the soil and at the same time reduces the effects of insolation in accelerating organic matter breakdown and reducing the soil's absorptive capacity for water. This protection is, of course, further increased by the continuous cover of the crop itself. Secondly the leaf fall from the shade provides a mulch which is of the utmost value, as has been shown by Lowdermilk in California, in reducing run-off considerably in excess of its absorptive capacity.

**Erosion control in mature coffee plantations.** In mature coffee therefore, erosion control is achieved to a considerable degree by natural methods—the utilization of a plant association approximating to quite a considerable degree to the natural vegetation of the areas, in which the crop is inserted, as it were. At the same time, it must be repeated that the value of the system has rarely been consciously attributed to its influence on the stability of the surface soil. This has resulted in a complete lack of recognition of the dangers which can arise from a failure to take additional precautionary measures under certain circumstances.

**Erosion losses in young plantations.** The main dangers arise in the early stages of opening land under coffee or in replanting old lands with new plants, and in the laying down of drainage which is frequently necessary. Under these conditions, the coffee industry has been slow to undertake conservation measures from a lack of understanding of the damage that can occur in a very short period of time.

Work in East Africa showed that in a coffee clearing on a slope of one in  $\alpha$  and under a rainfall of between 60 and 80 inches without any control

measures, the loss of soil amounted to 38 tons in two years or about 2½ per cent of the top foot of the soil. There is no reason to believe that losses of the same order do not occur in South India in newly opened land as the shade affords small protection at this stage and the rainfall and slopes often exceed those experienced in the experiment in question.

**Erosion control measures rare in S. India.** It is rare to see any measures for erosion control in coffee clearing in this country; planting and working is carried out up and down the slope, felled trees lie across the contours, cover crops are very rarely seen and only very recently has any interest been aroused in the use of green manure plant hedges. In only one district, where slopes are exceptionally steep, are any attempts at terracing common. Even the use of green manure hedges cannot be regarded as introduced as a measure of erosion control, since the emphasis is mainly on the provision of organic matter and of temporary shade. Contour ridging or box ridging such as is practised in East Africa is quite unknown.

**Effects of erosion control measures are not spectacular.** It is clear that much can be done in reducing the losses which undoubtedly occur in the early years of opening up coffee or when old areas are replanted. The great difficulty lies in convincing the planter of the damage that is taking place. The effects of erosion control may not be obvious nor the economic gains considerable. The results in the experiment quoted above are of interest in this respect. Where the erosion control measures depended on growing green manure hedges on contour bunds or on the provision of a cover crop, the check to soil losses was very great but the condition of the coffee in the dry season following the rains was noticeably better in the controls. This was traced to a lower percentage of soil moisture in the plots carrying the supplementary crops. To many planters, the immediate differences would bulk very much larger than prospective gains resulting from the soil retention, which could only be cashed in over a long period of years. Even where the control measures would not involve soil moisture competition, it is unlikely that any striking differences in growth and development would be visible for some considerable time and the cost factor would discourage a practice the value of which is not readily demonstrable. Herein lies the great problem of erosion control. In its spectacular manifestations, the damage done is obvious and calamitous. The spectacular manifestation is, however, the end product of a long series of invisible movements, the control of which means trouble and expenditure without any apparent return. The return comes in time in the maintenance of productivity and of the capital value of the land but unless the cultivation methods are very wasteful the differences may take a long time to show themselves.

**Soil erosion not serious in South Indian coffee plantations.** The situation is especially difficult in coffee, where with growth of the shade cover and the development of a litter of fallen leaf, the early losses

checked and the damage done greatly slowed down. At the same time, the efficiency of the litter cover must be regarded as having been reduced by the damage done in the few years of exposure in the early stages of opening the land. At the same time, it must be pointed out that it is not easy to point to coffee areas in South India where a reasonable shade policy has been followed, which show serious signs of deterioration from soil erosion. Individual cases may occur on small areas where special circumstances play a part but speaking generally, I think it would be agreed by those familiar with South Indian coffee areas, that soil erosion plays a small part in determining the productivity of the land under this crop.

**Conclusion.** In conclusion, therefore, it may be said that the system followed on most coffee areas in South India affords a substantial degree of protection against soil erosion. There seems no great need for elaborate measures for its control and on the whole, it seems that attention to the improvement of control by the use of vegetation will meet most of the needs of coffee cultivation. This requires most emphasis in connection with the opening up of land for coffee or the replanting of old land. Most of all, planters require education on the question of soil erosion so that special cases can receive prompt attention and that cultivation methods, especially trenching and draining, shall be carried out with the dangers of badly designed work in mind. There is no question that much can be done in opening new clearings by the effective disposal of debris along contours, carrying out weeding and other works along contours and by raising green manure crops at a very small cost to check the losses during the years before the shade and its litter become effective.

## **Some Correlations in the Appendages of the Indian Honey Bee.**

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**Introduction.** That variations in honey bees are displayed not only in the average dimensions of their various appendages, but in the coefficients of correlations between such measurements as well, was indicated by Alpatov (1929). In the present paper are furnished the coefficients of correlation of the measurements of tongue, right forewing and right hind leg of four colonies of *Apis indica*, the variations in the biometry of which were reported previously (Ratnam, 1939). The data used for the present paper are the same as those used for the previous one.

**Material and Method.** The data relate to four colonies of *Apis indica*, which differed in the number of supers each had and in their honey storing abilities. About 50 nectar gathering bees from each hive were collected separately within a period of six days and killed immediately in cyanide bottles. They were numbered serially noting also the number of hive from which each bee was collected. Wings and leg were removed immediately

and kept mounted on separate slides and labelled properly. The heads of the bees were macerated in a five percent solution of potassium hydroxide as described by Alpatov (1929). The tongues were then dissected and kept mounted in glycerine jelly, the slides being labelled properly.

The slides for the right forewing, right hind leg and tongue pertaining to each individual bee were handled together. The following measurements were recorded from these slides : (1) lengths of submentum, mentum and ligula each separately ; (2) the proximal and distal length of the right forewing measured separately ; (3) the breadth of the right forewing ; (4) lengths of femur, tibia and metatarsus taken separately ; and (5) the breadth of metatarsus. For purposes of measuring, a Leitz micrometer eyepiece calibrated previously with an object micrometer was used. Initially all measurements were noted in terms of the number of divisions in the micrometer eyepiece. For purposes of computing all correlation coefficients, the metric measurements were not used, but frequencies were tabulated as per the micrometer eyepiece readings only, since the unit of measurement adopted in all cases is identical. The figures presented in Table II below were first arrived at in terms of micrometer readings, and then converted into millimetres.

**Appendages.** In Table I, the correlations of the lengths of any two of the three appendages, namely tongue, right forewing and right hind leg are presented. It will be seen that the tongue length is not correlated to either the wing length or the leg length. To this extent the observations of Grout (1937) who obtained a significant positive correlation between tongue length and wing length in the European bee does not obtain confirmation in the present study. In the case of leg length, significant positive correlations have been noticed in all the hives except hive IV, and these correlations do not also differ significantly.

**TABLE I. Appendages.**

Correlation between	Hive No. I	Hive No. II	Hive No. III	Hive No. IV
1. Tongue length and length of right forewing.	0·0602	0·0632	0·1631	0·2396
	(43)	(45)	<u>±</u> 0·1126 (34)	<u>±</u> 0·0959 (44)
2. Tongue length and length of right hind leg.	0·1774	0·1420	0·1895	0·0768
	<u>±</u> 0·0974 (45)	<u>±</u> 0·1007 (43)	<u>±</u> 0·1054 (38)	<u>±</u> (48)
3. Length of right hind leg and length of right forewing.	0·4170	0·5495	0·5581	0·2160
	<u>±</u> 0·0893 (39)	<u>±</u> 0·0778 (41)	<u>±</u> 0·1105 (47)	<u>±</u> 0·0967 (44)

Note:— 1. The numbers within brackets indicate the number of pairs of observations (*n*) from which the correlations have been computed.  
 2. The correlations underlined are highly significant. The others are not significant.

In Table II the calculated length of right hind leg for a given length of right forewing in the case of hives I to III respectively is furnished for the sake of comparison. These have been computed by the use of the usual regression formula. It is observed that the bees of hive III possess relatively longer legs as compared with those of the other hives. These observations further confirm the previous findings (Ratnam, 1939) wherein judging from the mean leg lengths alone it was stated that the bees of hive III have long legs.

**TABLE II. Calculated length of right hind leg for a given length of right forewing (in millimetres).**

Wing length.	Leg length		
	Hive No. I	Hive No. II	Hive No. III
7.301	5.490	5.855	6.037
7.371	5.714	6.009	6.220
7.441	5.939	6.150	6.402
7.511	6.164	6.304	6.571
7.582	6.388	6.458	6.753

**The Tongue and its parts.** In Table III are furnished the coefficients of correlation of the tongue and its parts for the four hives under study. The existence of a very high positive correlation amounting to over 0.9 between the length of ligula and the total tongue length in all the hives indicates that the ligula almost solely contributes to the length of the tongue. Grout (1937) observed in the European bee that the length of proboscis correlates significantly with its integral parts. In the present study, however, the submentum does not correlate at all with the total tongue length while mentum correlates significantly with the tongue length only in the case of hive I. Whether this correlation is merely spurious or whether it should be taken as indicative of an inherent variation in this colony, it is not possible to conclude definitely with the available data, and further work would be necessary. Ligula length is not correlated either with the length of the mentum or of submentum, nor is there any correlation between the latter parts. In a previous communication (Ratnam, 1939) it was pointed out that the mean aggregate length of submentum plus mentum in the four hives showed less variations despite the existence of remarkable variations in the mean lengths of each one of these parts and a conclusion was attempted to be drawn that the bees from those hives having short mentum have relatively long submentum and *vice versa*. The present study indicates that as between the length of submentum and of mentum of each bee no significant correlation exists in any of the hives showing that these dimensions are independent of each other. This perhaps points to the fact that the occurrence of short submentum coupled with a long submentum or *vice versa* noticed in particular hives is a case of inherent variation. A further study with a larger number of hives would alone confirm this observation.

TABLE III. Tongue and its parts.

Correlation between	Hive No. I	Hive No. II	Hive No. III	Hive No. IV
No. of pairs of readings	50	49	50	49
1. Total tongue length and length of				
(a) Submentum	0·1886 ± 0·0921 0·5265 ±	0·1868 ± 0·0914 0·2106 ±	-0·1248 ± 0·0939 0·0198	0·0626 —
(b) Mentum	0·0690 0·9604 ±	0·0921 0·9781 ±	0·9190 + 0·0146	0·9647 + 0·0067
(c) Ligula	0·0074 0·5195 ±	*0·0041 *0·3228 +	-0·1448 + 0·0934	-0·0102
(d) Submentum plus mentum	0·0697	0·0863		
2. Length of ligula and length of				
(a) Submentum	0·2199 ± 0·0908	0·0684	-0·2100 ± 0·0888	0·0807
(b) Mentum	0·2480 ± 0·0891	0·2128 + 0·0920	-0·0741	0·0820
3. Length of mentum and length of submentum	0·1147 ± 0·0942	0·1398 + 0·0945	-0·1303 r 0·0938	-0·2577 + 0·0900

Note:— The correlations underlined are highly significant, while those marked with \* are significant only at the 5% level. The others are not significant.

TABLE IV. Wing and its parts.

Correlation between	Hive No. I	Hive No. II	Hive No. III	Hive No. IV
No. of pairs of readings	43	45	34	45
1. Length and breadth of right forewing.	{ 0·0142 ± 0·0747	0·5070 ± 0·0757	0·5032 ± 0·0864	0·3804 + ± 0·0860
2. Proximal length and distal length	{ 0·2251 ± 0·0971	0·2847 ± 0·0924	*0·3569 ± 0·1009	0·2071 ± 0·0962
3. Proximal length and breadth	{ 0·2795 ± 0·0948	*0·3250 ± 0·0899	0·4822 ± 0·0888	*0·2998 ± 0·0915

Note:— The correlations underlined are highly significant, while those marked with \* are significant only at the 5% level. The others are not significant.

**Wing and its parts.** Alpatov (1929) has arrived at a correlation of 0·593 between the length and width of the right forewing. This is comparable with the highly significant positive correlation amounting to 0·5142, 0·5070, 0·5032 and 0·3804 observed in the present study in the case of the four hives (vide Table IV). The last mentioned correlation does not differ significantly from the others. The proximal and distal lengths of wing do not appear to be correlated and the correlation coefficient of 0·3569 obtained for hive III which is significant only at the 5% level cannot be taken as fully indicative of the existence of any special variation in this hive till further confirmation is available. Further, this hive gives a highly significant positive correlation between the proximal length and breadth of the wing. Hives II and IV have furnished correlation between

the lengths of these parts which are significant only at the 5% level. Further studies may be necessary to conclude if the proximal length of the wing is at all correlated to its breadth and if hive III is a case where exists a variation from the others in respect of this relationship.

**The Leg and its parts.** The correlation of the dimensions of the leg and its parts namely, femur, tibia and metatarsus are presented in Table V. The lengths of these parts generally exhibit a significant positive correlation to the total length of the leg, and it therefore appears that every one of these parts individually and severally contribute to the relative shortness or otherwise of the leg. Nevertheless as between these parts, the existence or otherwise of a correlation does not seem to be consistent. For instance the length of femur is correlated to the length of metatarsus only in the case of hives I and III while the tibia length is correlated to that of metatarsus only in hive I. The data appear to be too meagre for spotting out any special variation in any colony or for generalising on the existence of relationships between the lengths of these parts.

**TABLE V. Leg and its parts.**

Correlation between	Hive No. I	Hive No. II	Hive No. III	Hive No. IV
No. of pairs of readings	45	43	41	49
1. Total length of leg and length of				
(a) Femur	<u>0.6519</u> ± 0.0578	<u>0.5109</u> ± 0.0760	0.5355± 0.0751	*0.3518± 0.0844
(b) Tibia	<u>0.8341</u> ± 0.0306	0.7920± 0.0383	0.6317± 0.0631	<u>0.8119</u> ± 0.0328
(c) Metatarsus	<u>0.7811</u> ± 0.0392	<u>0.7358</u> ± 0.0472	<u>0.7049</u> ± 0.0530	*0.3458± 0.0848
2. Length of femur and length of				
(a) Tibia	0.1811± 0.0973	0.0450	-0.2050± 0.1009	0.2776± 0.0889
(b) Metatarsus	<u>0.4384</u> ± 0.0813	<u>0.2319</u> ± 0.0974	0.7696± 0.0430	0.1452± 0.0943
3. Length of tibia and length of metatarsus	<u>0.5641</u> ± 0.0686	*0.3413± 0.0909	<u>0.1592</u> ± 0.1027	—
4. Breadth of metatarsus and length of				
(a) Femur	*0.3318± 0.0895	0.0135	0.1930± 0.1014	0.1573± 0.0940
(b) Tibia	<u>0.5755</u> ± 0.0673	0.1548± 0.1004	<u>0.2084</u> ± 0.1008	<u>0.2027</u> ± 0.0924
(c) Metatarsus	0.0594	<u>0.2565</u> ± 0.0961	0.0335	<u>0.3784</u> ± 0.0826
(d) Total leg length	<u>0.2282</u> ± 0.0938	0.1334± 0.1011	*0.3545± 0.0921	<u>0.8778</u> ± 0.0221

*Notes:*—The correlations underlined are highly significant, while those marked with \* are significant only at the 5% level. The others are not significant.

**Discussion.** Correlation is not "the key to all the secrets of nature. In reality its utility as a statistical method is narrowly limited. The correlation coefficient measures association accurately only when the relation is linear. If non-significant correlations occur in the course of an investigation, interpretations should be made only tentatively". These words of Snedecor (1938) are as true for the present study on the Indian Honey Bee about which so little is known, as they are for any other biological investigation.

The scope of the present paper is indeed very limited. The data under consideration are admittedly too meagre to justify the drawing up of any general conclusions. The correlations obtained perhaps serve more as an indicator to what may be the expected trends and are to some extent different from those obtained by previous workers on the European bee.

The usefulness of correlation coefficients rests not only in spotting out variations as between colony and colony, but also in serving to conclude as to which particular appendages of the bee could be most efficiently used for biometric studies. The utility of the coefficients ultimately rests in their contributing to the isolation of useful races of bees. Our knowledge of such correlations is at present very meagre, and a carefully planned detailed study of the characteristics of bees available in different localities seems to be urgently necessary.

**Summary and Conclusions.** Some of the correlations in the dimensions of tongue, right forewing and right hind leg determined in four colonies of *Apis indica* are presented in this paper. The data considered are admittedly rather meagre for drawing any general conclusions. Significant positive correlations have been noticed between leg-length and wing-length, but no such correlations have been noticed between tongue-length and wing-length or between leg-length and tongue-length. The length and breadth of wing are highly correlated positively and so also the total length of leg and that of its integral parts. Again the tongue length is also correlated highly with the length of ligula. It is concluded that further work would be necessary to draw general conclusions.

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# Sorghum, Spikelet—Awn Relationships and Inheritance

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The classification of sorghum is based primarily on the characters of the sessile spikelets, because they are less likely to have been modified in the evolution of the various cultivated species from their wild ancestors. The spikelets of sorghum may be awned or awnless. The awn is prominent in wild sorghum, in which it can be as long as 40 mm. In cultivated sorghum, however, the awn is much shorter, the longest being about 15 mm. Most of the wild sorghums possess awns; in the cultivated races both awned and awnless conditions prevail. The presence or absence of awn and the gradations in its length when present, are governed by genic factors. Given the full compliment of factors determining maximum expression of length, it can be said in general terms, the bigger the spikelet the longer the awn tends to be. Among the wild sorghums that have so far been examined at the Millets Breeding Station, Coimbatore, this relationship was borne out.

## Wild sorghums

Species.	Size of flowering spikelets in mm.	Awn length in mm.
<i>Sorghum sudanense</i> , Stapf	5.0 × 2.5	7-9
<i>S. arundinaceum</i> , Stapf	6.0 × 2.5	9-11
<i>S. virgatum</i> , Stapf	6.0 × 2.5	11-13
<i>S. versicolor</i> , J. N. Anderss	6.5 × 2.5	30-35
<i>S. dimidiatum</i> , Stapf	7.0 × 2.5	32-37
<i>S. purpureo-sericeum</i> , Aschers et Schw	8.0 × 3.0	35-40

Among the cultivated races of sorghum, owing to constant inter-crossing and continued selection, this relation between the spikelet size and awn length was disturbed with the result that in the highly developed grain sorghum groups, numerous blends of spikelet-awn length combinations are met with. This disturbance was least in *S. coriaceum*, Snowden, an African group with markedly coriaceous glumes and prominent awns, in which the relationship is maintained.

## *Sorghum coriaceum*, Snowden.

Selection No.	Name of variety.	Place.	Size of spikelets mm.	Length of awn	
				Average mm.	Range mm.
A. S. 4165	Nsonte	N. Rhodesia	8.0 × 4.5	14	13-15
" 4203	Plot 69/1931 Masabuka Experiment Station	"	6.0 × 4.0	12	11-13
" 4149	Munkokwe	"	6.0 × 4.0	11	10-12
" 3445	Zibaiba	"	5.5 × 3.5	10	9-11
" 4132	Luano	"	5.5 × 3.5	10	9-11
" 4135	Masaka Luwemba	"	5.5 × 3.5	10	9-11
" 4160	Shamba	"	5.0 × 3.0	8	7-9
" 4161	Chibolwe	"	5.0 × 3.0	8	7-9

Describing the *S. coriaceum* group Snowden says, "Little is known as to its origin, but the strongly coriaceous glumes and the frequent occurrence of long strong awns suggest that it may have arisen through the inter-crossing of indigenous wild species with a cultivated race such as *S. caffrorum*, Beauv." (Snowden, J. D., 1936. *The Cultivated Races of Sorghum*", Pp. 126-27) Hence it is probable that *S. coriaceum* by virtue of its closer affinity to wild sorghums, is showing this ancient *spikelet-awn* trend graphically.

The size of the well developed flowering spikelets within a pure breeding line and within a panicle is constant, there being practically no variation. The length of the awn is fairly constant within a pure breeding line. Within a panicle there is a small variation in the length, those towards the top of the panicle tending to be a little longer than those below. This varies from 0.5 mm. to 2.55 mm. in cultivated sorghum and up to 5.0 mm. in the wild ones, depending upon the length of the awn, the longer awns showing greater variation. The awns at about the middle of the panicle may be taken to represent roughly the average length.

A. S. 4163 is a selection of *S. caffrorum*, Beauv. from North Rhodesia, Africa. This has ovate spikelets measuring 4.0 × 3.0 mm. with awns 4 mm. in length. In this family a natural cross with spikelets ovate in shape measuring 4.5 × 3.2 mm. with awns 6 mm. long was noted. The characters of this F<sub>1</sub> and the behaviour of the progeny in the F<sub>2</sub> and subsequent generations indicated that the pollen parent must have belonged to the group *S. coriaceum*, Snowden. This selection segregated in the F<sub>2</sub> generation for spikelet shape and size and awn length. The following are the character pairs that segregated.

Character.	Dominant.	Recessive.
Spikelet shape	Ovate	Elliptic
Spikelet size	Length 4.5 mm.	Length 7.0 mm.
	Breadth 3.2 mm.	Breadth 4.5 mm.
Awn length	{ Range L. 4.0 to 5.0 mm. }	11.0 mm.
	{ " B. 3.0 to 3.5 mm. }	
	6.0 mm.	
	( Range L. 4.0 to 8.0 mm. )	

The character group ovate, smaller spikelets and shorter awns went together. The bigger elliptic spikelets with longer awns also went together. The segregation was for these two groups, viz., 81 of the former and 31 of the latter. From this segregating family, 10 selections consisting of 7 with small ovate spikelets and short awns and 3 with large elliptic spikelets and long awns were carried forward and an F<sub>3</sub> generation raised. Of the 7 selections with short ovate glumes and short awns, 3 bred pure and 4 segregated again giving a total of 303 plants with small ovate spikelets with short awns and 99 plants with bigger elliptic spikelets with long awns. The 3 large elliptic spikelet selections with long awns bred pure. There was the inevitable accentuated fluctuation and the consequent wider range in the size of spikelets and length of awns in the dominant group, especially with a 2/3 heterozygous population.

Concurrent with the segregation for spikelet size, the stigma and anther sizes also varied. The smaller spikelets had smaller stigmas (4.0 mm.) and smaller anthers (2.5 mm.) and the bigger spikelets had bigger stigmas (6.0 mm.) and bigger anthers (3.5 mm.). Even the size of the lodicules responded likewise.

**Summary.** In sorghum it could be stated in general terms that awns, when present (in whatever strength of expression) increase in length and keep pace roughly to spikelet size. In Mendelian segregations small ovate glumes with short awns have proved a monogenic dominant to big elliptic spikelets with long awns. The stigma, anther and lodicules kept pace with spikelet size.

## SELECTED ARTICLE

### Nutrition and Agriculture.

By W. R. AYKROYD

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If human beings are to be properly nourished they must have enough food to eat and the right kind of food to eat. In India we are faced with the problems of obtaining enough food for the people and the right kind of food. The former takes precedence over the latter. A considerable part of the population is underfed in the quantitative sense—as the nutrition workers say, food intake falls short of calorie requirements. What proportion lacks sufficient food we do not exactly know, but recent dietary investigations suggest that it is no small one. In some parts of the country the danger of famine is always imminent.

**Enough Food.** It follows that the *principal* aim of agriculture must be to increase production of *all kinds of food*. It is essential, as we shall see, that the quality of diets should be improved, but in attempting to achieve something in this direction we should never lose sight of the primary need for more food. At present this must be produced in the country itself, because India cannot afford to import food in large quantities. All activities which will increase food production are therefore of the utmost importance. The development of fisheries, the extension of irrigation, the use of efficient manuring methods, the introduction of improved or high-yielding strains of common food crops—all come under this head. The value of the last may be particularly emphasized. Improved strains may give a yield from 10 to 30 times in excess of those they replace. In the Madras presidency in 1937, 1.78 million acres were under improved varieties of rice, representing about 18 per cent of the total area under rice; while in the Punjab 4.26 million acres were sown with similar varieties of wheat, which amounts to nearly half the total acreage under wheat in that province. This represents an achievement on which agricultural research institutes and departments are to be congratulated.

One of the advantages of increasing the production per acre of staple food grains is that it releases land for the production of other kinds of food. India is a densely populated country, and at present most of the good land must be used to grow cereal crops. Otherwise there would not be enough food to go round. Land so cultivated gives a higher return of solid food than land used, let us say, for producing fruit, vegetables or milk.

**The right kind of food.** The chief defect of Indian diets, on the qualitative side, is that they contain too much grain and too little else. Diets of this kind

are "un-balanced" because of the preponderance of cereals. Sir Robert McCarrison, in his little book *Food\** describes a balanced diet as follows :—

The right kind of food for Indian children and, indeed, for children in any country is one made up of the following, simple things:—(1) any whole cereal grain or mixture of cereal grains; (2) plenty of milk and the products of milk—curds, buttermilk, butter, ghee; (3) sprouted pulses; (4) eggs or liver, or meat, or fish, occasionally, if religion permits their use; (5) tuber and root vegetables; (6) abundance of green leafy vegetables and (7) fruit. These are the things with which the appetite should be satisfied; the things that should be eaten for health's sake. What else is eaten does not greatly matter so long as it is simple, clean, easily digestible, well prepared and not in excess of the body's needs.

**Diet Surveys.** We have today a good deal of knowledge about the kind of diet which people eat in many parts of India. This has been obtained by what are called *diet surveys*. If you ask a man what kind of diet he eats he will tell you vaguely that he sometimes eats this and sometimes that and even after careful questioning you will remain in doubt as to what his diet really consists of. He may want to show how well he feeds or perhaps the opposite, and in either case he will make exaggerated statements. In a diet survey a trained investigator visits families twice daily for a number of weeks and weighs all the foods which they are going to eat so that exact data are obtained. It is sometimes hard to persuade poor families to cooperate in such investigation; they are naturally suspicious of the motives of the investigator. But this difficulty can be overcome by tact and patience. The result of diet surveys of this nature has been to provide a clear picture of Indian dietary habits, and one of the points which has been demonstrated is the insufficient intake of foods other than cereals. The average Indian diet contains too little milk, pulses, vegetables, fats of various kind, and fruits. It does not approach the kind of diet which Sir Robert McCarrison recommends.

**The cereals.** The cereals, which include wheat, rice, the various millets, barley, rye, oats and maize are as a group approximately similar in food value. They do not contain a sufficiency of various food constituents, including vitamins which are needed by human beings. The rice grain is designed by nature to feed the rice germ or embryo, and no doubt it is well adapted for this purpose. But it is not well adapted to fulfil human food requirements in every respect. Still less is it suited to this end when it has been milled. The outer layers of cereal grains are richer in various nutritive materials than the starchy inner part or endosperm. Milling removes the outer layers and leaves the grain impoverished. In India it is the chief food crop—rice which suffers most by milling, rice being a grain which is particularly easy to mill. Wheat as a rule is eaten "whole" in the form of *atta*—a very healthy habit. The various millets which follow rice and wheat in order of importance are not usually milled. The grains are so small that removal of the outer layers would be difficult.

**Supplementary Foods.** But whatever the state in which cereals are eaten, a sufficient intake of other foods is essential. Nutrition research workers have studied the value of the various supplementary foods consumed in India and have gained a very fair idea how much of each is desirable and how far typical Indian diets fail to contain the desirable amounts. We are therefore in a position to suggest, the broad lines which agricultural policy should follow in order to improve the quality and balance of Indian diets. A greater intake of milk and milk products, eggs, fish, pulses, vegetables and fruit, is particularly necessary. Every attempt should therefore be made to encourage the production of these foods.

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\* Published by Macmillan and Co., Ltd, Madras.

A considerable amount of detailed knowledge about food value, etc. is available to guide food production in the right direction. A few examples may be given; all kinds of milk—including cow's, buffalo's, and goat's milk—are of high nutritive value, as is the evaporated milk product of North India (*Khoa*) which is largely used in making sweets. Skimmed or separated milk is very good food. Most of the pulses are roughly similar in nutritive value, so that it does not much matter which variety is encouraged. The soya bean has in the past been considered an exceptionally valuable food which should be made popular in India. Experiments have however shown that it is no better than many other common pulses and there is not much point in spending a great deal of time and money in increasing its cultivation. Among the vegetables, the green leafy kind is particularly rich in vitamins and other necessary food constituents. The food value of most fruits grown in India has been investigated and the results are available. These show, for example, that two kinds of fruits the cultivation of which is spreading—the tomato and the orange are rich in certain vitamins and are worth further encouragements. There are fish available in Indian waters which can provide liver oil richer in vitamin A than cod liver oil and the development of fisheries might allow local industries for the production of such liver oils to be established. Many other examples of useful data about food values might be given.

**Sugar.** Within comparatively recent times the peoples of Europe and America have begun consuming sugar in large quantities. This habit has been made possible by the large-scale development of sugarcane production in the tropics and beet production in Europe. The only concentrated form of sugar known in European antiquity was honey, a relatively rare and costly product, for bees, however industrious, cannot rival sugar factories in their output. In India sugar has been manufactured from cane for many centuries. The sugarcane originated in the Ganges basin and it is said that about the year A. D. 648 the Chinese Government sent officials to India to study its cultivation and methods of extracting the juice. In the last few years the sugar industry has shown rapid development in its original home as the result of protection and imports of sugar have fallen. *Per capita* consumption of sugar in India is however, small in comparison with consumption in Europe and America.

An increase in the supply of sugar in India is all to the good; as has been said, any increase in total food production is of the utmost importance. But it must be remembered that sugar whether refined or unrefined, is a food of limited value. While it is a concentrated source of food energy, it contains no protein or vitamins and an increased intake of sugar will not help to balance Indian diets. In England nutrition experts have objected to the Government subsidy to the beet sugar industry on the ground that the money might have been better spent in improving the supply of milk or other highly nutritious foods.

**Cash crops.** Another subject about which nutrition workers have something to say is that of cash crops. It is of course desirable that the production of valuable non-food crops, such as cotton, tobacco, etc. should be encouraged up to a certain point. The wealth of the country is thereby increased. But there may be danger in paying too much attention to cash crops at the expense of food crops. Prices fluctuate according to the level of world markets and an area in which the cultivation of a paying crop has been taken up with enthusiasm may experience a disastrous slump. When this occurs the population suffers because it is no longer producing food for its own use. The recent report *Nutrition in the Colonial Empire* published by the Economic Advisory Council\* contains a

\* Committee on nutrition in the Colonial Empire, First Report. Parts I and II, 1939.

good deal about this question which is probably more urgent and important in Africa and the West Indies than in India.

The report sums up the position as follows :—

“ The aim should be the establishment of a *balanced agriculture* for the production of commodities produced to be used either for direct consumption by the producer and his family or for sale for consumption elsewhere in the country or for sale in overseas markets. As regards commodities produced for export it appears that the producer must continue to expect wide variation in his income from money crops. Family production of foods to meet family needs is a great safeguard against some of the worst social and economic effects of fluctuations in the income from money crops.”

In the southern United States a serious food deficiency disease called *pellagra* is prevalent. This is usually caused by a diet which contains too much maize and too little else. Maize is a dangerous food for very poor people and this fact should be remembered should there be signs of its becoming an important crop in India. The southern United States are a great cotton-producing area, and the small farmer may devote his land almost exclusively to cotton and buy his food, chiefly maize, in the local market. When the price of cotton slumped in the bad years around 1930—33, the incidence of *pellagra* did not rise ; rather it tended to fall. The reason for this was that the farmer, instead of growing cotton which no longer paid, began to produce vegetables and other foods for his own use. Though he had less money in his pocket, he was actually better fed.

This example illustrates the disadvantages of relying too much on a single crop. It can also be used to illustrate the advantages of growing vegetables for home consumption. In many parts of India much more vegetables could be grown in the village, if people would take the trouble to do so. Every house should have a little vegetable garden, or else vegetables should be grown on some suitable piece of ground near a well or wherever water is available. Waste water from the house can be used to water vegetables. It is surprising what a large amount can be raised from a small plot.

**Farming and Diet.** The improvement of farming and the improvement of diet are so closely inter-related as to be almost the same problem. An increase in the production of certain kinds of food may create new habits of diet. Thus, the consumption in England of tropical and sub-tropical fruits, such as bananas and oranges has risen enormously during the last 30 years, because of their cheapness and availability which followed the development of fruit farming in the West Indies and elsewhere. In India the increasing supply of excellent home-grown oranges is visibly creating a taste for this fruit. Conversely, a demand for certain kinds of food which can be stimulated by educating the people about nutrition, may influence agricultural production. For example in America the insistence of nutrition experts on the value of milk and milk products has raised national milk consumption and brought prosperity to certain states largely occupied in the dairy industry. An interesting review of such questions will be found in the League of Nations report, *The Relation of Nutrition to Health, Agriculture and Economic Policy*.\* This report shows how agriculture in Europe has been able to adapt itself to a change in food habits in the direction of more dairy products, vegetables and fruit—i. e. a change for the better. We may hope that in time Indian agriculture will be able to make the adaptations which are necessary to improve the nutrition of the people.—*Indian Farming*.

\* Final Report of the mixed committee 1937.

## ABSTRACTS

**The Copper content of Long Island soils in relation to tuber-rot of potatoes caused by *Phytophthora infestans*:** (Mont. de Bary), J. B. Skaptason, L. C. Peterson and F. M. Blodgett. *Amer. Pot. Jour.* 17 : 88-92.

Tuber rot of potatoes was found to be very negligible in spite of abundant and continued supply of sporangia introduced into the soil by very severe infection of foliage and dying of plants. To determine whether copper in the soil due to continued spraying with Bordeaux mixture over a period of years might be a factor, germination of sporangia of *P. infestans* was tested in water in which these soils were suspended. The soils were also analysed for copper content. Bordeaux mixture of different strengths from 2-1-50 to 8-4-50 were tried on foliage and the average number of blight lesions decreased with the increase of the strength of Bordeaux mixture. All the plants died in the check plots but there was no tuber-rot in any of the plots. Ten fields (9 of 'old' soils and one of 'virgin' soil) were analysed for total copper. The old soils have been used to potato for periods ranging from 18 to 32 years. The copper content of these fields varied from 69.6 to 90.5 parts per million of metallic copper. The 'virgin' soil was found to have rather a high content of copper probably due to water run-off from adjacent fields. Germination tests of sporangia were tried on a film of water surrounding virgin soil and soil used to potato for 32 years. Germination was 8.6 per cent in 'old' soil and 50.4 per cent in 'virgin' soil as against 65.4 per cent in distilled water.

C. R. V.

**Tobacco Seed-bed Fertilizer Experiments.** L. F. Mandelson *Queensland Agr. Jour.* 53:516-525 (1940).

The physiological trouble known locally in Queensland as 'yellow patch' of tobacco seed beds was found to be associated with the use of large quantities of organic nitrogen such as dried blood or animal manures and was probably caused by the accumulation of free nitrogen in the soil coming in contact with the roots of young tobacco seedlings. (*Queensland Agr. Jour.* Sept. 1939). To avoid this trouble tobacco growers were advised to use only nitrate of soda as a source of nitrogen in mixed fertilizers for seed beds. Two seed bed fertilizer experiments were conducted in 1939-40 season with a view to control 'yellow patch' and to obtain satisfactory seedling growth. They were designed to investigate the effect of (1) nitrate of soda applied at the rates of  $\frac{1}{2}$  oz., and 4 oz., per sq. yard. (2) superphosphate applied at the rates of 0 oz., 1 oz., 2 oz., and 3 oz., per sq. yard. and (3) sulphate of potash applied at the rates of 0 oz.,  $\frac{1}{2}$  oz.,  $\frac{1}{3}$  oz. and  $\frac{2}{3}$  oz., per sq. yard. The treatments were arranged in randomised blocks of sixteen plots, certain of the higher order interactions being partially confounded. Each plot was 1 sq. yard in area. Observations on growth of seedlings, plant population per plot and root development of seedlings were recorded. One of the experiments was a partial failure due to nematode infestation. All the data were statistically analysed, and the following conclusions were arrived at. (1) A significant increase in growth resulted from the application of 4 oz., of nitrate of soda per sq. yard in both experiments. (2) Superphosphate at the rate of 2 oz. per sq. yard in the first experiment and at the rate of 3 oz. per sq. yard in the second experiment resulted in optimum growth responses. When applied at the rate of 2 oz. per sq. yard, in the second experiment superphosphate significantly increased both seedling root development and plant population per unit area and neither nitrogen nor potash had any such effect. (3) Sulphate of potash, did not significantly enhance seedling growth in either experiment. When applied

in relatively heavy doses, associated with relatively heavy applications of superphosphate it had a depressing effect on growth.

Based on the above conclusions, a seed bed fertilizer mixture is recommended by the author. It consists of 48 percent nitrate of soda, 10 percent cotton seed meal (to supply bulk), 32 percent superphosphate, 3 percent sulphate of potash and 7 percent magnesium sulphate. When this is applied at the rate of  $5\frac{1}{2}$  lb. per 100 sq. ft. it supplies the equivalent of 4 oz. of nitrate of soda  $2\frac{1}{2}$  oz. of superphosphate and  $\frac{1}{2}$  oz. sulphate of potash to each square yard of seed bed.— T. N.

**Farmyard manure.** *Trop. Agriculturist*, 94:257—261.

Farmyard manure is a mixture of the litter and solid and liquid excreta of farm animals, which may have undergone a certain degree of fermentation, and would supply the soil with all the essential elements, viz., nitrogen, phosphorus and potash; and in addition activates the soil's biological and chemical processes, thus increasing the availability of other essential elements. The agricultural value of any sample of manure depends primarily upon its composition; this composition, is largely determined not only by the relative proportions of solid and liquid excreta and litter, but upon such factors as the kind, age, food and functions of the animals producing it, and the care taken in the production and preservation of the resulting manure. Proportionately, urine is much richer in nitrogen and potash than the solid excreta. The nitrogen of urine (in the form of urea) is quickly converted into available plant food, whereas the nitrogen of the undigested food in the solid excrement is but slowly changed into available forms. The cow produces the largest amount of manure, but while this is comparatively the lowest in its content of fertilizing elements, its abundance makes it economically the most important manure in mixed and dairy farming. More than one half of the nitrogen and at least three-fourths of the potash excreted by the cow are to be found in the urine, while most of the phosphoric acid is excreted in the faeces. Horse manure is distinctly richer in nitrogen, phosphoric acid and potash than cow manure; but it ferments more easily, and is thus liable to lose more of its nitrogen. It would be best, therefore to mix cow and horse manure if they are to be left for any length of time in the heap. Sheep manure is very rich in nutrient elements and when not mixed with straw, contains approximately twice as many units of plant food as cow manure. It is concentrated, can be easily applied, and has therefore been found of special value for top dressing and for fertilizing garden soils, lawns, etc. Analyses have shown that one ton of dried sheep manure is equivalent to approximately four tons of good, fresh, mixed farmyard manure.

Poultry manure is the richest manure produced on the farm. It is particularly valuable for garden and leafy crops. It should be remembered that poultry manure ferments very rapidly and if left exposed loses a large proportion of its nitrogen as ammonia. This manure is generally applied directly to the soil and worked in during the summer after being mixed with earth, but should it be necessary to keep it for some time especially in winter it should be mixed with a proportion of light soil, peat or saw dust, if available together with a little superphosphate or gypsum to fix the nitrogen. Sheep and poultry manure are therefore much richer in plant food constituents than horse and cow manure. Manure in animal sheds does not maintain the same composition; it undergoes certain transformations and decompositions. The mineral substances such as potash, phosphates etc., generally escape these transformations but the nitrogenous organic matter cannot. Urine contains urea, uric acid, etc., which under bacterial influence are converted into carbonate of ammonia; this fermentation takes place even at a low temperature and increases immensely as the temperature rises. This means a loss of nitrogen which is easily detected in animal

sheds if aeration is inadequate, by the offensive smell and some stinging in the eyes, characteristic of the production of ammonia.

To avoid these losses in nitrogen, experience has taught that the best practical way is to remove the manure frequently and to make it into heaps before fermentation sets in.

The following table shows the estimated quantity of manure obtained per 450 kgs. (about 1000 lb) of live weight:—

	Total excreta per year Tons.	Manure with bedding Tons.
Horse	8.9	12.1
Cow	13.5	14.6
Sheep	6.2	9.6
Calf	12.4	14.8
Fowl	4.3	4.3

**Agricultural products as insecticides.** R. C. ROARK (*Industr. Eng. Chem.* 31, pp. 168. Euston Pa., 1939). Although the materials now largely used for this purpose (compounds of arsenic, flourine, lead, copper and sulphur) are of mineral origin, vegetable products are being used to an increasing extent. This is because many organic compounds are more toxic to insects but less toxic to man than are lead arsenate and other inorganic poisons. In addition to organic insecticides that exist naturally in plants such as nicotine, ground-nut oil, and other plant oils, products derived from coniferous trees, such as pine-tree oil are also valuable insecticides and synthetic compounds derived from oils alcohols, furfural and other promising plant products are now coming into commercial use as insecticides. It is conjectured that in the future insecticides will be mostly organic compounds obtained from plants now regarded as worthless weeds or synthesized from products of plant origin. The possibilities of constructive chemical research in this field are boundless and should result in numerous products of great economic value. *Rev. App. Ent.* 27 : (1939) 593.

## EXTRACTS

### Kapok and the War.

It is probably true to say that many men and women, British and neutrals alike, to-day owe their lives to kapok.\* Their boats having been mined or torpedoed, they have been kept afloat by kapok-filled lifebelts and lifebuoys until picked up by other ships. Kapok is the most buoyant of all materials used for life-saving appliances. Its floating power is about five times as great as that of cork, and submerged, it has a carrying capacity of no less than 30 times its own weight. Not only so, but it has the added advantage of losing only 10 per cent. of its buoyancy in 30 days and can rapidly be restored to its former buoyancy simply by drying in the sun. A small pillow will hold one's head above water for days on end. This resilience and buoyancy is caused by the air-filled cells which, under a microscope, can be seen in kapok fibre. The cells are covered on the outside with a waxy substance which renders the fibre impervious to moisture. Java kapok has been approved by the board of Trade as a buoyancy medium in life-saving appliances, which include life-buoys, life-belts and life-jackets, while kapok is also used for pick-up buoys, fenders, cushions, seat cushions and mattresses. Owing to the saving in weight, a kapok-filled lifebuoy can be thrown a greater distance than the old-fashioned lifebuoy. The kapok-filled lifebuoy as used by the Royal National Life-boat Institution weighs only 5 lbs. 6 ozs. and supports 35 lbs. in water for a minimum period of 24 hours. The

\* Silk Cotton,

weight of an average man in water is only 9 lbs. Life-buoys depending on kapok for their buoyancy have been approved by the Board of Trade for use in British ships. Life-belts supplied to *R. M. S. Queen Mary* are filled with Java kapok. Similar lifebelts are to be supplied for use in *R. M. S. Queen Elisabeth* and *R. M. S. Mauretania*. In addition to its lightness and higher supporting power a kapok-filled life-belt lasts longer, and there are no sharp corners to wear through which minimises the necessity for constant recovering.

Kapok is on "national service" in other directions. The researches of a French army doctor during the last war showed that kapok has the most remarkable antiseptic and healing properties. It can be applied to an open wound and will absorb water. The insulating properties of kapok also make it the ideal bandage or wadding for the alleviation of rheumatism, sciatica, lumbago, bronchial troubles, or whenever warmth should be applied to the body. Again, a Harley Street specialist has designed kapok pneumonia jackets, body belts, kidney pads, rheumatic bandages, and vests for sufferers from bronchitis. The Pasteur Institute in Paris has discovered that kapok can be sterilised by heat several times without losing its properties. It is ideal, of course, for use in aeroplanes owing to its lightness. Nurses find that a mattress of kapok is much easier to turn saving much time and labour in hospitals containing hundreds of beds. *Industrial Fibres Review*, 5: (1940) 10.

#### Protection of Stored Grains from insects.

*Sprays.* Many storage buildings, particularly those in tropics are so constructed as to render fumigation difficult. Insect infestation in such buildings is probably best tackled by means of sprays. Insecticidal sprays may be divided into two types; those which rely on a direct hit, whereby the insect is thoroughly wetted, and those which, after atomization, ultimately settle on the insects. It is only in rare circumstances that a direct hit can be obtained on stored-products-insects and accordingly an atomized spray is essential. A good one consists of an extract of pyrethrum carried in a white oil (kerosene).

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*Dusts.* It is well known amongst colonial producers that seeds required for planting can be kept effectively free from insect attack if they are stored in vessels or tins with dry wood ashes. Experiments made by Squire in British Guiana have also shown that weevil damage in rice can be materially reduced by the addition of less than 1 per cent. of calcium carbonate (precipitated chalk) and that in the Federated Malay States it has been found at the Government Rice Mills in Perak that the treatment of stored rice with 5 per cent. slaked lime affords satisfactory protection from insect attack. In British Honduras it is a common practice to add lime when maize is stored in the cob in heaps or bins, with beneficial results.

In recent years the use of dusts for the protection, particularly of grain and cereal products, has become more and more general. It is unfortunate that at present no clear understanding of the action of these dusts has yet been attained and there is considerable controversy regarding it. From the practical man's point of view, however, the main point is that these dusts are said to be surprisingly effective and further, the variety of mineral dusts which are effective is considerable. Of the natural mineral dusts, the best known and probably the most effective is a naturally occurring rock phosphate widely known in Egypt under the name of "Katelsousse". This particular dust has been so generally successful that it is now marketed on behalf of the Egyptian Government by Imperial Chemical Industries, Ltd., under that name.

Other effective dusts consist of pure silica and one of these known under the proprietary name of "Naaki" has been widely used in Germany and elsewhere.

It is a German product and will in consequence not be available during the war. Other simple mineral dusts are precipitated chalk, slate dust and china clay. It is quite probable that a number of naturally occurring earths may prove effective. Some firms market or are about to market dusts for which they claim very high efficiency, and particulars of these can be obtained from Imperial Chemical Industries, Ltd.

The use of dusts is simple and consist merely in the mixing of the dusts with the grain or other product to be protected. Their general use is for the protection of grain and seeds, particularly pulses. It is worth noting that while experiments on the elimination of these dusts prior to milling and baking of grain are still in progress, the general opinion is that this elimination need present no difficulty, and further that many of the dusts mentioned are innocuous to the alimentary tract. Where dusts such as lime or powdered chalk are used in stored rice their elimination occurs when the rice is washed, as is customary prior to cooking.

Of all the methods of protecting grain and seeds in particular against insect attack it would seem that the use of dusts is much the most promising. *Jour. Jamaica Agri. Soc.* 44: 157—158.

## Gleanings.

**Black-heart of Potatoes.** Black-heart is induced by a deficiency of oxygen within the tissues of tubers. This may be brought about by high temperatures which increase the rate at which oxygen is consumed by the potato cells, or by storage under conditions where the supply of air is inadequate for the respiratory requirements of the cells. The death of the cells is followed by the production of pigments which gives rise to pink, brown and black colours characteristic of the various stages of black-heart. The final colour is jet black and this has given rise to the name of black-heart.

**Symptoms.** The symptoms of black-heart vary depending on whether the tubers are exposed to high temperatures with a normal air supply or to high, low or medium temperatures with an insufficient air supply. In the former case, there are internal symptoms only; in the latter, both internal and external symptoms may develop. Black-heart may, under certain conditions, develop in the field, but it occurs most frequently where large quantities of potatoes have been stored in a confined space.

**Control.** If given a good supply of air, tubers do not usually develop black-heart at temperatures below 95° F. Control, therefore, involves storage of the tubers at temperatures less than 95° F. with good ventilation. Moreover, if tubers must be stored in a confined space, the temperature should be kept as low as possible and arrangements made for ventilation, if this is feasible. As black-heart may sometimes occur in the field as well as in storage, the tubers should not be left long in hot soils after the vines have died or be left long on the soil surface after digging during hot weather. (*Agr. Gaz. N. S. Wales* 51: 259—260).

**The distribution of Insects, Spiders, and Mites in the Air.** A discussion of the results of an investigation carried out during the years 1926—31 inclusive, to test the height to which insects can ascend in the air. The collection of the insects was facilitated by means of special traps fitted to the airplane wings. Some 1,314 flights were made in Louisiana and 44 flights in Mexico, the traps being in operation for 1,007 hours; 30,033 specimens of insects and spiders were taken at altitudes ranging from 20 to 15,000 feet; 18 orders of insects and spiders and mites were collected, Diptera being the most abundant, followed by Coleoptera. Homoptera and Hymenoptera were taken at 14,000 feet—the highest altitude at which insects were found—but a spider was caught at 15,000 feet, the

highest altitude at which any specimen was taken. Temperature was the most important factor regulating the numbers of insects found in the air at any given time; the optimum range was from 75° to 79° F. surface temperature. The maximum numbers of insects were found at sunset, at which time many crepuscular and night-flying moths, together with the day forms, were active. Rain after a long period of drought caused an increase in insect activity, and greater numbers were found in the upper air at such time. In the airplane collections of insects in Mexico the pink bollworm moth was found as high as 3,000 feet. This and other studies indicate that the pink bollworm moths are carried in the upper air currents for considerable distances. (*The Empire Cotton Growing Review*, 17 : 43).

**Making full use of our Farms.** In the days before we had good roads and modern cars the farm was much more self-sufficient. Those were the days of the farm garden and orchard, when the farmer's wife kept the family fed on the produce of the farm. Now we have swung to the other extreme. It has become an age of specialisation, even with farmers. We have left off mixed farming in order to devote all our time to practically a single crop. The family fruit garden is on many farms no more, the vegetable garden a neglected weed patch; and some farm families eat most of the food out of tin cans. One often has to go a long way to find a farmer who has discovered the true art of living cheaply and well. It is, unfortunately, a rare sight to see a good vegetable garden on a farm. Home-grown products have been unfashionable, and the result is that many farmers wonder why their living costs are so high. By reviving the custom of our fathers and mothers in making the farm furnish more of our living, we would find that we had solved part of our economic problems and at the same time be living better. To-day, thanks to refrigeration, the farmer's wife has actually better chances of making more use of the products of the farm for her own table. (*Queensland Agr. Jour.* 53 : 598.)

**Farms as Gilt-edged Securities.** It is only in troubled times like the present that the man with money seems to realise that for real wealth—for something that is everlasting and tangible—he must go to the source of all life, the land. And that, judging from reports from all over Great Britain, is what he is doing now. In most districts in the old Country the demand for farms and estates of almost any size far exceeds the supply. It is not only those with money to invest however, who are interested in good farms to-day, for there are enquiries on all hands from men who see a period of stability coming to farming, and who hope that the industry may remain stable even when the war is over.

This is the opinion of one buyer who has a mere £ 150,000 to invest and which he is willing to risk in the first class agricultural and dairy farms:—  
“ There is no question but that the public to-day realise that food producing land is the finest gilt-edged security that it is possible to purchase ”.

(*Queensland Agr. Jour.* 53 : 594).

## Correspondence.

[We reproduce below an appeal issued by A. R. C. Westlake Esq., I. C. S., Director of Agriculture, Madras inviting Agricultural Propaganda material. Ed. M. A. J.]

To

The Editor,  
The Madras Agricultural Journal.

Sir,

*An Appeal.*

I require propaganda material for supplying to All-India Radio Stations. It has been observed that straight-forward talks on agricultural subjects do not

hold the attention of the audience. What is required is a dialogue or a short play, if possible with human interest and entertainment value. I shall be glad to receive dialogues, sketches or short plays in Tamil and Telugu containing agricultural propaganda from members of the Department and from present and past students of the Agricultural College. It is suggested that authors will be assisted in writing a 'live' sketch if they write down a detailed description of the personages in their dialogue or sketch with a little imaginary history for each person.

Authors might also remember the popularity of the speaking animal as shown by the *Pancha Tantra* stories and the Walt Disney cartoons, (Micky Mouse etc.) Some effective dialogues might be written between a conservative cultivator and a cow or other animal gifted with speech through whose mouth good advice might be given. Sketches might also be enlivened by short songs set to well known tunes which could be sung without difficulty by people at the Radio Studio. I am prepared to pay from my own pocket from Rs. 5 to Rs. 10 for each dialogue or sketch that is broadcast. It is also possible that if material of merit is submitted, authors might find a future market with All-India Radio for other material.

Authors should send their manuscripts direct to me at my office in Madras.

Madras, }  
1-8-40, }

Yours etc.,  
A. R. C. Westlake.

## Crop and Trade Reports.

**Statistics—Crop—Sugarcane—1940—First report.** The average of the areas under sugarcane in the Madras Province during the five years ending 1938-39 has represented 2·8 per cent. of the total area under sugarcane in India.

The area under sugarcane up to 25th July 1940 is estimated at 129,720 acres. When compared with the area of 102,910 acres estimated for the corresponding period of last year, it reveals an increase of 26·1 per cent. The increase in area is general outside East Godavari, Nellore, Coimbatore and Tinnevely and is due to the high price for jaggery which prevailed just before the planting season. The increase in area is marked in South Arcot (9,000 acres), Vizagapatam (5,000 acres), North Arcot (3,200 acres), Salem (2,700 acres) and Kistna (2,200 acres). The area estimated for Bellary, South Arcot and Tanjore is the highest reported in recent years.

The condition of the crop is satisfactory except in Vizagapatam where the crop was adversely affected by the very heavy rains of May.

The wholesale price of jaggery per imperial maund of 82½ lb. (equivalent to 3,200 tolas) as reported from important markets on 5th August 1940 was Rs. 5-11-0 in Mangalore, Rs. 5-4-0 in Salem, Rs. 5-0-0 in Erode, Rs. 4-15-0 in Rajahmundry and Cuddalore, Rs. 4-13-0 in Vizianagaram, Rs. 4-10-0 in Cocanada, Rs. 4-5-0 in Chittoor, Rs. 4-2-0 in Adoni and Vellore, Rs. 3-14-0 in Coimbatore, Rs. 3-10-0 in Vizagapatam, Rs. 3-7-0 in Bellary and Rs. 3-4-0 in Trichinopoly. When compared with the prices published in the forecast report issued at this time last year, these prices reveal a fall of approximately 58 per cent. in Adoni, 50 per cent. in Vizagapatam, 46 per cent. in Bellary and Trichinopoly, 41 per cent. in Vellore, 40 per cent. in Chittoor, 37 per cent. in Cocanada, 35 per cent. in Rajahmundry, 28 per cent. in Salem, 27 per cent. in Vizianagaram and Cuddalore, 24 per cent. in Mangalore and 22 per cent. in Erode.

**Statistics—Crop—Groundnut—1940—Second report Summer Crop—**The area under the summer or irrigated crop of groundnut in parts of the Madras Province during the five months—January to May 1940—is estimated at 120,300 acres. The harvest of the crop is in progress. The yield is expected to

be normal in all districts except Chingleput and South Arcot. The total yield is estimated at 100,100 tons of unshelled nuts.

**Early crop—Area and yield.** The area under the early crop of groundnut (mostly unirrigated) up to 25th July 1940 in the districts of Salem and Coimbatore is estimated at 153,000 acres. When compared with the area of 142,000 acres estimated for the corresponding period of last year, it reveals an increase of 7.7 per cent. A normal crop is reported from both the districts. The total yield is estimated at 76,500 tons of unshelled nuts as against 66,200 tons estimated for the corresponding period of last year.

The wholesale price of groundnut (shelled) per imperial maund of 82½ lbs. (equivalent to 3,200 tolas) as reported from important market centres on 12th August 1940 was Rs. 4-12-0 in Vizagapatam, Rs. 4-8-0 in Vizianagaram, Rs. 4-5-0 in Cuddalore, Rs. 4-3-0 in Guntur, Rs. 3-15-0 in Hindupur, Rs. 3-14-0 in Nandyal, Rs. 3-11-0 in Bellary, Rs. 3-8-0 in Adoni and Cuddapah and Rs. 3-3-0 in Tadpatri. When compared with the prices published in last report, i.e., those which prevailed on 8th July 1940, these prices reveal a rise of approximately 19 per cent in Vizagapatam, 15 per cent in Hindupur, 13 per cent in Nandyal, 10 per cent in Guntur, 6 per cent in Vizianagaram, 5 per cent in Cuddalore, 4 per cent in Cuddapah and 2 per cent in Tadpatri and a fall of approximately 3 per cent in Adoni, the price remaining stationary in Bellary.

**Statistics—Crop—Gingelly—1940-41—First Forecast Report.** The average of the areas under gingelly in the Madras Province during the five years ending 1938-39 has represented 16.2 per cent. of the total area under gingelly in India.

**Area** The area under gingelly up to 25th July 1940 is estimated at 344,200 acres as against 366,100 acres estimated for the corresponding period of last year. The estimated area is the same as that of last year in Cuddapah, South Arcot and the West Coast; a decrease in area is revealed in Kistna, Guntur, Bellary, Anantapur, Nellore, Chingleput (-7,000 acres), Chittoor, North Arcot, Salem (-30,000 acres) and Ramnad, partly counterbalanced by an increase in area in the rest of the Province, especially in East Godavari (9,000 acres), Vizagapatam and West Godavari (5,000 acres in each).

**Yield.** The yield per acre is expected to be normal in all the districts except Vizagapatam.

The wholesale price of gingelly per imperial maund of 82½ lbs. (equivalent to 3,200 tolas) as reported from important markets on 5th August 1940 was Rs. 7-4-0 in Trichinopoly, Tinnevely and Tuticorin, Rs. 7-3-0 in Cuddalore, Rs. 7-0-0 in Cocanada, Rs. 6-15-0 in Ellore, Rs. 6-12-0 in Vizianagaram, Rs. 6-7-0 in Rajahmundry, Rs. 6-0-0 in Vizagapatam and Rs. 5-12-0 in Salem. When compared with the prices published in the report for the corresponding period of the previous year i. e., those which prevailed on 7th August 1939, these prices reveal a rise of approximately 33 per cent in Trichinopoly, 28 per cent in Salem, 26 per cent in Cuddalore, 21 per cent in Tuticorin, 17 per cent in Ellore, 16 per cent in Tinnevely, 13 per cent in Vizianagaram, 8 per cent in Cocanada, 2 per cent in Vizagapatam and 1 per cent in Rajahmundry.

*(From the Director of Industries and Commerce, Madras).*

**Cotton Raw, in the Madras Presidency.** The receipts of loose cotton at presses and spinning mills in the Madras Presidency from 1st February to 16th August 1940 amounted to 398,480 bales of 400 lb. lint as against an estimate of 366,800 bales of the total crop of 1939-40. The receipts in the corresponding period of the previous year were 387,057 bales. 383,872 bales mainly of pressed cotton were received at spinning mills and 109,642 bales were exported by sea while 86,133 bales were imported by sea mainly from Karachi.

*(From the Director of Agriculture, Madras).*

# College and Estate News.

**Students' Corner.** An interesting debate was held on 5-8-40 with Sri Seshavatham (student) in the chair the subject being 'whether women students should be admitted into the Agricultural College'. Sri Narayanamurthy opened the debate and the discussions from varying angles of vision followed successively. The resolution in favour of the admission of women was carried. Sri Kantiraj, the observer, gave expression to some of his impressions on the debate for the benefit of the students.

**Mr. R. C. Broadfoot.** At an urgent general body meeting of the Students' Club on 19th August '40 a resolution was passed, praying for the quick recovery and restoration to normal health of Mr. R. C. Broadfoot the President of the Club, who was proceeding to Madras for treatment. A hearty send-off was given to Mr. Broadfoot on the railway platform as he left for Madras, by the students of the College.

**Games. Hockey.** The opening match of the season was played against the Central Recruits School team on the school grounds and our college won the match by 5 goals to nil. In a match played against the Coimbatore United Club our College won by 3 goals to 2. The matches played against Government College and Papanayakapalayam ended in goal-less draws. The College sustained the first defeat of the season in a match played against Madukarai Cement Factory Club by 3 goals to 2. In a match played against the Union Christian Collège, Alwaye, on 17-8-40 we won 5 goals to nil. The Union College avenged their defeat by winning a volley ball match against us when they snatched victory after a tough fight.

**Crickets.** The opening match of the season was played between Sri H. Shiva Rao's XI and Sri K. M. Thomas's XI and the match ended in a victory to the former. Sri H. Shiva Rao's XI—125 all out; H. Shiva Rao 34 retired. Shanker Rao 36; Hegde 3 for 22. Somanna 2 for 14.

Sri Thomas's XI—94 all out. K. M. Somanna 43, B. S. Krishnan 11, S. V. Srinivasan 6 for 35, Kodandaraman 3 for 41.

On 4-8-40 a match was played against the Scouts Recreation Club on our grounds. The College batting first, declared the innings at 152 for 7 wickets. H. Shiva Rao (54 retired) K. M. Somanna (23) C. Shanker Rao (17) and Deva Doss Kamath (14) were the chief run-gatherers. S. R. C. XI:— 72 for 7 wickets. B. S. Krishnamoorthy 29; Hegde 4 for 9 and Somanna 3 for 14

On 18-8-40 in a friendly match between Sri H. Shiva Rao's XI and C. N. Babu's XI, the former were all out for 169. B. S. Krishnan 52, Nambiar 34, S. V. Sreenivasan 15, Shanker Rao 35. Babu's XI;— 54 all out. Nageswar Rao 13, S. V. Sreenivasan 20, Reddiar 2 for 1

**Foot Ball.** In the first match played against the Ranganadhapuram Recreation Club, the College sustained a defeat by 3 to 2 goals. In another match played against Municipal High School, our College lost by 2 to 1 goal.

**Personal.** Consequent on the two month's leave granted to Mr. R. C. Broadfoot, Senior lecturer in Agriculture and Superintendent, Central Farm and Principal of the College, Rao Bahadur Sri. G. N. Rangaswami Ayyangar, Millets Specialist and Geneticist has been appointed Principal and Sri. K. Unnikrishna Menon, Deputy Director of Agriculture, IV Circle appointed as Senior Lecturer and Superintendent. Mr. C. Ramaswami, Deputy Director of Agriculture, II Circle, has been appointed as Deputy Director of IV Circle, Coimbatore. We offer our felicitations to these officers.

Information has been received that Mr. C. Jaganatha Rao, B.A., M.Sc., of the Cotton Specialists' Staff and Farm Manager, Agricultural Research Station, Nandyal, has been selected for appointment under the Imperial Council of Agricultural Research as Agricultural Experimentalist, Imperial Agricultural Research Institute, New Delhi. We offer our congratulations to Mr. Jaganatha Rao.

**Governor's War Fund.** There has been a spontaneous response among the officers of the Agricultural Department to the appeal issued by H. E. the Governor of Madras for contributions to the War fund. His Excellency's own example in contributing one day's salary per month for six months has been emulated by almost all the officers of the department. Many among the Subordinate officers drawing a salary below Rs. 100 have made such contributions though H. E.'s appeal was not made to them.

**Trinket Collections in aid of the War.** The ladies of the estate have not lagged behind their sisters in other parts of the province in making their own contributions to the War fund. Collections in the form of gold and silver trinkets were made by a band of enthusiastic ladies and it is hoped that a substantial collection in this form will be made.

## Moffusil News and Notes.

**Erode Agricultural exhibition.** The Agricultural exhibition along with the Health and Veterinary exhibits, was held in the municipal reading room building situated in Peoples' Park about a mile away from the Erode town.

The exhibition was declared open by Sri. K. Kamaraja Nadar, M. L. A., and President, Tamil Nad Congress Committee at 5-30 p m on 28-6-1940 after the inauguration of the Health and Baby Week celebrations by Sri. S. Satyamurthi, M. L. A. (Central) the Mayor of Madras Corporation. Visitors both from the urban and rural parts came in large numbers to see the exhibition. The agricultural exhibits such as best seeds, varieties of sugar and sugarcane, the various kinds of implements and the best products from ryots' fields were arranged so as to draw the attention of the large crowd. By means of explanations and demonstrations, the necessity of improving agriculture and farming by adopting scientific methods and using improved implements was impressed upon the people. The stalls were crowded throughout and the average attendance per day exceeded 600 of which ryots' population would be about 40 per cent. The Health and Baby Week celebrations came to an end on 4th July 1940.

Sri. Kulasekaram Naidu, Revenue Divisional Officer, Erode, presided over the last day's function and distributed prizes and certificates of merit to the competitors and to the best exhibits. One certificate of merit to the Agricultural Department stall and four of the same with two silver medals were awarded to four ryots for having exhibited the best produce from their lands. With a hearty vote of thanks by Sri. R. K. Venkataswamy, Chairman, Municipal Council, Erode, the function came to a successful termination.—K. U. M.

**Sbiyali (Tanjore District).** An Agricultural exhibition was held in connection with the Thirumulaipal festival. Besides the usual display of paddy and rice samples of the different strains and improved ploughs and other implements recommended to the rice grower, live specimens of a large range of green manure and fodder plants, and 'Korai' mat grasses raised in pots, and the attractive display of locally grown fruits like sapotas, figs, pomeloes, Sathgudi oranges and mangoes formed a special feature of the exhibition. The other exhibits included different breeds of poultry, bee hives smokers, and honey extractors. Fairly large crowds were attracted to the exhibition daily and the importance of the different exhibits explained to the interested visitors.—M. A.

**Avadayarkoil.** During the Anithirumanjanam festival at Avadiyarkoil (Aran-tangi Taluk) an Agricultural exhibition was conducted from 7-7-40 to 10-7-40. His Holiness Namasivaya Thambiran, Trustee of the Avadiyarkoil temple gave hearty co-operation and necessary assistance in the conduct of the exhibition. All agricultural improved implements, different strains of paddy and ground-nut and green manure seeds were exhibited at the stall. The economic advantage of using such improved implements and seeds were explained to the visitors. Leaflets were distributed. Lantern lectures on improved methods of agriculture were also delivered. The Health Department and the District Board, Tanjore also participated in this exhibition. About 1000 people visited the exhibition stall.—A. G. N.

## Weather Review—JULY 1940.

### RAINFALL DATA

Division	Station	Actual for month	Departure from normal @	Total since January 1st	Division	Station	Actual for month	Departure from normal @	Total since January 1st
Circars	Gopalpore	11.4	+4.5	43.0	South	Negapatam	1.9	0.0	5.9
	Calingapatam	6.2	+0.9	26.3		Aduthurai *	1.6	+0.3	10.3
	Vizagapatam	3.3	-1.2	17.1		Madura	0.9	-1.0	13.5
	Anakapalli *	3.7	-1.3	23.7		Pamban	0.0	-0.6	11.5
	Samalkota *					Koilpatti *			
	Maruteru *	7.4	+0.1	17.8		Palamkottah	0.0	-0.4	7.0
	Cocanada	5.2	-0.6	22.4					
	Masulipatam	6.2	-0.2	11.5					
Ceded Dists.	Guntur *	6.0	+0.2	16.3	West Coast	Trivandrum	6.6		39.0
	Kurnool	3.9	-0.9	11.7		Cochin	36.4	+13.6	76.2
	Nandyal *	4.2	-1.8	6.3		Calicut	44.3	+14.1	80.1
	Hagari *	1.0	-1.0	11.8		Pattambi *	35.0	+9.2	60.9
	Siruguppa *	2.4	-0.7	9.5		Taliparamba *	54.2	+9.1	92.0
	Bellary	1.1	-0.7	12.0		Kasargode *	46.1	+4.1	88.6
	Anantapur	0.2	-3.2	5.7		Nileshwar *	52.9	+10.0	99.9
	Rentachintala	6.3		12.5		Mangalore	45.0	+7.9	79.8
	Cuddapah	2.3	-1.6	18.1					
	Anantharajupet *	3.5	-0.8	13.3		Mysore and Coorg	Chitaldrug	5.0	+1.9
Carnatic	Nellore	1.1	-1.7	12.8	Bangalore		1.7	-2.5	15.7
	Madras	4.1	+0.2	11.1	Mysore		3.3	+0.7	17.0
	Palur *	2.8	+0.1	7.2	Mercara	44.3	-2.1	92.5	
	Tindivanam *	0.8	-1.0	9.2					
Central	Cuddalore	1.8	-1.3	7.2	Hills	Kodaikanal	3.6	-1.4	27.8
	Vellore	1.5	-3.8	10.4		Coonoor			
	Salem	3.5	-0.3	19.9		Ootacamund *	3.8	-1.5	29.3
	Coimbatore	0.8	-0.7	14.8		Nanjanad *	5.2	-5.6	26.8
	Coimbatore								
A. C. & R. I. *	1.1	-1.0	11.9						
Trichinopoly	0.0	-1.6	9.3						

\* Meteorological Stations of the Madras Agricultural Department.

@ From average rainfall for the month calculated upto 1937 published in the Fort St. George Gazette.

**General.** The monsoon was generally active over the whole country and was vigorous in Malabar, Konkan and the Bombay Deccan.

Four depressions of the Bay of Bengal and one depression of the Arabian Sea were responsible for widespread rainfall. Skies were moderately to heavily clouded in Mysore and Malabar and lightly to moderately clouded in South East Madras and North Bombay Deccan and clear or lightly clouded in the North Madras coast. Humidity was in excess in the Bombay Deccan, Hyderabad and Mysore and was in defect in North Madras Coast. Maximum temperatures were below normal in North Hyderabad, Mysore, Madras Deccan and North Madras Coast and normal elsewhere. The highest maximum of 102°F was recorded at Madras on the 6th.

The rainfall however was in defect generally except in the West Coast and parts of Circars and Mysore.

*The chief falls of rain were :*

Mahabaleshwar	...	6'0" on 15th.
Mangalore	...	7'7" on 17th.
Cochin	...	4'9" on 14th.
Calicut	...	4'8" on 14th.
Taliparamba	...	4'3"
Kasaragod	...	4'2"
Nileshwar	...	6'1"

**Weather Report for the Agricultural College and Research Institute Observatory.**

Report No. 7/40.

Absolute maximum in shade	...	...	89'0°F
" minimum "	...	...	67'8°F
Mean maximum in shade	...	...	85'3°F
Departure from normal	...	..	-1'2°F
Mean minimum in shade	...	...	72'5°F
Departure from normal	...	...	+0'2°F
Total rainfall for the month	...	...	1'13"
Departure from normal	...	...	-1'0"
Heaviest fall in 24 hours	...	...	0'21'
Total number of rainy days	...	...	5
Mean daily wind velocity	...	...	6 m. p. h.
Departure from normal	...	...	-2'6 m. p. h.
Mean humidity at 8 hours	...	...	73'3%
Departure from normal	...	...	+1'4%

**Summary.** The monsoon was active during the month. The rainfall was 1'13", which was 1'0" below normal. Skies were moderately to heavily clouded and the humidity was in excess. The mean maximum temperature was slightly below normal while the mean minimum was slightly above normal.

## Departmental Notifications.

### Gazette Notification.

#### 1. Appointments.

1. Sri. Rao Bahadur G. N. Rangaswami Ayyangar, Millets Specialist and Geneticist, Coimbatore to be Millets Specialist and Geneticist and Principal, Agricultural College, Coimbatore from the 20th August 1940 or date of taking charge from Mr. R. C. Broadfoot who has applied for leave.

2. Sri. K. Unnikrishna Menon, permanent Assistant Director of Agriculture and officiating Deputy Director of Agriculture, IV circle, Coimbatore to officiate

as Senior Lecturer in Agriculture and Superintendent, Central Farm, Coimbatore from the 20th August 1940 or the date of taking charge from Mr. R. C. Broadfoot.

### 2. Transfers.

Name of officers.	From	To
Sri. S. Sitarama Patrudu, „ M. Veeraraghava Rao	Asst., D. A. (on leave),	Asst., D. A., Rajamundry.
„ Naidu,	Asst., D. A., Rajamundry,	Asst., D. A., Vizagapatam.
„ P. Subrahmanyam,	Asst., D. A., Vizagapatam,	Asst., D. A., St. Thomas Mount.
„ C. Ramaswamy Nayudu,	Offg. D. D. II circle, Cuddapah.	D. D. A. IV circle, Coimbatore.

### 3. Leave.

Name of officers.	Period of leave.
Sri. Rao Bahadur Y. Ramachandra Rao, Govt. Entomologist, under the I. C. A. R., New Delhi.	L. a. p. for 4 months and leave on half average pay for 5 months and 10 days from 1-6-1940.
Mr. R. C. Broadfoot, Principal, Coimbatore.	L. a. p. for 2 months from 20-8-'40.

## Subordinate Services.

### 1. Appointment.

The services of Sri. N. Kesava Ayyangar, Assistant in Cotton are placed at the disposal of the Government of India for three years for appointment as Cytological Assistant under the Indian Central Cotton Committee in the scheme relating to the Interspecific hybridisation in cottons at Surat.

### 2. Promotions.

The following grade promotions of Lower Subordinate in Category 2—class I, Madras Agricultural Subordinate Service are ordered with effect from 1st April 1940:—

*From IV grade Rs. 75-4-95 to III grade Rs. 100.*

1. Sri. E. N. Rangaswami Ayyangar, Assistant Agricultural Demonstrator, Tindivanam.
2. Sri. C. K. Subrahmanya Ayyar, Sub Assistant in Entomology, Coimbatore.
3. Sri. R. Venkatarama Ayyar, now on foreign service as Market-yard Superintendent under the Groundnut-Market Committee, Cuddalore.

### 3. Transfers.

Name of officers.	From	To
Sri K. Purushottam,	A. D., Guntakal	A. D., Gooty.
„ T. Devasighamany,	A. D., Gooty,	A. D., Proddatur.
„ M. K. Gopalan	A. D., Proddatur,	A. D., Sullurpet.
„ V. Ratnaji Rao,	A. D., Sullurpet,	Kalahasti Farm.
„ P. Krishnamurthi,	A. D., Salur,	A. D. on special duty Sugarcane Growers Co-operative Society, Bobbili.
„ G. Kameswara Rao,	F. M., A. R. S., Samalkota,	A. D., Ongole.
„ M. V. Narasimha Sastri,	A. A. D., Kothapeta,	Asst., F. M., A. R. S., Samalkota.

Janab Muhammad Abbas	A. D., Gudiyatam.	F. M., Central Farm,
	Sahib,	Coimbatore
Sri K. P. Sankunni Menon,	F. M., Central Farm,	
	Coimbatore,	A. D., Cheyyar.

#### 4. Leave.

Name of officers.	Period of leave.
Sri R. Guruswami Naidu, A. D., Kaikalur,	L. a. p. for 30 days from 1-8-40.
„ D. S. Subramania Ayyar, A. D., Nilakottai,	Extension of l. a. p. for 15 days and l. a. p. on m. c. for 3 months from 2-7-40.
„ T. D. Eswara Ayyar, Asst., F. M., Sim's Park, Coonoor,	Extension of leave on half average pay for 1 year and 13 days from 2-8-40.
„ K. H. Subramania Ayyar, A. D., Avanashi,	L. a. p for 1 month from 30-7-40.
„ V. Ratnajirao, A. D., Sullurpet,	L. a. p. for 4 months from 15-8-40.
„ P. K. Kanuan Nambiar, F. M., A. R. S., Nileshwar II Station,	Extension of l. a. p for 1 month from 1-8-40.
„ K. Rajabapaniah, F. M., A. R. S., Guntur,	Extension of leave on loss of pay for six months from 30-7-40.
„ K. B. Viswanatham, A. R. S., Maruteru,	Extension of l. a. p. for 3 months from 4-8-40.
„ V. V. S. Varadarajam, F. M., A. R. S., Guntur,	L. a. p. for 1 month from 8-8-40.
„ K. Govindan Nambiar, F. M., A. R. S., Nanjanad,	L. a. p. for 2 months from 5-8-40.
„ C. T. Ittyachan, Asst. to the Oilseed Specialist,	Earned lerve for 33 days from 19-8-40.
„ J. Suryanarayana, A. D., Gurzala.	L. a. p. on m. c. for 3 months from the date of relief.
„ D. Shunmugasundaram Pillai, A. D., Aruppukottai.	Extension of l. a. p. for 1 month from 13-8-40.
„ T. V. Krishnaswami Rao, A. D., Vizagapatam.	L. a. p. on m. c. for 2 months from 26-7-40.
„ K. M. Jacob, A. D. (on leave).	L. a. p. on m. c. for 1 month from 11-8-40.
„ E. K. Govindan Nambiar, F. M. (on leave).	Extension of l. a. p. on m. c. for 4 months from
„ K. Raghunatha Reddy, Agri. Marketing Asst., Madras.	Earned leave for 2 months from 19-8-40.

### An Announcement.

**Wanted.** Assistant Marketing Officer (temporary) for 3 months from 1st October 1940, with prospect of continuance. Commencing salary Rs. 200 per mensem on a scale of Rs. 200-20-500.

**Qualifications.** Accustomed to rural environment. University degree in Agriculture or Economics. Knowledge of Statistics. Ability to write good English. Preferably with practical experience or commercial knowledge of Agricultural Marketing Survey work.

Applications to be submitted by 10th September to;— The Agricultural Marketing Adviser to the Government of India, Old Secretariat Buildings, Civil Lines, Delhi.

