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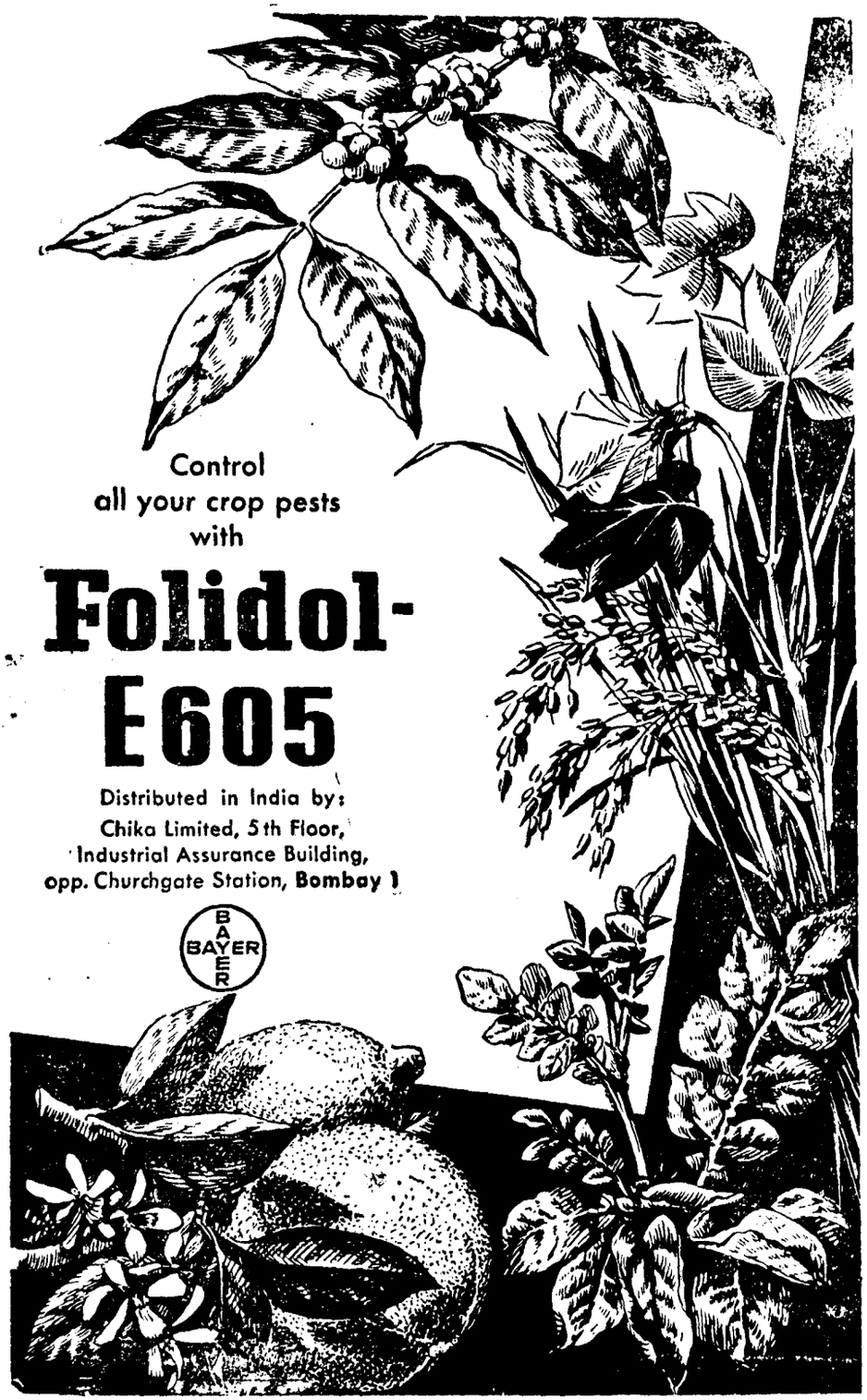

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THE MADRAS AGRICULTURAL JOURNAL

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Editorial

Crabs and Chlorosis: This may be taken as the twentieth-century version of Darwin's famous correlation between Cats and Clover. Our readers will find elsewhere in this issue two articles bearing on the subject of chelated compounds in the treatment of chlorosis. The term chelated is derived from a Greek word *Chela* meanting a claw and indicates the fact that in certain types of complex organic compounds the metallic elements of iron, manganese or copper as the case may be, are gripped tight as in a crab's claws; gripped in fact, so tightly that they no longer exhibit the characteristic properties of the free compounds of iron or other elements.

The increasing recognition of nutritional disorders in crops and fruit trees has brought into prominence the varied types and manifestations of chlorosis. The most widely prevalent among these is iron chlorosis, otherwise known as lime-induced chlorosis. Under conditions where the soil is rich in lime, the availability of iron is very much reduced. It is believed that phosphorus also plays an important role in retarding the uptake of iron by plants. Lack of sufficient organic matter in the soil, and inadequate potassium are also aggravating factors.

The deficiency of iron in plants in calcareous soils is not due to any actual deficiency of the element in the soil, but is due mainly to its unavailability. It is seldom that soil dressings of iron compounds like ferrous sulphate provide any relief and the usual and most economical method of correcting the disorder is generally by means of foliar sprays using 0·2 to 1% solution of ferrous sulphate. Unfortunately, foliar sprays have to be used with great care and caution, as they often prove injurious to the foliage. In certain cases,

heavy dressings of organic matter or even of elemental sulphur, have proved helpful, by lowering the pH of the soil and thereby releasing iron to become more readily available to plants.

In recent years, a new development bids fair to offer a much better solution to this widespread problem, consequent on the discovery by Jacobsen that the essential level of iron supply could be kept up in soil-less culture solutions by the use of the ferric salt of an organic complex, ethylene-diamine tetra-acetic acid. (EDTA) These are now being marketed by several firms under the name of "sequestrene" compounds viz. sequestrene iron, sequestrene manganese etc. Another term that is in common use for these compounds is "chelated compounds", the derivation of which has been explained earlier.

The compounds are recommended at present only as soil dressings but not for foliar sprays, due to the risk of leaf scorch and injury. In order to reach the maximum root surface these compounds have to be applied in the form of an aqueous solution, in a broad band between plant rows and early in the spring, at about the time of the new leaf flush. The timing, dosages and frequency of application in the case of specific crops, are all aspects that require further investigation in different tracts of the country. In Sweden, a different group of chelated compounds has been developed under the name of Versenols, that are claimed to be more effective under very alkaline soil conditions. Various derivatives of EDTA have also been found to be useful in soil analysis, and in determining exchangeable ions in the soil, but it is obvious that a great deal of further study is needed before we can fully understand the mode of action and applicability of these new compounds to varied conditions of soil, climate, crops and agronomic practices.

Studies on Green Leaf Manures*

A preliminary study on the comparative merits of the commonly used green leaves as manure for Paddy

by

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Introduction: It is well known that any kind of green leaf when incorporated into the soil adds organic matter to it, in addition to augmenting the nitrogen supply. There are so many varieties of plants that provide green manure that there is absolutely no restriction as to the choice of leaves. However, there appears to be a belief in the minds of farmers that particular kinds of green leaves play a greater part in enhancing the yield of paddy than others. It has also often been reported that some kinds of leaves have the property of rectifying or mitigating the saline or alkaline condition of soils. To see if this popular belief is based on facts the following studies were carried out, as it is reasonable to expect that the quality of any green leaf manure would depend upon its succulence, easy decomposability and nitrogen content.

Review of Previous Work: It is reported that studies were carried out on a few types of green leaves to test their relative merits at the Agricultural Research Stations at Tirurkuppam, Aduthurai and Pattambi. The experiments were conducted from the point of view of only the final yield of paddy. It was found at Tirurkuppam (1) in *Sornawari* season that *Croton sparsiflorus* at 8,000 to 10,000 lb. gave the maximum yield of grain. *Croton sparsiflorus* at 4,000 to 6,000 lb. was on a par with *Pongamia glabra* at 8,000 to 10,000 lb. In straw yield it was found that *Croton sparsiflorus* at 6,000 to 8,000 lb. and *Pongamia glabra* 4,000, 6,000, 8,000 and 10,000 lb. were virtually equal. At the Agricultural Research Station, Aduthurai (2, 3, 4) no difference was found during the three years of trial between the types of green leaves tried. At the Agricultural Research Station, Pattambi (5, 6) there was significant difference in the first crop in one year.

At Coimbatore, trials with *Sesbania*, *Daincha* and wild *Indigo* show that all of them were of equal value. Similar trials have been carried out in Nagina Farm in Uttar Pradesh and Suri,

*Paper presented at the 32nd Study Group Meeting of the Agricultural Research Institute, Coimbatore.

in Bengal, on different green leaves. The findings in those two places go to show that there is no appreciable difference among the various leaves when tried on equal nitrogen basis. In Nagerkoil green leaves such as *Konnai* (*Cassia florida*) *Pungam*, (*Pongamia glabra*) *Avarai* (*Cassia auriculata*) and *Vahai* (*Albizzia lebbeck*) were tried. It was found that though *Konnai* leaves contained the highest percentage of nitrogen, *Vahai* leaves gave a better response; *Avarai* was second. Similar differences were noted in Kumpta and Karjat Farms of Bombay State. Since these experiments had not conclusively proved the relative efficacy of the green leaves studied, a study was undertaken to assess the relative merits of the commonly used green leaf manures.

Materials and Methods: 1. *Laboratory Studies:* The more important of the green leaves available near about the Institute were collected just after the monsoon when the leaves were fresh and in full flush. The leaves were gathered in the same manner a ryot would do to manure his fields. Soon after collection the stem and leaf portions were separated and their weights recorded. Thus the leaf to stem ratio was available to get an idea of the nature of the material. Original moisture was also estimated to know the succulence. The leaves and stems were sampled and kept in a steam oven to arrest the action of enzymes. After drying they were sampled in the usual way. The kinds of leaves taken up for study were: *Delonix, Calotropis, Thespesia, Gliricidia, Pongamia, Croton sparsiflorus* and *Sesbania.*

Analytical Technique: The nitrogen content of both the leaf and stem was estimated by the Kjeldahl's method (7) (vide Table I).

The decomposability of the leaf and stem was determined by the method described by Fred and Waksman (7)

Nitrifiability: Nitrifiability of a material indicates the rapidity with which it undergoes decomposition in the soil leading to the formation of nitrates, in which form most plants take up the nitrogen. This was assessed by the usual method, i.e. thirty milligrams of nitrogen in the form of leaf and stem were added separately to 100 grammes of soil which were placed in jam jars under constant optimum moisture level and kept at room temperature (28°C) for six weeks. Samples were analysed periodically to find out the rate of nitrate formation.

2. *Pot Experiments:* Pot experiments were also conducted to test the capacity of the different green leaves on the yield of paddy, as a knowledge of their chemical characteristics alone would not give a complete idea of their relative efficiency. In these tests paddy Co. 25 was grown in pots and crop response was studied to the different green leaf manures, incorporated at 45 lb. nitrogen per acre over a basal application of superphosphate at 30 lb. P_2O_5 per acre. In addition, the performance of the crop due to the green leaves was compared against those raised with ammonium sulphate and groundnut cake on the same nitrogen basis and against "No manure" also.

The experiment was carried out with a typical paddy soil starved of nitrogen for over seven years.

Technique:

(a) *Green Manure:* The green leaves were collected at the time of application, their nitrogen and moisture contents estimated, and the calculated amounts of leaves were applied to the pots, cut into small bits, after duly watering and puddling the soil. Treatments were replicated four times.

(b) *Watering:* A known quantity of water was added to each pot. The amount of water in all the pots was maintained at a constant level throughout the growth period.

(c) *Transplanting:* As is usual under field conditions, the green manure was allowed to rot for one week and one month-old seedlings were transplanted at the rate of eight per pot. The plants that did not get established were replaced with fresh seedlings.

(d) *Observations:* The following observations were recorded:

1. Rate of growth.
2. Tillering.
3. Duration of flowering.
4. Number of panicles.
5. Length of panicle.
6. Number of grains well-set and ill-set, and
7. Weight of 100 grains.

(e) *Harvest:* As the crop matured, the grains were harvested separately and the straw cut close to the roots. They were dried to constant weight and the yield data recorded. (Vide Table VI)

Results: The stem to leaf ratio, moisture content of stem and leaf and decomposability are presented in Table I. It may be seen that *Cassia auriculata* and *Delonix regia* are characterised by high proportion of leaf to stem. The decomposability of *Thespesia* is highest. The original moisture contents of *Sesbania, Gliricidia* and *Calotropis* are very high. Hence these are very succulent green manures.

The nitrogen content and nitrifiability of the leaf and stem are presented in Table II. The nitrogen content of all the green leaves is generally high but *Calotropis, Sesbania, and Croton sparsiflorus* nitrified far more rapidly than the leaves of other varieties. Nitrifiability of *Sesbania* is the highest while *Gliricidia, Calotropis, Croton sparsiflorus* and *Thespesia* may be said to be good.

The nitrogen content and nitrifiability afford the best index of the usefulness of green leaves. Judged by these criteria the value of the green leaf manures studied may be arranged in descending order as follows: *Sesbania speciosa, Gliricidia maculata, Calotropis gigantea, Thespesia populnea, Croton sparsiflorus, Delonix regia, Pongamia glabra, and Cassia auriculata.*

The rate of growth of paddy plants due to different green leaf manures are presented in Table III. It may be seen that in the earlier vegetative stages of growth the plants in *Gliricidia* series were tallest followed by those in groundnut cake series. Plants in ammonium sulphate series were only slightly better than the "No manure" treatment.

During the second fortnight the plants in ammonium sulphate series were tallest and the rate of growth was markedly superior to the rest of the treatments. This superiority was maintained throughout the growth period. This may be due to the fact that the ammonium sulphate being soluble, the nitrogen might not have been available within the reach of the plants till the roots were well developed and the plants were able to assimilate it to the best advantage.

TABLE I

Showing the stem to leaf ratio, original moisture and decomposability.

Green leaf manure	Ratio of stem to leaf	Percentage moisture in green state		Decomposability Mgm. of CO_2 Evolved in 24 hrs.	
		Stem	Leaf	Stem	Leaf
1. Delonix ..	1:3·90	55·85	66·28	..	..
2. Calotropis ..	1:0·80	81·87	85·04	18·37	18·90
3. Thespesia ..	1:2·30	51·53	62·92	29·96	42·35
4. Gliricidia ..	1:1·89	76·95	76·00	17·27	20·13
5. Pongamia ..	1:1·34	54·50	58·70	12·76	13·09
6. Croton sparsiflorus	1:1·20	47·18	64·22	12·91	10·28
7. Cassia ..	1:3·80	42 79	55·58	..	..

The analysis of the other three green leaf manures has not been completed.

TABLE II

Showing nitrogen content and nitrifiability of the different green leaves.

Green leaf manure	Nitrogen percentage (Dry basis)		Nitrifiability of leaf %	Time in weeks
	Stem	Leaf		
1. Delonix ..	1·47	2·27	−3·09	6
2. Calotropis ..	1·40	3·52	23·17	4
3. Thespesia ..	1·56	3·28	21·33	6
4. Gliricidia ..	1·84	3·98	26·67	6
5. Pongamia ..	1·89	3·79	6·13	6
6. Croton sparsiflorus ..	2·10	3·85	23·53	4
7. Sesbania ..	..	..	34·73	4

TABLE III

Showing the rate of growth of paddy due to different green-leaf manures.
(at fortnightly intervals)

Intervals	I	II	III	IV	V	VI	VII	VIII
Treatments:								
1. Delonix ..	51·9	62·4	64·4	65·7	68·7	77·9	100·6	103·3
2. Calotropis ..	49·6	57·5	58·6	61·9	63·8	70·2	89·9	91·8
3. Thespesia ..	51·9	54·1	56·2	57·4	50·4	67·9	85·5	90·5
4. Datura ..	50·7	54·2	57·6	60·8	62·0	67·8	77·3	90·1
5. Gliricidia ..	58·1	59·6	63·9	68·0	68·4	75·6	96·6	98·3
6. Pongamia ..	50·2	55·7	58·6	62·2	63·6	70·7	89·7	89·3
7. Croton sparsiflorus ..	52·1	53·6	60·5	63·3	64·0	72·1	90·9	97·2
8. Cassia ..	49·4	56·7	63·2	65·2	67·7	80·6	98·8	100·6
9. Sesbania ..	50·3	56·5	60·8	64·1	65·6	72·9	93·1	95·6
10. Enterolobium ..	47·6	55·6	62·5	64·3	68·8	76·3	96·3	98·7
11. Groundnut cake ..	55·1	58·6	64·3	68·0	69·7	79·5	97·6	97·2
12. Ammonium sulphate ..	47·0	65·5	74·6	77·1	82·7	94·1	109·7	113·1
13. No manure ..	45·1	48·6	51·7	54·2	55·3	61·0	76·2	81·9

The vegetative characters are presented in Table IV. In the matter of tillering also the ammonium sulphate series was again the best, followed by *Delonix*. The rest of the treatments were about the same.

TABLE IV.

Showing the vegetative characters due to different treatments.

Treatments	Average number of tillers	Average number of earheads	Length of earhead in cms.
1. Delonix ..	2·25	11·8	19·38
2. Calotropis ..	1·88	10·0	17·37
3. Thespesia ..	1·68	10·0	16·56
4. Datura ..	1·68	10·5	16·75
5. Gliricidia ..	1·63	10·3	17·56
6. Pongamia ..	1·88	10·8	18·56
7. Croton sparsiflorus ..	1·75	9·5	14·12
8. Cassia ..	1·78	9·3	19·69
9. Sesbania ..	1·75	10·5	18·44
10. Enterolobium ..	1·78	9·8	18·38
11. Groundnut cake ..	2·20	9·8	18·31
12. Ammonium sulphate ..	3·60	21·5	19·38
13. No manure (control) ..	1·33	9·0	16·81

Flowering was observed in all the treatments simultaneously except in the ammonium sulphate series which was delayed by a couple of days. The duration of flowering was five days in almost all cases. The maximum earhead formation was in the ammonium sulphate treatment; *Delonix* occupying the second place. In the matter of length of earhead, however, the *Cassia* series topped the list followed by ammonium sulphate and *Delonix*. The maximum number of grains was found in the *Cassia* series followed by ammonium sulphate series. Groundnut cake ranked third and the other series such as *Pongamia, Sesbania, Gliricidia, and Croton sparsiflorus* were fairly good. (Table V). But the proportion of well-set grains to ill-set grains was highest in ammonium sulphate series (85·96%) followed closely by groundnut cake and *Cassia* series. *Delonix* and *Thespesia* were the poorest in this respect.

In the matter of yield of grain ammonium sulphate ranked first, being distinctly superior to the rest of the treatments with an increase in yield of 304% of grain and 283% of straw over the "No manure". Among the green leaves there was no significant difference in yield. In regard to straw also, ammonium sulphate ranked as the first (Vide Table VI.)

TABLE V

Showing the number of grains per earhead in each series with the percentage of well-set and ill-set grains

Treatments	Well-set	Ill-set	Total	Well-set %	Ill-set %
1. Delonix ..	68·9	32·4	101·3	68·03	31·97
2. Calotropis ..	68·3	22·3	90·6	75·39	24·61
3. Thespesia ..	49·1	23·8	72·0	67·36	32·64
4. Datura ..	64·1	17·4	81·5	78·65	21·35
5. Gliricidia ..	80·0	29·5	109·5	73·05	26·95
6. Pongamia ..	88 0	29·4	109·1	80·67	19·33
7. Croton sparsiflorus ..	95·5	21·1	117·4	81·34	19·36
8. Cassia ..	104·3	21·9	126·2	82·62	17·38
9. Sesbania ..	74·3	26·7	100·4	74·01	25·99
10. Enterolobium ..	83·3	25·5	108·8	76·54	23 46
11. Groundnut cake ..	101·1	20·6	121·7	83·08	16·92
12. Ammonium sulphate ..	107·0	17·5	124·5	85·96	14·04
13. No manure ..	55·8	17·8	73·6	75·80	24·20

(Average value of 8 ear-heads per series)

TABLE VI.

Showing the summary of results of the comparative manurial values of various green leaf manures for paddy. (Pot-culture experiments)

Treatments	Particulars: Grain — Average yield per pot	Grain — Percentage on control	Straw — Average yield per pot	Straw — Percentage on control
1. Delonix ..	11·48	168·8	23·25	193·9
2. Calotropis ..	8·15	119·9	15·75	131·3
3. Thespesia ..	6·98	102·6	16·75	139·6
4. Datura ..	8·73	128·3	16·75	139·6
5. Gliricidia ..	9·75	143·4	19·00	158·3
6. Pongamia ..	9·53	140·1	15·75	131·3
7. Croton ..	11·08	162·9	18·00	150·0
8. Cassia ..	12·25	180·1	20·25	168·8
9. Sesbania ..	8·23	121·0	19·00	158·4
10. Enterolobium ..	10·78	158·4	19·75	164·6
11. Groundnut cake ..	11·08	162·9	19·50	162·5
12. Ammonium sulphate..	27·43	399·6	46 00	383·3
13. No manure ..	6·80	100·0	12·00	100·0
General-mean ..	10·94		20·14	
Standard error ..	1·65		4·88	
'Z' test satisfied or not	Yes		Yes	
Critical difference at 1·0% level ..	4·9		13·27	
Conclusion :— GRAIN :	$\overline{12}$	8 1 7 11 10 5 6 4 9	2	3 13
STRAW :	$\overline{12}$	1 8 10 11 9 5 7 4 3	2	6 13

The weight of 100 grains of paddy from the different treatments are presented in Table VII. The weight of grains obtained from *Croton sparsiflorus* and *Cassia auriculata* was distinctly greater than the rest. Grains from *Calotropis* and *Thespesia* were distinctly poorer in weight and there was no significant difference between the other treatments. Ammonium sulphate, therefore, is noted not to have influenced the weight of grain. This, it has made up by the increased number of well-set grains per panicle and increased branching of the panicle.

From the data it is clear that ammonium sulphate is far superior to the green leaf manures in the matter of yield of grain and straw when applied on equal nitrogen basis. The factor responsible for the increased yield is evidently due to the readily-available nitrogen supplied by ammonium sulphate. Such an indication was also noted by Karunakar et. al (8).

Regarding the source of organic nitrogen in the form of different green leaves, the variety of green leaf has no material influence on the yield of paddy among themselves but, compared with "No manure" the green leaf manures have definitely increased the yield.

Summary and Conclusions:

(1) The stem to leaf ratio, original moisture content, nitrifiability and decomposability of the different green leaves were determined.

(2) The growth characteristics and the yield behaviour of the paddy crop due to the application of the different green leaf manures were studied in pots.

(3) Ammonium sulphate was found to be distinctly superior to any organic nitrogen supplied, in the form of green leaf manures and groundnut cake.

(4) Ammonium sulphate was found to significantly increase the yield of grain and straw.

(5) Grain weight with ammonium sulphate was significantly less; that with *Delonix* being the best.

(6) Supply of readily available nitrogen as in the case of ammonium sulphate may be taken as the factor influencing high yield.

(7) While application of green leaves gives enhanced yields generally, the variety of green leaves applied has no influence on the increase of yield.

(8) Ammonium sulphate is more quick-acting than green manure, but green manures are a cheaper source of nitrogen supply. The evidence, therefore, points to a combination of ammonium sulphate plus green manure as the most efficient and economical way of supplying nitrogen to paddy.

TABLE VII

Showing the weight of 100 paddy grains from the different green-leaf manure series

Treatments	Particulars	
	Average weight of grains	Increase or decrease in weight over control
A. Delonix	1·777	99·72
B. Calotropis	1·743	98·17
C. Thespesia	1·740	98·02
D. Datura	1·783	102·30
E. Gliricidia	1·775	100·00
F. Pongamia	1·775	100 00
G. Croton sparsiflorus	1·863	105·00
H. Cassia	1·835	103·40
I. Sesbania	1·795	101·10
J. Enterolobium	1·813	102·10
K. Groundnut cake	1·765	99·65
L. Ammonium sulphate	1·783	102·30
M. No manure	1·775	(100·00)
General Mean	1·786	
Standard error	0·00774	
'Z' test satisfied or not	Yes	
Critical difference at 1% level	0·021	

Conclusions:— G H J I L D A E F M K B C

List of botanical names of the green-leaf manures used in this experiment

1. *Delonix regia* Rafin
2. *Calotropis gigantea* R. Br.
3. *Thespesia populnea* Soland
4. *Datura Metel*
5. *Gliricidia sepium* Steud (*Gliricidia maculata* H. B. K.)
6. *Pongamia glabra* Vent.
7. *Croton sparsiflorus* Mor.
8. *Cassia auriculata* Linn.
9. *Sesbania speciosa* Soland
10. *Enterolobium saman* Prain

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Chelates in Agriculture — Sequestrenes and Versenols of Commerce

(A Review)

by

T. SESHAGIRI & A. MARIAKULANDAI

It has been recently discovered that iron chlorosis in fruits and garden crops could be completely cured by the use of certain complex organic iron compounds known as "iron chelates". The metallic elements in this complex form are referred to technically as being "chelated", or "sequestered" to denote the manner in which

the iron is combined with the organic fractions. 'Chelate' is a term derived from a Greek word meaning 'a claw'. These compounds combine with the metal in such a manner that the metal no longer exhibits the typical properties of the free compounds of the element (Bould, 1955, Allerton, 1955)

There are various causes attributed to chlorosis in plants and of these lime-induced iron chlorosis is the most common. Certain plants growing on a naturally calcareous soil are susceptible to chlorosis. In such cases, the soil and plant factors are such that iron is not in a form that can be utilized by the plant. Chlorotic leaves do not necessarily contain low amounts of iron, but, owing to adverse conditions within the plant cells, the iron is not available for chlorophyll formation. It is inactive and immobile. There exists an improper micronutrient balance. (Pierce and Alexander Hall, 1955.)

It is generally recognised that lime-induced chlorosis is difficult to cure. The use of inorganic salts of iron, either as leaf sprays or soil dressings has met with only partial success, for, although some intake and absorption of iron occurs, it is rapidly made unavailable. Even the radio-iron added to the soils was fixed in the soil to such a degree as to make it unavailable to the plants. (Holmes and Brown, 1955).

The use of iron chelates in this connection has aroused considerable interest. Some of the chelating agents in use are:

	Name	*Abbreviation*
1.	Diethyl-ethylene-triamine-penta-acetic Acid	DTPA
2.	Ethylene-diamine-tetra-acetic Acid	EDTA
3.	Hydroxy-ethyl-ethylene-diamine-triacetic Acid	HEEDTA
4.	Cyclohexane–1, 2–Diamino-tetra-acetic Acid	CDTA
5.	An Aromatic Amine (name not known)	138

For convenience these compounds are referred to by their abbreviations. If iron is combined with these compounds they are referred to as 'Chelated' e. g., Fe–EDTA, Fe–DTPA, etc; Otherwise they are just referred as 'Chelates' e. g. EDTA., DTPA, etc. These compounds dissolve freely to form pale-coloured solutions. The chemical characteristics of these compounds are not uniform nor is their behaviour in soils and on all crops the same. Some are stable in acid conditions, some others in alkaline conditions, some get fixed in the soil to a greater degree and so on. The use

of chelates with or without iron is both common. Leaf sprays have not proved successful. When used as soil dressings, the chelates have yielded good results. Even in minute quantities the chelates have a good effect and within a few weeks after application the full green colour of the leaves returned even in the most chlorotic leaves, (Wallace et. al. 1955, Bould June 1955, Cooper 1955, Holmes and Brown, 1955). With time the effectiveness of the chelate decreased, and hence for this reason and also to prevent it from getting fixed up in the clay, the chelate is applied just when chlorotic symptoms become manifest. (Holmes and Brown, 1955).

The mechanism of the behaviour of chelates is not well understood at present. The chelates when applied, even without Fe, have been able to activate iron in the soil and make it available to the plant. There is also evidence that the chelate molecule enters the plant and releases the immobile iron. The iron chelate also enters the plant and immediately the iron gets released for plant use. Some chelated iron compounds are found effective in decreasing the absorption and translocation of manganese and copper in the plant, while increasing the availability of iron, and thus restore the micro-element balance. (Wallace et al. 1955, Holmes and Brown, 1955)

There are possibilities of chelating these organic compounds with other microelements and extending their use to cure respective microelement deficiencies. In fact, attempts have already begun to prepare manganese chelates. Thus the use of chelates has great possibilities and is likely to play a very significant part in the treatment of micro-element deficiencies.

The chelated compounds are put on the market by various trade names like "Sequestrenes" "Versenols" etc. by different companies.

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Research Notes

Quicker and Better Germination in Snakegourd and Bittergourd

It is found that the seeds of Snakegourd *(Trichosanthes anguina)* and Bittergourd *(Momordica charantia)* take six to ten days to germinate and the germination percentage normally does not exceed 78%. With a view to hasten the germination of these seeds, trials were conducted at the Agricultural Research Station, Aduturai with the following treatments during the pre-storage period and just before sowing the seeds.

(1) The seeds after extraction were washed in water, mixed with cowdung and cast into cakes or 'bratties'. These cakes were allowed to dry on the walls of a building and removed from the wall after ten or twelve days when the seeds were completely dry and stored in tin containers.

(2) After extraction and washing in water the seeds were mixed with ash and dried in the sun for a day afterwards in the shade till the seeds were completely dry and stored in tin containers.

(3) As generally practised, the seeds after collection were washed in water, dried in the sun for a day and afterwards in the shade till the seeds were completely dry and stored in tin containers.

(4) Seeds treated as in (3) were soaked in cowdung emulsion for 24 hours just before sowing.

The seeds of snakegourd and bittergourd were extracted during the third week of April and after the treatments in the pre-storage period as mentioned above were stored till they were required for sowing during the third week of June.

The seeds treated by the above methods, were dibbled in pits of $1\frac{1}{2}$ feet diameter and $1\frac{1}{2}$ feet in depth during the third week of June. Seven seeds were dibbled in each pit and thirty pits were put under each treatment. The date of commencement of germination, the number of seeds germinated and the date of completion of germination under each treatment were noted daily. On the same date of sowing of the seeds in pits, fifty seeds of both snakegourd and bittergourd under each treatment were sown at distances of six inches either way in well-prepared plots in duplicate and the date of commencement of germination, the number of seeds germinated and the date of completion of germination were similarly observed. The details of germination of seeds sown

in pits and in the observation plots are furnished in Tables I and II below.

TABLE I

Details of germination of snakegourd seeds :—

1. Date of extraction of seeds — 24—4—55.
2. Date of sowing — 23—6—55.
3. Total number of seeds sown in 30 pits under each treatment — 210.
4. Total number of seeds sown in observation plots under each treatment — 50 in each replication.
5. Treatments :—(1) Seeds kept in cowdung cake, (2) Seeds mixed with ash, (3) Seeds stored after washing and drying, (4) Seeds stored as in (3) were soaked in cowdung emulsion for 24 hours just before sowing.

Date	Pits Treatments				Observation plots Treatments							
					1		2		3		4	
	1	2	3	4	I	II	I	II	I	II	I	II
24—6—55	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil
25—6—55	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil
26—6—55	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil
27—6—55	79	9	nil	12	7	9	2	3	nil	nil	5	5
28—6—55	108	27	28	49	34	34	18	18	13	10	22	24
29—6—55	12	95	73	75	5	3	9	8	8	10	8	7
30—6—55	nil	30	29	49	nil	1	4	3	4	5	6	6
1—7—55	nil	12	12	11	nil	nil	3	4	1	2	5	3
2—7—55	nil	nil	5	nil	nil	nil	1	2	2	nil	nil	1
3—7—55	nil	nil	4	nil	nil	nil	nil	nil	2	2	nil	nil
4—7—55	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil
Total	199	173	151	196	46	47	37	38	30	29	46	46
Percentage of germination	94·8	82·4	71·9	93·3	93·0		75		59		92	

It is seen that the seeds of snakegourd and bittergourd preserved in cowdung cakes start germinating three days after sowing and completes germination within another three days. The seeds soaked in cowdung emulsion and the seeds mixed with ash commence germinating three days after sowing and take five days to complete germination while the seeds stored in the usual method, that is, after washing and drying, germinate after five to six days of sowing and take six to seven days to complete germination. It is also seen that germination percentage is more for the seeds preserved in cowdung cake and for seeds soaked in cowdung emulsion just before sowing. The germination percentage is least for the seeds stored in the usual method.

TABLE II

Details of germination of bitter-gourd seeds :—

Date of extraction of seed, date of sowing, total number of seeds sown in pits and in observation plots and the treatments are same as in the case of snakegourd.

Date	Pits Treatments				Observation plots Treatments							
					1		2		3		4	
	1	2	3	4	I	II	I	II	I	II	I	II
24—6—55	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil
25—6—55	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil
25—6—55	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	1	3
27—6—55	80	4	nil	10	15	18	2	2	nil	nil	7	23	24
28—6—55	109	33	31	92	29	25	10	12	9	7	12	12
29—6—55	9	78	69	59	3	4	17	18	10	9	5	5
30—6—55	nil	50	45	20	nil	nil	5	6	4	8	3	2
1—7—55	nil	12	7	3	nil	nil	nil	nil	nil	3	nil	nil
2—7—55	nil	nil	8	nil	nil	nil	nil	nil	3	3	nil	nil
3—7—55	nil	nil	3	nil	fil	nil	nil	nil	3	3	nil	nil
4—7—55	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil
Total	198	177	163	184	47	47	34	38	29	33	44	46
Percentage of germination	94·3	84·3	77·6	87·6	94		72		62		90	

Thus with regard to quickness in germination, rate of germination and better germination seeds kept in cowdung cake are found to be the best, followed by the seeds soaked in cowdung emulsion. Mixing the seeds with ash helps to improve and hasten germination to some extent.

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[The "cowdung and wood-ash" methods of preserving snake-gourd and bitter-gourd seeds are in common use, as traditional methods in villages. —*Ed.*]

A High-Yielding White-Grained Ragi

Ragi - *(Eleusine coracana)* is an important millet grown over almost all the States of the Indian Union. In Madras alone, it is grown on an area of about 1·5 million acres and the estimated annual production is 5·9 lakhs of tons of grain. The crop is raised both under rainfed and irrigated conditions and being not season-bound it can be cultivated throughout the year, if sufficient irrigations could be provided.

As a food grain, Ragi is considered highly nutritious, particularly because of its higher calcium content and unlike other millets its use is not limited to the low income groups of the population. The colour of the grain in the common varieties of Ragi is brown of different shades and unless special methods of processing are adopted this undesirable tint is imparted to preparations made out of it. Though the variation in colour of the grain in this millet is the least compared to others, it has been observed that varieties which possess white grains also exist in particular localities. In the collection of different varieties studied at the Millet Breeding Station, a few from Tirunelveli district in the Madras State and some from the Mysore State were found to have this character. The white-grained varieties were, however, very poor in their yielding capacity, compared to the common brown-grained varieties, but the quality of grain was much superior, being higher in protein and vitamin content and having better malting qualities (Sastry-1939). It has been observed in previous studies that the colour of the grain in ragi is inherited in a Mendelian fashion, being dependent on two independent factors and the white being recessive (Rangaswamy Ayyangar et al 1931). In view of the fact that a white ragi grain will be preferred by the consumer because of its superior qualities, and consequently will fetch a better price to the grower, attempts were made to evolve a high-yielding white-grained strain of ragi by resorting to hybridisation.

Evolution of the white-grained ragi E. C. 4310: As a result of earlier studies, a selection E. C. 1940, higher yielding than the original white-grained varieties had been isolated from crosses between a white-grained selection E. C. 1008 and some of the brown-grained types (Ann. Rept. Madras Ag. Dept. 44—48). E. C. 1540 matures in about 120 days and gives an average yield of only 900 lb. per acre, while the normal brown-grained strains have an yield of more than 2000 lb. grain per acre. This white-grained selection was also found to have an appreciably higher percentage of vitamin B_1 content than Co. 1, a brown-grained one, the percentage in E. C. 1540 being 6·5 μg/g and that in Co. 1 being only 3 7 μg/g (Passmore and Sundararajan 1941). It was considered desirable to use this selection as one of the parents and step up its yield by hybridisation. A number of high yielding brown-grained types were, therefore, crossed with E. C. 1540 and progenies in successive generations were studied and selection with reference to tillering, earhead-shape, duration and yield.

A total number of 90 selections were studied and out of these, two viz., E. C. 4310 and E. C. 4455 (progency of a cross between E. C. 1540 and E. C. 985) were found worthy of further tests. There were compared in yield trials with E. C. 1540, the white-grained parent in 1947 and with Co. 2, the short duration strain (brown-grain) in 1948 and 1949. They were longer in duration than Co. 2 by 10 days and

therefore were tested against the standard Co. 1 (brown grain) in 1951. The yield trials were all conducted at the Millet Breeding Station, under irrigated conditions. The summary of the yield trials is given below:—

Results of yield trials of white-grained ragi selections

Year of trial	Selections					Differences significant or not	Critical difference
	E. C. 1540	E. C. 4310	E. C. 4445	Co. 1	Co. 2		
1947	711	1144	1122	..	..	Yes	106
1948	..	537	468	..	1335	Yes	88
1949	937	1304	1013	..	861	Yes	139
1951	..	1687	..	1974	..	Yes	298

Note:— (1) Results of trials from 1947 onwards only are presented.

(2) The yields of Ragi at the Millet Breeding Station in these years were very poor, due to want of irrigation facilities and adequate rainfall.

It may be observed that compared to E. C. 1540, the white-grained parent, the selections E. C. 4310 and E. C. 4455 have given increased yields of more than 20% grain in 1947. In comparison with Co. 2, the short-duration, brown-grained strain, E. C. 4310 was significantly superior and E. C. 4455 equal to it in the trials of 1949. They were however, longer in duration than Co. 2 by 10 days. Further trials with E. C. 4310, the better of the two selections, in comparison with Co. 1, gave conclusive proof of their high-yielding capacity, as may be observed from the results obtained in 1951, wherein it is seen to be on a par with Co. 1 in the yield of grain.

The selection E. C. 4310 was sent out for trial at the Agricultural Research Station, Hagari and the Agricultural Research Station, Palur in 1952. At Hagari an yield of 1953 lb. of grain was recorded for the new strain in comparison with H. 1 which yielded only 1593 lb. while at Palur an yield of 494 lb. of grain per acre was obtained as against 600 lb. for P. 1 the standard strain of the Station. The selection is under intensive tests in the districts of Tiruchirapalli, Salem and Coimbatore and the results are awaited.

The new strain of ragi E. C. 4310 is non-pigmented and white-grained, with top-curved earheads and a maturity period of 120 days. The chemical analysis of the grain has shown that it has a higher content of protein than Co. 1. E. C. 4310 has 8·4% of protein compared to Co. 1 which has only 7·5%. The malting qualities and the vitamin content of this new strain have not yet been studied and investigations in this direction will be taken up separately.

Summary: The commonly cultivated varietles of ragi are brown-grained. The evolution of a white-grained strain of ragi with high

yielding capacity, by hybridisation between poor yielding white-grained types and selections from common high yielding brown-grained varieties is reported. The new strain is superior in quality of its grain and is expected to have a quick spread because of its high yield, absence of colour in the grain and the higher protein content.

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Extracted Article

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A Recent Advance in the Correction of Trace Element Deficiencies

by

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There has for long been recognition that, whereas the "fertilizer" elements, nitrogen, phosphorus and potassium constitute the main nutrient requirements from the quantitative point of view, at leat another nine elements figure in the basic make-up of all plants.

These are sometimes loosely referred to under the collective term of "trace" or "minor" elements but, in fact, three of them, calcium, magnesium and sulphur, are more correctly defined as "intermediate" elements of plant nutrition as they are required in smaller quantities than the fertilizer elements but in considerably larger amounts than the strictly trace elements, iron, manganese, boron, zinc, copper and molybdenum. It is with these latter in general and certain of them in particular that I am concerned in this article.

Now, chemical analysis shows that by far the greatest proportion of soils have reserves of the trace elements sufficient to supply the needs of crops for an indefinitely long period of years. That trace element deficiencies do arise quite frequently in a wide range of plants is generally due to an insufficient availability of the reserves to supply even the quite small requirements of these elements.

This is a fact of fundamental importance since it leads logically to the conclusion that factors antagonistic to trace element availability can exist in otherwise fertile soils.

This circumstance is, indeed, verified beyond all doubt by the results of countless experiments over the years which have been concerned with the influence of liming on fertility.

Thus, parallel to the very generally recorded increase in fertiliser element availability resulting from the application of lime in some form, especially with highly organic soils, has been the frequent observation that deficient trace element uptake appears in the wake of a rise in the soil pH due to liming.

It has been shown that the availability of all the trace elements decrease as the pH figure reaches and exceeds neutrality, with the exception of molybdenum. In certain cases, e. g. manganese, the effect of high pH is greater when the organic content of the soil is high. The other major factor influencing the availability of the metallic trace elements is, according to increasingly impressive evidence, the level of available phosphoric acid. In theory this is logical since the phosphates of these elements are of the same order of insolubility as the basic carbonate complexes considered to be formed under conditions of alkalinity.

It would seem then that we are concerned with potential plant deficiencies of iron, manganese, boron, copper and zinc (a) wherever the soil is naturally limy or where liming has carried the pH above the 6·3—6·5 mark which is optimum for the growth of the great majority of our plants, and (b) where, as

under conditions of heavy "balanced" fortilizer application, phosphates accumulate.

In practice however, iron and manganese are the only trace elements, required in such quantities that excessive free lime or available phosphates are likely to reduce their availability to the plant to a degree sufficient to give rise to significant deficiencies.

Over the years, at least in this country, biochemists have been mainly concerned with induced deficiencies of these two elements and it is in this regard that significant advance has recently been made.

In 1952, Stewart and Leonard of the Florida Citrus Experimental Station, Lake Alfred, published a report in the Citrus Magazine dealing with the causes and control of iron chlorosis.

They had extended to use on iron-deficient orange trees under field conditions, the discovery by Jacobsen that the essential iron supply could be maintained in soil-less culture solutions by the use of the ferric salt of an organic complex, ethylenediamine tetra-acetic acid (EDTA).

When used as a dormant season soil application to citrus showing the typical chlorosis and branch die-back of severe iron deficiency, the full green colour of the leaves returned within six weeks and vigorous new extension growth was soon apparent. As little as two ounces of actual iron in this organic form per tree had performed what 15 pounds per tree of sulphate of iron had failed to do.

This work was extended with the co-operation of the Alrose Chemical Co., Providence, a subsidiary of Geigy, and it was through the Geigy Company Ltd. of Manchester that EDTA metallic trace element compounds were first made available for experimental work in this country in the winter of 1952.

The first name given to this form of preparation was "Sequestrol" and this became a registered trade mark of the Geigy Company. Later, by general agreement, the name "Sequestrene iron"* was substituted, and to day reference is invariably made to "Seqestrene iron", Sequestrene manganese" and so on.

(* "Sequestrene" and Sequestrene Plus" are registered trade marks of the Geigy Company Ltd.)

The metallic elements in this complex form are referred to technically as being chelated — a term derived from a Greek word meaning "a claw".

Both terms — sequestered and chelated — refer to the property of EDTA and allied compounds of isolating or gripping the metal in such a manner that it no longer exhibits the typical properties of the free compounds of the element.

Thus, for example, if sulphate of iron is dissolved in water and a solution of lime is added, a bulky brownish, insoluble precipitate is formed. When Sequestrene iron is treated in the same manner there is no immediate precipitate and breakdown of the complex is slow.

Another range of chelated metallic trace elements has been developed in Sweden under the name of Versenols. It is claimed that they are more effective under very alkaline conditions than the Sequestrenes, but, as yet, little work appears to have been done with them in this country.

I was privileged to have some of the earliest supplies of Sequestrene iron, and work carried out on Hydrangeas, in conjunction with Cheshunt Research Station, led to the Hydrangea experimental exhibit at Chelsea Flower Show two years ago which readers will doubtless remember seeing.

This particular plant was chosen for the original tests because the foliage shows such obvious yellowing or chlorosis when the pH of the pot soil rises much above six as, in fact, it frequently does due to continual use of "hard" mains water.

Within ten days plants which were so chlorotic as to be almost devoid of green colour, were visibly returning to a normal condition. It should be noted, however, that, whereas a very quick and persistent effect is achieved in regard to the foliage, pink varieties are not "blued" by Sequestrene iron. This would appear to confirm the theory that "blueing" of pink Hydrangeas results mainly from pH changes in the cell sap.

Plants which have been "blued" with the usual iron/aluminium compound are often greatly improved in foliage colour by the use of Sequestrene iron, and it has been noted that the intensity and clarity of the blue colour is sometimes markedly enhanced where Sequestrene aluminium is applied at the stage when the inflorescence is just visible.

Other plants which have been found to react favourably are various Primulas, Camellias, Azaleas and Rhododendrons, *Solanum capsicattrum*, decorative vines, chrysanthemums, tomatoes and a number of soft and top fruit crops.

The method of applicatian varies somewhat with the subject being treated for chlorosis, but it has been found both satisfactory and convenient to standardize the strength of solution at 1 in 1000, i. e., approximately 1 oz. in 6 gallons of water.

Sequestrene iron dissolves freely to form a pale-brown solution which is stable for at least a period of seven days even in hard water.

With pot plants the solution is used to the extent of a light watering on already moist soil. Row crops, such as raspberries and strawberries. are treated at the rate of 1-2 gallons per yard run of row, preferably when the soils is already moist and when growth is fully active in the spring.

Plants which can be treated individually, such as tomatoes and chrysanthemums growing in the border or field soil, are best treated by applying 1 — 4 pints of the solution per plant. according to circumstances. Where an area is closely planted, as, for example, in bedding schemes, it is satisfactary to apply 1—2 gallons of solution per square yard.

The necessity for or frequency of, repeat doses must, at the present stage of knowledge, be determined by the appearance of the plants, and much work remains to be done on this complex aspect of trace element deficiency correction with Sequestrenes.

During the course of considerable work over the last two years, there has been no evidence that damage can arise from soil treatment on the lines indicated above. It is important, however, that the solution be kept off the foliage, or that the solution contacting low growing plants be washed off before it is dry, with plain water.

Even in Sequestrene form, iron causes appreciable scorching of growth at the I in 1,000 strength, and, though this tendency can be minimized by the addition of a wetting agent, foliage application of the Sequestrenes is not recommended on grounds of safety as well as of efficiency.

A limited amount of work has been done in connection with trees, including orchard top fruits. Several instances have been recorded where application of Sequestrene iron at 2–8 ozs. per tree, dissolved in a convenient quantity of water for application has resulted in a marked improvement in colour of the foliage and in the vigour of growth.

In order to reach the area of maximum surface root activity, application in a broad band between the rows in early spring seems satisfactory. With individual trees or bushes. treatment of the whole area overshadowed by the branches is often advisable, and, in such instances, 1—2 gallons of solution per square yard is indicated.

Most of the information so far to hand concerns Sequestrene iron. Work is progressing with the Sequestrenes of manganese and other metallic trace elements, but it is premature yet to attempt precise recommendations.

In a number of cases, however, manganese deficiency has been found to run parallel to that of iron and, to take account of this circumstance and to give the gardener an opportunity of using the Sequestrenes under his own conditions, a Sequestrene mixture has recently been made available through retail sources. This material has been named "Sequestrene Plus", and is based on the Sequestrenes of iron and manganses together with active magnesium. It should have very general application, particularly on chalky soils, and is used as already indicated for Sequestrne iron, but at the more convenient amateur strength of 1 oz. per gallon of water.

It will be apparent that so complex a subject as the correction of trace element deficiencies cannot be covered in more than very brief detail in the course of one article, but a sufficient indication may have been given of the trend of progress as instanced by the discovery and application of the Sequestrenes. Much, very much, remains to be done, but we would appear to have in these materials a most valuable new approach to a problem which has for long ranked as one of prime importance in the effective culture of our garden. orchard and glasshouse crops.

REFERENCE:

(1) "Maintenance of Iron Supply in Nutrient Solutions by a single adition of Ferric Potassium Ethylenediamine Tetra-acetate".

Plant Physiol. **26**, *511-413, (1951).*

Extracts

The Work at the Birbal Sahni Institute of Palaeobotany, Lucknow

Introduction: It would perhaps be well to mention first how fossils are preserved in the rocks as records of the past. During the time which elapsed between the cooling of the earth and the present day, the earth's crust has experienced widespread changes in its topography, as changes in the distribution of water and land, or by elevation of submerged land and submergence of the of the land areas. During the periods of quiescence lands and mountains have been eroded by rivers and ice sheets and the sediments, along with plant and animal remains brought by them, were laid down at the bottom of the lakes and oceans. These sediments were then transformed into rocks, with plant and animal remains preserved in them as fossils. Rocks of such origin are called sedimentary rocks. These sedimentary rocks have been divided into well-marked epochs on the basis of their fossil contents.

GROUP I. Research of the Form and Structure of Ancient Plants.

Cambrian: (About 553 million years ago): In the Vindhyan rocks plant remains belonging to Algae and Fungi has been discovered by Sitholey, Varma and Srivastava. In a published paper they have described these plant remains and have remarked on their affinities and the age of these rocks in the light of their discoveries.

Devonian: (About 354 million years ago). Some plant fragments consisting of axes with spreading, undivided spines were discovered in the Devonian rocks of Norway by Hoeg. These plants showed an affinity with a group of early land plants called Psilophytes.

Carboniferous: (About 309 million years ago). Morphological studies on *Botryopteris antiqua*, one of the earliest ferns, and *Stauropteris burntislandica* have been published by Surange. From these studies he has been able to show that these early plants did not possess flat leaves as in modern plants but possessed just a branch system. He has also discussed the evolutionary trends in these plants and the habitat in which these plants grew.

Permian: (About 223 million years ago). From one of the coal seams in in West Bokara coal-field (Bihar), have been discovered shoots, leaves and seeds of a conifer *Walkomiella* by Surange and Prem Singh. This conifer was known so far only from Australia. Surange, Srivastava and Prem Singh have obtained microspores, megaspores and wood pieces from some coal seams of Bokara (Bihar) on the basis of which they have made an attempt to correlate different coal seams in that area. The presence of an Equisetalean cone in the Raniganj coal field has been recorded by Srivastava. In another paper Surange, Srivastava and Prem Singh have published megaspore types recovered by them in different coal seams of the West Bokara coal-field. Some coal samples from Jharia coal-field have been analysed by Uttam Prakash. He was successful in correlating one unknown seam with a certain coal seam in that area. A study of the stratigraphy and palaeobotany of South Rewa Gondwana has been made by Lele who has made an interesting study of the plants in the Parsora beds, enabling him to collect some evidence as regards the age of Parsora beds which is in dispute for a long time. A collection of plant fossils from China has been worked out by Hsu and Bose who have found a stem which they have named as *Cordaites Sahnii*. Some new plants and two winged pollen grains have been discovered in the Permian rocks of Salt Range by Sitholey. Fossil algae from the Salt Range have been studied by Rao and Varma.

Jurassic: (About 157 million years ago). A collection from Rajmahal, Bihar, has revealed the presence of a male flower of *Williamsonia* which has been named by Sitholey and Bose as *W. santalensis*. A number of woods belonging to conifers and not known previously from Rajmahal have been studied by Bhardwaj, who has described four new species viz., *Taxevlon rajmahalense, Mesembrioxylon indicum, Cupressinoxylon rajmahalense and Dedoxylon jurassicum*. Further study was done on *Homexylon rajmahalense* the problematical plant first described by Professor Sahni, by Hsu and Bose. Some Coniferous cones from Rajmahal were studied by Bose who refers them doubtfully to Brachyphyllum. He has also published his studies on *Bucklandia Sahnii*, the stem of *Williamsonia* brachyphyllum and on a fossil Cycadean stem. Studies made by Shah on a Rajmahal collection show the presence of *Ginkgoites*, the fossil representative of the living and famous sacred tree of Japan, *Ginkgo biloba*, for the first time from this area and he has also established the presence of three different species. Yet another collection was studied by Mittre who has published the presence of Charophytic remains and described male flowers and female cones belonging to *Pentoxyleae*, a new group of Gymnosperms established by Professor Sahni. A collection from a Rajmahal outlier on the eastern coast of India was studied by Suryanarayana, who has discovered a new species of a *Mesembrioxylon*, coniferous wood.

Cretaceous: (About 125 million years ago). A very small collection from Trichinopoly Cretaceous rocks has been studied by Varma who has published the occurrence of an algal genus, *Clypeina*, discovered for the first time from the Cretaceous formations. This is claimed to be a linking form between the Jurassic and Eocene representative of this genus and has been named *C. Sahnii*.

Tertiary: (About 60 million years ago). Further studies on *Cyclanthodendron Sahnii*, a palm-like plant now found in South America but extinct in India, have been published by Surange as a joint author with the late Professor Sahni. Studies on a palm fruit made by Lakhanapal have been published. He has named the new species as *Nipa Sahnii*. Studies on the algal flora of the lower Eocene beds of Nammal Gorge (Punjab Salt Range) have been conducted by Varma. He has published three new species of *Archaeolithothamnium;* in another publication he described two new species of *Mesophyllum*. He has also recorded a new species of *Lithophyllum*. From the same area Rao and Varma have published a new species of *Solenomeris* and have established its algal nature. In a collection from the Intertrappean beds of C. P., Uttam Prakash has discovered woods belonging to *Euphorbiaceae* and *Anacardiaceae* and also some palms and fruits. A collection from near Pondicherry, S. India, has been studied by Ramanujam who has published a new species of Palmoxylon and two new species of *Mesembrioxylon* and has discovered many dicot woods, including that of Mango also. Lignites from near Pondicherry were studied by Suryanarayana who has reported poor preservation of the microflora. He has also analysed coal samples from Makum Coal-field, Assam with a view to correlate the coal seams and has discovered in these plant fragments of angiospermic nature.

Quarternary: (About 1 million years ago). Lignites and clays from the Quarternary deposits of Kashmir were studied by Dube who discovered spores and pollen in them. He has made some observations regarding the climatic conditions prevailing at that time in the Kashmir Valley.

Recent and present day: A study of the atmospheric pollen of Uttar Pradesh is being done by Nair with a view to study the pollen flora of this Province and to interpret them in terms of pollen production of the present flora and their flight in the air. A collection of pollen and plants of the present flora is being made by Mittre and Nair.

GROUP II. Results of the research work done under the various research schemes conducted at the Institute.

1. Palaeobotanical investigations in relation to measurement of geologoical age of rocks: In geology, groups of a certain type of individual come into being at a certain period in the earth's history and then they become extinct. Surprisingly, this phenomenon of extinction of individuals and groups has been found almost universally widespread. This fact has lead to the discovery of certain index fossils, i. e., these fossils indicate a particular age of the rocks for their distribution on the land, thus making it possible for the palaeobotanist to separate rocks of different ages or the land and water surface which was not contiguous with that type of life-conditions. Based on this principle this scheme tries to fix the age of rocks of disputed Ages in India as accurately as possible. One such attempt to fix the age of the Vindhyan rocks of India has already been published under this scheme by Dr. R. V. Sitholey and his co-workers. A preliminary investigation has been carried out on various horizons from Simula Subathu area; Darjeeling and Kashmir Gondwanes. The Infra-Korls have yielded some organic remains which indicate its age as Permo-Carboniferous.

2. Scheme on the palaeobotanical investigations of Indian coals: In this scheme is being studied microfossils of coal seams in India, on the basis of which attempts will be made to correlate various coal seams. Millions of years have passed since these coal seams were formed and during this period there have been many upheavals in the earth which have caused disturbances in the coal seams. As a result, the coal seam may get broken from their main mass and may be shifted downwards, upwards or laterally. If a coal field has suffered enormous disturbance and for a number of times the directions in which a particular seam was running changes several times and differently at different places thus, presenting a very complex pattern for the geologist. Here the fossil contents can be of great help to the geologist in tracing out the relationships between different masses of coal seams. This sort of correlation of different seams often helps to discover the untraced coal seams in that area. These studies can also point out the fuel value of different coals. One such analysis of some coal samples from different seams has been published by Dr. K. R. Surange and his co-workers, wherein they have been able to indicate the relationships and differences between certain coal seams in West Bakare coal fields.

3. Research Scheme on Palynology: This scheme has been taken up very recently and the work has just been started. Under this scheme it is aimed to build a plant and pollen herbarium and to study the fossil and recent spores and pollen grains. These studies would form a basis for indentification of the fossil spores and pollen grains, whereby a correct information regarding the affinities of the fossil spores and pollen would be possible. So far about 200 pollen slides, along with a collection of 350 plants has been made. Besides this, a study of the atmospheric pollen of the Uttar Pradesh is also in progress. A research worker in this scheme has devised a pollen catcher and a motor-driven electric blower which would facilitate work in the study of atmospheric pollen. The pollen work which is being done at the Institute would be of value in taxonomical studies of the flora, interpretation of the pollen in the recent sedimentary deposits, studies of the evolution of pollen and phylogeny of modern plants, studies of hay fever (which is caused by certain types of pollen to which different people are susceptible), studies of climatology, ecology, and plant geography, etc. Pollen studies could also be of help to the honey industry and in various archaeological and geological problems.

Gleanings

Chemistry: This department, in collaboration with the workers in the Plant Physiology department, is developing the technique of using radioactive tracers like C^{14} and P^{32} for following plant metabolic processes, including photosynthesis. For this purpose paper chromatography and autoradiography techniques are also being employed. With the completion of the cold room, of the electrophoresis apparatus and the equipment of the low temperature laboratory with apparatus like refrigerating and other types of centrifuges, Warburg's apparatus and other apparatus, this laboratory will be equipped for the isolation of particulate bodies like virus, mitochondria, microsomes etc; and for the study of their biochemical behaviour, as well as of enzymes which occur in higher plants and in microorganisms.

Plant Physiology: The algae *Chlorella* and *Scenedesmus*, which have been used mainly for photosynthetic studies in the U. S. A. and other countries, have been collected and their photosynthetic activities under various environmental conditions studied. The feasibility of using photosynthetic products of different kinds of algae as a food substitute is being investigated in U. S. A. and Japan. For tropical countries a type of alga is required which can remain active at higher temperatures of the tropical countries, and whose chlorophyll content is comparatively low so that they can fully utilize the absorbed sunlight for photosynthesis.

J. C. Bose's active substance: Recent investigations with highly metabolising animal tissues like liver, kidney, heart, and skeletal muscles have established the occurrence in them of particulate bodies identified as mitochondria, whose density of occurrence is proportional to the activity of the organ. Staining investigations on thin sections of contractile plant pulvini have shown that in them mitochondria bodies also occur in proportion to their contractile activity, being the highest in the main pulvinus of *M. pudica* and lowest in the inactive pulvinus of *Phaseolus*. These bodies are not identical with J. C. Bose active substance whose nature is still under investigation.

Cytogenetics: The Institute has been carrying out investigations on the production of mutants in economic plants by X-ray irradiation of seeds and by selecting out of the mutants those with desirable economic properties. By irradiation of Jute variety (*Corchorus olitorius*) var. R. 26, now strain named Tall Mutant with several desirable economic properties has been evolved, which has remained stable up to seven generations.

Irradiation experiments have been started since 1950 on *Sesamum* (Til) and *Brassica* (Mustard). In some irradiated Bengal Types of *Sesamum* e. g. No. 12 and No. 16 substantial increase in yield of fruits and in weight of seeds have been observed upto the third generation. The yield of oil, their chemical composition are being studied. Similar significant increases in yield are observed with some strains of *Brassica* (Mustard), but they are still in the early stage of selection.

This year a new mutagenic agent, the β-ray active P^{32}, in the form of sodium dihydrogen phosphate solution, has been used to soak the jute seeds. Phosphorus salts are selectively absorbed in the plant nuclei and the *in situ*. β-irradiation from P^{32} is a very effective mutagenic agent. Out of the plants raised from such treated seeds of R26, a few have shown the characteristics of the Tall Mutant, while some are entirely green, having the character of another *Olitorius* var. *Chinsura green*.

It is a curious fact that during the past nine years irradiation of R26 with X-rays, not a single green mutant was obtained, This year the experiments are being repeating (i) with seeds obtained from the P^{32} mutants and (ii) freshly treated seeds. The group (i) are showing the morphological characteristics of their parents and in (ii) amongst other results from a treated tall mutant a Chinsura green plant has come out It appears that red coloration probably arises from a single gene mutation which also affects other properties of the jute plant. The relation between gene mutation and anthocyanin coloration have been previously studied in England and other countries in plants like primroses and sweet peas. A similar line of investigation will be started soon in collaboration with the Chemistry Department.

[The Report of the Bose Institute 1953-54 P 6-8]

Trace Elements in Soils: The Division of Plant Industry of the Commonwealth Scientific and Industrial Research Organisation is continuing research in many parts of Australia into deficiencies of trace elements in soils. Similar research is being carried out on trace element nutrition of animals. The results of research so far completed suggest that an undeveloped country can be vastly improved wherever the rainfall is sufficient and where the country is not steep and inaccessible. According to the research workers, there are millions of acres in Australia where one or more of the trace elements must be used to bring the undeveloped country into production.

In his presidential address to the Australian Institute of Agricultural Science, Dr. J. Griffiths Davies said that of the total area of Australia, approximately one-third, or 600,000,000 acres, consisted of relatively well-watered land and about 155,000,000 acres of this was at present undeveloped. Assuming that half of the remainder could not be improved because of difficult topographical features, urban use, etc., Australia was left with an area of 220,000,000 acres capable of improvement. The C. S. I. R. O. believes that trace elements will play an important part in this development.

Sawdust as Mulch: Australian fruit-growers are using sawdust as mulch for apple trees with successful results. An orchard in the Camden district, near Sydney, was treated with sawdust last September, and the crop this year was good. The district fruit officer at Camden, Mr. J. V. McGrath, stated that a dressing of sulphate of ammonia had been applied at the same time as the sawdust, at the rate of half a ton per acre. The mulched trees showed no ill-effects from the dry conditions that prevailed during part of the summer in the district, while trees on adjoining properties which were unmulched, were adversely affected by lack of soil moisture.

Fruits from the mulched trees were considerably larger and better coloured than those from adjoining areas, and the trees themselves maintained a much better and healthier appearance throughout the season. At the end they carried more and stronger lateral and leader growth than the unmulched trees. In northern New South Wales some banana growers have also experimented with sawdust with good effect. Banana-growing is increasing in that area. The total area under bananas in New South Wales this year is 30,144 acres, the highest on record. Previous highest acreage was 30,144 acres in 1948. During the past two years 756 new growers have entered the industry, making the total now 4,987. Of the total acreage, 26,000 acres are in bearing this year and organisers are getting growers together to meet any marketing problems that may arise.

Urea as a Nitrogen Fertiliser for Potatoes: A potato-grower of Echunga district, South Australia, reports an apparent response from the application of

urea in irrigation water for his potato crop. The urea was applied just after flowering and during the formation of tubers. He dissolved 56 lb. of urea in 44 gallons of water and fed it into the intake side of a pump during the last 20 minutes of a sprinkler run over one acre. This acre of land yield 495 lb. of table potatoes as against 431 lb. from a similar area without urea. The total yield from the treated acre was 14·6 tons as against 12·7 tons with out wera. The results showed a 15 per cent. increase in marketable potatoes, 26 per cent. increase in oversize tubers, and a 35 per cent. decrease in small tubers.

Weather Review — For January, 1956

RAINFALL DATA (IN INCHES)

Division	Station	Total rainfall for the month	Departure from normal	Total since 1st January	Division	Station	Total rainfall for the month	Departure from normal	Total since 1st January
North	Madras (Meenambakkam)	1·3	— 0·1	1·3	South	Madurai	1·2	+ 0·4	1·2
	Tirurkuppam*	1·3	— 0·3	1·3		Pamban	0·6	— 2·0	0·6
	Vellóre	0·8	— 0·7	0·8		Koilpatti*	0·7	— 0·6	0·7
	Gudiyatham*	0·6	— 0·1	0·6		Palayamcottai	3·0	+ 1·3	3·0
East Coast	Palur*	1·1	— 1·3	1·1		Ambasamudram*	3·2	— 0·3	3·2
	Tindivanam*	1·6	+ 0·1	1·6	West Coast	Trivandrum	0·8	J. N.	0·8
	Cuddalore	0·7	— 1·7	0·7		Fort Cochin	Nil	— 0·9	Nil
	Nagapattinam	2·6	— 0·1	2·6		Pattambi*	0·2	— 0·1	0·2
	Aduthurai*	2·1	+ 0·3	2·1		Kozhikode	Nil	— 0·2	Nil
	Pattukottai*	2·6	+ 0·4	2·6		Taliparamba*	Nil	— 0·2	Nil
Central	Salem	0·3	J. N.	0·3		Wynaad*	Nil	— 0·3	Nil
	Coimbatore (A. M. O.)*	0·1	— 0·5	0·1		Nileshwar*	Nil	— 0·2	Nil
	Coimbatore	Tr.	— 0·6	Tr.		Pilicode*	Nil	— 0·3	Nil
	Tiruchirapalli	0·5	— 0·3	0·5		Mangalore	Nil	— 0·3	Nil
						Kankanady*	Nil	— 0·1	Nil
					Hills	Kodaikanal	1·9	— 1·3	1·9
						Coonoor*	2·6	— 1·7	2·6
						Ootacamund*	0·3	— 0·6	0·3
						Nanjanad*	0·2	— 0·5	0·2

Note :— * Meteorological Stations of the Madras Agric. Dept.
Tr = Trace (0·01" to 0·04")
J. N. = Just Normal.

The weather was practically dry in the first seven days of the month. In the subsequent two days, mild scattered showers occurred in a few places in south Tamilnad. On 10—1—1956 the weather was again dry practically throughout the Madras State. Then on 11—1—1956 localised showers were received in Travancore-Cochin and at a few places in south Tamilnad. On the next day showers were fairly widespread in Travancore-Cochin and somewhat localised in Tamilnad. Localised thunder-showers were recorded in Tamilnad on 13—1—19 6. From 14—1—1956 to 25—1—1956, both days inclusive, the weather was mainly dry in all the districts in Madras State. But during this period a number of mild western disturbances were noticed with no conspicuous change in the weather conditions of the Madras State. On 26—1—1956 showers occurred at a few places in Tamilnad. The weather on the next day was dry. Again on 28—1—1956 light showers were received in a few places in Tamilnad. This sort of receipt of mild scattered showers, at times of a highly localised nature, in Tamilnad and Malabar and South Kanara continued during the remaining three days of the month.

Considering the month of January, 1956 as a whole, practically the rains received happened to be sub-normal in the majority of the districts.

The noteworthy rainfalls and the zonal rainfall in inches are furnished below :—

Noteworthy Rainfalls			Zonal Rainfall			
Date	Place	Rainfall in inches	Name of Zone	Rainfall for the month	Departure from normal	Remarks
12/1/56	Palayamcottai	1·5	North	1·0	— 0·3	Below normal
13/1/56	Nagapattinam	1·5	East Coast	1·8	— 0·4	do.
29/1/56	Madras (Nungampakkam)	2·0	Central	3·1	— 1·6	Far below normal
29/1/56	Madras (Meenambakkam)	2·0	South	1·7	— 0·2	Below normal
30/1/56	Kallakurichi	1·0	West Coast	0·1	— 0·3	Far below normal
30/1/56	Palghat	1·0	Hills	1·3	— 1·0	Below normal

Agricultural Meteorology Section,
Lawley Road P. O.,
Coimbatore, 9—2—1956.

C. B. M. & M. V. J.

Departmental Notifications

Gazetted Service — Postings and Transfers

Name and present post	Posted as
Krishnaswami, P. N., Assistant Cotton Extension Officer, Madurai,	Assistant Cotton Specialist, Tirupur
Neelakantan, L., Assistant Cotton Specialist, Koilpatti,	Assistant Cotton Specialist, Srivilliputhoor
Narayanan, K. T., Agricultural Engineering Supervisor, Coimbatore,	Assistant Agricultural Engineer, (Research), Coimbatore
Raghavan, A., Assistant Cotton Specialist, Tirupur,	Assistant Cotton Extension Officer, Madurai
Santhanam, V., Assistant Cotton Specialist, Coimbatore,	Assistant Cotton Specialist, Koilpatti
Sankaranarayana Reddy, N., Assistant Agricultural Engineer, (Research), Coimbatore,	Assistant Agricultural Engineer, Soil Conservation Scheme, Vellore

Upper Subordinates

Name and present post	Posted as
Doraiswami, G., P. A. to D. A. O., Coimbatore,	Extension Officer, Kangayam
Ganapathy, N. K., A. D., Uthiramerur,	Extension Officer, Tiruvannamalai
Koyammu, K., Oil Seed Assistant, Pilicode,	Coconut Assistant, Chowghat
Kumaran, V., Soil Conservation Assistant, Kangayam,	A. D., Badagara
Krishnaswami Sarma, M. C., A. D., Natham,	Coconut Nursery Assistant, Muthupet
Krishnamurthy, P. S., A. D., Vegetable Seed Stores, Madras,	A. D., Poonamalee
Malathi, M., Botany Assistant, Coimbatore,	Assistant in Plant Physiology, Coimbatore
Masilamani, S., Conservation Assistant, Satyamangalam,	Special A. D., Ootacamnnd
Mohamed Ibrahim, P. A., Oil Seed Assistant, Nileshwar. II.	Oil Seed Assistant, Pilicode
Mohamed Sultan Mohideen, A. D., Poonamallee,	A. D., Kavaraipettai
Mohamed G. Fathauddin, A. D., Kavaraipettai,	A. D., Vegetable Seed Stores, Madras
Natarajan, T. E., Tiruvettipuram,	Chemistry Assistant, Palur
Nalla Gounder, S. C., Trainee in Soil Conservation, Ootacamund,	Soil Conservation Assistant, Kangayam
Narayanan Nambiar, P. K., A. D., Tirumalavadi,	Coconut Nursery Assistant, Adirampatnam
Ummerkutty, O. V., Coconut Nursery Assistant, Nileshwar,	Coconut Assistant, Badagara
Pattabhiraman, R., Extension Officer, Kangayam,	A. D., Peravurni
Pinagapany, N., P. P. A., Cuddalore,	A. D., Cuddalore
Palaswami, K. K., A. D., Devakottai,	Extension Officer in Agriculture, Devakottai
Ramasubhu, G., A. D., Vilathikulam,	A. D., Abiramam
Rangaswami, S., A. D., Tiruvadanai,	Extension Officer in Agricultural, Tiruvadanai
Raman, N. V., Special A. D., Ariyalur,	Breeding Assistant, Vegetables, Coimbatore
Ramakrishnan, C., Breeding Assistant, Vegetables, Coimbatore,	Chemistry Assistant, Coimbatore
Ramanarayana Menon, Analyst, Coimbatore,	Coconut Nursery Assistant, Tikkotti
Samuel Joshua Moses, A. D., Sivaganga,	Extension Officer in Agriculture, Kalayarkoil
Sivasubramaniam, T., Trainee in Soil Conservation, Ootacamund,	F. M., C. F., Coimbatore

Name and present post	Posted as
Subramaniam, M., Trainee in Soil Conservation, Ootacamund,	A. D., Dharmapuri
Shanmughavelu, K. A., Extension Officer, Tiruvannamalai,	A. D,, Uthiramerur
Thomas, N. K., P. A., to D. A. O., on leave,	P. P. A., Entomology, Tellicherry
Thiyagarajan, N. M., Assistant in Plant Physiology, Coimbatore,	Chemistry Assistant, Coimbatore
Thiruvenkataswami, K. R., Trainee in Soil Conservation, Ootacamund,	Soil Conservation Assistant, Ootacamund
Venkataraman, N., Assistant, Winter Cambodia Scheme, Coimbatore,	Cotton Assistant, Aduthurai
Venkataswami, B., A. D., Cuddalore,	P. P. A., Entomology, Cuddalore
Viswanatha Shetty, B., Research Student,	Assistant in Millets, Coimbatore
Vedachalam, C. D., Trainee in Soil Conservation, Ootacamund,	Soil Conservation Assistant, Satyamangalam

FIELDMEN ASSOCIATION, MADRAS AGRICULTURAL DEPARTMENT,

LAWLEY ROAD P. O., COIMBATORE.

The Thirtieth Annual General Body Meeting for the year 1955 of the Fieldmen Association, Madras Agricultural Department, Lawley Road P. O., Coimbatore held on 4-2-1956 under the Presidentship of Sri V. Narayanan in the Freeman Hall of the Agricultural College and Research Institute, Lawley Road Post.

The following resolution was passed:

"It was resolved to submit necessary representations to the authorities regarding the service conditions of the Fieldmen cadre and for the regularisation of the emergency candidates now faced with discharge".

Office bearers for the year 1956:-

President: Sri M. Saravanabhavandam, Secretary: A. Adiapatham, Asst. Secretary: N. R. Ramamoorthi, Committee Members: C. R. Venkataramanan, A. V. Krishnaswamy, S. Amirthalingam, P. K. Ponnuswamy, Navarathanam, Balagangadaran, K. Ramachandran, Balakrishnan and M. Ranganathan.

Review of the Activities of the Market Committees during January 1956

I–1: Of the seven Market Committees in the State, only five in the districts of North Arcot, South Arcot, Coimbatore, Malabar and South Kanara continued to function actively, during the month. The activities in the other two Market Committees are just now commencing.

1–2: The following progress was made by the Market Committees during the month in the matter of issue of licences under Madras Commercial Crops Markets Act.

	Section 5(1)		Section 5(3)		Weighmen		Broker	
	A	B	A	B	A	B	A	B
North Arcot Market Committee ..	173	173	144	144	62	62	—	—
South Arcot Market Committee ..	434	434	410	410	381	381	—	—
Coimbatore Market Committee ..	57	57	85	85	92	92	3	3
Malabar Market Committee ..	137	137	432	432	109	109	4	4
South Kanara Market Committee ...	86	86	77	77	34	34	—	—
Ramanathapuram Market Committee ..	2	2	3	3	—	—	—	—
Tirunelveli Market Committee ..	1	1	1	1	—	—	—	—

A: During the Month. B: Up to the end of the month from January, 1956.

1–3: The total volume of transactions in commercial crops in 14 Regulated Markets in the State during January 1956, is extracted below.

Crop		Quantity	No. of Regulated Markets
Groundnut Kernels	..	6,580 Tons	10
Gingelly	..	71 Tons	3
Cotton Kapas	..	470 Pothis	2
Cotton lint	..	Nil	—
Coconut	..	Nil	—
Arecanut	..	Nil	—
Tobacco	..	Nil	—

II. **Meetings:** 2–1: The first meeting of the Coimbatore Market Committee during 1956 was held in the office of the Committee at Tirupur. Sixteen subjects were discussed at the meeting. The following are a few important subjects discussed.

(a) Raising the minimum quantity from 20 maunds to 60 maunds allowed as a concession to petty dealers of Tobacco as per by-law 21(i)b and 21(2) (b)

(b) Resolved to replace the word "fee" in the By-laws by the word "cess".

(c) Approval of the budget estimates of the Committee for 1956.

2–2: No meetings were held in other Market Committees.

III. **Quality Appraisal:** 3–1: The South Arcot Market Committee continued its work on the quality analysis of Groundnut Kernels marketed in that district. A total of 257 samples were drawn and analysed during the month from out of 4,057 lots comprising of 44,356 bags of Kernels. The details of analysis, which may be of interest are extracted below:—

Particulars		Cuddalore	Villupuram	Virudhachalam	Panruti
1. *Dryage:*					
2% and below	..	8	4	44	2
Above 2% and upto 3%	..	12	4	11	5
Above 3% and upto 4%	..	18	3	4	7
Above 4% and upto 5%	..	27	4	1	1
Above 5% and upto 10%	..	33	6	—	27
Above 10%	..	8	3	—	19
2. *Total Refraction:*					
4% and below	..	8	10	19	65
Above 4% and upto 8%	..	55	11	41	—
Above 8%	..	43	3	—	2

The total common refraction was below 4% in 102 samples, 5 to 8% in 107 samples and above 8% in 48 samples.

3-2: During the month 76 entrants were enlisted for the Winter Crop Quality Competition in South Arcot District.

State Marketing Officer.

Quality Analysis of Winter Groundnuts of 1954—'55 Marketed in South Arcot District.—Objective Study conducted by South Arcot Market Committee, Cuddalore

by

SRI K. V. NATESAN, B. sc. (Ag.,)
(Secretary, South Arcot Market Committee, Cuddalore)

The objective study of the quality of groundnuts marketed in South Arcot District started from the 1954 summer crop season in five markets of this Committee, was continued in the winter crop (rainfed crop) season also.

Review of Summer Crop: The total arrivals of groundnut kernels marketed in all the five markets during the summer crop season, where the analysis was done, amounted to 3,96,076 bags. 3,245 samples were drawn from 12,526 bags at random and analysed for moisture, foreign matter and other detracting elements like blacks, splits, brokens, nooks and shrivelled nuts etc. Studies made in respect of variety such as "Spreading" or "Bunch" revealed that 98% of the quantity marketed were all of the spreading type and only 2% of the "bunch type". Methods adopted in decorticating the groundnut pods were also studied with an idea to see how far machine decortication is adopted by ryots. This revealed that hand-beating the produce with sticks after moistening the pods is still continued on a large scale and 53·5% of the produce marketed were of the hand-beaten stuff only. Machine-shelled groundnuts represented only 45·9% of the total produce marketed. Besides this, the size of groundnut holdings of individual ryots whose lots were analysed and the interval between the time of harvest and marketing of the crop were also studied. From the analysis of the processing details, it was revealed that of all the markets,

Vridhachalam had the lowest percentage of foreign matter and other detracting components with minimum moisture in the samples as against other markets. At Cuddalore and Villupuram the samples analysed showed high percentage of both 'moisture' and 'refraction'. Tindivanam stuff contained a high percentage of refraction with low percentage of moisture, while Tirukoilur stuff contained high percentage of moisture with low percentage of foreign matter and other detracting elements. The time lag between harvest and marketing was very short in the majority of the cases and within two weeks after harvest 78% of the total produce got marketed, and 20% between two weeks and two months from harvest and the balance of 2% any time later than two months. The poor economic condition of the ryots of this district in general coupled with the lack of staying power in holding back their harvested produce for a reasonable period, due to want of facilities for storing and the pressing need for money, have all been responsible for the rush of produce to the markets soon after harvest.

Observations on Winter Crop: The following observations are made in respect of quality analysis conducted during the winter crop season of 1954—'55 in the markets mentioned above. Total arrivals of winter crop from November 1954 to March 1955 amounted to 2,70,816 bags in the above five markets. 2,573 samples were analysed and quality factors determined as in the summer crop season. Hand-beating with sticks of the pods has been the vogue in the market areas of Vridhachalam, Villupuram and Cuddalore. 92·2% of the samples, representing a quantity of 1980 bags at Vridhachalam, 77% of the lots representing a quantity of 1210 bags at Villupuram and 64·6% representing a quantity of 1505 at Cuddalore were hand-beaten. Machine-shelling has been more popular among ryots in the market areas of Tirukoilur and Tindivanam, only, where 67% of the samples representing a quantity of 760 bags and 79% of the samples representing a quantity of 1229 bags were machine-decorticated.

Taken as a whole it was found that machine decortication was only 44·7% in the rainfed crop season against 45·9% in the summer crop season. Hand-beaten produce was 55% against 53·5% in summer. A comparative statement showing the different percentages is appended in annexure I.

The ordinary spreading variety (Local Mauritius) is the crop grown in usually in the District. Bunch variety is grown only in the market areas of Tindivanam and Vridhachalam.

STATEMENT I

Name of the Market	Lots	Quantity of arrivals of winter crop in bags	Samples analysed		Samples spreading variety		Samples of bunch variety		Samples of machine shelled		Samples hand-beaten		Samples hand picked		Average dryage reduced to percent common per cent basis	Average refraction reduced to common per cent basis
			No.	Qty.	No.	Qty.	No.	Qty.	No.	Qty.	No.	Qty.	No.	Qty.		
Tindivanam	18,578	74,313	303	1,329	303	1,329	..	..	240	1,229	63	100	..	..	3·5	10·1
Cuddalore	5026	21,905	600	2,509	593	2,499	7	10	202	984	388	1,505	10	10	4·9	5·1
Vridhachalam	25,678	92,035	752	2,157	752	2,157	..	..	59	177	693	1,980	..	..	4·2	2·7
Villupuram	7,564	30,256	516	2,282	516	2,282	..	..	119	1,072	397	1,210	..	..	8·5	3·9
Tirukoilur	17,435	52,307	402	1,161	402	1,161	..	..	260	760	142	401	..	..	6·0	5·0
Total	74,281	2,70,816	2,573	9,438	2,566	9,428	7	10	880	4,222	1,683	5,196	10	10		
Percentage			3·4%	3·4%	99·7%	99·8%	0·27%	0·1%	34·2%	44·7%	65·4%	53%	0·4%	0·1%		

Note: Quantity in all the columns denote bags of 177 lb. net kernels.

STATEMENT II

Moisture variation

Name of the Market	Samples analysed		Samples in which moisture is below 1%		Moisture is upto 2% but above 1%		Moisture is above 2% but below 4%		Moisture is above 4% but below 8%		Moisture is above 8% but below 10%		Moisture is above 10% but below 15%		Moisture is above 15%	
	No.	Qty.	No.	Qty.	No.	Qty.	No.	Qty.	No.	Qty.	No.	Qty.	No.	Qty.	No.	Qty.
Tindivanam	303	1329	12	50	93	264	164	682	23	284	7	36	4	13	..	..
Cuddalore	600	2509	2	35	18	65	254	549	223	1480	68	253	35	127	..	..
Vridhachalam	752	2157	155*	324	238	961	329	775	12	48	8	24	10	25	..	..
Villupuram	516	2282	..	..	..	..	65	167	205	1346	166	598	80	171	..	..
Tirukoilur	402	1161	1	1	52	173	207	351	68	415	41	164	33	57	..	..
Total	2573	9438	170	410	401	1463	1019	2524	531	3573	290	1075	162	393		
Percentage	100		6·6%	4·3%	15·6%	15·6%	39·8%	26·7%	20·6%	37·8%	11·2%	11·4%	6·2%	4·1%		

* Of this sixty lots are "pucca." Pucca means fully dried produce fit for crushing in the expeller.

Statement No. II. The average percentage of moisture in groundnuts varied from 3 to 8%. It was 3·5% at Tindivanam, 4·2% at Vridhachalam, 4·9% at Cuddalore, 6% at Tirukoilur and 8·5% at Villupuram.

Vridhachalam and Tindivanam accounted for 52·3%, (1285 bags) and 34·6% containing a quantity of 314 bags analysed for moisture between 0 and 2%. From a comparative study between the markets and the summer crop it was found that the produce received at Tindivanam and Vridhachalam contained 3·5% and 4·2% of moisture only, whereas the produce of Villupuram market contained 8·50% moisture on the average. This is due to the fact that the pods are over-moistened for hand-beating the stuff with sticks and the kernels after decortication are not dried before sale.

Presence of Foreign matter: Taken as a whole 56·9% of the total number of samples of all the markets viz., 1464 samples showed foreign matter below 1%, while 39·3% contained foreign matter below 4% and above 1%, and 3·4% of the samples showed foreign matter between 4% and 8%. Individually high percentage of foreign matter was visible at Tirukoilur and Villupuram whereas samples from Vridhachalam showed minimum foreign matter.

Nuts in Shell: All the samples analysed contained nuts in shell within 10% range. Nuts in shell were more common in samples which were subjected to machine decortication than in samples which were hand-beaten.

Damaged kernels: High percentage of damaged kernels was visible in the samples analysed in the four markets of Cuddalore, Villupuram, Tirukoilur and Tindivanam while it was at its minimum at Vridhachalam market in which 79% of the total samples viz. 594 lots consisting of 1671 bags contained damaged kernels within 2% range only. At Tirukoilur, Tindivanam, Cuddalore and Villupuram the percentage of damaged kernels within 2% range was visible in 39·8%, 35%, 28·5% and 9·8% of the samples. At Cuddalore it ranged between 4% and % in 175 samples, at Tindivanam in 86 lots, at Tirukoilur in 142 lots and at Villupuram in 175 lots, while at Vridhachalam it was visible only in 51 lots. Damaged kernels above 10%, was visible at Cuddalore and Villupuram in 135 lots consisting of 814 bags at the former at 156 lots consisting of 569 bags at the latter.

STATEMENT No. III.

Refraction and other deleterious contents.

Market	Foreign matter such as stones and dust			Nuts in Shell		Damaged Seeds				Splits		Brokens		Nooks			Shrivelled		Total Number of Samples
	4 and below	Above 4% upto 8%	Above 8%	10% and below	Above 10%	2% and below	Above 2% but below 4%	Above 4% but below 10%	Above 10%	25% and below	Above 25%	10% and below	Above 10%	5% and below	Above 5% but below 10%	Above 10%	2% and below	Above 2%	
Tindivanam																			
No. of Samples	286	12	5	300	3	106	65	86	46	249	54	287	16	303	..	..	303	..	303
Quantity	1274	49	6	1303	26	424	285	361	259	942	397	1254	75	1329	..	..	1329	..	
Cuddalore																			
No. of Samples	591	9	..	599	1	171	119	175	135	552	48	597	3	475	113	12	192	408	600
Quantity	2457	52	..	2509	..	583	281	831	814	2218	291	2497	12	2119	350	40	521	1988	
Vridhachalam																			
No. of Samples	752	..	..	752	..	594	72	51	35	752	..	750	2	637	98	17	164	588	752
Quantity	2157	..	..	2157	..	1671	216	170	100	2157	..	2145	12	1808	311	38	533	1624	
Villupuram																			
No. of Samples	481	35	..	516	..	51	134	175	156	516	..	516	..	484	20	12	..	516	516
Quantity	2009	273	..	2282	..	416	377	920	569	2282	..	2282	..	1750	459	73	..	2282	
Tirukoilur																			
No. of Samples	370	32	..	402	..	160	38	142	62	397	5	347	55	390	12	..	326	76	402
Quantity	1051	110	..	1161	..	195	208	519	239	1161	..	1098	63	1131	30	..	929	232	

STATEMENT IV

Size of Holdings

Name of the Market	Samples 1 Acre and below		Above 1 acre but below 2 acres		Above 2 acres but below 3 acres		Above 3 acres but below 4 acres		Above 4 acres but below 5 acres		5 to 10 acres		Above 10 acres		
	No.	Qty.	No.	Qty.	No.	Qty.	No.	Qty.	No.	Qty.	No.	Qty.	No.	Qty.	
Tindivanam	81	97	63	218	79	296	12	197	20	103	40	327	8	91	
Cuddalore	183	404	139	762	63	317	52	513	18	375	44	101	11	36	
Vridhachalam	501	652	155	989	43	299	21	96	19	28	13	93	..	..	
Villupuram	160	391	164	458	63	231	39	242	37	177	48	689	5	...	
Tirukoilur	222	260	98	117	32	279	37	153	8	71	5	81	..	..	Total
	1147		619		280		161		102		150		24		2483
Percentage	47%		24·8%		11·2%		6·3%		4·1%		5·9%		0·9%		

Splits and Brokens: Splits and brokens were large in places where machine decortication is popular, eg. at Tindivanam and Tirukoilur. In the majority of samples in other markets the percentage of splits and brokens were at their minimum as could be seen from the Statement III.

Nooks: The presence of nooks in the majority of samples was within 5% range. However, a high percentage ranging between 5 and 10% was visible at Virdhachalam and Cuddalore. This is perhaps due to beating the pods with sticks.

Shrivelled Kernels: High percentage of shrivelled kernels was noticed at Tindivanam, Villupuram and Cuddalore while it was low at Vridhachalam and Tirukoilur. Harvesting of immature pods due to want of sufficient rains at the growing period is the chief cause for such high percentages.

STATEMENT V.

VARIATIONS IN HARVESTING

Months in which the crop is harvested, with number of samples in each.

Name of Market		November	December	January	February
Tindivanam	..	161	117	23	2
Cuddalore	..	260	103	64	87
Tirukoilur	..	129	210	40	..
Vridhachalam	..	127	625	..	..
Villupuram	..	25	150	24	21
Total	..	693	1,205	151	110
					Total 2,159
Percentage	..	32·1%	55·3%	7%	0·6%

STATEMENT VI.

Interval Between Harvesting and Marketing

Name of Market		Within one week of harvest	Between one week and two weeks	Between 2 and 4 weeks	One month and more after harvest
Tindivanam	..	8	28	24	243
Cuddalore	..	42	161	148	159
Tirukoilur	..	180	130	55	5
Vridhachalam	..	..	27	105	620
Villupuram	..	82	64	48	230
Total	..	212	410	380	1,257
					Total 2,259
Percentage	..	9·0%	18%	21%	52%

General: As in the case of summer crop the quality of kernels was above average at Vridhachalam in respect of moisture and refraction and good in respect of moisture alone at Tindivanam. In other markets the quality was below average and the incidence of moisture and refraction was fairly high. Even though ryots as a class in South Arcot District are poor as could be seen from the size of their holdings, they have been told very many times that by marketing wet and inferior stuff they will only lose heavily in their income, yet they bring only wet stuff with 2% to 8% moisture. Even educated ryots bring such bad stuff. Not that they

COMPARATIVE STATEMENT OF

QUALITY ANALYSIS OF GROUNDNUTS 1954—1955

Details		Summer Crop 1954			Winter Crop 1954—1955		
1. Total Arrivals to the Markets where analysis was done	..	3,96,076 Bags			2,70,816 Bags		
2. Number of Samples analysed	..	3,245 Samples comprising 12,526 bags			2,566 Samples		
		Spreading	Bunch		Spreading	Bunch	
3. Variety	..	98%	2%		99·7%	0·3%	
4. Decoration:							
Machine-Shelled	..	45·9%			34·2%		
Hand-Beaten	..	53·5%			65·7%		
Hand-Shelled	..	0·6%			0·17%		
Hand-beaten:							
Vridhachalam	..	88·8%			92·2%		
Cuddalore O. T.	..	70·0%			64·6%		
Tindivanam	..	40·0%			21·0%		
Villupuram	..	40·0%			77·0%		
Tirukoilur	..	20·0%			33·0%		
5. Variations in size of holdings	..	They are mostly within one acre range			They are within one to two-acre range		
		Early.	Mid-season.	Late.	Early.	Mid-season.	Late.
6. Harvesting Period:		May	June Aug.	Sep.	Oct. Nov.	Dec.	Jan. Feb.
7. Percentage of harvests in each of the seasons	..	30%	50%	20%	32·1%	55·3%	7·6%
8. Arrivals to the markets after	..	78% within 2 weeks 20% within 2 months 2% later			27% One month 21% After one month 52%		
9. Moisture Variations:							
Below 1%	..	3.42%			6·6%		
Between 1—2%	..	10·84%			15·6%		
Between 2—4%	..	27·70%			39·6%		
,, 4—6%	..	27·70%			—		
,, 6—8%	..	6·8%			20·6%		
,, 8—10%	..	7·80%			11·2%		
Above 10%	..	5·10%			6·2%		
10. Average Dryage:							
Cuddalore	..	5·66%			4·5%		
Tindivanam	..	3·86%			3·5%		
Tirukoilur	..	6·98%			6·0%		
Villupuram	..	6·32%			8·5%		
Vridhachalam	..	3·30%			4·2%		
11. Total Refraction reduced to common basis:							
Cuddalore	..	10·07			5·1%		
Tindivanam	..	8·51			10·1%		
Tirukoilur	..	3·91			5·0%		
Villupuram	..	6·35			3·9%		
Vridhachalam	..	3·07			2·7%		

have not understood that by getting better dried stuff they will get better price, but they probably imagine they can dupe the merchants in this manner.

A scheme for quality competition of groundnuts was submitted to Government and has been sanctioned for the year 1955–'56.

Crop and Trade Reports

Pepper — Second forecast report — 1955 — '56 — Madras State: The area under pepper upto 25th December, 1955 in the districts of Malabar, South Kanara and the Nilgiris is estimated at 123,750 acres (105,000 acres in the Malabar district, 18,600 in South Kanara district and 150 acres in the Nilgiris district). Compared with the acrea of 119,350 acres (101,900 acres in Malabar 17,300 acre in South Kanara and 150 acres in the Nilgiris) estimated for the corresponding period of last year it shows an increase of 3·7 percent. The seasonal factor is estimated at 92 percent of the normal for Malabar district, 98 percent of the normal for South Kanara and the Nilgiris districts as against 92 percent of the normal in Malabar district, 88 percent of the normal in South Kanara district and normal in the Nilgiris district estimated for the corresponding period of last year. On this basis the total yield is estimated at 9,700 tons (8,150 tons in Malabar district, 1,540 tons in South Kanara district and 10 tons in the Nilgiris district). Compared with the yield of 9,200 tons (7,910 tons in Malabar, 1,280 tons in South Kanara and 10 tons in the Nilgiris) estimated for the corresponding period of last year it shows an increase of 5·4 percent. The wholesale price of pepper per standard maund of 82 - 2/7 lb. or 3,200 tolas on 6–1–1956 was Rs. 99–15–0 for Nadam and Vatakkan varieties, Rs. 111–11–0 for Wynaad variety at Kozhikode, Rs. 122–10–0 at Tellicherry and Rs. 117–9–0 at Mangalore. Compared with the prices in corresponding period of last year i. e., those which prevailed on 8–1–1955, these prices show a fall of 5·6 percent for Nadan and Vatakkan varieties, 9·5 percent for Wynaad variety at Kozhikode and a rise of 18·1 percent at Tellicherry and 16·2 percent at Mangalore.

Ginger — Second forecast report — 1955 — '56 — Madras State: The area under singer crop upto 25th December, 1955 in the Districts of Madurai, Malabar, South Kanara and the Nilgiris is estimated at 15,200 acres. Compared with the area of 14,880 acres estimated for the corresponding period of the last year it shows an increase of 2·2 percent. Compared with the average area of 13,450 acres for the previous five years ending with 1954–55, the present estimate reveals an increase of 13·0 per cent. A decrease in area is estimated in the districts of Madurai and the Nilgiris and an increase in the district of Malabar. There is no change in the area estimated for South Kanara district. The yield per acre is expected to be normal in the districts of Malabar, South Kanara and the Nilgiris and below normal in Madurai district. On this basis the total yield is estimated at 5,430 tons of dry ginger Compared with the estimated yield of 5,310 tons of dry ginger for the corresponding period of last year it shows an increase of 2·3 per cent. Compared with the average yield of 4,680 tons of dry ginger for the previous five years ending with 1954–55, the present estimate reveals an increase of 16·0 per cent. The wholesale price of dry ginger per standard maund of 82 – 2/7 lb. or 3,200 tolas at important market centres on 6–1–1956, was Rs. 76–6–0 for Charnad variety Rs. 73–7–0 for ordinary variety at Kozhikode and Rs. 180–0–0 at Mangalore. Compared with the prices for the corresponding period of the last year (i. e. 8–1–1955) these prices show a decrease of 3·7 per cent for charnad variety, 3·8 per cent for ordinary variety at Kozhikode and an increase of 104·3 per cent at Mangalore.

Figures of area and yield by districts are furnished in the statment appended.

Cotton Raw, in the Madras Presidency: The receipts of loose cotton at presses and spinning mils in the Madras Presidency from 1st September 1955 to 13–1–1956 amounted to 61956 bales of 392-lb. The receipts from 1st February 1954 to 14–1–55 of the previous year were 149439 bales. 197578 bales mainly oi pressed cotton were received at spinning mils and 724 bales were exported by sea while 5662 bales were imported by sea mainly from Karachi and Bombay.

The Madras Agricultural Students' Union.

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