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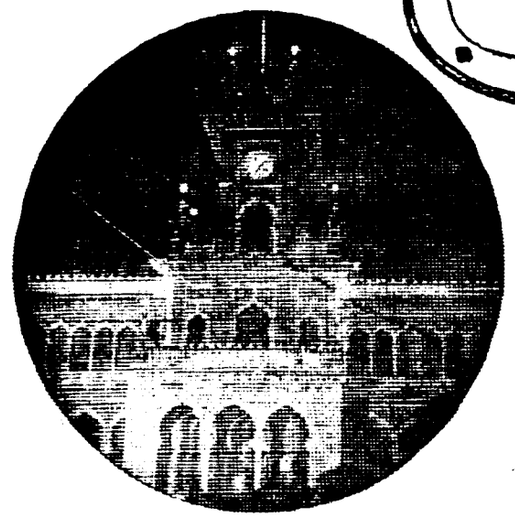

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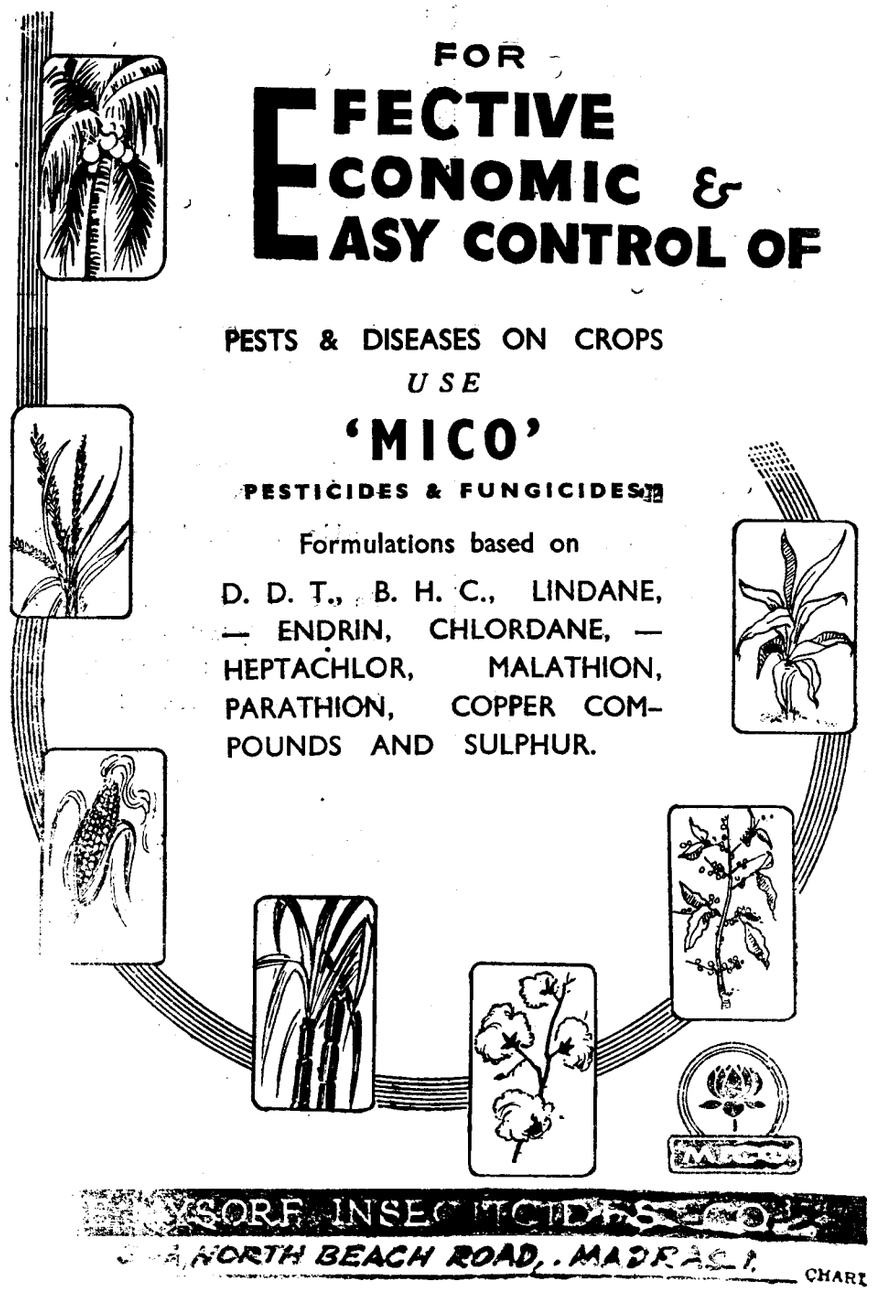

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A *Pythium* Root Rot and Chlorosis Complex of Sugarcane

by

K. V. SRINIVASAN

Sugarcane Breeding Institute, Coimbatore

During the last two years a disease of sugarcane has been observed in the neighbourhood of Coimbatore. The chief symptom is a marked and severe chlorosis. Affected plants may be recognized from a distance by the striking white colour of the crown leaves. The disease has also been noted in some varieties in the collection of this Institute. It has been observed on Co. 419, Co. 421 and Co. 467 at Tudiyalur north of Coimbatore. Specimens of Co. 419 forwarded from Pugalur in the Tiruchirapally district, and examined through the courtesy of Dr. K. Ramakrishnan also showed similar symptoms. At Coimbatore it has been so far observed only in the gardenland soils but not in wetland soils. In the collection at the Institute the disease is not confined to any particular species of *Saccharum* but occurs in different species.

Symptoms: There are atleast three distinct phases in the life history of the sugarcane plant when the disease appears. Germination failure is common in the planted setts. This is quite distinct from the 'pineapple' disease caused by *Ceratocystis paradoxa* (deSeynes) Moreau. '*Spontaneums*' and certain '*officinarums*' are particularly prone to such failures. Either the shoot does not emerge at all or if it emerges the shoot is sickly, yellow or almost white and soon starts withering. The sett may easily be pulled out of the soil. There are no sett roots or if a few have developed they bear a number of red lesions, the root tips are blackened and the roots are in various stages of decay. The sett may be slimy and the tissues are of a red colour and emit a disagreeable odour. They do not however emit the smell of over-ripe pineapples characteristic of 'pineapple' disease. The sett soon undergoes a wet rot and disintegrates.

Some setts may germinate normally and the first leaves may be green and healthy looking. But in two to six weeks the leaves turn yellow and soon turn almost completely white. Short red longitudinal streaks appear on the leaves. The plant remains severely stunted and may wither away in a few weeks or carry on an unthrifty existence. On digging out the plants the sett roots and

the newly formed shoot roots exhibit pits, scattered reddish lesions and root tip injury and are rotted back. In certain varieties like Co. 419 recovery may occur after 8 to 12 weeks when new green leaves are developed and the chlorotic leaves wither away.

The disease may also occur after cane formation at any time from four months onwards up to maturity. The leaves of one or more tillers may begin to exhibit alternate green and yellow stripes all along their length. Later leaves show progressively increasing chlorosis till the top leaves are bleached white (fig 1). In such completely chlorosed leaves short narrow red streaks may appear along the length of the blades. The sheath does not appear to be affected. The oldest leaves may not show the symptoms. Late tillers bear a crown of white leaves and none of the leaves on such tillers may be normal. The root system shows extensive injury. Many of the roots show reddening of the ends and bear blackened root caps. Many pits and red lesions are seen all along the length. The lesions are circular or elliptical and of varying size, mostly three to five millimeters in diameter. Some of the lesions may be of a darker colour. The branch roots, secondaries and tertiaries, are rotted back beginning from the tip nearly up to their points of origin. Often only a cluster of long primary roots almost devoid of branches is seen. Sometimes there may be a cluster of branches at the end of a primary root and the rest of the root may not bear any living secondary roots. The anchorage of the plant does not appear to be seriously affected at this stage.

Sections through the root lesions at various stages of the disease reveal that the cortex is injured. In older primary roots the stele is not affected although the cortex may have suffered extensive injury and may slough away. However in very young roots almost the entire root is destroyed. Embedded in the tissues especially in recently affected roots may be seen a number of nematodes in various stages of development. In older lesions however few nematodes may be seen, presumably because the latter have deserted the roots. Fungal mycelium occurs both intra and intercellularly in the affected tissues.

Aetiology: Examination of the roots and the rhizosphere showed the presence of a large number of nematodes. On certain roots there were hundreds per linear inch of root. The nematodes were separated by the Baermann funnel technique. In the beginning a number of forms were encountered many of which were undoubtedly

saprophytic. By repeated transfer of washed and chopped roots to fresh plants raised on sterilized soil the pathogenic form was obtained in a relatively pure form. The separated worms were fixed in hot water and 5% formalin and examined. The females were predominant. These are 0·6 to 0·7 mm. in length and 20 to 29 μ in diameter; oesophagus 90 to 100 μ, tail 70 to 75 μ, vulva posterior to the middle about 60 μ distant; there are rather coarse striations on the cuticle. The body has crenate winged edges at the posterior end and the tail tapers to a blunt conical apex. The general appearance of the worms suggests their similarity to *Radopholus similis* (Cobb) Thorne (=*Tylenchus similis* Cobb, *Anguillulina similis* (Cobb) Goodey).

The worms on separation were washed by centrifugation in sterile water and plated on oatmeal agar. The cultures were characterised by their slimy appearance. Within 5 to 8 weeks the cultures contained numerous worms. A species of *Fusarium* belonging to section *elegans* was associated with the cultures and the worms did not thrive in the absence of the fungus in the culture. In the nematode cultures the *Fusarium* produced submerged growth but when purified by single spore technique it produced whitish aerial mycelium and salmon coloured pionnotes.

Isolations of fungi were made from the root rot lesions by plating roots on plain agar after several washings in sterile water and transferring hyphal tips of the resulting growth to Quaker oats agar. In all cases a species of *Pythium* was obtained. Hyphae are hyaline, coenocytic, with granular contents, 4 to 7 μ in diameter; sporangia formed of inflated segments and irregular toruloid digitate elements at the ends of branches or in intercalary fashion; zoospores 20 to 40 per vesicle, 8 to 10 μ in diameter when encysted; oogonia readily formed on all media and in the tissues of the host, spherical, thin-walled, smooth, terminal, 20 to 35 μ in diameter; antheridia monoclinous, 1 to 4 per oogonium, clavate; oospores plerotic, smooth-walled, yellowish to brown 18 to 32 μ in diameter. In certain tubes of quaker oats agar chlamydospore like bodies were formed after about a month which germinated by germ tubes. The organism appears to be identical with *Pythium graminicolum* Subram. (Middleton, 1943).

Pathogenicity: Pathogenicity was studied with Co. 467, which proved to be highly susceptible to the disease, as test variety. The results are given in table 1. Coimbatore local, a variety of *spontaneum* was also used principally for studying germination failures.

(i) *Nematodes :* Single-eyed cuttings were planted in soil taken from affected fields and sterilized by autoclaving. At the time of planting, nematodes were added to the soil as a suspension made up by mixing an agar culture with water.

The setts of *spontaneum* failed to germinate and on digging out were found to have decayed. The root-eyes were damaged and no roots had developed. The bud was also soft and rotten. The internodal tissue was soft and slimy.

Nematodes were found to have colonized the setts in large numbers particularly the root eyes and buds.

In the case of Co. 467 the shoots emerged. In 9 out of 20 cases the leaves showed typical chlorosis. The roots had pits all over the surface and slight reddening around the pits. There was no rotting of the roots. Isolations yielded, besides the nematodes, *Fusarium* sp. usually found associated with the nematode cultures.

(ii) *Fusarium sp. :* The *Fusarium* was multipled on sand-oats medium and mixed with sterilized soil on which the plants were raised. The resulting plants did not show any symptoms of the disease. The roots were normal and had no singns of injury.

(iii) *Pythium graminicolum : Pythium* was grown on oat meal and after one week the entire contents of one 250 ml. flask was mixed with sterilized soil in a 9" pot in which two single-eyed setts were planted. All the shoots emerged satisfactorily. Most of them grew without any sign of injury. Only three of them showed curling of the margin and drying of the edges and tips. The plants were taken out at the end of six weeks and the roots examined after washing them free of soil. Affected plants bore damaged roots with a number of red lesions on them. Two apparently healthy plants had stray secondary roots with one or two small lesions. All the others had normal healthy roots. *Pythium* was reisolated from the lesions.

It was felt that the technique was inadequate and that the roots had escaped coming into contact with the pathogen. The fungus was grown on potato dextrose solution and inoculations were carried out in the following two ways :

(a) The setts were planted in sterilized sand and when the shoots had emerged the plants were carefully removed and the roots were washed free of sand without injury. The mycelium of the fungus was lightly beaten up in a mortar with sterile water to get a

thick suspension of aggregates of mycelium without dividing the hyphae into too small pieces. The roots were dipped in the suspension and the plants immediately set in sterilized soil and copiously watered.

(b) The second technique was kinglly suggested by Mr. T. S. Ramakrishnan. Single-eyed setts of Co. 467 were planted in sterlized soil in 4" pots with detachable bottoms. After the plants had grown for about two weeks the pot was inverted, the bottom taken out to expose the root tips and the lower portions of the roots. The culture was applied around the exposed ends of the roots without injuring them, sterilized soil was packed around the roots and the bottom replaced. The pots were righted and watered.

The controls in both cases were similarly treated except for the application of the culture.

After one week 12 out of 20 of the plants treated with mycelial suspension and 11 of those inoculated at the root end showed symptoms of root rot. The leaves stiffened and became erect. They dried along the margin and tip and the margins tended to curl inwards. Affected plants died within a few days. There was no chlorosis. The plants were taken out and the roots were examined. There were a number of red coloured rot lesions all along the roots which had been dipped in culture suspension. In the case of the plants which had only their root ends inoculated the lesions were confined to the tip and the portion of the root behind the tip to a distance of up to two inches. There were no lesions in the proximal parts of the root. However the disease lesions appeared to be progressive resulting in root decay. Reisolations yielded *Pythium.*

The controls in either case were healthy looking. The roots were healthy and normal.

(iv) *Effect of mixed inoculation with nematode and Pythium :* Sterilized root rot soil was filled into 10" pots and mixed with a culture of *Pythium* and a suspension of nematodes. Co. 467 was planted. The majority of the shoots (17 out of 20) that emerged were chlorotic with numerous red streaks on the white leaves. The plants remained severely stunted and dried up in three weeks. Three plants germinated normally but after 15 to 20 days they too turned chlorotic and soon withered. The roots were short and severely pitted and covered with red lesions. In some of the cases the sett roots were almost completely rotted back. There was little branching of the roots and the new roots that were produced also showed symptoms of attack. Both nematode and *Pythium* were present as

revealed by direct examination as well as by reisolations. The controls were normal as in the other experiments, and were much taller than the diseased ones.

TABLE I

Results of inoculation of Co. 467.

Pathogen added	Number of plants inoculated	No. showing chlorosis	No. showing withering without chlorosis	No. apparently healthy	No. showing root lesions
I Nematodes	20	9	..	11	10 (pits)
II *Pythium graminicolum*:					
(i) Mixed with soil	20	..	3	17	3 (red lesions)
(ii) Root dip in mycelial suspension	20	..	12	8	14 ,,
(iii) Root tip inoculation	20	..	11	9	12 ,,
(iv) Control of each kind	10	..	..	10	.. ,,
III Mixed inoculum	20	20*	..	...	20 (pits and red lesions)
IV Control	20	..	..	20	..

* All the plants withered sooner or later. Three plants were apparently healthy on emergence but turned chlorotic after 15 to 20 days and withered.

(v) *Response to iron spray:* The chlorosis resembles the symptoms of iron deficiency (Martin, 1938). Aqueous ferrous sulphate solution (1 in 1000) was sprayed on the leaves of the affected plants which had been raised on root rot soil in pots. Within 48 hours numerous green islands developed on the sprayed leaves. When the spray was repeated more green spots appeared and coalesced with the older ones. The experiment was also carried out with older plants standing in the field. Only the spindle leaves of these plants responded and the older leaves remained unaffected.

(vi) *Cumulative nature of deficiency:* Setts were cut from plants showing typical symptoms and also from healthy plants growing on wetland clay. A microscopic examination of pieces of tissue of the setts was made. Nematodes could not be detected in them. Both were planted in root rot sick soil. The shoots emerging from the former were yellow and turned white; the plants showed severe stunting and the leaves had a number of streaks. On the other hand the shoots emerging from the setts taken from the healthy plants were normal and green. However, after three or four weeks these also produced chlorotic leaves. The chlorosis was of a milder type and the leaves did not have any red streaks. The setts taken from chlorotic plants were planted in non-root rot soil.

The initial leaves were chlorotic, but soon they turned green and developed normally. Evidently in the absence of nematodes the roots were able to supply the deficiency.

(vii) *Susceptibility of* Saccharum *species*: Observations were made on the standing crop in the root rot sick field. The disease was found to be severe on many of the 'officinarum' canes and the thicker hybrid varieties. In general the thinner canes, particularly those in the *S. barberi* and *S. sinense* groups appeared to be less affected. Variants of *Saccharum spontaneum* did not appear to be affected so severely with chlorosis. Many of them appear to be highly susceptible at the stage of germination. Certain variants appear to be suceptible in the adult stage also. This aspect of varietal resistance is under study.

(viii) *Control of germination failure:* A preliminary slide experiment showed that wettable sulphur was lethal to the nematodes. Young spontaneum plants which showed a mild attack, i. e. those where the shoot had emerged but was making poor progress, were dug out soon after the symptom was detected. The roots were washed in running water and severely affected roots pruned back. The sett with the root system was immersed in a suspension of wettable sulphur (one ounce in 2½ gallons of water) for 10 minutes and planted out in sterile soil. The soil was then given one irrigation with sulphur suspension. Control plants received the same treatment but not sulphur. In two weeks sulphur treated plants recovered by putting on fresh growth and thereafter grew normally while the plants which had not received sulphur did not make progress. Similar results were obtained when nonsterile soil was used, but after a time there was a set back and the symptoms returned indicating that the treatment had not completely eliminated the nematodes.

Discussion: Nematodes have been known to be associated with *Pythium* root rot of sugarcane (Muir and Henderson, 1926). They were believed to facilitate the entry of the fungal pathogen by causing injury to the roots. However in later years nematodes were not thought to be important in the occurrence of the disease. Recent reports have again focussed attention on the injury caused to sugarcane roots by nematodes (Birchfield, 1953). Observations recorded here have indicated that nematodes directly cause slight root injury but the attack leads to a severe from of chlorosis. Heavy nematode infection has been known to be associated with a chlorotic condition of sugarcane (Goodey 1933) and other plants (Good 1956).

The 'Mentek' disease of rice in Java was originally believed to be due to potassium deficiency but ultimately found to be associated with the nematode *Radopholus oryzae* (Van der Vecht, 1953). The affected soil in this Institute has an alkaline reaction (pH 8·4). Response of affected plants to foliar applictions of iron has indicated that an accute deficiency develops following nematode attack. Possibly other elements are also in short supply in the affected plant. This is under investigation. The deficiency is of a cumulative character as revealed by the deterioration of plants from setts taken from chlorotic plants and set in root rot sick soil and by the fact that such setts could make recovery and produce normal plants in the absence of the nematodes on root rot free soil. The mechanism by which a state of deficiency is brought about in the plant is not properly understood. The large scale destruction of lateral roots and root hairs may lead to decreased absorption. But this may be expected to lead to general starvation, and interference with the absorption of water should result in wilting and rapid death. This is probably the case in the young plants which remain stunted and wither away within a short period. However in older plants growth does not altogether cease and there are no symptoms of water deficiency as should be expected if starvation is due to root destruction. The possibility remains of the metabolic products of the nematodes or of the plant roots in response to the presence of nematodes either oxidizing the ferrous iron into the nonavailable ferric state or otherwise chelating with the iron and preventing its absorption.

Pythium graminicolum causes severe root rot but without chlorosis of the leaves. The disease under study appears to be an interesting complex clearly separable into two distinct but complementary aetiological entities, one a *Pythium* root rot and the other a malady associated with nematode injury of the roots and interference with the ferrous iron metabolism of the host. When the two occur together a synergistic effect is apparent and the disease assumes severe proportions. *Pythium* does not appear to be capable of appreciable growth through the soil even when the latter is sterilized. Thus when the fungal culture was mixed with sterilized soil in which setts were planted disease developed only on a few plants as compared to a larger number of plants being affected following direct application of the pathogen to the roots. However when nematodes were present in the soil many of the roots were attacked and yielded *Pythium* on reisolation. Evidently the nematodes help in disseminating *Pythium* through the soil. On account of the attraction

FIG. 1

Sugarcane plants showing Chlorosis

exercised by the roots the worms tend to congregate in the rhizosphere and in the process carry the fungus into this zone of intense activity. Other unpublished studies have in addition revealed that *Pythium* by itself is preferentially stimulated in the rhizosphere of sugarcane. Nematodes appear to play a somewhat different role in the causation of *Pythium* root rot than was assumed by earlier workers (Muir and Henderson, 1926). They seem to be important in building up a pathogenic population in the immediate neighbourhood of the roots and thus help in producing a very severe root rot.

For the purpose of saving plants in pots, treating the roots and drenching the soil around the roots with wettable sulphur has been used with a measure of success. This is particularly welcome as fumigants like chloropicrin, Methyl bromide or Ethylene dibromide cannot be used on living plants. Sulphur appears to be a useful nematicide. Incidentally it is possible that sulphur reduces the alkalinity of the soil by getting oxidized into sulphuric acid and this may make iron available for absorption by the plant and thus mitigate the effects of the disease.

Summary: 1. A disease of sugarcane has been observed characterized by striking chlorosis of the leaves. There may be failure of germination due to rotting of root eyes and bud. Young plants are extremely chlorotic and may soon wither away. Leaves on older plants may turn white but the plants do not die. The root system is decayed.

2. The disease is not confined to any particular species of *Saccharum* but occurs on different species.

3. Nematodes which resemble *Radopholus similis* and the fungus *Pythium graminicolum* are found associated in the diseased roots.

4. When the plants were raised on sterilized soil infested with nematodes severe chlorosis developed.

5. When the plants were inoculated with *Pythium* alone a typical root rot developed but not accompanied by chlorosis.

6. When the plants were raised on soil infested with both nematodes and *Pythium* the symptoms were very severe, with chlorosis of leaves and stunting of plants soon followed by withering of the plants. There was severe root rot.

7. Chlorosis affected plants responded to foliar sprays with ferrous sulphate solution.

8. Young plants of spontaneum showing symptoms of infection, tended to recover when treated with wettable sulphur.

9. It is concluded that the disease is a complex involving two pathogens, nematodes and *Pythium*, the former associated with reduced absorption of iron, and that the coincidence of the two organisms results in synergistic severity of the disease.

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Some Agronomic Experiments with Unirrigated 'Desi' Cotton at the Agricultural Research Station, Kovilpatti from 1901 to 1949

by

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I. INTRODUCTION

The Agricultural Research Station, Kovilpatti was opened in 1901. Among the various activities of this Station, breeding and agronomic experiments on the indigenous desi cotton known as *Tinnevellies* or *Karunganni* formed an important programme of work. Breeding investigations came to be intensified in 1949 under a special scheme financed by the Indian Central Cotton Committee. This work is in progress. The results of a large number of agronomic experiments concluded during the period 1901 to 1949 are summarised in this paper in order to serve as a guide to future investigations on problems of agronomical importance. The results are classified under the following sections.

A. CULTURAL B. ROTATIONAL
C. MANURIAL D. MISCELLANEOUS

II RESULTS OF EXPERIMENTS

A. CULTURAL:

(i) *Experiments on Preparatory Cultivation:* The local practice is to work the indigenous wooden plough for preparatory cultivation as often as weather and soil conditions permit. This plough does not penetrate enough to exterminate deep rooted and pernicious weeds like the 'hariali' *(Cynodon dactylon)*. Therefore, the farmer incurs extra expenditure every year to dig out these weeds by engaging manual labour with crow-bar during summer immediately following the previous cereal. In an observation study conducted on the station for a few years ending with 1911—12, cotton soil plough (a heavy iron plough) was compared with the wooden plough. The mean yield of seed cotton in lb./acre was 147 for the wooden plough and 266 for the iron plough. It is recorded

that the plots which had received shallow ploughing were foul with 'hariali'. The poor yield might have been due to this weediness. Based on this finding, farm lands were deep ploughed following a systematic programme for a few years after acquisition. It is believed that the cumulative effect of these operations was a general improvement of the farm soil in regard to weed infestation compared to the condition of the fields in the farm neighbourhood, so much so that an experiment in which the monsoon plough was compared with the 'guntaka' (an indigenous blade harrow) conducted over a five year period ending with 1930—31 failed to show the expected yield improvement in favour of deep ploughing. It was apparent that deep ploughing was not necessary for fields kept on such high levels of cultivation. Actually the mean yied in lb. of seed cotton per acre was 489 for the 'guntaka' plot compared to 466 for the monsoon plough.

In order to secure more definite information on the comparative merits of the available methods of preparatory cultivation an experiment named 'Permanent Cultural Experiment' was conducted over a twelve year period from 1935—'36. There were three variants namely (a) no cultivation (b) working the 'guntaka' and (c) working the monsoon plough. These were randomised and replicated six times. The net experimental area was three cents. Cotton occurred once every other year following a four-course rotation, cumbu (Pennisetun typhoides)–cotton–irungu (Sorghum dochna–a variety of fodder cholam)–cotton. The implements were worked in July–August each year since this period was the earliest fallow coming after harvest of all the major crops. Weeds were removed as part of farm routine in all the plots. Cotton yields for six years during the period of the experiment indicated that no spectacular effects were evident because of deep ploughing. The mean yield (Average of six years) ranged between 300 lb. for control (no cultivation) and 313 lb. for fields worked with monsoon plough. These trials proved that *there was no substantial yield increase by deep ploughing with the monsoon plough.*

(ii) *Experiment on frequency of inter-cultivation:* On the station, cotton is sown in drill lines 18 inches apart. Bullock power with the 'danthi' is the usual source of interculture to the crop. In order to know how many times the crop needed to be intercultured thus, an experiment was conducted during the period 1934–35 to 1936–37. Four variants, namely interculturing once, twice, three

times and four times were compared with no intercultivation (control). The five variants were randomised and replicated six times. Experimental areas ranged between 1·5 and 2·5 cents, it was constant for all the variants in any year. The interval between successive intercultures ranged between 3 and 4 weeks. The data for the smaller number of intercultures were fixed with reference to the needs determined by prevailing soil and weather conditions. In none of the seasons studied were the yield differences significant. The mean yields for the period of study ranged between 389 lb. to 410 lb. of seed cotton for varying frequencies of interculture and 420 lb. for no interculture. *It was apparent from these studies that frequent intercultures to line sown cotton crop were unnecessary.*

(iii) *Experiments for spacing in line sowing:* The local method of sowing is bradcasting using a seed rate of 15 to 20 lb. But on the station, almost since its inception, line sowing with the indigenous seed drill has been adopted successfully for cotton and the cereals. The spacings adopted was 18" x 8" as in the Ceded districts using a seed rate of 12 lb. With the establishment of drill sowing attention was turned to the possibilities of varying spacings between lines and in the lines for maximising cotton yield.

Preliminary studies during the period 1906 — 1938 gave indications of late harvests with spacings, wider than 18" x 8" and early harvest with closer spacings. Very close spacings tended to lower yield. It was also noted that crop yield was as good with line sowing as with broadcast sowing. Systematic experiments with combinations of spacings both in lines and between lines were carried out for three consecutive seasons ending with 1940–41. Following were the combinations.

Between lines.	9", 12", 15" and 18"
In the lines.	4", 8", and 12" in each.

The twelve variants thus obtained were randomized and replicated. There were six trials, three after cumbu and three after irungu. In two of them broadcasting the seed was included as an additional variant. The yield data are summarised in Table I.

TABLE I

Spacing Experiment — Line and Plant Spacings — Combined Summary of Yields over Seasons.

Spacing between lines and plants and particulars	Yield in lb. of seed cotton per acre							
	after Cumbu				after Irungu			
	1938—39	1939—40	1940—41	Mean over seasons	1938—39	1939—40	1940—41	Mean over seasons
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
9″ x 4″	408@	378@	57	281	456@	97@	123@	225
9″ x 8″	544	471	130	382	578@	147	187	284
9″ x 12″	590	480	118	396	581	162	216	320
12″ x 4″	508@	469	74	350	458@	141	191	263
12″ x 8″	507@	445	79	344	560	150	218	309
12″ x 12″	569	428	133	377	612	178	232	341
15″ x 4″	602	522	162	429	572	164	201	312
15″ x 8″	650	476	96	407	594	153	283	343
15″ x 12″	648	433	139	407	561	173	238	324
18″ x 4″	597	481	136	405	553	181	219	318
18″ x 8″ (Control)	607	486	92	395	618	179	233	343
18″ x 12″	541	398@	210	383	497	175	205	392
Broadcast	..	..	73	..	..	..	193	..
Significance P = 0·05	Yes	Yes	Yes		Yes	Yes	Yes	
Critical difference in lb./acre	88	53	58		82	38	48	

Note: 1. Underline denotes significantly higher values than control.
2. @ Denotes significantly lower values than control.
3. Column 4—low yield due to inundation from excessive rains in the field in which this trial was laid.

It will be observed that *no combination had any special advantage to merit preferential recommendation to the established spacing of 18″ x 8″ adopted on the station.*

(iv) *Experiments on 'Bunding':* Though the farm soils are relatively better placed in respect of general topography and total rainfall than then the dry farming areas of Bombay or elsewhere in the tract, some seasons are known to be much below the normal of 30 inches of rainfall and some much in excess. In order to know how far methods for conserving rainwater such as bunds and scoops help in enabling cotton to yield more, preliminary experiments were conducted during the period 1936—'37 to 1942—'43. The results were, inconclusive and there were technical defects on account of layout, and plot size. A systematic trial was started in 1943—'44 and continued till 1946—'47. The object was to secure information on the comparative effects of bunding to cotton following irungu and cumbu. Three variants namely, no bunding, bunding on four sides, and bunding all round with cross bunds were compared. The gross area of each plot was 10 cents from which a central area of 5 cents was demarked so that this area was well beyond the range of influence of the adjoining variant in the randomisation. The three variants together with the two cereal rotations formed six in all, and these were randomised and replicated four times. The varieties used were K.1 cotton, K.1 irungu and K.1 cumbu. The results *showed that none of the methods of conserving water helped in improving cotton yields appreciably.*

B. ROTATION:

(i) *Harmful after effects of fodder cholam on cotton yield:* Comparative observations on yields of cotton after the major cereal crops for a three year period ending with 1909–1910 showed that the mean yields were 374 lb after cumbu, 303 lb after irungu, and 341 lb after cotton. The indications were thus in favour of a rotation with cumbu. *Cotton after irungu suffered a reduction in yield by about* 16%. Later, examining the yield data for cotton after these cereals over a period of 31 years at the Agricultural Research Station, Ramanatha Iyer and S. Sundaram (1941) confirmed this finding.

(ii) *Systematic studies on rotation:* A series of rotation studies was conducted during the period 1927–'28 to 1933—'34 with the object of fixing a suitable pulse for rotation with cotton. Beyond a general indication that cotton after pulse tended to yield more than after the cereal no useful recommendation for general adoption came out of these studies. A more systematic study adopting a randomized and replicated technique was undertaken in 1934—'35 in which cotton yields, were compared in the following schemes of rotation.

1. Cumbu – Cotton – Irungu – Cotton : Four course rotation.
2. Cumbu – Cotton – Cumbu – Cotton : Two course rotation.
3. Irungu – Cotton – Irungu – Cotton : Two course rotation.
4. Pulse – Cotton – Pulse – Cotton : Two course rotation.
5. Cotton – Cotton – Cotton – Cotton : No rotation.

The study was continued over 12 years. The varieties used were K1 cumbu, K1 irungu and unselected bulk pulse 'Pillipesara' (Phaseolus trilobus) in the first four years, and blackgram subsequently. There were six replications. The plot area for cotton was 1·5 cents. The average yields for cotton in the different systems of rotation over the twelve year period are summarised in table II.

TABLE II.

Rotation for Cotton - Summary of Yields over Seasons
(Yield in lb. of Seed Cotton per acre).

Season	Four course rotation (Control)	Two course rotation with			No rotation
		Cumbu	Irungu	Pulse	
1	2	(3)	(4)	(5)	(6)
1934—'35	..	..	..	..	315
1935—'36	352	299	288	260	237
1936—'37	..	..	..	..	230
1937—'38	392	510	426	581	395
1938—'39	..	..	..	..	331
1939—'40	415	401	279 @	458	249 @
1940—'41	..	..	..	..	141
1941—'42	370	532	353	666	309
1942—'43	..	..	..	..	472
1943—'44	811	644 @	551 @	921	554 @
1944—'45	..	..	..	..	565
1945—'46	794	765	719	1154	667
1946—'47	..	..	..	..	112
Mean	522	525	436	673	381

Notes: Cotton yields in all the rotations were analysed statistically in each of the six years in which comparable data were available. The differences were significant for P=0·05, except in 1935—'36. Significantly higher yields than the control (four course rotation) are underlined. Significantly lower yields have been marked thus @.

The results showed cotton yields were highest after black gram but the most desirable was a four course rotation on grounds of farm economy.

C. MANURIAL:

(i) *Early trials:* In the beginning, research was directed towards an assesment of the comparative values of organic manures like farm yard mannure prepared in different systems, sheep manure and prickly pear compost. Cotton responded well to all these manures. As the supplies were limited, usefulness of artificial like ammomium sulphate was exploited. Indications were obtained that increased yields followed applications of artificials, that application in instalments was not necessary and that a single application prior to sowing was enough to evoke good response. But information on aspects of placement of manure, dosage on nitrogen basis and relative values of different forms of nitrogenous manures on crops raised on lands of low and high fertility levels was wanting.

(ii) *Systematic investigations:* In order to obtain information on these points a series of trials was arranged during the period 1943—'44 to 1945—'46. The variety used was K. 1. cotton. Different doses of nitrogen ranging between 0–100 lb. per acre, supplied in the form of cake or ammonium sulphate and applied by broadcasting immediately before sowing or drilled close to the seed lines were compared. In drilling the manure, care was taken to see that it was worked a little away from the seed line. This precaution helped in securing normal germination and stand. For cake, groundnut and *Neem* cakes were employed. Neem cake was included in the third year of trial. The variants were randomized and replicated four times. Each year the trial was arranged in two different fields, one after irungu, and the other after cumbu representing low level and high level fertility respectively.

There were thus six trials spread over three seasons. In all the years direct manuring at 20 lb. nitrogen raised cotton yields for both the levels of fertility. The increase was significant in low level fertility land in all the three years. In the high level fertility fields also the manured plots recorded increases, but the increases were not significant. In table III are summarised mean yield of 13 manurial variants common for all the three years for each level of fertility. Data on values of extra yield over the control and net gain after deducting cost of manure have also been furnished.

TABLE III

Mean Yields of 13 Manurial Treatment Over-seasons for two levels of fertility and average for both levels.

S. No.	Kinds of manure	Dosage in lb. of nitrogen per acre	Yield in lb. of seed cotton per acre			Average	Extra yield	Value of extra yield over control	Cost of Manure	Net gain after deducting cost of manure.
			Method of application	Low level fertility	High level fertility					
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
		lb.						Rs.	Rs.	Rs.
1	Ammonium sulphate	60	Drilled	657	780	716	232	40	42	— 2
2	Ammonium sulphate	60	Broad cast	638	766	702	218	38	42	— 4
3	Groundnut cake	60	Drilled	620	780	700	216	38	68	— 30
4	,, ,,	40	,,	626	740	683	199	35	45	— 10
5	Ammonium sulphate	40	Broad cast	649	709	679	195	34	28	6
6	Groundnut cake	60	,,	647	706	676	192	33	68	— 35
7	Ammonium sulphate	40	Drilled	593	746	670	286	32	28	4

Table III (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
8	Groundnut cake	40	Broad cast	567	711	634	150	26	45 —	19
9	Ammonium sulphate	20	Drilled	571	681	626	142	25	14	11
10	,, ,,	20	Broad cast	571	669	620	136	24	14	10
11	Groundnut cake	20	Drilled	584	641	613	129	22	23 —	1
12	,, ,,	20	Broad cast	495	658	576	92	16	23 —	7
13	No. Manure (control)	..	..	431	537	484	..	..	..	..

Notes : 1. Seed cotton valued at Rs. 43/- per *pothi* of 257 lb. (Mean of prevailing market rates for the period 1943—'44 to 1946—'47)

2. Value of ammonium sulphate at Rs. 14-1-0 per 100 lb (Mean of market prices for the period 1943—'44 to 1946—'47)

3. Value of groundnut cake @ Rs. 9/- per 100 lb. (Mean of market prices for the period 1943—'44 to 1946—'47).

The data on yields and net profit are revealing. Though increased yields were obtained from all dosages *20 lb. nitrogen in the shape of Ammonium sulphate was the most desirable dose as a net profit of rupees ten to eleven was possible with this dose. Allowing rupees two as cost of application there was a net profit of rupees nine per acre with drilling the manure.* This was the recommended dosage worthy of adoption on cultivators' holdings.

D. MISCELLANEOUS :

(i) *Mixed cropping with coriander :* The problem of a suitable form of mixed cropping with coriander and cotton under line sown conditions was studied experimentally for two seasons namely; 1934–'35 and 1935–'36. It was concluded that *a small quantity of coriander seed (about three lb.) broadcast in drill lines of cotton was profitable* in that it gave a mean yield of 507 lb. of seed cotton along with 173 lb. of coriander whereas in a pure crop of cotton alone the mean yield was 525 lb. of seed cotton.

(ii) *Sun drying cotton seed :* In 1942—'43 an experiment was conducted with the object of comparing yield of cotton raised with seed sundried in different ways with seed stored without drying from ginning to sowing. The object was to verify if there was any truth in the local belief that seed sun-dried gave poor yields. The results showed that sun-drying did not adversely affect cotton yield. The mean yield with seed sundried for one to two days and once every month was 504 compared to 534 with seed not sun dried. The differences were not significant.

(iii) *Use of summer harvested seed for sowing :* There is a strong belief among the cotton farmers in Kovilpatti taluk that 'Kodai' seed (seed harvested in summer) does not give a good crop compared to normal seed. The truth of this was investigated in 1933—'34 and 1934—'35 and again in 1951—'52. Seeds from season and summer harvests were compared for yield. The results were presented in a paper by Kalyanaraman etal in 1953. The authors have reported that no difference was noted in yield and quality of the crop raised from season and summer seed. Use of summer seed was recommended safely for sowing purposes at least in years when on account of adverse season, the crop did not yield enough seed to meet sowing requirements.

III EVALUATION OF THE RESULTS

Cultural : The experiments on prepatory cultivation and interculture described give the rather curious result that this practice can be done away with. For it cannot be denied that one or two ploughings by way of prepatory cultivation done timely do help in rain water penetrating lower levels of soil, so that it would be available to the deep rooted cotton at a later period in its growth. As Ramanatha Iyer *etal* would put it, " the pratice of preparatory cultivation has become so habitual and well established that any demand for proofs will be deemed as an outrage on truth ". Absence of expected increase attending preparatory cultivation on the farm is possibly due to the fact that years of systematic ploughing of all the lands on the station obviated need for elaboration in their operations. It would therefore be safe to interpret the findings of the experiment described more as a pointer to the need for a judicious restriction of the preparatory cultivation than as a total negation of the practice. *Considering the fact that farm lands are on a higher state of cultivation than what usually obtains in the neighbourhood, it would be necessary to conduct these trials on a regional scale on selected cultivators' holdings so that recommendations could be made to suit needs of specific areas of the tract.*

A perusal of the results on spacing experiments furnished in Table I showed that no variant was consistantly better than the control namely 18" x 8". Very close spacings were not economic as the crop was stunted in growth, forced in earliness, sparse in branching and poor in yield. The spacing of 15"x8" appeared to have certain virtues. Judging from the final over all mean yields, and barring the unusual behaviour in 1940—'41 one could reckon the performance on this spacing as more desirable than the rest because of the following advantages over 18"x8".

1. The crop matured slightly earlier.
2. It forestalled reduction in population from the ground weevil (Atactogaster finitimus), grass hopper and wilt which accounted for 10 to 20% loss in population.
3. In parts of the tract use of 15" gorru, was already in vogue and so it was easier to push on propaganda for this practice in other areas.
4. It was apparent that brodcasting as practised by the ryots did not have any special virtue to commend it; on the otherhand it needed a higher seed rate.

The results of bunding experiments demonstrated the super-fluity of the dry farming practice for lands like those as at the Agricultural Research Station, Koilpatti which receive a well distributed rainfall and which are generally free from undulation and slopes. A similar experience has been recorded at Nandyal. *But it is necessary to survey the Tinnies tract for locations of regions with soil-climate complex different from that of the station and similar to conditions obtaining on dry farming areas. Bunding trials are to be conducted on such locations. It is only after these regional trials are conducted that the tract can be cut up into areas which need bunding to maximise cotton production and those like the station which do not need this practice.*

Rotation: It was evident that the best rotation was a two-course rotation with pulse (black-gram). But on considerations of farm economics and fodder needs for cattle such a rotation was uneconomical. Among other rotations, cotton yields were more or less similar in the four-course rotation and two-course rotation with cumbu. Cotton raised without rotation was poorer than cotton in rotation, and the poorest was cotton after irungu. In view of the need to arrange the cropping scheme of the holding in such a manner that cotton (money crop) cumbu (staple food crop) and irungu (fodder) were all available in the same year, a four course rotation of cumbu-cotton-irungu-cotton was more frugal and had everything to recommend it for general adoption than any of the other rotations studied.

Manurial: In recent years as a result of intensified propaganda on the findings of the experiments, and supply position of ammonium sulphate being easier than before, the cotton grower in Tirunelveli has become more and more manure minded. The official figures for

Madras State places the total area under cotton in Tirunelveli district at 2·3 lakh acres with an output of 57,920 bales (392 lb. of lint). This can be stepped up by at-least a third as much more if the area in the district adopts manuring with ammonium sulphate at 20 lb. nitrogen per acre.

IV SUMMARY

Results of a large number of agronomic experiments conducted from 1901 to 1949 on the Agricultural Research Station, Kovilpatti representing the Tinnies cotton tract in Madras State are summraised under section heads like Preparatory cultivation, Rotation and Manure. The results are reviewed and their value for cotton extension service on cultivator's holdings discussed.

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A note on the Statistical Assessment of Probability of Rainfall and its Agricultural Significance

by

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The value of rainfall to agriculture depends as much on its distribution and reliability as on its absolute amount. Farmers in regions with a long established agricultural tradition, are fortunate in having the heritage of the accumulated weather lore of centuries for their guidance. This enables them to assess their chances of successful crop production. In the absence of reliable weather lore, the enlightened farmer, has had perforce to use rainfall means as an indication of likely expectation of rain, his most important climatic factor. Such expectations without reference to variability may often be quite misleading. The failure to allow for this variability has led to disappointing results in some agricultural ventures, and may account in part for the fatalistic attitude adopted towards attempts at predicting rainfall expectation. Hence it is proposed to expound in this note that an efficient expression of rainfall variability, which is of fundamental importance to the better understanding of seasonal crop variation, is statistically practicable, with the annual rainfall data of Nagercoil – Kanyakumari District.

Nagercoil, situated as it is at 8° latitude to the north of the equator, is expected to experience occasional periods of convection storms, typical of tropical rainfall, which may distort the mean rainfall figure to such an extent as to destroy its value as a measure of central tendency. An examination of the past records would, of course, indicate the likely extremes, but without a measure of variability the frequency of occurrence of rainfall would remain uncertain. Expressions of rainfall variability and reliability have been devised by meteorologists, but the concept of 'confidence limits' introduced by Manning has, of late, found wider application in the field of agricultural meteorology[1,2,3]. The confidence limits estimate the chance or rather the risk of obtaining values that lie outside prescribed limits for a given statistic, like mean annual rainfall as in this study or, in other words, they may be said to define a range together with an associated probability, which expresses the confidence that a particular value lies within the range and consequently, the possibility of exceeding the limits set, will

become obvious. The limits within which the rainfall may be expected to lie can be set according to need, that is, such limits can be calculated to any required level of probability. For example, with 9 : 1 confidence limits, an annual rainfall value outside these limits can be expected only once in ten years (i. e. 90% fiducial probability or $p = 0{\cdot}1$) and of these deviations, half (i. e. once in twenty years) are to be expected below the lower limit and the other half above the upper limit. This indicates that only once in twenty years the rainfall can be expected to fall either below the lower limit or exceed the upper limit.

The calculation of confidence limits is illustrated from an analysis of the annual rainfall totals for the 36 year period (1921 — 1956) for Nagercoil. The mean and the standard deviation were calculated for the data. Given the standard deviation and the values for 't' for the required levels of probability, the computation of confidence limits for minimum and maximum rainfall expectation, is a simple statistical procedure. This, of course, assumes that the frequency distribution of annual rainfall of Nagercoil over a period of 36 years is normal in form. The calculation of the measures of skewness, g_1 and g_2 with their respective standard errors (vide table), proved the normality of the data under study.[4] The confidence limits for various levels of probability ranging from $p = 0{\cdot}5$ to $p = 0{\cdot}05$ were worked out and the comparisons of expectation and observation are given in the table appended.

It is obvious from the table that there is quite a good agreement between the expected and the actual observed deviations in annual rainfall even under a stringent level of probability like $p = 0{\cdot}05$. Expressed in terms of confidence limits for $p = 0{\cdot}05$, values outside the limits of 19·06 inches and 56·86 inches of rain, would be expected to occur nearly two times in 36 years and in fact it is noticed that these limits were exceeded three times in this period. As expected, these deviations tend to fall almost equally below and above the prescribed limits, under all levels of probability. Thus for $p = 0{\cdot}5$, giving a minimum expectation for three years in four, the farmers in Nagercoil can be sure of receiving at least 31·61 inches of rain and in fact it is seen that they have received this amount of annual rainfall 28 times in a period of 36 years, the expectation for the period being only 27 times. If such an annual total rainfall is required for getting bumber crops, they can afford to run the risk of losing a crop about once in four years, the prospects for the other three years being definitely to their advantage. In considering the

risk of crop loss through inadequate rainfall, it is more rational to think of the lower limit than the mean rainfall. Hence, while assessing the agricultural significance of an area a statement concerning the reliability of rainfall will be of great value and for this purpose information on the least amount and the greatest amount, likely to be received over a specified number of seasons would be more useful than the mean. This, in fact, would specify the crop risk either from too dry or too wet conditions. It is seen, therefore, that this study clearly demonstrates the value for the assessment of rainfall probability, of minimum and maximum rainfall expectations calculated from the statistical properties of the normal curve. Suitable transformations are available for rainfall data which are asymmetrically distributed.[1] So, this concept of rainfall expectation at selected levels of probability can be deemed a completely objective and reliable estimate of rainfall to be expected, and thus is bound to be of immense use in assessing long-term crop risk, which is not usually apparent when means alone are considered.

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TABLE I.

Analysis of 36 years' (1921—1956) annual rainfall at Nagercoil (Data in inches).

Confidence limits for various levels of p.

S No.	Probability (p)	Confidence interval (years)	Chances of falling outside, either the lower limit or the upper limit, once in (years)	Confidence Limits of rainfall in inches		Deviation from limits				Total observed
				Lower	Upper	Expected + values —	Actual observed values Below the lower limit	Actual observed values Above the upper limit	Total expected	
1	0·5	1 in 2	4	31·61	44·31	9·0	8	7	18·0	15
2	0·2	4 in 5	10	25·80	50·12	3·6	4	4	7·2	8
3	0·1	9 in 10	20	22·23	53·69	1·8	2	2	3·6	4
4	0·05	19 in 20	40	19·06	56·86	0·9	1	2	1·8	3

Standard deviation = 9·31 inches.

Mean Annual Rainfall : 37·96 inches.

Measures of skewness of the distribution of annual rainfall: $g_1 = -0·8011$, S. E. $g_1 = 0·4006$. $g_2 = 0·1770$, S. E. $g_2 = 0·7681$.

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Studies in Green Leaves II

Seasonal Variations in the Nitrogen and Carbon Contents of Green Leaf Manures.

by

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Introduction: The application of green manure to paddy soils under water-logged conditions has been found to be beneficial for increasing the yield of the paddy crop (in most cases) and is almost an universal practice in this country. The incorporation of the manure is effected either by raising a crop and ploughing it in situ, or by applying the material brought from roadside trees and forest areas. The former practice is generally adopted where sufficient water facilities are available. In places where this is not possible green leaves are collected from outside and added to the soil just prior to puddling or two or three weeks before transplanting the paddy seedlings.

A study of the comparative merits of the commonly used green leaf manures was carried out by Varadarajan and Raju (1956). They found that while application of green leaves gave enhanced yields generally, the variety of green leaf applied had no influence on the increase of yield.

That the usefulness of plant materials added to the soil has a relationship to the carbon nitrogen ratio of the material has been established by several workers. The material with a high nitrogen content decomposed at a more rapid rate than did the material of low nitrogen content. Jenson (1929) and Martin (1921) have adduced evidence to show that more narrow the carbon to nitrogen ratio of freshly added materials the greater is the amount of nitrogen mineralized in the first several weeks of decomposition. Bower (1951) and Waksman *et al* (1927) have shown that if the carbon to nitrogen ratio is greater than 33 to 1 immobilization, and, if the ratio is as narrow as 17 to 1 mineralization, can be expected. There is evidence to show that materials with a carbon to nitrogen ratio of about 40 to 1 require 2 to 4 weeks for decomposition under favourable weather before the crop is planted. Pink *et al* (1948)

found the critical carbon to nitrogen ratio at near 35. Thus it is seen that the value of a green manure crop or material depends on its carbon and nitrogen contents. These studies were therefore undertaken to find out the extent of variation if any in the succulency and carbon/nitrogen ratio of the commonly used green leaf manure owing to changes in season. Such data may be useful to show when the green leaves may be very rich in nitrogen and low in carbon or vice versa, so that they may be cut and applied straight or composted before application for better crop growth.

Experimental: Green leaf manures were gathered as per local practice by lopping the small branches comprising leaves and stems from the following six trees.

(A) *Gliricidia maculta*
(B) *Pongamia glabra*
(C) *Delonix regia*
(D) *Enterolobium saman*
(E) *Thespesia populnea*
(F) *Azadirachta indica*

Representative samples were taken from the green leaf cuttings and amalysed for total nitrogen and organic carbon contents. The nitrogen was estimated by the Kjeldahl method and the organic carbon by the Walkley and Black method.

Samples were taken at monthly intervals for a period of one year.

Results and discussion: The succulency as revealed by the moisture content of the green leaf manures are presented in Table I. The data of organic carbon content of the green leaf manures are given in Table II. The nitrogen content is presented in Table III and the carbon to nitrogen ratio in Table IV.

The original moisture varies from about 50 percent to about 76 percent. Generally at any one period Gliricidia and Portia are more succulent than the rest, but between the two, Gliricidia is more succulent. The least succulent is Neem. If the period is divided into four seasons as North East Monsoon, South West monsoon, Premonsoon and Winter, there is a general increase in the moisture content of the leaves in all cases during the monsoon periods. The data on nitrogen, organic carbon and the carbon to nitrogen ratio were statistically analysed. The conclusions are as below :

Mean Nitrogen percentage in the different green manures on moisture free basis.

Green manure	Gliricidia	Pungam	Delonix	Rain-tree	Portia	Neem
	(A)	(B)	(C)	(D)	(E)	(F)
Mean N. Percent	2·64	3·10	3·47	3·43	2·57	2·40
C. D. at 5%	0·19%					
Conclusion :—	C D	B	A E	E		

Mean Nitrogen percentage in the different season

Seasons	N. E. M.	Winter	Pre-monsoon	S. W. M.
	(K)	(L)	(M)	(N)
Mean N percent	2·94	2·89	3·11	2·81
C. D. at 5%	0.15%			
Conclusion :-			M	K L N

From the above it is evident that the differences in the percentage of nitrogen in the different green leaf manures are significant. Delonix and Raintree cuttings show the highest values but there is no significant difference between them. Portia and Neem cuttings have the lowest nitrogen percentage.

"Green manures" and "seasons" do not interact revealing thereby that the differences in nitrogen content of green manures are uniform throughout the seasons considered. In the Pre-monsoon period all the green manures show the maximum nitrogen content.

Organic carbon — Mean percentage.

Green manure	Gliricidia	Pungam	Delonix	Rain-tree	Portia	Neem
	(A)	(B)	(C)	(D)	(E)	(F)
Organic carbon						
Per cent	36·10	36·09	41·81	37·91	34·14	35·68
C. D. at 5%	1·936%					
Conclusion :—			C	D A B	F	E

It may be seen that the Delonix cuttings have the maximum content of organic carbon. Portia and Neem cuttings have the lowest, the trend being similar as in the case of nitrogen content. There was no significant variation due to seasons. The interaction between green manure and season was not of any significance.

Carbon–Nitrogen ratio

Green manures	Gliricidia	Pungam	Delonix	Rain-tree	Portia	Neem
	(A)	(B)	(C)	(D)	(E)	(F)
C/N ratio	13·71	11·65	12·14	11·15	13·29	14·97
Conclusion :—	D	B C	E	A	F	

Carbon to nitrogen ratio in the different seasons

Seasons	NEM	Winter	Premonsoon	S. W. M.
	(K)	(L)	(M)	(N)
C/N ratio	13·01	12·82	12·26	13·18
C. D.	0·648			
Conclusion :—		M	L K	N

It is seen from the above that the Carbon to Nitrogen ratio is narrowest for rain-tree cuttings but is in no way significantly different from that of Pungam or Delonix. Neem cuttings have the widest ratio. Seasonal effect though not significantly different is seen to some extent, and during premonsoon period, tends to be narrow.

Conclusion: From the foregoing statistical results the following conclusions may be drawn.

1. Though there is variation in the nitrogen content of the different green manures, there is no variation in one and the same green leaf manure due to season.
2. Organic carbon content also varies in the different green manures but there is no variaton due to seasonal effects.
3. There is idication to show that the carbon to nitrogen ratio is different in different grren manures but there seems to be very little variation due to changes in season.
3. Thus it can be said that the green leaves of any of the trees studied may be used for green manuring purpose or for composting at any time of the year.

Acknowledgment: The authors' acknowledgements are due to Sri T. Govinda Iyer, Statistical Assistant, for this assistance in the statistical analysis of the data.

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TABLE I

Moisture percentage of fresh green leaf cuttings

Seasons		Gliricidia	Pungam	Delonix	Rain-tree	Portia	Neem
		(A)	(B)	(C)	(D)	(E)	(F)
Sep.	N. E. M.	70·40	64·35	67·65	60·90	68·10	61·55
Oct.		71·70	65·15	68·00	61·20	70·25	61·40
Nov.		72·75	65·50	66·60	56 70	69·85	57·95
Dec.	Winter	68·20	53·50	64·35	52·10	69·45	55·60
Jan.		68·65	55·20	62·40	50·05	69·10	54·25
Feb.		69·50	52·90	64·65	56·60	64.05	50·65
March	Premonsoon	67·35	53·65	62·40	59·05	60·55	54·25
April		65·10	52·35	59·50	51·70	57·45	52·00
May		75·85	68·05	66·45	63·35	68·15	63·75
June	S. W. M.	72·00	63·10	67·20	64·10	64·50	61·35
July		73·10	61·25	70·95	64·40	68·05	66·90
Aug.		76·50	62·75	65·05	61·40	66·80	59·50

TABLE II

Organic carbon content of green leaf cuttings

(Expressed as % on moisture free basis)

Seasons		Gliricidia	Pungam	Delonix	Rain-tree	Partia	Neem
		(A)	(B)	(C)	(D)	(E)	(F)
Sept.	N. E. M.	34·72	31·51	41·12	40·93	33·99	35·16
Oct.		37·19	32·87	42·67	41·04	35·43	36·58
Nov.		37·35	37·05	46·39	40·22	35·31	37·77
Dec.	Winter	36·07	36·08	42·38	37·77	35·13	36·30
Jan.		36·53	37·07	39·97	38·70	36·54	36·68
Feb.		33·74	34·48	38·91	33·60	36·15	33·17
Mar.	Premonsoon	40·03	39·63	41·14	36·41	35·22	37·47
April		36·42	39·50	40·22	36·88	32·96	35·14
May		31·69	39·37	42·21	36·91	32·10	36·30
June	S. W. M.	35·70	35·71	42·27	37·41	32·17	36·70
July		39·86	34·77	44·51	36·71	31·14	33·28
Aug.		33·96	35·07	39·90	38·32	32·53	33·58

TABLE III

Nitrogen Contents of Green Leaf Cuttings (Expressed as % on moisture free basis)

Seasons		Gliricidia	Pungam	Delonix	Rain-tree	Portia	Neem
		(A)	(B)	(C)	(D)	(E)	(F)
Sep.	N. E. M.	2·59	2·85	3·32	3·31	2·44	2·26
Oct.		2·61	2·85	3·54	3·44	2·48	2·41
Nov.		2·81	3·41	4·08	3·23	2·75	2·59
Dec.	Winter	2·43	2·95	3·87	2·96	2·81	2·63
Jan.		2·81	3·08	3·24	3·40	2·77	2·70
Feb.		2·56	2·85	3·19	2·88	2·72	2·11
March	Premonsoon	2·95	3·49	3·78	3·72	2·76	2·59
April		2·72	3·22	3·67	4·15	2·42	2·24
May		2·46	3·40	3·73	3·71	2·47	2·56
June	S. W. M.	2·68	2·92	2·92	3·85	2·39	2·54
July		2·67	2·95	3·24	3·08	2·37	2·00
Aug.		2·41	3·28	3·10	3·49	2·48	2·13

TABLE IV

Carbon/Nitrogen ratio of the green leaf cuttings

Seasons		Gliricidia	Pungam	Delonix	Rain-tree	Portia	Neem
		(A)	(B)	(C)	(D)	(E)	(F)
Sept.	N. E. M.	13·41	11·06	12·39	12·38	13·93	15·56
Oct.		14·58	11·57	12·06	11·93	14·29	15·17
Nov.		13·19	10·86	11·37	12·47	13·20	14·58
Dec.	Winter	14·88	12·23	10·95	12·76	12·50	13·80
Jan.		13·00	12·03	12·34	11·39	13·19	13·58
Feb.		13·18	12·10	12·20	11·66	13·30	15·71
Mar.	Premonsoon	13·57	11·36	10·96	9·78	12·76	14·46
April		13·39	12·27	10·96	8·89	13·62	15·69
May.		12·88	11·58	11·32	9·95	12·99	14·19
June	S. W. M.	13·32	12·23	14·47	9·72	13·46	14·45
July		14·93	11·79	13·74	11·92	13·14	16·64
Aug.		14·09	10·69	12·87	11·01	13·11	15·76

Madras agric. J., 45 : (3) 120—121, 1958

Oenospila (Thalassodes) *flavifusata* Wlk.

A Geometrid Pest on Eugenia jambolana in South India

by

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Introduction : *Eugenia jambolana* plant is subject to the attack by a number of insect pests. Padmanabha Aiyar (1942) noted three major caterpillar pests namely *Bombetelia delatrix Guen, Argypoploce mormopa* Meyrick and *Thalassodes flavifusata* Wlk., doing extensive damage to Eugenia in Travancore. Ananthanarayanan and Venugopal (1954) recorded observations on five important pests on this crop including this geometrid for the first time in South India. *Thalassodes flavifusta, W.* is, beautiful geometriad moth and has a wider distribution in India, Sikkim, Ceylon, Java and Borneo. The following is a brief account on its bionomics and control of this interesting insect.

Life History and Habits : The female moth lays its eggs in small groups on the edges of tender leaf-blades. Twenty to thirty eggs may be laid by a single moth. The egg is small, disc–like, circular, greenish and measure 25. m. m. in length (Plate I, Fig. 1). The eggs hatch in 2 to 3 days. The newly hatched caterpillar is brick-red in colour uniformly and measure 4 m. m. in length. The head-shield is slightly swollen with two small projections dorsally. Thoracic legs are directed forward and brownish in colour. The full grown caterpillar is 1½" in length and greenish in colour with short scattered bristle like hairs arising singly. On the dorsal side of the body are three longitudinal lines extending from the mesothorax to the anal segment. The thoracic and abdominal legs are of the same colour as the body (Plate I, Fig. 2). The larval period lasts from 17 to 18 days. It pupates inside the rolled up leaf. Pupa is greenish and cylindrical in shape and measure 5 m. m. in length (Plate I, fig. 3). The pupal period ranges from 7 to 8 days. The total life-cycle of the pest varies from 26 to 29 days.

Alternate host plants : Besides Euegnia it is noted as a pest on *Anacardium occidentale.*

Economic Status : The caterpillar is pest of *Euegenia Jambos* and the damage to tender foliage is often very serious. Large number of caterpillars may be found nibling or disfiguring tender foliage wholly or in parts.

Control measures : The pest can be controlled effectively by the application of BHC (Wettable) spray at a dosage of 1 lb. in 13 gallons of water or dusting 5% BHC to the undersurface of the leaves.

Acknowledgments: The author is deeply indebted to Sri K. P. Ananthanarayanan B. A. (Hons.) Retired Govt. Entomologist and Sri M. Basheer. B. Sc. (Aligh.) M. A. (Stan.) F. E. S. I. Government Entomologist, for valuable suggestions and for critically going through the manuscript.

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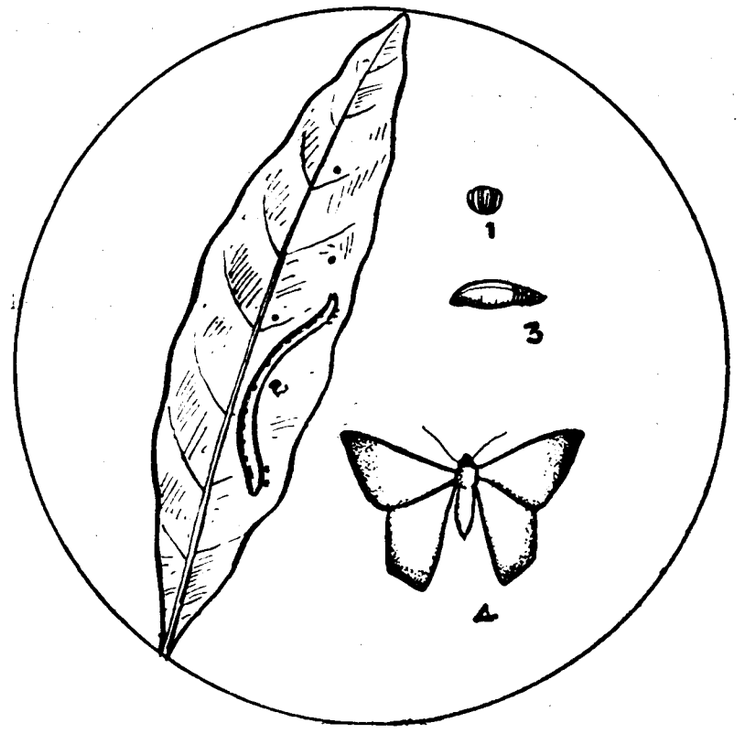
Life History Stages of Oenospila flavifusata



Explanation to the plate : 1. Egg magnified. 3. Pupa. 2. Caterpillar. 4. Adult.

Madras agric. J., 45 : (3) 122—123 1958

Research Notes

A note on the insecticidal property of tea fluff

Tea fluff is a fine, brownish yellow powdery stuff obtained as a residual product in the manufacture of tea. It is produced in large quantities and being found not useful for any purpose, it is dumped into the manure pit. A small quantity of this product was obtained from M/S. Brooke Bond, Ltd., Coimbatore for testing its insecticidal property. It was tested on a variety of insects as dust and spray both in the field and laboratory. For dusting, the product was used as such, using a muslin cloth and for spaying an aqueous extract prepared in the following manner was used. One pound of the material was soaked in a gallon of water overnight, which was filtered and the filtrate was used as spray. Table I furnishes the insects tested with the product and the results obtained.

Table I, showing the insecticidal action of tea fluff.

Name of the insect	Percentage of kill in 48 hrs.	
	Dust	Aqueous extract
Caterpillars:		
1. *Prodenia litura*, F. on castor	Nil	Nil
2. *Eupterote mollifera*, W. on *Moringa*	8	84
3. *Amsacta albistriga*, W. on groundnut	Nil	14
4. *Earias fabia*, S on cotton	Nil	Nil
Beetles:		
5. *Epilachna sp.* on brinjal	Nil	Nil
6. *Cylas formicarius*, F. on sweet potato	10	Nil
7. *Bruchus sp.* on pulses	60	Not tested
8. *Sitophilus oryzae*, L. on paddy	Nil	Not tested
9. *Aulocophora spp.* on gourds	Nil	Nil
Aphids:		
10. *Aphis craccivora*, K. on *Glyricidia*, *Dolichos lab-lab* and Cowpea	12	100
11. *Aphis gossypii*, G. on cotton, bhendi and brinjal	10	100
12. *Aphis maidis*, F. on cholam	Nil	100
13. *Aphis malvae*, K. on gourds	12	100
14. *Aphis tavaresi*, D. on citrus	Nil	98
15. *Macrosiphum*, sp. on rose	Nil	100
Scales and mealy bugs:		
16. *Ferrisiana virgata*, G. on *Anona*	Nil	58
17. *Aionidomytilus albus*, C. on tapioca	Nil	Nil
18. *Pulvinaria psidii*, G.	Nil	Nil
Mites:		
19. *Tetranychus telarius*, L. on castor	Nil	70
20. *Tetranychus* sp. on bhendi	Nil	86

The tests indicated that the material was highly effective on aphids though less potent on other insects. It was also noted that the addition of a small quantity of soft soap (1 oz. in a gallon) increased the efficacy. A stronger dose scorched the foliage. As the material is obtained in large quantities, it can be made use of with advantage on crops like vegetables, fruits; etc., where there is risk of using some of the modern poisonous pesticides.

The author is thankful to M/S. Brooke Bond Co., Ltd., Coimbatore for supplying the material for the tests.

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Madras agric. J., 45 (3) : 124, 1958.

Occurrence of Tricotyledony in *Arachis hypogaea* Linn.

In a population of nearly one thousand seedlings of the bunch groundnut variety (TMV. 2) raised for nutritional studies, a seedling with three cotyledons was noticed; these were arranged symmetrically in a whorl on the stem axis and none of them showed any sign of external distortion or splitting (Plate). The three were nearly equal in size and similar in shape. In the normal seedling the epicotyl consists of one terminal bud and two cotyledonary laterals while in the tricotyledonous seedling it consisted of four buds, one terminal and three cotyledonary laterals. This tricot seedling was carefully grown in the green house to the adult stage and out of eight of its seeds sown only six germinated. Of the six seedlings only one repeated the behaviour of the parent.

1. Normal. 2. Tricotyledonous.

Iyengar (1941), Haltrop (1944) and Banerji (1957) have pointed out that the phenomenon, tricotyledony is heritable in *Dolichos lab. lab.*, *Brassica sp. and Cosmos bipinnatus* respectively. However the tricotyledony reported herein cannot be ascribed to be herditary at this stage of the study. Recently a case of syncotyly has been reported in *Arachis* (Aiyadurai and Nagarajan, 1957) but as far as the authors are aware the phenomenon of tricotyledony has not so far been recorded.

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10—11—1957.

S. S. NAGARAJAN.
S. G. AIYADURAI.

Weather Review — For February, 1958.

RAINFALL DATA (IN INCHES)

Division	Station	Total rainfall for the month	Departure from normal	Total since 1st January 1958
North	Madras (Meenambakkam)	Nil	— 0·4	0·4
	Tirurkuppam*	Nil	Nil	Nil
	Vellore	Nil	— 1·4	1·1
	Gudiyatham*	Nil	— 0·2	1·6
East Coast	Palur*	Nil	— 0·2	0·5
	Tindivanam*	Nil	— 0·3	1·8
	Cuddalore	Nil	— 0·9	1·6
	Nagapattinam	Nil	— 0·8	0·4
	Aduthurai*	Nil	— 0·6	0·5
	Pattukkottai*	Nil	— 0·9	0·8
Central	Salem	Nil	— 0·3	0·1
	Coimbatore (A. M. O.)* ..	Nil	— 0·3	0·2
	Coimbatore	Nil	— 0·4	0·2
	Tiruchirapalli	Nil	— 0·3	0·1
South	Mathurai	Nil	— 0·5	0·5
	Pamban	0·2	— 0·7	0·6
	Koilpatti*	0·1	— 1·2	0·1
	Palayamcottai*	1·3	+ 0·1	1·9
	Ambasamudram*	1·9	+ 0·5	3·0
	Nagercoil*	1·6	+ 0·8	1·6
Hills	Kodaikanal	0·5	— 1·0	1·4
	Coonoor*	4·4	+ 1·6	7·8
	Ootacamund*	1·0	+ 0·5	1·1
	Nanjanad*	0·7	Nil	0·9

Note :— 1. * Meteorological Stations of the Madras Agricultural Department.

Due to the appearance of a shallow trough of low pressure in the east central Arabian sea off the Kanara-South Konkan coast, on 1st February 1958, shower, were received at a few places in Madras State. As the trough of low pressure became unimportant and a fresh easterly wave was moving across the extreme Bay of Bengal, there were showers at a few places in south Madras on 2nd February, 1958, when the weather was mainly dry elsewhere in the region. On 3rd February, 1958, the easterly wave was lying over the extreme south-west and adjoining south-east Bay of Bengal, when isolated showers occurred in interior Madras, while dry weather prevailed in the rest of the State. The easterly wave apparently merged into a feeble trough and became unimportant while a fresh easterly wave that was apparently moving across the south-east and adjoining south-west Bay of Bengal became unimportant after reaching Ceylon and South Coromandel coast. As the dry continental air was generally prevailing over the country outside the north-east Assam and the extreme south Peninsula, Weather was dry throughout the Madras State for twentyone days from 4th February, 1958. Showers were received at a few places in interior Madras for two days from 25th February, 1958, when weather was dry elsewhere in the region. On the last two days of the month mainly dry weather prevailed over the entire Madras State.

Regarding the fluctuations of the night temperature, they were appreciably above normal during the first three days of the month and then fell down below normal for a few days, later on fluctuating between above normal and appreciably above normal throughout the rest of the month.

There were nine frosty nights recorded in Ootacamund and four frosty nights at Nanjanad during the month of February, 1958.

Rainfall: The noteworthy rainfalls and the zonal rainfall for the month are furnished below:

Noteworthy Rainfalls

S. No.	Date	Name of place	Rainfall in inches
1.	1—2—1958	Coonoor	4·40
2.	1—2—1958	Ambasamudram	0·74
3.	2—2—1958	Palayamcottai	0·98

Zonal Rainfall (in inches)

Name of Zone	Rainfall for February 1958	Departure from Normal	Remarks.
North	Nil	— 0·5	Below normal
East Coast	Nil	— 0·6	do.
Central	Nil	— 0·3	do.
South	0·9	— 1·0	do.
Hills	1·7	+ 1·1	Above normal

Agricultural Meteorology Section,
Lawley Road Post, Coimbatore.
12—2—1958.

C. B. M., M. V. J., & M. S. D.

Departmental Notifications

Gazetted Officers - Postings and Transfers

Name and Designation	Posted to or Transferred.
Sri. Mohamud Basheer, Govt. Entomologist, Coimbatore.	Deputation for Training at Amsterdam. Senior – most Asst. Entomologist to be in charge.
,, F. L. Daniel, Asst. Agrl. Chemist, Coimbatore.	Granted Leave - subject to eligibility.
,, K. M. Krishna Menon.	To be in additional charge.
,, S. Sundaram, Asst. Cotton Specialist on leave.	Appointed as Millets and pulses Specialist.
,, R. Krishnamurthi, Asst. Cotton Extention Officer, Coimbatore.	Leave, subject to eligibility.
,, R. Ratnam, A. O., Coimbatore.	Extention of Leave one month from 1—3—1958.

Upper Subordinate - Postings and Transfers

Name and Designation	Posted to or Transferred.
Sri. D. Krishnaswamy, Asst. in Entomology, Coimbatore.	Asst. in Cytro-genetics, Coimbatore.
,, I. K. Sambasiva Rao, Asst., Kallar.	Hort. Asst., Coimbatore.
,, C. K. Kuppamuthu Pillai, Fieldman on leave.	A. D., Mettupalayam.
,, K. G. Ramachandra Unni.,	Fruit Asst., Coonoor.
,, B. Rangaiah Pillai, Fieldman, in G. E. Section.	Asst. in Entomology, Coimbatore.
,, M. Jayaraman, After Completion of his tranining in analytical work.	Asst. in Chemistry, Cuddalore.
,, Y. Vittal Hegde, Sugarcane Asst., Cuddalore.	Transferred to Mysore State.
,, Elias Daniel, B. sc.,	Cane Asst., Pandayarajapuram.
,, S. T. Sundar Sigh.	Asst. in Entomology.
,, M. Balachandran, Asst. in Millets.	Asst. in Mycology.
,, P. Vincent, Asst. in Mycology.	Asst. in Millets.
,, K. M. Jesudasan, A. D., Kadambur.	Asst. (Agrl. Section) Parasite Breeding Station, Nagarcoil.

Fieldmen Promoted as : Upper subordinates.

Sri. S. Arasappan - UDC. Coimbatore		Spl. A. D., Khadi, Udamalpet.
,, N. S. Rajan,	Fieldman	A. D., Kuzithurai.
,, G. Marudhachalam	do	A. D., Ariyalur.
,, P. K. Ponnuswami	do	Oilseeds Dev. Asst., Udamalpet.
,, K. P. Krishnan	do	P. P. A., Nagarcoil.
,, P. Rangaswami	do	Ext. Officer, Perambalur.
,, C. D. Anantapadmanabhan,	do	Manager, S. S. Farm, Harur.
,, R. Palaniappan	do	A. D., Trichencode.
,, K. Ramachandran	do	Ext. Officer in Agri., Krishnagiri.
,, M. Venkatachalam	do	A. D., Peralam (Tanjore).
,, S. Sambandam	do	A. D., Gudiatham.
,, V. Doraiswami	do	Oil Seed Dev. Asst., Orthanad.
,, G. K. Rangarajulu	do	Spl. A. D., Palladam.
,, K. Somasundaram	do	S. S. Farm Manager, (Madurai Dist.).
,, R. Janikiraman	do	P. P. A., Pattukottai.
,, K. Ramakrishna Alwa, Asst. Central Potato Res. Station Fern Hill, on reversion.		Asst., A. R. S., Nanjanad.
,, Abdul Shakoor. Y. Asst. A. R. S. Nanjanad.		Asst. Sim's Park, Coonoor.

Madras agric. J., 45 (3) : 129—132, 1958

Review of Market Conditions of Commercial Crops in the Notified Areas for the Month of February 1958.

Cotton : (In this Section Lint : Candy of 784 lbs.
Kapas : Pothi of 280 lbs.)

Season : There was no rain during the month under report. In Pollachi taluk cotton crop is reported to be affected by pests.

Tirupur : The market started with an opening balance of 1761 candies of Cambodia and 96 candies of Karunganni lint. The total arrivals into the market at Tirupur during the month were 2998 candies of Cambodia and 5 candies of Karunganni lint which included 497 candies of Cambodia and 3 candies of Karunganni lint locally ginned. The total despatches from Tirupur accounted for 2711 candies of Cambodia and 26 candies of Karunganni lint sent to Madras, Salem, South Arcot, North Arcot in Madras State and Ahemedabad, Tiruchur and to places in Kerala and Andhra States. There was a closing stock of 2048 candies of Cambodia and 75 candies of Karunganni lint.

Kapas : The kapas market opened with a stock of 1568 pothis of Cambodia kapas. The total arrivals into Tirupur during the month were 10976 pothis of Cambodia and 204 pothis of Karunganni. The disposals during the period were 8856 pothis of Cambodia and 101 pothis of Karunganni kapas in the market area of Tirupur. There was a closing stock of 3688 pothis of Cambodia and 103 pothis of Karunganni kapas at the end of the month.

Prices : The cotton market was steady during the month. The price ranges were as follows :

Lint per candies of 784 lb.

Cambodia superior quality	Rs. 900 to 981
Cambodia average quality	Rs. 800 to 860

Kapas per pothi of 280 lb.

Cambodia superior quality	Rs. 120 to 133·50
Cambodia average quality	Rs. 100 to 120

Ramanathapuram District: There was practically no rain during the month in the district. However the chill winds that prevailed during nights benefitted much the cotton crop.

The following were the arrivals and disposals of kapas and lint in the important markets of the district during the month.

Pothi of 280 lb:

	Opening stock	Receipt	Total	Disposal	Closing stock
Kapas	—	7350	7350	7350	
Candy of 784 lb:					
Lint	630	760	1390	790	600

The following were the prices of cotton kapas, lint and seeds, in the district during the month:

Commodity.	*Unit.*	*Prices in Rs.*
Karunganni Kapas	280 lb.	96 to 108
Tinny Karunganni	280 lb.	88 to 102
Karunganni lint	780 lb.	801 to 836
Tinny Karunganni	780 lb.	966 to 818
Uganda certified	780 lb.	1100 to 1120
Uganda Uncertified	—	—
Cambodia	780 lb.	980
Karunganni seeds	82 2/7 lb.	11·50 to 12·45
Cambodia seeds	,,	7·35 to 7·66

South Arcot District: The season having come to a close, transactions were almost nil, 16 pothis were despatched to Tirupur in Coimbatore district. The trade had a stock of 37 pothis of kapas at the end of the month.

Groundnut: *South Arcot District:* The market started with a opening balance of 3398 tons of kernels. The arrivals amounted to 3034 tons from the district produce and 591 from other districts like North Arcot, Tiruchirapalli districts etc. The off take by oil mills and country chekkus totalled respectively 2604 tons and 311 tons. A quantity of 1621 tons and 24 tons were despatched to Salem, Coimbatore, Tiruchirapalli and Madras in Madras State and Pondicherry State respectively. The stock left with the trade at the end of the month stood at 2363 tons. Prices of kernels were on the decline due to fall in price of oil. The average prices in the several markets ranged from Rs. 130·38 to 139·25.

North Arcot District: There was no rain at all, only dry weather conditions prevailed.

The Stock position of Groundnut was as follows in the district during the month:

Stock Position in Tons:

	Opening Balance	Arrivals	Disposals	Closing Balance
Groundnut kernels	468	780	767	481
Groundnut pods	1116	471	513	1074

The prices of groundnut kernel and oil etc., were as follows:

Groundnut kernel (Candy of 531 lb.)	Rs. 110 to 142
Groundnut oil (per candy of 500 lb.)	Rs. 275 to 290
Groundnut pods (bag of 80 lb.)	Rs. 10·12 to 1325
Groundnut oil cake (per standard maund)	Rs. 8 to 9·50

Ramanathapuram District: As the seasonal arrivals have declined due to the closure of the winter crop season and in sympathy with the prices that prevailed in North Indian markets the local markets also improved but later due to want of demand for oil and accumulation of oil stocks the prices had a mild set back during the close of the month.

The following were the arrivals, disposals and closing stock of groundnut pods and kernels during the month at Virudhunagar.

	Opening stock	Receipt	Total	Disposals	Closing stock
Groundnut Pods in tons	650	400	1050	600	450
Groundnut kernel in candy of 531 lb.	2305	600	2905	120	1705

The following were the prices for kernels pods and oils during the month.

(1)	Groundnut Pods per standard maund	Rs. 14 to 18.
(2)	Groundnut kernels per candy of 531 lb.	Rs. 130 to 150.
(3)	Groundnut oil 35 lb.	Rs. 19·88 to 20·50.
(4)	Groundnut oil cake	Rs. 8·00 to 9·25.

Gingelly: *South Arcot District:* The market started with a opening balance of 333 bags during the month. Arrivals amounted to 781 bags comprising 594 bags from district produce and 187 bags from neighbouring district, Tiruchirapalli. The oil mills crushed 165 bags and the chekkus 495 bags. Despatches to other districts like Salem, Tanjore, Tiruchirapalli etc., came to 107 bags.

The trade had a closing stock of 347 bags at the end of the month.

Prices improved by Rs. 6/- per bag and the average at Virudhachalam market worked out to Rs. 65·42 per bag of 164 lb. The rise in price was due to increased demand from Chekku owners coupled with purchases made by speculative traders.

Tobacco: *Coimbatore District:* The conditions of the standing crop is reported to be satisfactory and normal yields are expected. Harvesting of tobacco is in progress in all the taluks. Second half of February was quite hot as usual and this was helpful for curing of tobacco.

At the end of the month under report there was a stock of 11990 candies of chewing and 80 candies of cheroot tobacco. About 2700 candies of chewing and 100 candies of cheroot tobacco were exported to North Arcot, Mathurai, Salem, South Arcot, Tanjore, Tiruchirapalli in Madras State and Mysore, Kerala, Andhra and Bombay States.

The price ranges were as follows: (per candy of 500 lb.)

Variety	I Grade	II Grade	III Grade
	Rs.	Rs.	Rs.
Chewing Tobacco: Suncured:			
Meenampalayam	250—300	200—250	150—200
Other Varieties	200—280	120—190	80—110
Cheroot varieties:			
(Grown in Erode & Bhavani taluks)	200—250	110—190	70—100
Pit cured:			
Chewing tobacco (grown in Palladam & Sulur areas)	225—275	150—200	75—100

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Review of Administrative activities of Market Committees during February, 1958.

General: The South Arcot Market Committee, North Arcot Market Committee and Coimbatore Market Committee continued to function during the month. The Market Committees of Ramanathapuram and Tirunelveli could not function due to the cases pending with the Supreme Court.

Enforcement: The progress of licencing by the Market Committees during the month are as follows:

Name of the Market Committees	Section 5 (1) A	Section 5 (1) B	Section 5 (3) A	Section 5 (3) B	Weighmen A	Weighmen B
South Arcot Market Committee	343	983	269	694	253	652
North Arcot Market Committee	172	424	164	400	111	245
Coimbatore Market Committee	162	329	146	263	109	226

Meetings: *South Arcot Market Committee:* Two special meetings of the Committee were held on 12—2—1958 and 27—2—1958. Eleven members attended the meeting on 12—2—1958 when 56 subjects were disposed of. Nine members attended the meeting on 27—2—1958 when 23 subjects were disposed of.

Coimbatore Market Committee: No meeting of the Coimbatore Market Committee was held during the month under report.

North Arcot Market Committee: An ordinary meeting was held at Arkonam on 22—2—1958.

Quality Analysis: Nil.

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A short note on Cardamom Market prices in Madurai district during February, 1958.

Cardamom: Arrivals of cardamom in different primary assembling centres like Bodinaickanoor, Thevaram, Kombai, Uthamapalayam, Cumbam, Gudaloor and Pattiveeranpatti were declining when compared to approximately one lakh of lbs. sold in open auction during January 1958 in the different centres only about 73,800 lbs. are sold during February, 1958 in open auction. The quality of the most of the offerings were inferior.

The market was weak at the beginning of the month due to reported poor demand in important consuming and distribution centre like Bombay, Delhi, Calcutta, Kanpur, Amirtasar etc. In the first week there was a slight increase in prices by 10 to 20 naye paise per lb. in the case of superior qualities due to reported poor stock of such qualities in North India. This was seen in the 2nd week also. In the 3rd and 4th week the market became very weak and the prices of inferior qualities fell by 25 to 35 naye paise per lb. while that of the better qualities fell by 10 to 15 naye paise per lb. Thus the market was weak almost throughout the month.

At the beginning of the first week of the month there were good showers in Kerala Hills and it was reported that the crop was having a good stand. But subsequently there were no rainfall and the crop was reported to be having a fair stand at the close of the month.

The minimum and maximum prices prevailed during February, 1958 for the different trade qualities are given below :—

Name of trade quality		Price per lb. in Rs. & nP. Minimum	Maximum
A. Pattiveeranpatti assembling centre:			
1. Sundried	...	Rs. 8·25 to Rs.	10·40
2. Store green	...	Rs. 8·02 to Rs.	10·94
3. Splits	...	Rs. 6·16 to Rs.	8·15
4. Lights	...	Rs. 5·00 to Rs.	6·52
5. Rice (seed)	...	Rs. 10·50 to Rs.	10·75
Rice – Very inferior	...	Rs. 6·00	—
B. Bodinaickanoor, Thevaram, Kombai, Uthamapalayam, Cumbum and Gudaloor centres:			
1. Green	...	Rs. 8·50 to Rs.	10·56
Green – extra	...	Rs. 10·27 to Rs.	11·13
2. Shipment	...	Rs. 7·55 to Rs.	8·99
3. Splits	...	Rs. 5·65 to Rs.	8·28
4. Lights	...	Rs. 5·65 to Rs.	7·68
5. Rice (seed)	...	Rs. 9·00 to Rs.	10·52
C. At Virudhunagar market:			
1. Green	...	Rs. 8·75 to Rs.	9·25
2. Green (extra)	...	Rs. 9·75 to Rs.	10·50
3. Shipment	...	Rs. 8·25 to Rs.	8.75
4. Rice (seed)	...	Rs. 10·75 to Rs.	11.00

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