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Announcement

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THE RAMASASTRULU MUNAGALA PRIZE, 1957

1. The prize will be awarded during the College Day and Conference in 1957.

2. The prize will be in the form of a medal and will be awarded to the member of the Union who submits the best account of research or enquiry, carried out by him on any agricultural subject.

3. The subject matter shall not exceed in length twelve foolscap pages, typewritten on one side.

4. Intending competitors should notify to the Secretary of the Madras Agricultural Students' Union with a covering letter giving the full name and address of the competitor. The author's name should not be shown on the paper, but should be entered as a *nom-de-plume*.

5. Four typewritten copies of the paper should be sent.

6. The name of the successful competitor will be announced and the prize awarded at the time of the College Day and Conference.

7. Paper or papers accepted will become the property of the Union, and the Union reserves to itself the right to publish all or any of the papers.

8. All references in the papers to published books, reports or papers by other workers must be acknowledged.

9. The last date for receipt of papers is 1st July 1957.

K. S. Shetty,
Secretary.

JUBILEE SHIELD FOR CHEMISTRY

The Golden Jubilee rolling shield of the Chemistry Section to be awarded during the College Day and Conference to the best scientific workers in the field of Agricultural Chemistry.

Rules and conditions for the award:

(1) The shield will be awarded to the best scientific worker in the field of Agricultural Chemistry. All Scientific workers and Research students of the chemistry section at the Agricultural College and Research Institute, Coimbatore as well as in the Department of Agriculture, Madras State will be eligible for the award.

(2) The shield is a rolling one and will be awarded at the time of the Annual College Day and Conference of the Agricultural College and Research Institute every year.

(3) A committee to adjudge the best worker for the award shall comprise.

(1) The Principal (Chairman — Ex-Officio)

(2) The Government Agricultural Chemist (Ex-Officio)

(3) A senior officer of the Research Council elected by Research Council).

(4) The award will be made to the worker adjudged as the best on the basis of the reports or papers containing either (i) an account of original research in which the author's share is the maximum or (ii) a critical discussion or analysis of any subject related to agricultural chemistry, throwing new light on or adding new knowledge to the subject.

(5) A certificate will also be awarded to the winner of the rolling shield.

(6) The shield shall be returned to the Government Agricultural Chemist after the award for keeping in safe custody.

(7) The award will not be made more than once to the same person.

(8) The power to modify the rules to suit any situation that may arise at any time rests with the Government.

Papers and reports etc. for the award are invited on or before the 15th of July 1957 by the undersigned.

A. Mariakulandai,
Government Agricultural Chemist.

Lawley Road P. O.

The Madras Agricultural Students' Union.

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Editorial

Educational facilities in the fields of Agricultural and Veterinary sciences are expanding rapidly. With the increase in the number of colleges and larger enrolments, there is an ever-growing need for good teachers and good teaching, to maintain and wherever possible, to improve the standards of instruction imparted; for, on the results of good teaching and the resulting technical personnel depend the sucess of our present and future Five Year Plans. The evolution of suitable techniques to improve teaching methods along with suitable teaching aids has become urgent and the 'Seminar on Teaching Methods' organised by the Indian Council of Agricultural Research and held at Trivandrum this month has come none too soon.

The Seminar, the first of its kind in India to lay plans for overall teaching improvement, appreciated the significance and importance of the problem and made valuable recommendations to promote teaching efficiency. The fact that the recommendations emerged out of free discussions by over sixty mature and experienced members of the teaching profession, advised by fourteen distinguished educationists of the American Technical Co-operation Mission, adds prestige to these recommendations.

The recommendations which dwelt on teaching methods, teaching aids, the value of field studies and tours, student-teacher relationships and teacher evaluation, highlighted the fact that 'teaching' is not a stagnant and static field but is a dynamic technique which could be improved on for more and more effectiveness and better results. The purpose of good teaching is to stimulate a spirit of inquiry in the mind

of students and to improve their creative abilities so as to enable them to think and act for themselves. A good teacher can do much to enthuse his student and therein lay the success of good teaching. Along this line, Prof. Kumar, the Chairman of the Seminar said 'Let us teach students and not subject matter'.

Though this approach may sound revolutionary to many who 'tutor' students through memorisation and other similar preparation methods to get through the examination, it is time that the professional institutions realise the importance of good teaching, for, the student is taught not only to get through an examination, but taught to run a profession all his life where he has to put into daily practice not only what he has learnt from his teachers, but has to face new and tough problems every day and solve them as they come. The responsibility on the teachers in professional institutions is therefore, all the more great and it is only timely and proper that the teachers of the Agricultural and Veterinary professions took the lead at Trivandrum to focus attention on some of these aspects.

The Soils of Madras
Part-II — The Black Soils of Madras

by

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Introduction : In the preceding Section (Part-I) the distribution of the different soils in the districts and taluks of the districts was given. The soils were shown as belonging to four categories namely the black, red, alluvial and arenaceous soils. Nothing was said about the nature of each category. In the present and subsequent papers it is proposed to deal with each category in respect of mechanical and chemical composition and Physic-chemical properties.

Although revenue authorities have divided the soils of the State into the categories given above it would be more correct to classify them into (a) black (b) red (c) laterite (d) mixed (e) alluvial (f) saline and alkaline and (g) forest and organic soils according to their nature and properties. In these classes there are various types and the properties of the important types are discussed under each class.

The geological formations of Madras State : The oldest and the most extensive geological formations in Madras State are granites and gneisses of the Archean Period. These can be broadly subdivided into (a) the younger granites and granatoid gneisses and (b) the older gneisses. The granites and gneisses which cover the major portion of the State vary very much in mineralogical and chemical composition. The felspars present in them may be potash felspars, lime or sodalime felspars. The other minerals found in the rocks are quartz, muscovite, biotite, hornblende, augite and others. Accessory minerals found in these rocks vary very much and garnet, apatite, corundum etc. are sometimes met with. Acidic rocks generally give rise to red and sandy soils while basic rocks rich in soda-lime felspars are mainly responsible for the development of black soils.

The other rock formations of any importance in the State are the charnokites which contain hypersthene or enstatite. These occur in Nilgiris and in parts of Salem and Coimbatore districts. Khondolites occur in Northern Circars and along the east coast. Rocks of the Gondawana system are found in parts of the State from Madras to Tanjore. The main rocks of the system are grits,

sandstones, shales and limestones. Loose textured sandstones and pebbles known as Cuddalore formations or Cuddalore sandstones are found in parts of South Arcot and Tanjore districts. Laterite formations derived from various kinds of rocks occur in the West Coast and on the hills and in parts of the East Coast.

Rock formations which can grouped under granites and gneisses give rise to both black and red soils. The rocks responsible for the two soils, however, differ in their chemical composition as can be seen from the following table.

Chemical Analysis of typical rocks giving rise to Black and Red Soils in Madras State:

Heads of analysis	Rocks giving black soil		Rocks giving red soils		
	Trap rock	Hornblende Schist	Red granite	White granite	Mica granite
1. Moisture %	..	2·88	0·33	0·48	..
2. Loss on ignition %	0·07	0·14	..	..	..
3. Silica (SiO_2) %	52·69	50·48	71·37	73·36	72·15
4. Iron Oxide (Fe_2O_3) %	8·05	9·60	3·49	1·92	3·60
5. Alumina (Al_2O_3) %	23·04	20·13	14·54	14·12	14·31
6. Sesquioxides % (R_2O_3)	31·09	29·73	18·03	16·04	17·91
7. Lime (CaO) %	9·43	10·98	1·54	1·40	1·65
8. Magnesia (MgO) %	5·21	4·21	0·42	0·52	0·54
9. Potash (K_2O) %	1·08	0·14	3·83	4·34	4·41
10. Soda (Na_2O) %	2·74	2·23	3·54	3·60	4·21
11. *Silica* Sesquioxide ratio (Molecular)	3·17	3·26	7·24	8·36	7·72

From the above table it is seen that there is a considerable difference in the chemical composition of the rocks giving rise to black and red soils. Black soils originate from basic rocks containing 45–55% of silica while acidic rocks with over 65% of silica are mainly responsible for red soils. The trap and hornblende schist are richer in sesquioxides, lime and magnesia and poorer in Potash than the granites which form red soils. There is a considerable variation in the molecular silica/sesquioxide ratio of the two types. The felspars exist in the trap rock and the hornblende schists mainly as lime and soda–lime felspars while in the three granite types listed above they are present chiefly as alkali felspars (sodium and potassium felspars). It is believed that the nature of the felspars determines the type of soil which is obtained from the rock.

The Black Soil: The total area of black soil in Madras is about 67 lakhs of acres. It is found in all the districts of the State except in Nilgiris, Malabar and South Kanara. The non-occurrence of the of the black soil in these districts is due to the heavy rainfall received there. The black soil area is the greatest in the districts of Ramanathapuram and South Arcot where it forms 61% and 45% respectively of the total cultivable area. The black soil is generally formed under semi-arid conditions with an annual precipitation of 20–40 inches.

The depth of the soil varies considerably. Some are 4 to 5 feet in depth while others are 8 to 15 feet deep. In some places the top soil is black in colour while the lower depths may be grey, light yellow or light brown. The black soil cracks deeply in summer with the result that there is a common saying that the soil ploughs itself. The belief among the ryots is that the wider the cracks the more fertile is the soil. The cracks are some times so deep that it is dangerous for cattle to walk in the field. The power to develop cracks in summer generally possessed by black soils is due to two causes. First of all, the soils vary from clays to heavy clays (containing 30 – 50% and more of clay). Secondly the black soil clay belongs mainly to the montmorillonite group which possesses high expansion on the absorption of water and considerable shrinkage when it becomes dry. The soil has a high molecular silica/sesquioxide ratio of 2·7 to 3·5. Its base exchange capacity is high (30 to 70 milliequivalent per 100 gms. of soil) but varies considerably from tract to tract. There is a distinct correlation between the clay content of the soil and its cation exchange capacity, 1% of clay generally accounting for about one milliequivalent of base. The soil has a high lime status and 70 – 80% of the cations in the exchange complex consists of calcium. Free calcium carbonate is generally present in the soil in the form of Kankar and in some profiles the lower depth below 4 feet consist mainly of this constituent with small infiltration of the soil. The black soil may be divided into two classes according as it contains gypsum or not. Where gypsum occurs it is generally found below the third foot and it is always associated with a high concentration of soluble salts particularly sodium and magnesium sulphates. The black soil is generally fertile containing fair amounts of available phosphoric acid and adequate amounts of Potassium and lime. It is deficient in nitrogen. The limiting factor for its cultivation is insufficiency of water.

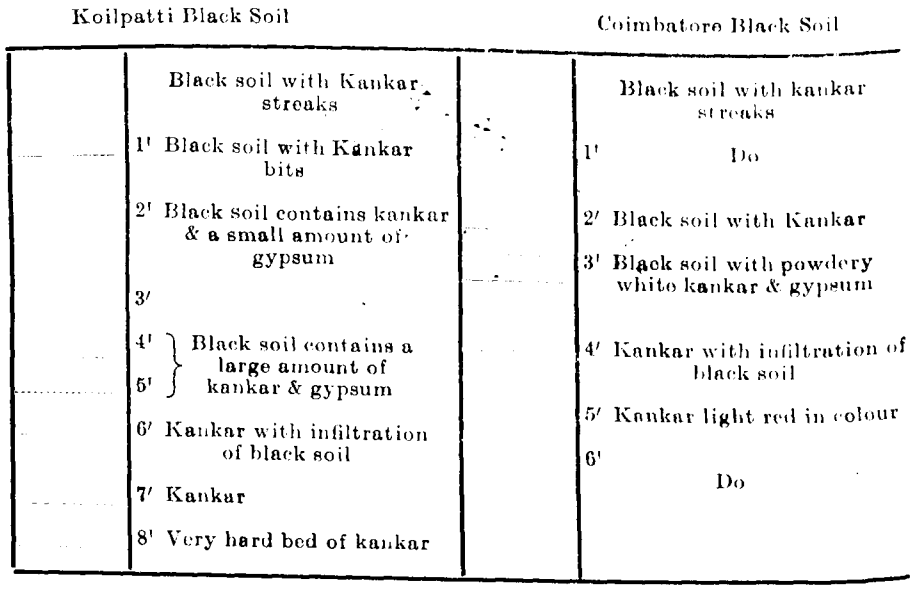
The black soils of Madras are derived from many geological formations such as granites, gneisses, schistose gneisses, chlorite, hornblende schists, traps and Dharwar formations, cretaceous lime stones of Trichinopoly and shales etc.

Colour of Black Soils: There has been much speculation about the colour of the black soil and various theories have been advanced to account for it. Some of these are: (1) the colour is due to the presence of large amounts of organic matter in the soil; (2) a black mineral containing titaniferous iron ore present in the coarse fractions is responsible for the colour; (3) complex humus compounds give the colour to the soil. All these hypotheses have been found to be incorrect or inadequate. The organic matter and humus content are less than 1% and titaniferous minerals, even if present, are not sufficient to give the black colour to the soil. C. Raghavendrachar (2) working at Coimbatore (unpublished records) has given a satisfactory explanation to account for the colour of the soil. He attributes the colour to a very thin coating of a small amount of black calcium humate on the colloidal complex of the soil just as ferric oxides give red and yellow colour to soils. The calcium humate is formed particularly on the surface soil from the decomposition of the organic matter of plant residues in the presence of abundance of lime. In support of this, it has been shown that many of the black soils are black only at the top (where calcium humate forms) and are light grey or dirty white below the surface even when the chemical composition is the same throughout the Profile. So, it is clear that the natural colour of the clay complex is light grey or dirty white and that the calcium humate which is formed on the surface is responsible for the black colour of the soil. A very small quantity of the substance is sufficient for giving the colour as it is present as a thin coating on the colloidal complex. This black coating of calcium humate is resistant to the action of hydrogen peroxide and so the colour of the black soil is not destroyed by boiling with hydrogen peroxide. However, when the combination between calcium and the humic material is broken up by treatment with dilute hydrocholoric acid (N/5) and the soil is then boiled with hydrogen peroxide the black colour disappears and the clay complex assumes its natural light grey or dirty white colour. It is therefore the peculiar combination of humic material with calcium and the coating of the resultant product that is responsible for the colour of the black soil. There is as much (or even more) iron in the black soil as in the red; but in the former it exists mainly as combined iron in the divalent condition as against at least a part as free ferric oxides in the red soil.

Occurrence of Black and Red Soils side by side in Madras State: In many localities in Madras State the black and red soils are found to occur side by side. Many Indian Scientists (4, 5) believe that the two soils have originated from the same kind of rock and the red soils are found at higher elevations and the black soils at lower levels. They also consider that the red soil washed down into the lower topography may change into black soil. Extensive field observations have, however, shown that the black soil does not always occupy a lower topography as compared with the adjacent red soil although in many places it does so. It cannot also be conceived how the red soil with low silica-sesquioxide ratio, base exchange capacity and entirely different mineralogical pattern can change into the black soil. Field observations and laboratory data indicate that both the types of soils are formed from rocks of different mineralogical and chemical composition although the rocks may be classified under the same group such as granites and gneisses. It is possible that different portions of the same rock formation (such as granites and gneisses) give rise to the two types of soil on weathering. Basic rocks rich in soda lime felspar give rise to black soil while granites and gneisses with a preponderance of alkali felspars form the red soil. The occurrence in many places, of the black soil at a lower topography than the red soil may be explained as being due to the greater mobility of montmorillonite clay. The particles of montmorillonite clay are very much smaller than the Kaolinitic clay of red soils. So when black and red soils are formed in a place the black soil clay has a greater tendency to wash down and accumulate in regions of lower topography leaving behind the larger particles of red soil clay.

Properties of the Black Soil: The black soils found in the various districts of the State are not identical. They vary in mechanical composition, base exchange properties and other characteristics. In texture they vary from clays (30% to 50% of clay) to heavy clay (over 50% of clay). For practical purposes the black soils of Madras State may be divided into two main types: (1) the heavier black soil exemplified by the Koilpatti black soil and (2) the lighter type found in Coimbatore. Intermediate between these are several other types differing in mechanical composition and other properties.

Profile Study: The profile characteristics of the two types are indicated diagramatically as below:



In both the profiles the first and second foot of soil are black in colour with Kankar streaks. In the lower depth Kankar is found in abundance. Below 4 feet considerable amounts of Kankar are found with small infiltrations of the soil. At greater depth especially in the Koilpatti area there is very little of soil and the material is mainly Kankar. Gypsum with associated salts is found in the profiles from $2\frac{1}{2}$ to 5 feet.

Mechanical Composition: The mechanical composition of the soil and sub-soil as determined by the International method are tabulated below:

Mechanical Composition:

Koilpatti type.				*Coimbatore type.*	
%	0–1'	1–2'	2–3½'	0–1'	1–2'
Clay	53·2	58·1	72·8	34·2	65·0
Silt	15·6	16·0		11·4	
Fine sand	14·0	12·5	11·2	17·7	39·0
Coarse sand	11·5	8·5	4·6	30·1	
Matter soluble in N/5 HCl (By diff.)	5·7	4·9	10·7	7·5	6·0
Total	100·0	100·0	100·0	100·0	100·0

The Koilpatti soil is a heavy clay with over 50% of particles of 0·002 mm and less (clay). The finer fractions (clay + silt) make up about three fourth of the soil. The matter soluble in dilute hydrochloric acid (mainly calcium carbonate) increases with depth. The Coimbatore type of black soil is a clay soil containing about equal amounts of the finer and coarser fractions. The clay content of the soils is near about 30% and so it should be classified as a *clay soil.* The admixture of about equal proportions of the finer and coarse fractions make the Coimbatore black soil more suitable for crop production than the heavier Koilpatti type.

Water Soluble Salts: The soluble salts present in 1:5 water extract of the soils and sub-soils are presented below.

	Coimbatore type.			Koilpatti type.			
	0–1'	1–2'	2–3'	0–1'	1–2'	2–3½'	3½–4½'
Total soluble salts %	0·090	0·14	1·83	0·069	0 095	1·42	1·92
Calculated Salts:							
Calcium bicarbonate % $Ca(HCO_3)_2$	..	0·043	0·031	Soluble salts not calculated when the total salts are less than 0·1%		0·025	0·038
Calcium sulphate % ($Ca SO_4$)	..	..	0·88			0·79	0·81
Magnesium sulphate % ($Mg SO_4$)	..	..	0·10			0·18	0·26
Sodium bicarbonate % ($NaHCO_3$)	0·067	0·0094	..	..	..	..	..
Sodium carbonate % (Na_2CO_3)	0·0085	0·0085	..	..	..	..	..
Sodium sulphate % (Na_2SO_4)	0·0050	0·0022	0·33	..	...	0·32	0 69
Sodium chloride (NaCl)	0·0058	0·041	0·12	..	..	0·0099	0·012
pH	8·78	8·75	8·32	8·76	8·74	8·65	8·51

In both types the top soil and the sub-soil contain less than 0·1% of soluble salts. But lower down the salt concentration increases to 1% and more. This is the gypsum layer and the salts consist of calcium, magnesium and sodium sulphates. The layer extends from $2\frac{1}{2}$–3 feet to 5–6 feet. It is noted that at the top of the gypseous layer sodium sulphate is much less in quantity than calcium sulphate while in the middle the two salts are present in nearly equal amounts and still lower down sodium sulphate exceeds calcium sulphate. For details of the salt distribution in the whole of the gypseous layer of the Koilpatti soil (8) may be referred to.

As the black soil contains considerable amounts of sodium salts its irrigation should be undertaken with caution. In certain parts of the country as in Nira valley in Bombay and the Irwin Canal area in Mysore indiscriminate irrigation of the soil with salt accumulation in the lower depth has lead to its alkalinisation and impoverishment. To prevent such damage irrigation water must be used judiciously, the water table should not be allowed to rise and the drainage must be kept efficient. Experiments carried out at Siruguppa in Bellary district have indicated that with or without crop the black soil can be given light, medium or heavy irrigation without any danger of the rise of salt from the lower depths. Irrigation only washes down the soluble salts and the danger of alkalinisation is remote. However it should not be forgotton that the area where the experiments are now conducted is situated in a land mass of dry soil, that the drainage is excellant and that the water table has not risen. What the position will be when the whole area becomes irrigated and the water table rises should be studied carefully. Irrigation of the black soil should therefore be undertaken with precautions.

Base Exchange properties of black Soils: The study of the base exchange properties of black soils presented considerable difficulties on account of the presence in them of free calcium carbonate and soluble salts including gypsum. One of the authors has worked out a suitable method for such soils (6). The results of the base exchange studies and the silica sesquioxide ratio of the soils are tabulated below.

Base exchange properties of Black soils.

	Coimbatore type			Koilpatti type			
	0—1′	1—2′	2—3″	0—6″	6—12″	1—2′	2—3′
Cation exchange capacity (Milliequivalents ..	32·3	34·4	27·4	61·38	65·85	67·22	65·85
Exchangeable							
Calcium (me) ..	23·46	21·4	19·6	49·54	53·16	52·97	50·46
,, magnesium (me) ..	6·9	7·6	6·8	9·93	11·11	12·73	13·62
,, Potassium (me) ..	0·61	0·57	0·42	1·29	0·76	0·81	0·89
,, Sodium (me) ..	0·65	0·43	0·41	0·62	0·62	0·71	0·88
Molecular silica/sesquioxide ratio of composite soil ..	—	2·7	—	—	3·5	3·7	—

The base exchange properties indicate that the two types differ considerably in their cation exchange capacity, the Coimbatore soil showing only half the value for the Koilpatti soil. However

in both types calcium forms more than 70—80% of the exchange capacity and the next important cation is magnesium. The monovalent cations, sodium and potassium are present only in small amounts and the degree of alkalinisation of the soil and sub-soil are low. Sodium was estimated directly by a modification of Kahane's (10) method standardized by one of the authors (7).

It is also noted that in both the soil types 1% of clay (0·002 mm and less) contributes to about 1 milliequivalent of cation exchange capacity to the soil. Facilities do not exist at Coimbatore for the identification of the clay minerals. But from the base exchange properties of the soil, the silica-sesquioxide ratio and the dehydration studies of the clay it has been deduced that the black soil contains montmorillonite clay with some admixed Kaolinite.

The fertility status of the black soils: The results of the chemical analysis of the black soil with the range of the nutrients from a number of estimations is tabulated below. The methods employed for the estimations are those usually adopted in the laboratories of the Government Agricultural Chemist, Coimbatore. Nitrogen was estimated by the reduced iron method using 1:1 sulphuric acid. Total phosphoric acid and potash calcium and magnesium were estimated in the hydrochloric acid extract and the available constituents by Dyer's 1% citric acid method.

	Coimbatore type	Koilpatti type
Nitrogen (N) % ..	0·02 — 0·05	0·30 — 0·50
Total phosphoric acid % (P_2O_5) ..	0·033 — 0·065	0·065 — 0·095
Total Potash % (K_2O) ..	0·17 — 0·45	0·20 — 0·35
Total Calcium % (CaO) ..	1·07 — 2·40	3·08 — 4·85
Total Magnesium % (MgO) ..	0·64 — 1·61	0·60 — 1·35
Available phosphoric acid (P_2O_5) ..	0·005 — 0·017	0 0060 — 0·025

Both the soil types are deficient in nitrogen, organic matter and available phosphoric acid. Total phosphoric acid and total and available Potash are, however, present in adequate amounts. There is abundance of lime in the soil especially in the lower depths. Low organic matter content is a common feature of tropical cultivated soils. During the major part of the year the temperature and the moisture content of the soil are conducive to vigorous microbial activity and the added organic matter undergoes active

decomposition. In summer when the moisture in the surface soil is too low for microorganic activity oxidative decomposition is vigorous. Both these causes operate to make the organic matter in the soil low.

Summary of the properties of Madras black soils: The black soils of Madras are derived from granites and gneisses containing soda lime felspar and generally range from clays to heavy clays the finer fractions (clay + silt) accounting for 40 — 70%. The clay minerals of the soil belong to the montmorillonite group. The soil has a high silica — sesquioxide ratio of 2·7 to 3·5 and a high cation exchange capacity of 30 — 70 milliequivalents per 100 gms. of the dry soil. Each gram of clay generally contributes to about 1 milliequivalent to base exchange capacity. Calcium forms 70 to 80% of the exchangeable cations and there is abundance of free calcium carbonate in the soil. Some of the black soils contain gypsum. The gypsum is generally associated with considerable quantities of sodium sulphate and magnesium sulphate. So the irrigation of the soil must be taken up with caution. The black soils are comparatively fertile. They are poor in nitrogen, organic matter and available phosphoric acid but contain adequate amounts of Potash and lime. Bumper crops can be raised on the soil with proper manuring.

REFERENCE

1. Annual Reports of the Government Agricultural Chemist, Coimbatore, 1940-52.
2. Unpublished records of C. Raghavendrachar, Asst. Agricultural Chemist, Coimbatore, 1935—40.
3. Bal, D. V. (1935) Trans. Third Internat, Cong. soil Sci. 3, 155.
4. Viswanath, B,, (1939) Ind. Soc. Soil. Sci. Bull 2, 4-7.
5. Raychaudri, S. P. (1941) Ind. J. Agri. Sci. 100-109.
6. Menon, P. K. R. and Sankaranarayanan, M. P. (1953) Mad. Agri. J. Vol. II.
7. Menon, P. K. R. (1951) Report of the First Sci. Off. Conference Department of Agriculture, Madras.
8. Menon, P. K. R. and Sankaranarayanan, M. P. Studies on the General Characteristics of Indian Black Soils — Black soils of the Tinnies Tract (Koilpatti) Part I - unpublished - Sent to Ind. J. Agri. Sci.
9. Robinson, G. W. Soils, their constitution, classification and properties.
10. Kahane, (1931) Bull. Soc. chem 47, 382-401.

Millets in Ramanathapuram and Tirunelveli Districts with Special Reference to Spread of Strains

by

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Introduction: The term "Millets" is a collective name for eight different cereals grown mostly under rainfed conditions. The more important among them — *Cholam*, *Cumbu* and *Ragi* form the major millets and *Samai*, *Varagu*, *Kudiraivali*, *Tenai* and *Panivaragu* which are of lesser importance are called minor millets. The above mentioned cereals thrive in areas of low fertility and rainfall and form the staple food of the population in areas where they are extensively cultivated. Millets are also very important fodder crops and are grown practically in all the districts of the State, except in the heavy rainfall districts.

In the districts of Ramanathapuram and Tirunelveli millets are cultivated extensively under rainfed conditions while a small area is raised under irrigated conditions. The area under millets (rainfed and irrigated) is furnished below:

Millets Area in Ramanathapuram and Tirunelveli Districts.
(in acres)

Crops	Rainfed			Irrigated		
	Ramanathapuram	Tirunelveli	Total	Ramanathapuram	Tirunelveli	Total
Cholam	15,136	23,334	39,170	30,864	56,640	87,504
Cumbu	110,587	158,331	268,911	12,103	3,759	16,562
Ragi	12,757	19	12,776	63,813	24,801	88,684
Tenai	7,128	133	7,261	122	77	199
Varagu	9,905	4,594	14,499	54,405	496	54,405
Samai	29;214	54,405	83,619	146	217	363
Kudiraivali	30,410	43,759	74,179	..	..	..

From the above table, it is observed that *cumbu* is the crop extensively cultivated under rainfed conditions, i. e., over 2·5 lakhs of acres followed by *Cholam*, *Ragi*, *Samai*, *Varagu* and *Kudiraivali*. The important crops raised under irrigation are *Ragi*, *Cholam* and *Varagu*.

In four taluks in Ramanathapuram District, i. e., Sattur, Srivilliputhur, Aruppukottai and Mudukulathur and four taluks, i. e., Koilpatti, Srivaikuntam, Nanguneri and Tenkasi in Tirunelveli district, millets occupy a very large area. In the other nine taluks, millets are not grown on an extensive scale.

Local Agricultural Practices: The two districts of Ramanathapuram and Tirunelveli are contiguous and form the southern end of the State. The climate, rainfall (28″ per year) and agricultural practices are almost similar in the two districts, except for very minor variations. Rainfed crops are raised in the black soil areas immediately after the receipt of the north east monsoon rains. It is to be noted that rains are received slightly earlier in the Ramanathapuram district than in the Tirunelveli district, consequently, the area under *Varagu* and *Samai* is more in Ramanathapuram district.

The cultivation regimen of millets is the same as in other districts, except for certain practices which are peculiar to the tract and they are detailed below:

Cumbu: *Cumbu* is grown in the same field, year after year, without rotation and without any consequent reduction in yield. This practice is known as *Cumbu-adi-Cumbu*, and is peculiar to the tract. These fields are heavily manured — sheep penning at 1,000 per acre and 4–5 tons of farm yard manure, since *Cumbu* — a short duration crop of 90–95 days only — is grown year after year, there is not much drain on the manure. Every rich cultivator relegates one fourth of his area to *Cumbu-adi-Cumbu* and gets a return of 1,200 lb. to 1,500 lb. grain per acre.

Cholam: A peculiar variety of *Cholam*, known locally as "Irungu" *cholam* (Sorghum dochna) is grown exclusively for fodder purposes. The grain is dark brown in colour and is enclosed completely by the glumes. The grain does not thresh out easily and has a slightly bitter taste, hence this variety is not popular for grain purposes. For fodder, a very heavy seed rate of 80–100 lbs., per acre is adopted, and since no thinning is done, the stalks remain thin. The grain yield from such a crop is naturally poor. The dry straw yield is about 2500 – 3000 lb. per acre.

Attempts were made in the early years of the opening of the Agricultural Research Station, Koilpatti, to introduce other varieties of *Cholam* suitable for both grain and fodder purposes. A number of varieties, i. e., *Periamanjal Cholam* of Coimbatore, *Pacha jonna* of Guntur and Nandyal, *Tella jonna* of Bellary and sorghums from Bombay province and U. S. A. were tried, but it was found that none of them suit the conditions prevailing in the tract. Though the vegetative growth is satisfactory, they do not set seed due to want

of sufficient moisture in the soil, at the flowering time. The cultivation of *Cholam* for grain purposes in red soil areas under rainfed conditions, is a peculiar feature in the Tenkasi Taluk of Tirunelveli district. A large patch of red loamy soil of nearly 50,000 acres i. e., a semi circle with Courtallam as the centre, gets the benefit of both the south west and north east monsoons. In this area, with the receipt of stray showers during the months of January, February and March, lands are ploughed, manured, covered and kept ready for the receipt of summer showers during the month of April. As soon as rains are received in April, *Cholam* is sown broadcast at the rate of 20 lb. to the acre and covered with country plough. When the seedlings are about six inches in height, a thinning, weeding and hoeing is given. Till about the beginning of the first week in June, no rains are received. Thus from the date of sowing in the month of April to the first week of June, the crop passes through a critical period. The seedlings shrivel up and look parched due to drought and with the advent of the south west monsoon rains, the crop recovers and the growth during June–July is remarkable. If, instead of *Cholam*, any other crop is sown, it is almost sure that it would dry up. The *Cholam* crop comes to maturity in September. An acre yield of about 1,500 lb. is not unusual. The *Cholam* stalks are not cut as is usual in the other tracts, but the plants are pulled out so that the land can be easily got ready for the black gram crop to be sown in the north east monsoon season, i. e., in October. The blackgram crop is not manured and no preparatory cultivation like ploughing is given. The seeds of blackgram are sown and covered with the country plough. Ploughing and manuring, it is believed, result in the blackgram crop, growing bushy, without producing pods.

Ragi: Ragi is cultivated on an intensive scale, mostly under irrigation. Two crops — one during January–April and the other during March–June — are raised and both go by the name of "COEAI KEPPAI" or summer *ragi*. The crop grown during September–December goes by the name of "KALA KEPPAI" or main ragi. The area under summer *Ragi* is limited and usually short duration varieties with 90–110 days are preferred for this season. For the main season, longer duration varieties with a duration of 120–140 days are planted, since well irrigation is supplemented by the north east monsoon rains.

Varugu: This crop is raised on an extensive scale in Ramanathapuram district since the receipt of north east monsoon rain is slightly earlier than in Tirunelveli district. A peculiarity in the

Ramanathapuram district is that *Varagu* is grown regularly as an irrigated crop by transplanting seedlings in summer. Even rich cultivators prefer to have a course of *Varagu* rice.

Tenai: The area under this crop is very limited. It is grown as a mixture with cotton under rainfed conditions. When it is grown as a pure crop under irrigation from February–April, nurseries are raised and seedlings transplanted.

Spread of Improved Strains released from the Station: The strains of millets released at Coimbatore were tested at this station and out of the several selections and strains tried, only a very few suited the tract. Hence selection work on the important millets, i. e., (1) *Cumbu* (rainfed), (2) *Irungu* fodder (rainfed), (3) *Vellai Cholam* (irrigated), and (4) *Ragi* (irrigated) were taken up from the year 1930.

1. Cumbu: (rainfed) By selection work, an improved strain of Cumbu K1, giving 10% more than local, was released during the year 1934. This strain is very popular in all the Cumbu growing taluks and an area of 1,05,000 acres is estimated to be under this strain; the percentage of spread in Tirunelveli and Ramanathapuram being 41 and 36 percent respectively.

Breeding work on Maize in U. S. A. has resulted in a number of hybrid strains (giving more yield than either parents) being released for distribution. In a similar way, breeding work to produce hybrid Cumbu is in progress and results so far achieved are encouraging.

2. Irungu Cholam: Breeding work to improve the straw yield of *Iruugu cholam* resulted in the release of *Irungu* K1, giving 14% more than local in the year 1934. Due to paucity of seed production, the area under spread is limited and is estimated to be 3,000 acres.

An extracted selection of *Cholam* from a cross between "Periamanjal" of Coimbatore and "Irungu" of Tirunelveli was received from the Millets and Pulses Specialist, Coimbatore and tried at the Agricultural Research Station, Koilpatti. This selection gave better yields of both grain and straw over "*Irungu* K1" and local *Irungu*. This selection has been renumbered after extensive trials as *Cholam* K3, and is under distribution, but the area under spread is limited due to want of sufficient seed, and is estimated at 400 acres. Special efforts are being made to increase the seed production

and bring more area under its cultivation. This strain has the grain qualities of *Periamanjal cholam* and the fodder qualities of *Irungu Cholam.*

3. Ragi: By selection, two strains K1 and K2, giving 14% more yield than local *Ragi*, have been released for distribution. *Ragi* K1 is green pigmented, while *Ragi* K2 is purple pigmented. *Ragi* K1 has a tendency to lodge at the time of harvest, while *Ragi* K2 does not lodge. Gradually, *Ragi* K1 is being replaced by *Ragi* K2. Attempts to get non-lodging green pigmented extracted types are being made by crossing *Ragi* K1 and K2. The area under spread of these two strains is estimated to be 47,000 acres, the percentage of spread in the Tirunelveli and Ramanathapuram districts being 60 and 50 percent respectively.

4. Vellai Cholam: By selection, a strain *Cholam* K2 has been released for distribution. This strain is shorter in duration than local *Cholam* by a week to ten days and gives an extra yield of 15% over local. The grain is pearly white in colour. This strain is very popular and the area under spread is estimated to be 60,000 acres, the percentage of spread in Tirunelveli and Ramanathapuram being 74 and 58 percent respectively.

NOTE: The area under improved strains, the area cultivated under each crop and the percentage of the area under improved strains to the total area are furnished in Appendix I.

Details regarding the strains of millets released from the Agricultural Research Station, Koilpatti are furnished in Appendix II.

Acknowledgements: Thanks are due to the Millets and Pulses Specialist, Coimbatore, for kindly suggesting the subject and giving necessary assistance in the presentation of the paper.

APPENDIX I.

Spread of Millet Strains in the tract.

Strains	Tirunelveli			Ramanathapuram		
	Total area	Covered by improved strains	Percentage of spread	Total area	Covered by improved strains	Percentage of spread
Cholam K2 Irrigated	56,640	42,000	74 %	30,864	18,000	58 %
Cumbu K1 Rainfed	158,331	65,000	41 %	110,587	40,000	36 %
Ragi K1 and K2 Irrigated	24,891	15,000	60 %	63,883	32,000	50 %

APPENDIX II.

Improved Strains evolved at the Agricultural Research Station, Koilpatti.

Strain No.	Local variety from which selected	Duration	Irrigated or Dry.	Yield per ac. in lbs.	Remarks
K1 Cholam	Irungu Cholam	120 days	Dry	6,000 lb. (of straw)	Purely fodder type
K2 Cholam	Vellai Cholam	90 days	Irrigated	2,600 lb. (grain)	Grain type.
K3 Cholam (Periakanjal Irungu)	Extracted type from cross between Periamanjal and Irungu Cholam	120 days	Irrigated and Dry	600 lb. (grain) 7,000 lb. (fodder)	A grain cum fodder type under irrigation gives 3,000 lb. grain and 18,000 lb. fodder.
K1 Cumbu	Kattu Cumbu	95 days	Dry	800 lb. (grain)	..
K1 Ragi	Kala Keppai	130 days	Irrigated (grain)	2,600 lb.	..
K2 Ragi	Karunganni Keppai	130 days	Irrigated	2,600 lb. (grain)	Has stiff straw and is resistant to lodging.

Influence of Fertilizers on the Abundance of Pyrilla, Infesting Sugarcane

by

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Introduction : It is not always true that crops grown in soils with nutrients optimum for vigorous plant growth are able to with stand the attack of insect pests better than the crops grown in deficient soils. Experimental facts are available where certain pests have shown a greater preference for crops having luxurient growth as a result of increased plant nutrients in the soil. Schoene (1941) showed that the injury to apple trees by the mealy bug, *Pseudococcus comstockii* Kuw., was most severe in orchards that had been treated with nitrogenous fertilizers for several years but no damage occurred on unfertilized trees. Gadd (1943) noted increased damage to tea plants by the borer, *Xyleborus fornicatus* Egg., following increased

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amounts of nitrogenous, phosphatic and potassium fertilizers. The results of the field experiments conducted by McGarr (1943) showed that the nitrogenous fertilizers caused a definite increase in the number of aphids, *Aphis gossypii* Glov,, on cotton. Eden (1953) found that the damage of the rice weevil on the maize in the field increased with the addition of nitrogen in the soil. During the past several years it has been observed that pyrilla infestation was severe in sugarcane fields with higher level of manuring. Similar observations have also been made by Mathur and Gupta (1940) and Mathur (1941).

Studies have been initiated in Balrampur Cane Development Council area to find out the effect of three important fertilizers on the abundance of pyrilla *(Pyrilla spp.)* in sugarcane fields. The results of some of these studies are reported in this paper.

Material and Methods : The sugareane variety Co. 453 was grown with different rates of the fertilizers as top dressing after germination and just before the forming of tillers. Each treatment consisted of 6 rows, 30 feet long and 3½ feet wide under the trench system of cultivation. Between the two treatments there was a gap of 5 feet and the treatments were replicated four times in randomised blocks. The treatments were four rates each of the three different fertilizers calculated as the actual plant nutrient in pounds per acre. Sources of the plant nutrients, N, P and K were sulphate of ammonia, super-phosphate and muriate of potash respectively. The experiment was performed in pyrilla years and in the area where serious pyrilla infestation had occurred in the previous year. Moreover, an initial infestation was also made artificially fn April. The leaves bearing egg masses were collected from different fields and sorted to carry equal numbers of eggs as far as possible. In each sugarcane row four leaves bearing such egg masses were introduced by tying them on the different leaves of the four different plants at random. The population counts were made in the next November by counting the egg masses per cane as suggested by Khanna *et al* (1950). The experiment was conducted uuder irrigated conditions and the population assessment was made after the crop had received six irrigations.

Results : Nitrogen - The results of study on the effect of the varying rates of nitrogen on the population of pyrilla is summarised in table 1. In these observations where the rates of N varied from 0 to 120 pounds per acre, the average number of egg masses was 8·09 per cane. The means of the two years varied from 6·00 egg masses per

cane at 0 pound application of nitrogen to 9·85 egg masses per cane at 120 pounds. The difference required for significance was 2·55, hence there were differences between treatments. A significant correlation

TABLE 1

Effect of the varying rates of nitrogenous fertilizer on the population of Pyrilla.

N in pounds per acre	Average number of egg masses per cane		Mean
	1952	1953	
0	7·1	4·9	6·00
40	8·6	5·5	7·05
80	10·1	8·8	9 45
120	9·6	10·1	9·85
L S D 5% level			2·55

between the rates of nitrogen and the population of pyrilla was evident. The number of egg masses per cane increased with the increasing doses of nitrogen. The correlation coeficient (r of Snedecor, 1946) was 0·1206; and at 5 per cent level 0·1187 was required for significance.

Phosphate - the results with the phosphatic fertilizer are represented in table 2. The rate of P_2O_5 varied from 0 to 80 pounds per acre. The average number of egg masses per cane for the different

TABLE 2

Effect of the varying rate of phosphatic fertilizer on the population of Pyrilla.

P_2O_5 in pounds per acre	Average number of egg masses per cane		Mean
	1952	1953	
0	6·4	5·2	5·8
20	4·8	7·4	6·1
40	7·2	4·8	6·0
80	5 8	6·2	6·0

years was 6·05 in 1952 and 5·90 in 1953. The over - all population for both years was 5·975 egg masses per cane. There were no significant differences in the population of pyrilla due to the phosphatic fertilizer in either year.

Potash - Table 3 shows the results with the potassium fertilizer. The rate of K_2O varied from 0 to 100 pounds per acre. The average number of egg masses per cane in these treatments for

TABLE 3

Effect of the varying rates of potassium fertilizer on the popluation of Pyrilla.

K_2O in pounds per acre	Average number of egg masses per cane		Mean
	1952	1953	
0	7·1	5·3	6·2
25	5·3	6·9	6·1
50	6·8	6·2	6·5
100	7·3	4·7	6·0

the different years was 6·625 in 1952 and 5·775 in 1953. The mean population for both years was 6·2 egg masses per cane. There were no indications that the varying rates of potash influenced the pyrilla population as the results were not significant.

Summary: Studies were initiated in 1952 in Balrampur Cane Development Zone to determine the effect of three important plant nutrients, N, P and K to sugarcane on the incidence of pyrilla *(Pyrilla spp.)*. Experiment was performed under irrigated conditions and the variety of sugarcane grown was Co 453. The sources of N, P and K were sulphate of ammonia, superphosphate and muriate of potash respectively. Statistical analyses of the results showed that only nitrogen significantly influenced the incidence of pyrilla. The population of pyrilla increased as the rate of nitrogen was increased, The varying rates of phosphatic and potassium fertilizers had no significant effect on abundance of pyrilla.

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LITERATURE CITED

Eden, W. G. 1953 Effect of fertilizer on rice weevil damage to corn at harvest. Jour. Econ. Ent. 46(3) : 509—10.

Gadd, C. H. 1943 Does manuring reduce the damage caused by the shothole borer? Tea Quart. 16 : 30—39.

Khanna, K. L., *et al* 1950 Estimation of Pyrilla incidence in sugarcane. Proc. Ind. Acad. Sci., 31 : 34—44.

Mathur, R. N. 1941 Certain pysiological considerations in the damage caused to sugarcane by Phyrilla. Proc. 10th Ann. Conv. Sug. Tech. Asso. India, 35—44.

Mathur, R. N. and B. D. Gupta 1940 An analysis of factors underlying the deterioration of sugarcane crop. Proc. 9th Ann. Conv. Sug. Tech. Asso. India, 1—10.

McGarr, R. L. 1943 Relation of fertilizers to the development of cotton aphids. Jour Econ. Ent. 36(4) : 640.

Schoene, W. J. 1941 Plant food and mealy bug injury. Jour. Econ. Ent. 24(2) : 271—74.

Snedecor, G. W. 1946 Statistical Methods. Iowa State College Press. 138—168.

Studies on Drought Resistance in Rice*

by
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Introduction: According to Maximov (1929) "drought resistance means the capacity of plants to endure drought and to recover readily after permanent wilting, with the minimum of damage to the plant itself and to the yield produced." He suggests that the most important step must be to select from plants capable of growing in drier regions, those which can readily endure and do not merely escape or evade severe drought. In his opinion it should be possible, when we have decided which plants are truly drought resistant, to attack with success the problem of determining the peculiarities of organisation that actually confer on plants the faculty of enduring drought.

Drought itself is by no means a simple phenomenon. Categorically it is of two types; soil drought and atmospheric drought, of which the former is often more important than the latter. Hot and dry winds cause atmospheric drought and consequent wilting or desiccation of the plant, though the soil in which it grows might have enough moisture. Soil drought, on the other hand, causes the plant to wilt by not providing it with adequate water or providing it only in insufficient quantities so that the plant is not able to replenish the water lost by transpiration. Soil drought causes a permanent wilting of the plant, whereas wilting due to atmospheric drought is mostly temporary. Both soil and atmospheric drought therefore cause havoc to plant growth and adversely affect crop production in the semi-arid regions of the world.

In Madras State, rice on 75 percent of the area, is raised under wet conditions. The remaining 25 percent of the area is sown with rice varieties which are entirely rainfed. Some of them are dryland types grown under open conditions while some others are treated as wet rice, if conditions are favourable; but all of them have to withstand drought for considerable periods. In marked contrast, the wet rices grown in the majority of the rice growing areas, require a plentiful supply of water. Apart from this, there are about 25 species of *Oryza* known to occur in the wild state, of which *Oryza sativa* forma *spontanea* reckoned as the immediate progenitor of most of the cultivated rices in India, has a close resemblance to cultivated forms in several characteristics, with an affinity for easy crossing with them. It occurs all over India, and differs from the cultivated forms in respect of the ease with which the grains shatter from the panicle, helping in its dispersal. These wet, dry and wild rices greatly vary in their water requirements and consequently resistance to drought. It may therefore be assumed that drought resistance should be a specific character and one which requires very close study.

The present studies are directed towards the characteristics which are associated with drought resistance so that these may enable the breeder to use them in his attempts to evaluate drought resistance in his work of evolution of drought resistant forms. It relates to the study of hybrids between high yielding cultivated low-land rices and drought resistant wild rices and their behaviour towards drought.

Materials and Methods: A collection of 2,300 varieties of rice belonging to the cultivated forms of indigenous and exotic types as well as the wild species of *Oryza* is being maintained at the Paddy Breeding Station, Coimbatore as a live herbarium. The wild varieties chosen for the study belong to the species of *Oryza sativa* forma *spontanea* and are characterised by free awning and severe shedding of grain. These wild rices both exotic and indigenous are not therefore cultivated and they are very poor yielders besides possessing poor quality of grain. Some of them are extracted or synthetic types obtained from pure breeding hybrid materials studied. The wild rices are maintained in pure condition for their genetic characters as valuable material for study and use as parents in hybridization to combine their desirable qualities such as disease resistance, drought resistance, etc., with the cultivated types.

Among the wet varieties chosen for the study, GEB. 24 is an improved strain very popular throughout the State for its good quality as table rice, comparatively high proportion of rice to paddy by weight and its capacity for high yield under early planted conditions. The other strains evolved from the Paddy Breeding Station, Coimbatore, namely, Co. 1, Co. 2, Co. 5 and Co. 13 are equally popular in different parts of the State and also high yielding. The strain Co. 13 is a short duration variety which comes up for harvest in 110 days and is cosmopolitan in nature as it can be fitted into any season, either in the first crop season from June to September, or later in the 'Navarai' season from February to May or the intermediate season as well.

*Part of the Thesis approved for the award of M. Sc. Degree by the University of Madras.

Hybridisation was started in the year 1947 with the object of combining drought resistant habit of the wild species of *Oryza* with the high yielding non-shedding and other good qualities of the cultivated *Oryza sativa*. Nine sets of successful crosses namely. Co. 13 x T. 129 and Co. 13 x T. 469 (short duration crosses maturing in 125 days) and GEB. 24 x T. 1601, Co. 1 x T. 1702, Co. 2 x T. 1602. Co. 2 x T. 162, Co. 2 x T. 740, Co. 5 x T. 113 and Co. 5 x T. 128. (medium duration crosses maturing in 150 days) were effected during the year. (The description of the parents is given in Appendix).

The hybrids were grown during 1948—'49 under irrigated condition. The F1 and F2 generations were studied for their morphological characters. Single plants with ability to withstand drought and in addition possessing desirable characters such as good tillering, non-shattering, awnlessness and early maturity were selected.

The F3 and F4 generations of the crosses were studied for their reaction to drought by growing the progenies under controlled conditions of irrigation where the plants were subjected to artificial drought in the field. In one set of experiment the progenies were grown in a wet field where the plants were subjected to artificial drought by withholding irrigation at intervals till the crop flowered, after which the fields were always kept wet for the proper maturity of grains.

In another set of experiment the progenies were grown under purely dry conditions in an open dry field. The seeds were sown dry and the crop matured with the help of rains received during the season in addition to few irrigations.

The ultimate object of the studies was to synthesise ideal new types appropriate for every environment by accumulating in them valuable ancillary characters conducive to resistance to drought.

Review of Literature: Ashton (1948) who has adequately reviewed the work on 'Breeding for drought resistance in crops' observes that "comparatively little specific breeding for drought resistance bas been carried out on account of the complex nature of reaction to drought." Aamodt and Jonston (1936) observe that in Russia the nature of drought resistance and its application to breeding problems are being studied intensively and several new drought resistant wheat varieties superior to the old Russian ones both in yield and quality have been developed by plant breeders of

that country. Investigations were started in America in 1928 and much work on breeding for drought resistance has been reported in wheat from that country.

Stefanovskii and Petropavlovskii (1934), studied thoroughly the reaction of a large number of varieties, including 400 varieties of the world collection of wheats and arranged them according to their reaction to drought. Fleischmann (1934) in discussing the problem of developing drought resistant wheats in Hungary suggested hybridisation between Hungarian wheats and introduced wheats such as Marquis, as possible methods of breeding drought resistant varieties needed for local conditions. Udoljskaja (1936) distinguishes two distinct biological types of spring wheats on the basis of physiological behaviour and morphological characters and presents notes on a number of wheat varieties which are of interest in breeding work in the evolution of drought resistant forms.

Stefanovskii (1937 b) considers that the Afghanistan soft early maturing wheats of the desert and semi-desert types are considered to be of particular interest to the breeder in view of their general drought resistance. Udoljskaja (1937) found that the F1 hybrids of *Triticum - Agropyron* which resembled *Agropyron* were highly drought resistant. The F2 hybrids obtained by backcrossing the F1 to wheat varied in reaction to drought and some promising progenies were selected. Many lines that appeared uniform segregated with regard to drought resistance, when subjected to rigorous conditions of drought. Testing under these conditions is therefore suggested as the best means of selecting the most drought resisting forms. Isenbeck (1939) was of opinion that breeding for drought resistance is greatly hampered by the absence of any definite method by which it can be determined and carried out in the laboratory and hence only a general estimate of drought resistance of plants under field conditions becomes possible. Stefanovskii and Veceslova (1939 a) found that promising hybrids could be obtained only from crosses between parents both of which were drought resistant. They claim that the proportion of resistant plants were higher in families raised under arid conditions than otherwise owing to natural selection operating in the early stages.

Krasovskaja (1940) states that drought resistance and yield under drought conditions were higher in individuals derived from parents which had been grown in an arid environment. Saks (1941) stresses that in breeding drought resistant varieties it is important

to select forms that yield well both in bad years as well as in good years. Pal (1944) in discussing the wheat breeding work of the Indian Agricultural Research Institute points out the possibility of effecting wide crosses between wheat species and of cereals and grasses of the genera allied to *Triticum* which are reputed to possess characters such as disease resistance and drought resistance. Chinoy (1947 a, b) studied about 260 selected varieties of exotic and Indian wheats grown under dry and irrigated conditions. On the basis of such a study a classification of wheat varieties for their reaction to drought resistance has been made.

Various investigations on breeding for drought resistance in maize, (Jenkins, 1932, Heyne and Brunson, 1940), oats (Ersov, 1935), barley (Harrington, 1935), *Paspalum*, grasses and other crops such as potato, *Luffa*, *Citrullus*, tomato, beans and forest trees, have been reported. (Ashton, 1948).

There has not been much of breeding work with regard to rice in the matter of drought resistance in India. "Crossing between wild and cultivated types has been done at Coimbatore and it appeared possible to evolve types having the drought resistant character of the wild rice, without any of its undesirable characteristics." (Ramiah 1937). Srinivasan et al (1941) have recorded that some drought resistant cultures were obtained from the progenies of an inter-specific cross, *Oryza sativa* X *Oryzo longistaminata (Perennis)*. It was found in Madhya Pradesh that the trouble due to the wild rice *Oryza Sativa* L. Var. *fatua* (Spontanea) in rice fields was serious in years of drought than in normal conditions when it tillers more rapidly and profusely than the cultivated rice, showing that it can thrive better under unfavourable moisture conditions, At the Rice Research Station, Berhampore, from a cross made between the cultivated rice and the wild species *Oryza perennis*, progenies partially resistant to drought were obtained. Hybridisation was started in 1940 in Kashmir between low yielding, awned, hardy varieties of rice grown in higher altitudes and high yielding types of Kashmir valley proper. (Ramiah and Narasinga Rao, 1953).

In the fields of drought resistance, high yielding strains of dry varieties have been evolved by mass selection as well as pure line selection. Hybridisation has not produced so far a suitable strain to meet such conditions.

Observations: The progenies of nine sets of crosses between cultivated and wild rices were studied for their morphological and physiological characters and compared with their parents from 1948 onwards. Dominant characters such as purple pigmentation, awning, red rice, bold grain and shattering of grains were exhibited in the F1 generation. In this connection it may be pointed out that the cultivated rice varieties were used as male parents and the wild *Oryza sativa* forma *spontanea* forms were used as female parents, since the wild parent shatters its grain even ten days after seed setting. Out of the nine successful hybrids, two belong to the short duration group and seven to the medium duration group. The 54 F1 plants grown in 1949 were again studied in all stages of their growth for characters such as anthocyanin pigmentation in the leaf sheath, internode, junctura, auricle, ligule, pulvinus, septum, leaf axil, stigma, glume, lemma-palea, apiculus and leaf blade; sterility, duration, height, tillering, lodging of straw, shattering of grain and other panicle characters.

F3 progenies numbering 485 were subjected to rigorous drought test during the 1950—'51 season under purely dry conditions and under semi-wet condition. Parents of both the cultivated and wild varieties were sown after every 15 progenies. Sowing was done in July and it was found that the germination started in most of the progenies on the fifth day and continued upto the seventh day. The cultivated parents were quick in germination and they started their germination on the third day whereas the wild parents and some of the progenies showed delayed germination. This is an indication that the wild varieties and their progenies are slow in germination. The crop had an uniform stand and the seedlings were coming up well till the first week of September. The seedlings were thinned uniformly to one seedling per hole. The South-west monsoon showers received during the period were adequate and optimum. Some of the progenies were found to thrive very well with proper tillering and vigorous growth.

During the month of September when the South-west monsoon waned, the crop was affected by drought as the North-east monsoon was below normal and it was noted that some of the progenies were able to withstand the drought quite well while a few of them succumbed to drought altogether. It was also found that in the same progeny some plants were more susceptible to drought than the others. The drought susceptible progenies started yellowing, showed symptoms of wilting and finally dried up. The first symptom of wilting was noted on the 55th day after sowing. The plots were not irrigated immediately after the symptoms were

noticed. The next irrigation was given a month after the plants started symptoms of wilting. By this time some of the susceptible progenies had wilted permanently and never survived.

Association of drought resistance with other characters: The progenies as may be expected were segregating for many morphological characters as well as physiological characters. The study of the morphilogical characters revealed that anthocyanin pigmentation was not associated with the drought resistance of the plants since it was noticed that plants with different intensities of pigmentation had succumbed to drought. It may be mentioned, however, that the intensity of the purple pigmentation became more pronounced as the drought advanced.

Segregation for compact tillering resembling the cultivated parents and spreading habit resembling the wild parent were noticed. (Ramiah, 1930). Progenies with spreading habit were able to withstand drought better than the compact type. There was a great deal of variation in the thickness of culm and progenies possessing thicker or stouter culms were in general able to survive the drought better than those with thin culms. Other characters of the stem, viz., brittleness, pulvinus colour, node colour and pigmentation in the septum were not associated with drought resistance.

The leaf consisting of the leaf sheath, junction, ligule, auricle and the leaf blade were taken into consideration. It was noticed that few of the progenies possessed well developed auricle resembling that of the wild parent. No purple pigmentation was noticed in the leaf blade. But some differences in the intensity of the green colour in the foliage were observed and there appeared two definite shades of green, viz., light green and dark green. Progenies were segregating for these foliage colours and it was observed that plants with light green foliage were more drought resistant than dark green plants.

Size of the leaf blade was studied and both the narrow and the broad leaf blades were observed in the segregating progenies. The wild parents are characterised by a broad leaf blade. Progenies with broad leaf blades gave higher percentage of survival in the drought test than that with narrow leaf blades. Hairiness of the leaf was found in many of the resistant F3 progenies which possessed coarse hairs, and rough feel characteristic of the wild parents.

Another character of the leaf that was observed was its long, flowing habit as distinguished from the normal erect habit of the leaf blade. Most of the wild species of *Oryza* have the flowing habit of

the lamina and this character was inherited by the progenies. It may be said that the narrower the leaf blade, the less is the transpiring surface. But quite contrary to this fact the wild parents possess a broad leaf with flowing habit and progenies resembling this type were more drought resistant. It was observed in another study (vide physiological studies) that size of the leaf blade, both length and width, was not correlated with the drought resistant habit of the plant.

After the crop had flowered the characters of the panicle and the grain were observed. Genetic variations in the size and density of the panicle, colour of the glume, lemma and palea, colour of the apiculus, fertility of the spikelet, ripening colour of the lemma and palea, colour of the apiculus, fertility of the spikelet, ripening colour of the lemma and palea, awns and rice colour were all studied.

The wild rices are characterised by very low density of grain setting in the panicle and the ears are very open with sparsely arranged spikelets, in marked contrast with the cultivated rices. Both the lax, open type of panicle and the dense and close type of panicle were noticed. (Mitra and Ganguli 1935).

Lax type of panicle was always associated with other wild characters and it was found that some plants with lax panicle were able to withstand drought. While selecting plants, both the types with the lax panicle and the dense panicle were selected. Panicles of varying lengths were observed and care was also taken to select plants with longer panicles. Straw, brown and purple colours in the glumes were noticed with similar variations in ripening colour of grain. Since the ultimate aim was to carry forward plants which were able to withstand the drought test these characters did not weigh much in selection. Awn, however, which has an important physiological function as demonstrated by Hayes and Wilcox (1922) in barley, was studied with greater care as it has been found to be the most subject to change than other structure from environmental influences (Anandan 1933, Sethi *et al* 1937 b). Droughty conditions restrict awn development while shade induces greater awn development. Mendiola (1926) records that increased water supplies augmented awn growth in rice. Awn in rice, it is believed, has an intimate association with the general hardiness of the variety.

All the wild rices have fully developed awns. Both awnless and awned types were met with in the progenies and it was observed that the awned plants were more in number. Segregation for tip,

awned and long awned plants were observed in the hybrid population. Though awning is not a desirable economic character, recognising its importanee in drought resistance studies, plants with awns were not drastically rejected. Many promising plants with awns were found to come up well in an adverse condition and all of them were therefore selected for further tests.

The size and shape of the grain varied in the different cultivated and wild parents used for hybridisation in the study. Though genetic factors control the size of grain, environmental conditions also affect it. It was observed that in general, there was a reduction in size of grain in progenies grown under open dry conditions. The wild parents have coarse grains and the cultivated parents have medium and fine grains. Segregation for these characters were noticed in the F3 generation, but plants irrespective of the grain size were selected though fine and medium types were given preference. Segregation for rice colour, red and white, were observed and the majority of the progenies were red riced since red colour in rice is dominant over white (Parnell et al 1922). All the wild progenies except T. 113, T. 162 and T. 740 used for hybridisation in the study are red riced and the cultivated parents white riced. Here again progenies with red and white rice colour were selected. In all the several characters studied, those factors associated with drought resistance alone were given importance.

The drought resistant progenies selected were studied with special reference to their duration, tillering and root development.

It is very rarely that a variety is found to have a constant duration under different conditions of culture. As Copeland (1924) put it "duration although constant under fixed conditions, it is rarely a simple character". External conditions have a very marked effect upon this complex character of duration. The study of the F3 progenies under dry environment and under controlled irrigated conditions shows that withholding water and drying the plots slightly enhances the "flowering duration," as well as the "period of flowering". Taking the parents alone into consideration it was found that the short duration parent Co. 13 with a 'flowering duration' of 80 days completed flowering after 96 days in the semi-wet condition and after 104 days in the purely open dry condition. Similarly GEB. 24, a medium duration variety of 98 days flowering duration when sown in August 1st (Ramiah 1933 a) flowered in the semi-wet condition after 104 days but it failed to flower in the dry condition

as the plants did not survive the drought in the later stages of growth. Co. 1 with a 'flowering duration' of 110 days, flowered after 118 days in the semi-wet condition and 134 days in the dry condition. Co. 2 and Co. 5 with flowering duration of 127 and 134 days respectively flowered a week days later under the semi-wet condition but failed to flower under the dry condition. The "period of flowering" was also found influenced by the dry and semi-wet environment. The normal 'period of flowering' of a variety, that is the interval between the beginning and the ending of the flowering phase, is seven days. But it was observed that this period was extended upto 11 days in the semi-wet condition and very much protracted in the dry condition since the emergence of the ears in an individual plant itself was very slow. This kind of protracted flowering resulted in the uneven ripening of the ears. Hence under dry conditions individual yield of the progenies could not be recorded and only single plants were selected. In the semi-wet condition, from the time the progenies had started flowering, the plots were kept wet and never allowed to dry and hence ripening was uniform.

The F3 progenies were segregating for duration and it was found that the majority of the progenies were late. Duration was one of the main considerations in slection and it was seen that many plants earlier than the cultivated parents with good drought resistant quality were selected. From the performance of the hybrid progenies grown under purely open dry condition it was observed that cross Co. 13 x T. 469 was the earliest to flower with a 'flowering duration' ranging from 104 to 123 days and the most suitable for growing as dry paddy, though late duration cross progenies of Co. 1 x T. 1702 and Co. 2 x T. 1602 showed better resistance to drought in the early stages of growth.

The performance of the 284 F3 progenies grown in the puddle was watched for their drought resistance. The drought treatment here was not so severe as in the first instance. After transplanting, the plots were under restricted irrigation till the time of flowering. After blooming, there was a continuous supply of water. The observations recorded were but similar to what had already been described. There was no actual wilting of the progenies as noted under the purely dry condition but they showed differential behaviour towards the drought treatment, many of them having successfully withstood the test. Co. 13 x T. 129, the earliest among the hybrids studied, was the most promising. Among the medium duration hybrids. Co. 2 x T. 1602 was highly shedding since the wild parent is

of that character. Out of the 157 progenies studied, 120 were found shedding and hence no selection was made from the shedding types as they may not be useful in the later generations. Co. 2 x T. 162 and Co. 2 x T. 740 were quite promising crosses. A total of 2356 single plants were selected after going through all the F3 progenies. Weight of grain in all the progenies was recorded and selections which yielded above the mean for each progeny were carried forward. 1172 F3 selections on the aggregate were made available for further study.

The F4 generation of the short duration cross Co. 13 X T. 129 was subjected to drought for the second time during January to April in 1951. A total of 367 F4 progenies was transplanted and treated as a semi-wet crop with intermittent irrigation. Irrigation was cut off on the 17th day after transplanting, when the seedlings had established. It was observed that on the 12th day after stopping irrigation, some of the progenies started wilting with rolled leaves. The plots developed cracks on the 4th day and by the 12th day the soil cracks became wider. At this stage irrigation was given, though thereafter it was impossible to maintain the wet puddle condition in the plot. Fortnightly irrigation was never stopped. Observations as in the previous study were again recorded and it was quite obvious that drought resistance is an inherited character. Some of the progenies wilted in the drought test and some successfully withstood it.

The F3 progenies subjected to drought under dry and open condition were examined for their root development at the flowering stage. Ninety plants belonging to both drought resistant and drought susceptible types were dug out from the field with their roots, washed and the weight of root recorded after drying in the sun for eight hours. The number of tillers per plant was also recorded. It was found that the drought resistant types had better development of root system than the drought susceptible form (Plate 1). More of thick healthy roots were noticed in the drought resistant types and the root system had a deeper penetration. The drought susceptible types had shallow root system and less of thick roots but more of thin roots. The mean number of tillers for 45 drought resistant types was 15·7 and the mean weight of root was 2·57 grams, whereas the drought susceptible types had a mean tiller value of 15·5 and a mean root weight of 1·48 gms. It was found that the resistant types had highly significant increase in root weight over the susceptible types as shown in Table 1.

The yields of the F3 and F4 progenies of cross Co. 13 x T. 129 which were grown under restricted irrigations and subjected to drought were recorded. The frequencies of yield as percentage on control in the two generations are given in Table 2. The coefficient of correlation between the yield of F3 and F4 progenies is + 0·392 ± 0·152.

Tables 3 and 4 give the frequencies of yield as percentage on control of the F3 and F4 progenies respectively of cross Co. 13 x T. 129 with light green and dark green foliage. Though light green colour of the foliage was associated with drought resistance no correlation between the colour of the foliage and yield could be seen.

Table 5 gives the frequencies of yield expressed as percentage on control of the F4 progenies with two different duration groups. It is seen that the progenies with 'flowering duration' ranging from 110 to 125 days have significantly higher yield than those with flowering duration below 110 days.

(to be continued)

Research Note

Some parasites of *Dactylethra candida*, Meyr., an inspect pest of *Tephrosia purpurea* Pers.

The catepillars of *Dactylethra candida*, Meyr. cause fusiform stem galls on *Tephrosia purpurea* Pers. a valuable and widely cultivated green manure plant. Mani [6] has worked out the life-history of this pest and has also noted that the caterpillars are heavily parasitised by *Brachymeria* sp., *Elasmus* sp. and *Eurytoma* sp.

While studying the stem galls on *T. purpurea* the author of this note noticed a number of parasites on *D. Candida*. The parasites reared from this host were sent to the Commonwealth Institute of Entomology for identification. They were identified as follows:—

1. *Goniozus sp.* (Bethylidae)
2. *Brachymeria sp.* (Chalcididae)
3. *Antrocephalus sp.* (Chalcididae)
4. *Bracon greeni Ash.* (Braconidae)
5. *Eurytoma sp.* (Eurytomidae)
6. *Eupelmus sp.* (Eupelmidae)
7. *Bruchocida orientalis*, Crawford (Eupelmidae)
8. *Neanastatus proximus*, Ferriere (Eupelmidae)

1, 3, 4, 6, 7, 8 are recorded from this host for the first time. As all these parasites attack the caterpillars of *D. candida* it has been difficult to determine their true relationships. As suggested by Dr. W. J. Hall, it is clearly not a case of simple parasitism.

Among these forms, *B. orientalis*, Crawford has already been reared from three different hosts. Three females of *B. orientalis* were originally collected by L. C. Coleman from Bangalore. They were reared from *Bruchus chinensis* (Bruchidae). Crawford (1913) described them as new species [1]. Krishna Iyer [3,4] recovered a pupa of *B. orientalis* from a mature grub of *Pempheres affinis* Fst. in *Triumfetta rhomboidea* in Perur on 7th July 1937. The adult that emerged was a female and it lived for 21 days. It paralysed seven grubs of *P. affinis* but failed to oviposit. The same specimen was sent to C. Ferriere [2] who confirmed its identity as *B. orientalis* Crawford. Krishnamurthy and Usman (1954) [5] described the form as an egg parasite of *Callosobruchus chinensis* Linn. (Bruchidae) from Bangalore. The author has recovered *B. orientalis* from *D. candida* for the first time. The biology of this form claims much importance because it is a natural check on pests of useful crops. As it attacks a wide range of hosts it may effectively be employed in the biological control of pests.

Further investigation is in progress.

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REFERENCE

1. Crawford, J. C. — 1913 Proc. U. S. Nat. Mus. Washington Vol. 45. pp. 247.
2. Ferriere, C. — 1940 Bull Ent. Res. 30.
3. Krishna Iyer, P. N. — 1940 Indian J. Ent. Vol. II. Pt. II pp. 213.
4. Do. — 1940 Indian J. Agri. Sci. Vol. 10. Pt. iv. pp. 640.
5. Krishnamurthi, B and Usman, S. — 1954 Indian J. Ent. Vol. 16. Pt. iv. pp. 335.
6. Mani, M. S. — 1948 Journ. Royal. Asi. Soc. Bengal. SC., Indian Cecidozoa and Zoocecidia Vol. 14. No. 2.

Weather Review — For April, 1957

RAINFALL DATA (IN INCHES)

Division	Station	Total rainfall for the month	Departure from normal	Total since 1st January 1957
North	Madras (Meenambakkam)	Nil	— 0·6	Tr
	Tirurkuppam*	Nil	— 0·9	Nil
	Vellore	Nil	— 1·0	1·6
	Gudiyatham*	1·2	+ 0·4	1·3
East Coast	Palur*	Nil	— 0·6	0·1
	Tindivanam*	Nil	— 1·1	0·2
	Cuddalore	Nil	— 1·0	1·2
	Nagapattinam	Nil	— 1·1	0·4
	Adutharai*	0·1	— 1·2	0·9
	Pattukottai*	Nil	— 2·4	2·3
Central	Salem	0·8	— 1·1	1·6
	Coimbatore (A. M. O.)*	0·5	— 1·9	1·1
	Coimbatore	Nil	— 1·6	0·4
	Tiruchirapalli	2·0	— 0·4	2·0
South	Madurai	0·4	— 1·8	0·4
	Pamban	Nil	— 1·6	1·2
	Koilpatti*	Nil	— 3·3	1·9
	Palayamcottai	0·8	— 1·7	4·0
	Ambasamudram*	0·8	— 2·8	2·4
	Nagarcoil	2·4	— 1·5	4·2
Hills	Kodaikanal	6·3	+ 1·5	8·7
	Coonoor*	3·4	— 2·2	10·4
	Ootacamund*	1·8	— 2·8	3·7
	Nanjanad*	4·3	— 0·1	6·4
West Coast	Wynaad	3·3	— 2·1	5·0

Note:— 1. * Meteorological Stations of the Madras Agric. Dept.

2. Tr. = Trace (0·0″ 0·01″ to 0·04″)

The month began with a few showers in Madras and a sub-normal day temperature outside Kerala. Thundershowers were received at a few places in interior Madras on 2—4—1957 and in South Madras on 3—4—1957. Weather was mainly dry on 4—4—1957. For two days from 5—4—1957 scattered showers were received at a few places in Madras State. From 7—4—1957 to 12—4—1957, both days inclusive, the Madras State had only dry weather. On 13—4—1957 and on the next day as well thunder-showers were received at a few places in South Madras. For two days from 15—4—1957 a few places in interior Madras had some scattered showers. The weather was dry on 17—4—1957. Localised showers were received in South Madras on 18—4—1957. Except for the isolated light showers at Kodaikanal the weather was mainly dry in Madras State on 19—4—1957. Complete dry weather was experienced on 20—4—1957. On 21—4—1957 thunder-showers were received only in interior Madras. For two days from 22—4—1957 scattered showers were had in north Tamilnad, when the weather was mainly dry elsewhere. A few place in South Madras had localised showers on 24—4—1957. In the succeeding six days dry weather prevailed in Madras State.

There were fluctuations in day temperatures in Tamilnad. Not even on one day in April, 1957, the day temperature was above normal in any place in Tamilnad. But the severity of summer and the consequential scarcity of water even for drinking purposes were actuely felt in major districts of Madras State as almost all districts with the exception of Gudiyatham area of North Arcot district and Kodaikanal region of Mathurai district received only highly sub-normal rains during the hot months of March and April 1957.

Earthquakes: (i) An earthquake shock of moderate intensity at its origin with epicentre at Latitude 51 degrees North and Longitude 85 degrees East southern Tibet, about 1890 kilometers (1170 miles) away from Madras was recorded by the Seismograph at the Meterological Office, Madras at 12 hours 6 minutes I.S.T. on Sunday, the 14th April, 1957.

(ii) Another shock having its epicentre near about the same place was recorded at 22 hours 11 minutes I.S.T. on the same day.

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

Noteworthy Rainfalls for the month

S. No.	Date	Name of place	Rainfall in inches
1.	18—4—1957	Tiruchirapalli	1·57
2.	21—4—1957	Kodaikanal	3·54

Zonal Rainfall for the month in inches

Name of Zone	Rainfall for the month	Departure from Normal	Remarks
North	0·3	— 0·5	Far below normal
East Coast	Tr.	— 1·2	do
Central	0.8	— 1·3	do
South	0·7	— 2·1	do
Hills	4·0	— 0·9	Below normal

Tr. = Trace.

Agricultural Meteorology Section,
Lawley Road P. O.,
Coimbatore, 11—5—1957

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

Departmental Notifications

Gazetted Officers — Postings and Transfers.

Name and present post	Posted as
Francis T. S. Regl. Dy. Director of Agriculture Madurai.	Regl. Dy Director of Agricultural Tanjore.
Kamalanathan S., Asst. in Cotton, Coimbatore.	Asst. Cotton Specialist, Tiruppur.
Kanakaraj David S., Gazetted Asst. Lec. in Entomology Coimbatore.	Lecturer in Entomology, Coimbatore.
Kesava Iyangar N., Cotton Specialist, Coimbatore.	Soa Island Cotton Dev. Officer, Bombay.
Mohd. Abbas. UB. Spl. D. A. O., Madras.	Regl. Dy. Director of Agricultural Madurai.
Mohd. Ali. A. Regl. Dy. Director of Agriculture, Tanjore.	Regl. Dy. Director of Agricultural, Madras.
Ratnam R., Senior Supdt. D. A's Office, Madras.	Administrative officer, Central Office, Cbe.
Santhanaraman T., Asst. in Entomology, Coimbatore.	Gazetted Asst. Lecturer in Entomology, Coimbatore.
Subramaniam R. S., Asst. Agrl. Eng.	Principal Polytechnic, Pollachi.
Umapathy M., Asst. Agrl. Eng., Trichy.	Asst. Executive Eng. (Mechanical), Madras.

Review of Market Conditions of Commercial Crops in the areas of Market Committees for the month of March, 1957

Cotton: (In this section: Cdy = 784 lb.
Pothi = 280 lb.)

Tiruppur: There were no rains during the month. The weather was hot and dry. The arrivals of local crop were in full swing. The quality of the kapas received was good. The prices moved up due to good demand. The market started with an opening stock of 3524 pothis of Cambodia and 52 pothis of Karunganni kapas and 3491 and 46 candies of Cambodia and Karungauni lint respectively. The arrivals during the month amounted to 6778 and 266 candies of Cambodia and Karunganni lint respectively and 34367 pothis and 2820 pothis of Cambodia and Karunganni kapas respectively. Disposals during the month were 4646 and 129 candies of Cambodia and Karunganni lint and 18926 and 1833 pothis of Cambodia and Karunganni kapas respectively. The closing balance at the end of the month was 5620 candies and 183 candies of Combodia and Karunganni lint and 18965 and 1039 pothis of Cambodia and Karunganni kapas respeccively.

The prices of lint and kapas moved up and they were ranging from Rs. 956 to 981 per candy of Cambodia lint, Rs. 819 to 871 per candy of Karunganni lint, Rs. 116-8-0 to 117-12-0 per pothi of Cambodia kapas and 105 to 107-8-0 per pothi of Karunganni kapas.

Ramanathapuram district: The standing crops of cotton in this district were adversely affected by the failure of seasonal rains. The yield is estimated to be only half the normal. Condition of Uganda cotton at Rajapalayam improved and fairly moderate transactions were registered. The three markets of Rajapalayam, Sattur and Virudhunagar put together started with an opening stock of 650 pothis of kapas and 1830 candies of cotton lint at the beginning of the month. Receipts in the month came to 32,500 pothis of kapas and 3425 candies of lint, while disposals made during the month amounted to 32,500 pothis of kapas and 3,975 candies of lint. The markets closed with a stock of 650 pothis of kapas and 1280 candies lint at the end of the month.

The opening and closing prices of cotton kapas and lint that ruled in these markets are given below:

	Opening in Rs.	Closing in Rs.
Karunganni kapas per pothi	100—106	100— 108
Tinny Karunganni kapas per pothi	86— 92	95— 98
Uganda kapas III quality	70— 80	70— 80
M. U. 2 Certified Uganda lint per candy	1096	1060—1068
M. U. 1 „ „ „	977	1020—1028
Uncertified Uganda „	...	946— 957
Cambodia „	750—850	750— 860
Karunganni cotton seeds per Md. of 82 2 7 lb.	11—11·5	10— 11

South Arcot: The trade in this district had a stock of 135 pothis of cotton kapas. Arrivals to Villipuram Market were 90 pothis in all, while the despatches were 233 pothis. The despatches were mostly confined to Coimbatore district. The stock with the trade at the close of the month stood at 2 pothis. The average price per pothi worked out to Rs. 82·37 at Villipuram.

Groundnuts: (In this section Candy = 531 lb.)

North Arcot district: Groundnut markets were featureless during the month in this district. Since the prices for oil fluctuated widely buyers were cautious to make any fresh commitments. Demand for oil at Madras was by fits and starts. Hence crushers were greatly handicapped to find buyers for their oil. Added to this the cut in the supply of electricity by 25% bottlenecked their purchasing capacity to a considerable extent. Both arrivals and offtake were poor. Only small scale crushers dominated the market. Most of the big mills remained closed. The following is the stock position of groundnuts in this district.

	Opening balance	Arrivals	Disposals	Closing balance
	Tons	Tons	Tons	Tons
Groundnut pods	2278	266	385	2159
Groundnut kernels	359	516	512	363

The price of kernels which ruled steady till the first week of March showed a slightly declining tendency from the beginning of the second week. Prices would have fallen further if sellers were not obstinate. The prices of kernels ruled around Rs. 145—155 per candy while that of

oil around Rs. 305—310 per candy of 500 lb. Groundnut pods and oilcake were sold at Rs. 15—17 per bag of 80 lb. and Rs. 8—8/8 per Indian Standard Md. respectively. For the same period during last year the prices for kernels ruled at Rs. 147—150 per candy, oil at Rs. 310 per candy of 500 lb., pods at Rs. 13—20 per bag of 80 lb. and oilcake at Rs. 7 per standard Md. of 82 2/7 lb.

South Arcot district: The trade at the beginning had a stock balance of 4027 tons of kernels. Due to poor marketable surplus with the gorwers, arrivals to the market decreased and totalled 1358 tons. Receipts from North Arcot and Tiruchirapalli districts came to 1112 tons and imports from Andhra State to 211 tons. Crushing in oil mills and country chekkus declined and stood at 2580 tons and 198 tons respectively. Despatches to Madras and Tanjore districts came to 433 tons while exports to Pondichery State was 17 tons. Wastages were calculated at 145 tons. At the close of the month the trade had a stock balance of 3335 tons.

Prices showed an upward trend for the first two weeks of the month as the price of oil was encouraging. During the third week the prices declined. Again during last week the prices showed an increasing trend. The average prices ranged from Rs. 147 to 163 per candy in the several markets according to quality.

Ramanathapuram: The millers in this district are having enough stocke of kernels with them and receipts were therefore negligible. The absence of demand for oil has also upset the trade to a little extent. This position did not last throughout the month. At the end of the month, some improvement in the prices of oil as well as kernels was registered. The Virudhunagar market which started with an opening balance of 95 tons of pods and 2300 candies of kernels had a receipt of 125 tons of pods only. Disposals were placed at 180 tons of pods and 900 candies of kernels leaving a closing stock of 40 tons of pods and 1400 candies of kernels at the end of the month.

The prices of groundnut kernels, pods, oil and oilcakes that ruled in this market are given below:

	Opening price Rs.	Closing price Rs.
Groundnut kernels (per candy)	150—171	170—175
,, pods per bag of 82 2/7 lb.	14— 17	16— 18
,, oil (per tin of 351 lb.)	22— 22·4	22·75— 23
,, oilcake (per Md. of 82/7 lb.)	8·75— 9	9— 10

Gingelly: (In this section Bag = 168 lb.)

South Arcot district: The opening stock with the trade stood at 372 bags. Arrivals to markets increased since harvest of new crop was proceeding. Vridhachalam had an arrival of 1677 bags, Tindivanam

117 bags, Villipuram 34 bags and Tirukoilur 9 bags. The receipts from the neighbouring districts like Madras and Tiruchirappalli came to 310 bags. Imports from other States amounted to 192 bags. Crushing in power driven pinto chekkus is estimated at 176 bags and in country chekkus at 810 bags. Despatches to Madras and Tanjore districts amounted to 1141 bags. Wastages were calculated at 5 bags. At the end of the month the closing balance with the trade stood at 579 bags.

The prices were on the decrease this month. The average prices varied from Rs. 65-7-0 to 69-15-9 per bag of 168 lb according to quality.

Tobacco: *Coimbatore district:* During the month 1740, candies of chewing and 240 candies of Cheroot tobacco were despatched to places in Madurai, Tanjore, Tiruchirappalli, South Arcot, Madras, North Arcot, Mysore, Tirunelveli, Nilgiris, Jolarpet, Ramnad, Bombay, Kerala, Andhra etc. At the end of the month under report there was a stock of 7950 candies of cheroot tobacco.

The chewing tobacco market remained dull, while the prices of pit cured and cheroot tobacco were steady. The prices ranged as follows:

(Per Candy of 500 lbs.)

Variety	*I Grade* Rs.	*II Grade* Rs.	*III Grade* Rs.
1. *Chewing Tobacco-Sun-cured:*			
(a) Meenampalayam	300 to 320	200 to 270	150 to 170
(b) Other varieties	195 to 205	130 to 160	65 to 100
2. *Cheroot varieties:*			
Sun cured (grown in Erode and Bhavani Taluks)	260 to 403	200 to 250	120 to 160
3. *Chewing varieties:*			
Pitcured (grown in Palladam and Salem areas)	220 to 250	160 to 175	100 to 125

Review of Administrative Activities of Market Committees for March, 1957.

General: Except Coimbatore Market Committee all other Market Committees are functioning under 6-A of the Act, under their revenue heads of the districts concerned. The impediments in the case of Tirunelveli Market Committee and Ramanathapuram Market Committee are pending clearance. The election to the North Arcot Market Committee is not yet completely over.

The following are the progress of licencing by the Market Committees during the months.

	Section 5 (1)		*Section 5 (3)*		*Weghmen*	
	A	B	A	B	A	B
North Arcot Market Committee	123	464	119	424	149	339
South Arcot Market Committee	275	929	108	768	105	726
Coimbatore Market Committee	127	302	109	279	155	236
Ramanathapuram Market Committee	...	...	...	...	...	...
Tirunelveli Market Committee	...	...	...	...	...	...

A : During the month.

B : Up to the end of the month January.

Meetings: A meetng of the Coimbatore Market Committee was held on 25—3—1957 and seventeen subjects were discussed and passed. A meeting of the South Arcot Market Committee was held on 30—3—1957. The meeting was also attended by the Deputy Registrar of Co-operative Societies. On the whole 34 subjects were disposed of at the meeting.

Quality Analysis: During the month 23 samples were drawn and analysed by the South Arcot Market Committee in Vridachalam Market. The crop marketed at Vridachalam was fairly good. Eight samples contained total refraction below 4% and 15 samples contained total refraction from 4—8%.

Quality Competition: The quality competition for winter crop for 1956—'57 has closed on 28—2—1957.

Crop and Trade Reports.

Castor First and Final Report 1956—'57: The area sown with Castor in Madras State in 1956—'57 is estimated at 33,800 acres. Compared with the area of 32,000 acres estimated for the corresponding period of the previous year, the current year's estimate shows an increase of 5·6 percent. The present estimate is more than the average area of 32,000 acres for the five years ending 1954—'55 by 5·6 percent. The area estimated is the same as that for last year in the districts of Tanjore, Madurai and Ramanathapuram. A decrease in area is estimated in the districts of South Arcot, North Arcot and Coimbatore and an increase in the other districts of the State except Chingleput, the Nilgiris and Kanyakumari where the area under the crop is nil or negligible. The yield per acre is expected to be slightly below the normal in all the districts. The seasonal factor for the State as a whole works out to 98 percent of the normal, as in the case of the previous year. On this basis the total yield works out to 5,500 tons which shows an increase of 3·8 percent when compared with the yield of 5,300 tons estimated for the corresponding period of the previous year. The present estimate is more than the average yield of 5,000 tons for the five years ending 1954—'55 by 10·0 percent.

Korra Crop — Second Report 1956—'57 Madras State: The area sown with korra or tenai (Setaria Italica) in the Madras State upto December, 1956 is estimated at 70,000 acres. Compard with the area of 73,500 acres estimated for the corresponding period of the previous year, this is a decrease of 4·8 percent. As compared with the average area of 71,000 acres calculated for the five years ended 1955—'56, the present estimate shows a decrease of 1·5 percent. The condition factor for the State as a whole works out to 98 percent of the normal for the kharif crops as against 95 percent estimated for the corresponding period of the previous year. The yield of the kharif crop works out to 17 900 tons of unhusked grain or 14,300 tons of cleaned grain, as against 18,100 tons of unhusked grain or 14,500 tons of cleaned grain estimated for the corresponding period of the previous year, representing a decrease of 1·1 percent. As compared with the average production of 16,400 tons of unhusked grain or 13,100 tons of cleaned grain calculated for the five years ended 1955—'56, the current years estimate is an increase of 9·1 percent.

Tobacco — First Forecast Report 1956—'67 Madras State: The area sown with tobacco upto 25th December 1956 is estimated at 44,990 acres. Compared with the area of 40,500 acres estimated for the corresponding period of last year, this is an increase of 10·9 percent. Compared with the average area of 38,600 acres for the five years ending 1955—'56, the present estimate is an increase of 16·3 percent. The area estimated is the same as that of last year in the districts of Tiruchirapalli and Tanjore. An increase in area is estimated in all the other districts of the State except Chingleput and the Nilgiris districts, where the area was little or negligible. The condition of the crop is reported to be generally satisfactory in all the districts of the State.

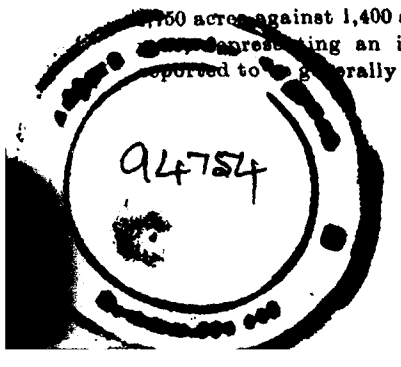
Samai — Second Report 1956—'57 Madras State: The total area sown with Samai (Panicum Miliare) in the Madras State up to December 1956 is estimated at 391,200 acres. Compared with the area of 393,800 acres estimated for the corresponding period of the last year, the present estimate shows a decrease of 0·7 percent. As compared with the average area of 350,300 acres calculated for the five years ended with 1955—'56, the present estimate shows an increase of 11·7 per cent. The seasonal factor for the State as a whole works out to 96 percent of the normal as against 95 percent estimated for the corresponding period of the previous year. The yield of the kharif crop works out to 57,800 tons of unhusked grain or

31,830 tons of cleaned grain as against 51,000 tons of unhusked grain or 31,900 tons of cleaned grain estimated for the corresponding period of the last year, representing a slight decrease of 0 3 percent. As compared with the average production of 48,700 tons of unhusked grain or 26,800 tons of cleaned grain calculated for the five years ended 1955—'56, the current year's estimate shows an increase of 18·7 percent.

Varagu—Second Report 1956–'57 Madras State: The total area sown with Varagu (Paspalum Scrobiculatum) in the Madras State upto the end of December, 1956 is estimated at 598,500 acres. Compared with the corresponding estimate of 605,200 acres for the previous year, that is a decrease of 1·1 percent. As compared with the average area of 554,500 acres calculated for the five years ended 1955—'56, the current year's estimate shows an increase of 7·9 percent. The condition Factor for the State as a whole works out to 96 percent of the normal which is the same as that estimated for the previous year. The yield of the kharif crop works out to 218,300 tons of unhusked grain or 131,000 tons of cleaned grain as against 218,200 tons of unhusked grain or 130,800 tons of cleaned grain representing an increase of 0·05 percent. As compared with the average production of 188,500 tons of unhusked grain or 113,100 tons of cleaned grain calculated for the five years ended 1955—'56, the present estimate is an increase of 15·8 percent.

Ragi—Third or Final Forecast 1956—'57 Madras State: The area sown with ragi (Elusine Coracana) in the Madras State in 1956—'57 is estimated at 8,79,800 acres. Compared with the provisional figure of area of 867,400 acres according to the Season and Crop Report for the previous year, this is an increase of 1·4 percent. Compared with the average area of 889,700 acres calculated for the five years ended 1955—'56, the present estimate shows a decrease of 1·1 percent. The area under the crop is nil or negligible in Kanyakumari district. The area estimated is the same as that for the previous year in the Nilgiris districts. A decrease in area is estimated in the districts of Salem, Madurai and Tirunelveli and an increase in area in the other districts of the State. The main crop has been harvested. The total yield works out to 352,000 tons of unhusked grain or 316,800 tons of cleaned grain on the basis of preliminary results of crop cutting experiments. Compared with the revised estimate of 332,600 tons of unhusked grain or 299,300 tons of cleaned grain according to the Season and Crop Report of the previous year, based on the results of crop cutting experiments the present estimate shows an increase of 5·8 percent. The wholesale price of ragi per standard maund of 82 2 7 lbs. as reported from some important market centres for the week ended 29—3—1957 was Rs. 11·56 at Coimbatore, Rs. 12·44 at Salem, Rs. 12·62 at Tiruchirapalli and Rs. 13·44 at Vellore. Compared with the prices which prevailed during the corresponding period of the previous year, the current prices reveal an increase of 21·7 percent at Tiruchirapalli, 31·2 percent at Coimbatore, 41·5 percent at Vellore and 44·3 percent at Salem.

Potato First Forecast Report 1956—'57 Madras State: Potato is mainly grown in the Nilgiris District and to a small extent in the districts of Salem, and Madurai. The area under the winter crop upto 25th December 1956 is estimated at [illegible]50 acres against 1,400 acres estimated for the corresponding period of the last [illegible] representing an increase of 25·0 per cent. The condition of the crop is reported to be generally fair.



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