The Madras Agricultural Journal

(ORGAN OF THE M. A. S. UNION)

Vol. XXXVII November 1950 No. 11

Editorial

Quality in Scientific Research: It is a common fallacy to reckon a country's greatness by its area and resources in minerals and manpower, ignoring the basic truth that it is always the quality that counts more than mere quantity. As a standing example we have the British Isles, where the greatness of the country is out of all proportion to its geographical extent or natural resources. Their greatness is obviously the result of the intrinsic quality of its people, as shown in their intellectual eminence, industry and discipline, their technical skill and commercial enterprise. Japan is another notable example, and in quite recent times we have also the example of Israel, where the grit and ability of the people have surmounted formidable difficulties, both natural and political.

With our new freedom, we have an added responsibility and nowhere is the need greater or more urgent than the need to mobilise all our potential talents in the service of science. In this as in many other things, we are too prone to rest on the laurels of a few brilliant individuals, as if a couple of sparrows are quite enough for an assurance of summer. Except for a handful of eminent exceptions, India's contribution to the world's scientific knowledge and advancement is woefully meagre. That the general raw material is in no way inferior to the material in other countries is amply proved by the brilliant work which many of our men have accomplished in foreign countries, under the stimulus of a more congenial research atmosphere than exists in our own country. The career of the late Dr. Y. Subba Row, who rose to the position of the Research Director of the Lederle Laboratories in America, is a notable instance but very often young scientists on their return to India from foreign training, find the local scientific climate anything but congenial and sooner or later get tied down to a sterile round of administrative routine.

In the connection it is worth quoting the words of one of our distinguished research workers, Sir T. S. Venkataraman; who has summed up the position in a very able manner.

"Wth a few honourable exceptions the spirit of wholehearted one pointed, continued devotion to research is lacking in many of our scientists. The reasons are partly social; the young enthusiast finds himself saddled with domestic and social commitments at a time when research should occupy his sole attention. Often so-called administrative needs pick him out of his line and place him elsewhere and this breaks the continuity and enthusiasm of the research worker.

Apparently because the spirit of modern scientific research is somewhat recent in the country, many of our scientists show a love for power and administration, both of which are inimical to true research. A brilliant agricultural scientist held sway over one of our important institutes for about a year and he was able to cut down routine administrative work of the directorate by a well-planned method of decentralization in the matter of control. Others who occupied the same position, both European and Indian, showed a regrettable tendency to gather more administrative control than necessary. Ultimately, the Government red-tape with its files and unending back-papers proved so stifling that he decided to quit. During his regime the scientists under him enjoyed a freedom they never had before or after. Our scientists would do well to rid themselves of the mania for control and power.

The present science departments have been modelled on the revenue-collecting departments, with their graded array of heads, deputies, and assistants in descending order, with great differences in emoluments. This difference in emoluments is often interpreted as connoting parallel differences in research talent, which is wrong. We have not yet learned to appreciate and give the proper position to scientific talent.

In the past, the scientific services in the country lost many useful and devoted votaries because of the allurements held out by administrative positions carrying higher status and better emoluments. Science departments should learn to appreciate and hunt for research talent wherever found. In the future set-up there should be no need for a researcher to give up his line of work and get lost in administrative nullity to improve his position. Scientific talents need to be paid on a par with administrative ability and within the science department itself the differences between pay scales should be lessened. I have very intimate knowledge of one agricultural researcher who had to give up higher emoluments in a different line of work and at a different place to enable him to produce tangible results. In this case, the individual lost but the country gained immensely, (Current Science, Vol. 18, No. 2 February 1949, Pp. 32-33).

Sweet Potato

By

SRI V. T. SUBBIAH MUDALIAR, L. Ag.
(Lecturer in Agriculture, Agricultural College, Coimbatore)

Origin: The sweet potato is essentially a crop of the tropics which is believed to have originated in South America. It is grown in the sub-tropics also. Though it is grown in a number of countries, the sweet potato regions are confined to Brazil, southern states of the United States of America, Malaya, East Indies, West Indies, China, India and parts of New Zealand and Australia.

Spaniards are said to have been responsible for spreading sweet potato from South America and Mexico to the other parts of the world. It does not appear to have been known to early Greeks, Romans, Arabs or Egyptians. Early Chinese books describe a number of varieties and some of the names of the sweet potato varieties found therein bear a close resemblance to certain names given to sweet potato varieties in America or New Zealand. Whatever may be the origin of the crop, it is cultivated widely in many countries of the world now and millions of people use it as an article of food. The wide distribution of the sweet potato indicates that it is a popular food crop; it is immensely liked everywhere and its high yield has its own appeal.

Sweet potato is a subsidiary food crop, capable of replacing cereals to a certain extent. It is satisfying to the palate and the stomach and meets nutritional requirements as well as cereals. It was used as a substantial part of the national diet during the war in America. It is an important human and livestock food crop in the southern states of the United States of America. Sweet potato produces larger amounts of carbohydrates from the land than cereals and is therefore a more efficient energy producer. The production of more carbohydrates is the pressing need of the present hungry world.

The accompanying statement furnishes the food values of rice, sweet potato and tapioca, based on the average yields obtained in South India and the food values furnished in Health bulletin No. 23 of 1941 of the Nutrition Research Laboratory, Coonoor.

		Rice	Sweet potato	Tapioca
1.	Duration in months ...	5	5	7—10
2.	Acreage in Madras State ...	10,774,620	35,000	41,600
3.	Yield in lb. per acre ...	1,127 (clean rice)	7,628 (tubers)	9,432 (tubers)
4.	Protein in lb. per acre ...	78	28	68
5.	Carbohydrates in lb. ...	892	2,365	3,651
6.	Calories per acre (in thousands) ...	1,776	4,562	6,794
7.	Relative calorific value ...	100	257	382

Tapioca produce nearly 4 times and sweet potato over 2½ times as many calories as rice, from the same area. Tapioca and sweet potato are efficient calorie producers. It must however be said that strict comparisons are rather difficult, because of the wide variations in the requirements in soil, climate and water of the different crops and fundamental differences in the duration of the crops. Any comparison made is therefore artificial and has its limitations.

The following analysis gives the food and vitamin value of tapioca and sweet potato tubers both raw and dried, and rice:

	Tapioca tubers		Rice	Sweet potato tubers	
	Raw	Dried		Dried	Raw
Moisture ...	59·4	13·0	13·0	13·0	66·5
Protein ...	0·7	1·5	6·9	3.1	1·2
Fat ...	0·2	0·4	0·4	0·8	0·3
Mineral matter ...	1·0	2·1	0·5	2·6	1·0
Carbohydrates ...	38·7	82·9	79·2	80·5	31·0
Calcium ...	0·05	0·11	0·01	0 05	0·02
Phosphorus ...	0·04	0 09	0·15	0·13	0·05
Iron ...	0·9	1·9	1·0	2·08	0·8
Vitamin value per 100 grams.					
Vitamin A. ...	—	—	—	26	10
„ B. ...	15	32	20	—	—
„ D. ...	—	—	—	62	24
Calorific value per 100 grammes ...	159	341	348	342	132

The air-dry tubers are as rich as rice in carbohydrates and the value of the other nutrients is not much lower. The tubers are mainly a carbohydrate food, capable of making up the deficiency of rice, as a subsidiary item of food. It is in the national interest, to switch over suitable areas from cereals to sweet potato and include this valuable food in the national dietary, as a partial substitute for cereals.

Distribution: Sweet potato is being grown in large areas in America and China. In India, however, it was classified as a vegetable crop and the extent of cultivation of sweet potato was not being recorded separately. This has since been rectified and sweet potato acreage is being separately recorded now. Sweet potato is being grown in about 35,000 acres in the Madras State and it is 0·1 per cent of the total cultivated area.

In Madras, South Kanara leads in the extent of cultivation of sweet potato with 14,000 acres and Malabar, Visakhapatnam, Tiruchirapalli, Salem and Tirunelveli have small areas under cultivation. This shows that sweet potato on be successfully grown all over the State.

Description: The sweet potato is a plant of the family of *Convolvulaceae*, with a trailing habit. The stems are thin, pliable and vinous; the tender stems are light green and the mature stems are dark green, or pigmented in varying shades of purplish or reddish-brown. The leaves are variously shaped and placed alternately on the stem Some varieties have leaves which are entire and heart-shaped and some are palmately lobed in different degrees with light indentations to deep fingering. The colour of the leaf stalk and the veins of the leaf are more or less of the same colour pattern as the stem. The flowering of the crop is said to be extremely sparse and not common, but the crop flowers freely under South Indian conditions. Seed-setting is not normal, due to incompatibility of pollen of the same variety, but pollen from other varieties are capable of fertilising the ovaries. Artificial crossing of varieties has been done successfully to produce new varieties and forms. The vines that trail on the ground send down roots from the nodes. The sweet potato roots develop into tubers that are variously shaped, rounded, elongated, bulged at the centre or at the ends and conical-shaped with the bulge at the base or the tip. The rind of the tubers is whitish, creamy, yellow or pinkish. The flesh is either 'dry and mealy' or 'moist and sugary' on cooking, depending upon the variety.

Sweet potato is propagated vegetatively by planting stem cuttings generally and in certain cases tubers. The number of varieties of sweet potato is therefore limited, when compared to other crops raised from seed. A number of varieties are said to be grown in America, East Indies, Hawaii and China. The local names given to varieties differ from place to place and the nomenclature is often confusing.

Climate, Water and Soil Requirements: Sweet potato thrives in a warm climate as in the tropics. It is also grown in the sub-tropical regions, but it does not stand frost and has to be grown during frost-free periods. In the sub-tropical regions, the crop requires a clear growing period of 4½ months, warm nights, abundant sunshine during the day and moderate rainfall. In the tropics, however, the growing period need not necessarily be so long; there are varieties which mature in about 100 days; there are also others that stand in the field for over 5½ months The duration of the crop is more or less a varietal character. There is an indication that the crop exhibits photo or thermo-periodism. The best tuber formation is in the cooler months of the year. The summer crop trials at the Central Farm, Coimbatore were a failure, either due to the prevalence of high temperature or long hours of daylight. Since the crop matures in long day periods in the U.S.A. and also in the West-Coast districts of this State, the higher summer temperature may be a disturbing factor. Short-day light on the other hand favours the formation of flowers.

The sweet potato crop makes good growth and comes up well as a purely rain-fed crop, where the rainfall is plentiful and well-distributed as in Malabar and South Kanara districts. It is grown as an irrigated crop in the other parts of the State, where the rainfall is comparatively less. It is not able to withstand drought or stagnation of water. Excessive irrigation tends to promote rank vegetative growth at the expense of the tuber-formation.

Sweet potato comes up best in deep, loamy soils and sandy soils, which are friable. Soils that harden on drying, shallow soils, clayey soils and soils rich in organic matter are not suitable. The growth of the vines tends to be excessive in clayey soil and rich soils, with correspondingly reduced yield of tubers. The heavy soils do not permit the development of the tubers and clay adheres to the tubers at harvest and spoils their appearance. The physical texture of the soil affects the size, shape and texture of the tubers. Nitrogen-rich soils and soils manured heavily with nitrogen tend to develop the vines at the expense of the tubers.. This is particularly so when the manure is not properly balanced and lacks potash. The advice given in foreign countries is to apply 1,000 to 1,500 lb. of a complete fertiliser containing 2—3% nitrogen, 8% phosphoric acid and 10% potash with at least 50 per cent of the nitrogen in organic combination.

Varieties: The varieties of sweet potato, under cultivation are limited when compared to the diversity and multiplicity of varieties noted in other crops. America, East Indies, Hawaii and China are said to have many varieties and the number of local names is confusing and complicates the study and classification of varieties. The cultivators recognise two varieties, or to be exact two types, only based on the colour of the rind of the tuber—"Red" or "White". The general concept is that the red variety is an early variety with a low yield, but with excellent table qualities and that the white variety is a late type which gives heavy yields of tubers of a slightly inferior quality. This is not a correct basis of classification, since a number of varieties with a common rind colour are grouped together as one variety.

The American classification is based on the shape and cooking quality of the tubers. Round types of tubers, having a central bulge, go by the name of "Sweet potato" and the elongated tuber types go by the name of "yams". Yam is the name given to tubers produced by the Dioscoreas, in the English-speaking countries and the use of the term "yam" for connoting a type of sweet potato is confusing.

The next classification of type is based on the cooking quality. Certain types are granular in texture and opaque on cooking and are dry for consumption. These are called "Dry and mealy" types. When the tubers cook to a waxy material that is translucent in appearance, the type is called "moist and sugary" or "moist-fleshed".

Classification of varieties is also done on leaf and petiole characters, pigmentation and so forth. Certain varieties have nearly rounded and entire leaves, while at the other end are some varieties with deeply lobed leaves.

Uses: The sweet potato tubers are mainly used as a vegetable in different ways, either raw, boiled, steamed, baked or roasted. They are also used for canning and dehydration. Dehydrated chips and flour keep well in storage. Starch, syrup, and alcohol are made out of the tubers on an industrial scale in America and sweet potato is coming into the lime-light, as a big commercial crop in place of corn and cotton.

The tubers not fit for human consumption and the sweet potato vines are used as feed for cattle, horses, sheep and pigs. The vines are also made into silage in a small way in America, but it is said to be slimy and inconvenient for handling. The vines could be cured into hay of medium to good quality. The green vines are fed to cattle in this country and what is not immediately consumed goes to the manure pit, a wasteful procedure. The green vines is a good feed for milch cattle, comparable with succulent leguminous fodder in value, but are apt to lossen the bowels when used as the sole roughage. 30—40 lbs. may be safely fed per head per day and supplemented by dry fodder. The surplus vines may be dried and made into hay. The vines contain about 17 per cent of proteins on an air-dry basis and properly made hay may be treated as a protein-rich feed.

The following analysis of sweet potato, compiled from various sources, gives an idea of the value of the different types of produce.

	Green vines	Vines (air-dry)	Silage	Tubers (range of)	Desiccated tubers
Moisture ...	86·42	10·00	54·87	78·26—58·85	10·46
Ash ...	2·98	19·75	1·85	0·76— 1·58	3·04
Crude protein ...	2·58	17·11	1·82	1·02— 2·91	4·50
Fat ...	0·32	2·12	0·66	0·55— 1·66	1·18
Crude fibre ...	3·05	20 22	1·48	1·11— 1·69	1·91
Carbohydrates* ...	4·65	30·80	39·41	15·38—34·42	78·91
	100·00	100·00	100·00		100·00
*Inclusive of					
Invert sugars ...				2·08— 5·74	18·55
Sucrose ...				0·58— 7·23	10·93
Total sugars ...				2·77—11·90	29·48
Starch ...					46·22

The sweet potato tuber is a good source of carbohydrates, present in a palatable form. The moisture content of the different varieties range from 58·85 to 78·26 per cent. To put it in another way, the dry matter content ranges from 21·74 to 41·15 per cent and the carbohydrate content from 15·38 to 34 42 per cent, and this is very significant to us.

The higher carbohydrate content is more than twice the lower carbohydrate content. The relative values of varieties depend therefore not only on the yields but also on the carbohydrate content of tubers. Since the carbohydrate content closely follows the dry matter, the relative values may be appraised by comparing the yield of air-dry matter content of the tubers For practical purposes the yield of air-dry tuber provide a basis for valid comparison. The air-dry material has a moisture content of about 10 per cent and air-dry matter yield automatically includes the yield of green tubers and their dry matter content.

General Cultivation: Sweet potato is generally cultivated by planting cuttings of stems having 4—6 leaves and which are called "setts". The vines are taken from a previous crop or a special nursery raised by planting vines or small-sized tubers. The planting is done on ridges spaced 2—2½ feet apart, with a distance of 9 inches to one foot between the setts along the ridges, or in beds. The crop is usually irrigated in this State, though purely rainfed crops are raised with the South-West monsoon rains in Visakhapatnam, Malabar and South Kanara districts. It is generally grown as a rainfed crop in other countries. The vines produced have a tendency to strike roots at the nodes, which is attempted to be averted by occasionally turning the vines in certain cases. Depending upon the variety and season of planting, the crop matures in 100 to 165 days, when the vines are cut and the tubers dug and marketed straightaway.

Season: In Visakhapatnam, Malabar and South Kanara districts, the rainfed crop is planted in June, with the onset of the South-West monsoon. In Visakhapatnam district, a second planting season is September, just when the North-East monsoon commences. In the Nilgiris, the crop is planted in April—May with the help of the pre-monsoon showers.

The irrigated crops are all planted from September to November, almost throughout the state, though plantings may be done later in certain cases. These crops get the benefit of the North-East monsoon rains and are later irrigated when necessary. Ten to 20 irrigations are given to the crops on the whole. The crops planted in the other months of the year do not generally form tubers properly, which may be due to either photo-or thermo-periodism to which the crop is subject.

Tuber formation commences after the close of the North-East monsoon. This assures freedom from stagnation of water for the tubers during heavy rainfall periods. Stagnation of water during the growing period does not appear to be so harmful to the crop as during the tuber forming and maturing phases. The nights are particularly cool during the period of formation of tubers and this is helpful.

Preparatory Cultivation: Sweet potato is usually grown after a cereal crop. After the harvest of the previous crop, the land is ploughed 4 – 6 times, to bring about a fine, powdery condition of the soil. Since the sweet potato field is usually friable and loamy, proper tilth is easily secured. Just before the last ploughing, cattle manure is applied at 10 to 40 cart-loads (5 – 20) tons per acre. In the Circars region, cattle are penned in the fields during summer, instead of applying the cattle manure. A levelling board is sometimes worked over the land for breaking clods. Finally the land is thrown into ridges and furrows, 2 – 2½ feet apart or into beds 3 – 4 yards square, with irrigation channels in-between every two rows of beds. In the coastal sandy soils, however, beds 4 feet by 20 feet are formed for planting the setts, as at Bapatla and irrigation is done by splashing water from mud pots.

American experience indicates that the method of planting, whether on ridges or in beds on the level, does not materially affect the yields.

Manuring: Sweet potato is an exhausting crop and requires for its growth large quantities of nitrogen, phosphoric acid and potash. It has been computed that a 11,000 lb. crop removes from an acre of soil, the following manurial ingredients :—

		Nitrogen	Phosphoric acid	Potash
Tubers (11,000 lb.)	...	30	10	50
Vines dry weight—1 ton	...	40	11	33
Total	...	70	21	83

Sweet potatoes may be taken to yield 8 to 10 thousand pounds of tubers per acre in this country and an ordinary crop may be expected to remove ingredients of plant food from the soil, almost as much as shown above. The heavier the crop, the greater will be the removal of plant food ingredients. The large doses of cattle manure applied here may normally be expected to supply a sufficiency of plant food ingredients to the sweet potato crop. The soils are generally well furnished with potash, except the West-Coast districts, where however, wood ash is applied in addition to other manures.

The cultivators in the coastal areas apply 1 – 2 cwts. of ammonium sulphate per acre to the sandy soils. Fish guano, tobacco stems and wood ash are applied in Malabar and South Kanara districts, before ridging up the crop. Green leaves are also applied in addition, in the South Kanara district.

American workers have recorded that manuring the sweet potato crop with ammonium sulphate and other inorganic manures for the supply of nitrogen, tends to produce vines at the expense of the tubers and to

induce low keeping qualities in the tubers. While nitrogen promotes vegetative growth and builds up the plant body, phosphoric acid is required for the proper development of the roots. Tubers are after all roots enlarged by the deposition of starch and sugar and tuber formation and development are associated with the availability of phosphoric acid. Potash aids the elaboration of starch in the green leaves and its translocation to the tubers. The importance of an adequate supply of potash cannot be over-emphasised. Where potash is in short supply, the sweet potato leaves get thickened, there is derangement in the mechanism of translocation of starch to the tubers and the tubers do not develop properly. South Indian soils are said to be supplied with a sufficiency of potash, but poor soils would be benefited by potassic manuring. The application of wood-ashes as in Malabar and South Kanara are attempts to add potash to the soil. Even in other areas complete fertilisers may help to increase the yields.

Nurseries: The crop is propagated by planting stem cuttings. The tender as well as the over-mature stems are not used as planting material. The main crop harvest is from January to March and the harvested vines are used for planting the primary nurseries. The primary nurseries, about an eightieth of the area proposed for the crop of the next season, are prepared like the main field and should be located near wells, for facilitating irrigation during summer months. The setts are planted in beds with a spacing of 9 to 12 inches between the setts. The central part of the setts is pressed into the soil, leaving the two ends exposed. About 50% of the length of the sets is buried in the soil, with the top-end sticking out a little more than the bottom-end. The ends strike root at the nodes and sprout appear in 7 – 10 days. The nurseries are irrigated once in 4 – 7 days, during the early stages and later at longer intervals. The nursery areas make good growth and the land is covered by about June, when the vines are cut and planted in a second nursery, 8 — 10 times the primary nursery area. The secondary nurseries provide planting material from September onwards, for the main tuber crop. After the vines in the nurseries are cut, the nurseries may be irrigated for providing a second flush of vines for use as setts later in the season, if required.

When there is moisture in the main field, after the harvest of the tubers, the immature and undeveloped tubers in the soil sprout and vines produced are sometimes used as setts for planting the primary nurseries. This is a common practice in the sandy areas.

In America, the usual practice is to place sweet potato tubers side by side in sandy beds, 3 – 4 inches deep, overlying 8 – 12 inches of fresh horse manure trampled in, and cover the tubers for sprouting, 6 weeks before taking up the planting. The beds are watered after

bedding the tubers. 6 — 8 bushels (330 — 440 lb.) of tubers bedded in 16 square yards of beds give 10 to 15 thousand slips for planting an acre. The shoots called 'slips' are pulled with one hand, while the soil over the mother tuber is pressed with the other. The roots of the slips are dipped in a thick suspension of clay and cow-dung. The beds are watered immediately after pulling the slips, to settle the soil and promote the formation of further batches of slips. When 2 or 3 crops of slips from the same bed are used for planting, three to four bushels of tubers provide sufficient slips for planting an acre. Sometimes, the slips are allowed to run to vines and the vines are cut into setts for planting. The beds are then watered freely, with nitrate of soda dissolved at one ounce per gallon of water.

Planting the Crop: The setts are planted on the sides of ridges or in beds, after a soaking irrigation. The usual spacing is 2—2½ feet between the rows and 9 — 12 inches between the setts in the row. When planting is done in beds, the spacing given between the setts is 9 to 12 inches either way. 15 — 30 thousand setts are required for planting an acre, depending upon the method of planting and the spacing between the setts.

The vines being very succulent, get heated up and start rotting, when packed in gunnies for transport to other places. If the vines are to be sent long distances, they may be partially wilted, stripped of the leaves and the young tender portions, and packed in gunnies. Vines so treated keep in good condition for 10 — 12 days. One gunny bag of fresh green vines weigh about 60 lb. and give 2,000 setts. One bag of wilted vines, stripped of the leaves and tender shoots give an equal number of cuttings and weigh about 25 lb. Removal of the more succulent leaves and tender portions and wilting the vines save freight charges and prolong the keeping quality of the vines intended for setts.

The newly planted crop is irrigated on the fourth day after planting, if there are no rains and also on the 8th or 9th day to facilitate the rooting of the setts and the establishment of the crop.

Irrigation: Nearly 40 per cent of the sweet potato in this State is raised under rainfed conditions in Malabar, South Kanara and Visakhapatnam districts, during monsoon seasons, from June to December. The other areas are under irrigation, which is the most important operation during the period of growth of the crop.

The sweet potato is irrigated like most other crops, with about 3 inches depth of water each time, given periodically as and when required. The irrigations given at intervals of 3 — 5 days establish the crop. The North-East monsoon rains keep the crops growing

vigorously till about the middle of December. Even during this period, irrigations are given if rains withhold. After the monsoon ends, the crop is irrigated regularly once in 10 — 15 days, depending upon the type of soil and the depth of irrigations given. The crop receives 10 irrigations at least and at the most 20 irrigations. The final irrigation is carefully adjusted, so that the soil is lightly moist at the time of harvest. If the moisture is at the proper level, the soil does not stick to the tubers and they present a clean appearance.

The sweet potato is affected by drought, as well as by stagnation of water. The leaf surface of the crop is considerable, transpiration losses through the leaf surface are heavy and the leaves droop when the moisture in the soil gets low. If soil moisture is not then readily made-up, the growth is arrested, with a corresponding drop in the yield of tubers. The crop is particularly susceptible to stagnation of water after tubers commence forming; the tubers tend to rot and decay.

In the coastal sandy areas, temporary wells are dug and water is generally available at depths ranging from 3 — 6 feet from the surface. The water is carried in pots and splashed over the crop for providing moisture to the soil. Splash watering is done in such areas almost every day during the first month and later every alternate day till about 10 days before harvest of the crop. The quantity of water used for splashing is much less than that used for crops under flow irrigation and the sweet potato is likely to require 60 — 70 splash or hand waterings.

After-cultivation: The sweet potato establishes within 10 days of planting and starts growing vigorously after three weeks, when it is given the first weeding. The second weeding is done a month after and later the vigorous vines tend to strike roots at the nodes contacting the soil. The growing vines are gently lifted to break and disconnect the roots. One view is that if rooting at the nodes is permitted, they would also develop into tubers, the large number of tubers that develop would necessarily be of small size and that the quantity of marketable tubers would be reduced. The American experience is that this supposition has no basis and that the rolling or lifting of the vines sometimes interferes with the metabolic activites of the plant. At best, the lifting of the vines may be inocuous.

With ridge planting, the ridges are earthed up, when the crop is about 2½ months old. The ridges get disintegrated by the heavy rains in Malabar and South Kanara and green leaves and wood-ash are applied to the rows at the time of earthing-up.

In America, the crop is planted both on ridges, as well as on level ground, with a spacing of ½ to 4 feet between the rows and 14 — 20 inches between the plants in the row. The vines spread all over and interfere with the cultivation of the inter-rows. The vines are rolled

over to alternate rows with the help of suitable rods or poles and the vacated rows are first cultivated. Later the vines are rolled over to the cultivated rows and the uncultivated rows are next taken up. The vines are generally moved with manual labour. Some implements are provided with leaf guards which lift the vines and clear the rows in advance.

Harvesting: When the tubers are fully developed and mature, the leaves turn pale and later lightly yellow. This is one of the usual signs of the maturity of the crop, but certain varieties do not exhibit this character. As the tubers develop, cracks develop about the base of the plants, though this may not be very apparent in irrigated lands and very loose soils. The mature tubers are comparatively brittle and the juice exuding from broken ends dry up quickly, without any discolouration, while the surface darkens or gets greenish when the juice dries up rather slowly in the case of immature tubers. The skin of the mature tubers is not easily bruised, nor does it peel off easily. Soil does not stick fast to the mature tubers.

The harvest of the crop is commenced a fortnight before the crop is fully mature and continued for a fortnight or so after full maturity. The harvest is done in stages so that the harvested tubers could be disposed off in the markets readily as they are dug in batches. The tubers are not usually kept in storage in this country for disposal later in a rising market. The harvest may, in extreme cases be postponed by a fortnight and the harvested tubers may remain with the cultivators for 7 — 10 days at the most, when there is no demand in the market. Since the tubers are not kept in storage, the area under the crop is limited to the demand in the market for fresh produce. If suitable methods of storing tubers are developed it may be possible to increase the area under the crop and supplement the country's food supply in a substantial manner.

The harvest of the tubers is best done at the correct stage of maturity to get the maximum yields and this point requires to be specially emphasised. If the tubers are harvested before they are mature, the yield and quality of the tubers are lowered. If the crop is kept on the land after maturity, the tubers tend to get damaged by the sweet potato weevil (*Cylas formicarius* F.) and the proportion of marketable tubers is reduced. The adult weevils as well as the grubs bore into the tubers and spoil them. The furrows get darkened and surrounding tissues are spoilt, giving an unpleasant smell and bitter taste. Fungal and bacterial damage follow in the wake of the weevil attack. The affected tubers have to be rejected; being unfit for table purposes. The extent of damage that the weevils effect has to be seen to be believed; 40 per cent of the tubers may be damaged in the course of a fortnight and 70 — 80 per cent in the course of a month. It is also noteworthy that immature tubers are seldom affected to the same extent by the weevil. It appears not unlikely that

the character of the latex in the tubers may be responsible for this differential behaviour of the weevils. The latex of the mature tuber dries up readily without any discoloration of the wound surface, while the latex of the immature tubers dries at a slower rate to a sticky material, which is discoloured. The weevil trouble is serious in certain localities and keeping continuous supply of planting material may be one of the causative factors. The presence of alternate host plants is another possibility. No effective remedial measures are known. Taking all these into consideration, it may be safe to advise that the harvest be done as soon as marketable tubers have formed in spite of the lower yield. Where however, the weevil damage is negligible, the harvest of the crop may be done at the correct stage of maturity or if necessary, even later.

The harvest is commenced by cutting the vines and clearing the land of the vines. The field is dug up with crow-bars and mammotties (spades) and the exposed tubers are collected, shaken free of soil and transported either in gunny bages or loosely in carts. 70 — 80 per cent of the tubers are marketable and the rest is made up of small-sized and immature tubers, diseased tubers and tubers cut while digging. The cut tubers are purchased by labourers at reduced rates and used in their households. The immature tubers are fed to cattle and other livestock. The diseased tubers are not useful and are rejected.

In America, sweet potato is harvested with potato digger ploughs designed for tuber-crop lifting. The mould-board of the plough is of a special design. There are slots running in the direction of the mould-board through which the cut furrow soil falls back in the furrow and the tubers are delivered in rows. The tubers lie partly buried in the soil and are picked by hand. There are sharp disc coulters attached to the beam of the plough, which cuts the vines in advance. The digging is done in the mornings, to permit the lifted crop being gathered before frost sets in, in the night. The tubers are transported to the store-houses.

The store-houses are insulated structures with facilities for the regulation of temperature and aeration. The tubers are spread out on racks and the temperature is maintained at 15° — 130°F, for 7 — 20 days. During this period the tubers lose their extra moisture, about 6% in the first week and another 6% in the next fortnight, and they are then able to stand storage, without sprouting. The temperature is then brought down and maintained at 55° — 60°F till required for the market. Surplus tubers that could not be accommodated in store houses, are put in conical heaps over a thick bedding of straw and covered over with straw and finally a thick layer of earth. Ventilation is provided for these clamps through a hole at the top. When tubers are required for the market, the tubers are cleaned, graded and packed in veneer barrels or baskets. They are never marketed in bulk or in bags as in India.

Changes take place in the composition of the sweet potato tubers, when kept in storage, after preliminary curing. There is a slight reduction in the moisture content. A part of the starch, upto 25%, gets transformed into dextrose and finally into sucrose. The dextrose content increases lightly, upto 0·77%, but the sucrose content increases up to 4·16%. There is a similar conversion of starch to sugars, during cooking, the sucrose content risings lightly upto 0·45% and the dextrose content. considerably, from 4 — 9%. The starch in the tubers is said to be dissolved by the diastatic enzymes present in the tubers, when the temperature is raised from 60° — 100°C. and maintained for in 1—1½ hours. The addition of sweet potato flour at 1·5% level to wheat flour is claimed to raise the loaf volume of the bread by about 10 per cent.

Successful storage of tubers in America is made possible by the observance of the following principles :—

1. Mature tubers are selected.
2. Diseased and bruised tubers are rejected.
3. The tubers are first cured partially, by subjecting them to sweating at high temperature for varying periods, depending upon the original moisture, and by
4. Regulating the storage temperature.

The natives of Africa are said to store sweet potato tubers in holes dug for the purpose. The tubers are spread out in shade for a few days, to reduce the moisture content. Later they are stored in pits, in layers alternately with wood-ash. The pits are finally sealed with a thick layer of earth. A large part of the tubers are said to keep well, without spoilage. Even when some tubers are spoiled, the spoilage does not spread to the neighbouring tubers, because of the ash in between. Experiments done in America show that any dry material will serve as a packing and that sand or road dust could replace the ash without any difference in storage efficiency.

Tubers wilted for 2 — 3 days, washed, cooked for an hour, split longitudinally into 3 or 4 pieces and dried in the sun till they are brick-hard are said to keep well in ordinary storage for over two years in East Africa. The slices are washed and cooked in the ordinary manner as and when required. It is claimed that such preserved tubers are even tastier than fresh tubers.

It has been noted that sweet potato tubers do not stand long storage under the conditions prevailing here. They have a tendency to sprout soon after they are put in storehouse here. Possibly the method of pitting followed in East Africa may be adapted to our

conditions, with suitable modifications. Preservation of slices that have been cooked and dried by the East African method may be suitable for localities, which are not very humid.

Yields: The yield of tubers is variable. The rainfed crop gives 5,000 — 7,000 lb. of tubers per acre and a variable quantity of vines. The yield of irrigated crops ranges from 4,000 — 24,000 lb. of tubers per acre, with an average of 8,000 lb. for the whole State.

The vine yield of the irrigated crop ranges from 10,000 lb. to 20,000 lb. per acre. Sweet potato planted in November – December, as a green fodder crop gives 3 – 4 cuttings of vines from March to May, aggregating 55 to 70 thousand pounds per acre. The growth of vines during the summer months is vigorous, when compared to the growth of other green fodder crops.

Tuber yield appears to be associated with the vigour of the vines but not necessarily with the growth of the vines. A certain extent of growth of the vines is necessary for the production of tubers, but excessive, rank growth of the vines is at the expense of the tubers. The proportion of vines to tubers may be a primary varietal character, but is greatly influenced by the richness of the soil, its content of organic matter, and the preponderance of nitrogen in the manures applied, without being balanced by sufficient quantities of potash.

Information on the performances of the local varieties of sweet potato under cultivation in this state, is lacking. Preliminary observation of six varieties of sweet potato introduced at the Agricultural Research Station, Koilpatti from Travancore in the 1948 – 1949 season, indicates that there are wide differences in the potential capacities of the different varieties. Whether the heavy croppers would behave consistently year after year and maintain their relative superiority remains to be seen. The yields obtained in the first year of the trial are however given below :—

No.	Name of variety	Yield in lb. per acre			Vine-tuber Ratio
		Tubers	Vines	Total	
1.	Seelanthi chuvalai ...	28,206	15,857	44,063	0·56
2.	Aruvan vellai ...	25,448	27,069	52,517	1·06
3.	Dindigul variety ...	15,220	19,189	34,409	1·26
4.	Bhadrakali ...	12,455	25,473	37,928	2·04
5.	Parenkima ...	10,241	33,291	43,540	3·24
6.	Kuduku Vellai ...	8,445	26,540	34,992	3·12

Variety No. 2 leads in the total production of succulent tubers and vines. No. 1 leads in the production of tubers. Where vines are fully utilised the preference may be for variety No. 2; otherwise preference may be for variety No. 1.

The choice of suitable varieties should help in increasing greatly the yield and profits obtained and consequently in popularising the crop and expanding the acreage under it.

The 'Pelicon Processor' one of the starchy varieties of sweet potato evolved in U. S. A. for use in industries is said to yield 20 to 30 thousand pounds of tubers per acre and the table variety 'Puerto Rico' an average yield of 16,500 pounds of tubers, with yields going up in some cases to 33,000 lb. per acre, in America.

Marketing: Sweet potato is grown in this State, principally as a vegetable crop and the area under the crop is regulated by the demand from the nearby consuming centres. It is perishable to an extent and is not moved over long distences, nor kept in storage or under preservation. Urban centres are the chief consuming areas and are catered to by suitable producing areas round about. Madras is a big consuming centre and collects the produce from the neigbouring districts of Nellore, Chingleput, North and South Arcot. Similarly, the various district headquarter towns draw their supplies from the surrounding taluks, through vegetable vendors and middlemen. The several weekly shandies are also collecting centres, where the cultivator himself disposes off his crop directly. The harvesting is adjusted to meet the demands of the consuming market. The people engaged in the vegetable trade are able to guide the cultivators in such a regulation of the harvests. The harvested tubers left unsold in the principal markets are attempted to be sold in the villages. The left-over tubers, when few, are sliced and made into chips by drying in the sun, to serve as a stand-by for the cultivator, but the total quantity so preserved is negligible.

If sweet potato is grown as a subsidiary food crop to supplement the food grains in short supply in the country, the tubers produced in excess of the current requirements may have to be kept in proper storage or preserved in suitable forms, by developing suitable methods. Sweet potato was used as a subsidiary food crop in the southern states of the United States of America during the war and if necessary, a similar and suitable adaptation of the food habits should not be impossible in this country. The prevailing high temperature would be an additional factor that may have to be taken into consideration, while storage and preservation problems are being tackled and solved.

Pests and Diseases: A number of insects and fungoid diseases are known to affect the crop and cause serious damage, in the various parts of the world. But fortunately none of them are of major importance in South India, excepting the "Sweet potato weevil"-*Cylas formicarius F.* The damage done by the weevil is very severe in certain localities. There are no known remedies against the weevil, but the observance of the following plant sanitation methods should help to minimise the damage:—

(1) The weevil burrows into the vines and later attacks the tubers. If the crop is grown in rows or on ridges and earthed up well, before the formation of the tubers, it would assist in reducing the incidence of the weevil.

(2) The fields selected for planting sweet potato should be far away from those cropped with it in the previous season and from nurseries. The distance from a possible source of infection is all-important, since the weevil is a slow-moving creature that is not able to traverse long distances.

(3) When vines are being cut for setts, 12—15 inches of the vine near the base of the plant should be rejected, as the weevil is mostly confined to the base of the plant.

(4) Keeping the prepared setts submerged in thin tobacco docoction or subjecting them to Gammexane smoke generated from pellets, for about 6 hours before planting, would reduce the weevils.

(5) The bunds and surroundings about sweet potato fields should be kept free of convolvulus weeds and plants, so that they may not act as alternate host plants for the weevils.

(6) The harvested fields should be cleaned and sweet potato residue of all kinds should be removed. The voluntary slips that develop in the harvested fields should be removed with the tubers and destroyed.

(7) Plant sanitation and segregation of the unaffected crop are the only rational methods of keeping the weevil population in check.

Cost of Cultivation and Returns: The cost of cultivation of sweet potato varies widely and a rough estimate is given below, assuming that all the items of labour, seed, and manure are paid for.

Cost of cultivation of sweet potato per acre.

Particulars	Cattle pairs at Rs. 2—4—0 a day	Men at Re. 1 a day	Women at Re. 0—8—0 a day	Cost Rs.	A.	P.
Ploughing 4 times ...	8	8		26	0	0
Forming beds and channels ...		8		8	0	0
Carting and applying manure ...	3	4½	6	14	4	0
Cost of 20 cart-loads of cattle manure at Rs. 4 per cart ...				80	0	0
Planting setts ...		1	8	5	0	0
Cost of 15,000 setts at Re. 1 per thousand ...				15	0	0
Lift irrigation with mhote ...	37½	37½		121	0	0
Guiding water (15 irrigations) ...		15		15	0	0
Weeding twice ...			16	8	0	0
Harvesting and carting tubers ...	2	15	20	29	8	0
Lease of land ...				60	0	0
Total expenditure ...				381	12	0
Receipts.						
Value of 12,000 lb. of tubers at 20 lbs. per rupee ...				600	0	0
Value of 18,000 lb. of vines at Rs. 2/- per 1000 lb. ...				36	0	0
Total receipts per acre ...				636	0	0
Net profit per acre ...				254	4	0

If electrical energy were used instead of bullocks for lifting water for irrigation, 270 units of electricity would be used for 15 irrigations costing Rs. 16—14—0, instead of Rs. 121/- spent on mhoting. There would be a saving of Rs. 104—2—0 in expenditure and the net profit would increase correspondingly and be Rs. 358—6—0 per acre.

The quantity of manure and irrigation given is variable and determines the size of the crop harvested. The setts used for planting, the manure applied and bullocks worked with the mhote are with the cultivator and they are not paid for and these are the major items of cultivation. The cultivator and his family work in the field and the labour engaged for field work gets reduced thereby. The cultivation charges actually incurred by the cultivator are therefore much less than what has been figured, whereas the receipts shown are all real and tangible, so much so the real profit obtained is more than what has been worked out.

Further, 12,000 lb. has been shown as the average yield and this is low for the intensity of cultivation indicated, that is for the manure and irrigations given. The cultivator should get greater yields under such conditions and his profit should be more. Sweet potato cultivation is thus a very paying proposition and should appeal to the cultivators. It is a big commercial food crop, whose cultivation now at this time of shortage of food supply in the country is a real national service that combines the profit motive as well.

Cooking sweet potato and recipes: Sweet potato is a common vegetable which is well known and used by all classes of people. It is suitable for being made into almost all types of South Indian curries, just like the ordinary potato. It is commonly boiled with a little salt and water and sold in throughfares, and bazaars. It is taken as a light repast by children and labourers. It is tastier when it is cooked in steam with the jacket on. Baking in live coal is considered to be best form of cooking the tubers, which retains the full flavour of the tubers.

A few recipes are given below to help the house-wife in making a fuller use of the sweet potato and in indicating new methods of serving the tubers.

(1) *Bondas:* Boil and skin the sweet potato and mash it. Add salt, chilli powder, coconut scrapings and seasoning to taste. Seasoning consists of heating a little gingelly oil and roasting a mixture of black gram dholl and mustard, till the mustard sputters. Mix thoroughly and form small balls of about $1\frac{1}{2}$ inches in diameter, dip in a thin batter made with Bengal-gram flour and fry in deep oil or ghee.

(2) *Chappathis:* Mix 4 cupful of mashed sweet potatoes with one cupful of American flour and a little salt and roll into a stiff dough, adding a little water, if necessary. Make chappathis with the mixed dough and serve.

(3) *Poli:* Prepare the dough as for chappathis given above using jaggery instead of salt. Form small balls 2 inches in diameter, roll rather thinly on a floured board and bake on a hot plate adding a little ghee while baking. Turn the poli on the plate after the under-side is done. and bake to a light brown colour. Serve hot with a little ghee.

(4) *Chips:* Wash the tubers and slice into discs 1/8 of an inch thick and fry in coconut oil. Remove the chips when crisp and add salt and chilli powder to taste.

(5) *Porridge:* Mash boiled tubers, add sugar to taste and serve with hot milk. Dried sweet potato chips may also be cooked and used instead, similarly.

(6) *Bread:* Mashed sweet potato may be added to sifted flour, in the proportion of one of the mash to 2½ parts of flour and leavened bread made in the usual manner.

(7) *Biscuits:* Dried sweet potato flour may be added to sifted flour upto one-eighths and biscuits made in the usual manner.

(8) *Poori:* Mix dough as for chappathis, take small portions and roll thinly on a board fry in deep oil or ghee.

(9) *Salad:* Young leafy tops and stems are seasoned with salt, onions, lime juice and a little sweet oil, for use as salad.

Sweet potato is a profitable crop and produces from the same area more calories than cereals. It is necessary in the national interest to switch over larger areas for sweet potato cultivation. The cultivators are able to study the market and adjust their cropping to suit the market. Yet the area under the sweet potato crop is not increasing, because of certain risks associated with it. Sweet potato production is seasonal. The produce comes to the market from January to April mainly. Sometimes large areas come to maturity together and everybody sends his produce to the market, there is a glut and prices are depressed to uneconomic levels. The cultivator wants to avoid this and restricts the acreage under the crop. This is because the harvested produce cannot be kept in storage and held over for proper distribution. Here then is the bottle-neck and it is necessary to evolve methods of storage of sweet potato tubers to suit the prevailing climatic conditions.

Sweet potato is harvested in January to April and what can not be consumed in the fresh state, could be preserved by slicing, drying and storing as chips. The harvest is fortunately in the dry season and the drying could be done in the production village centres themselves, without resorting to artificial and costly methods. Methods of utilising

the dried chips to suit the taste and palate of the people, have to be evolved. The best way of drying also has to be worked out. Would raw tubers give the most acceptable type of chips or should the tubers be blanched or cooked partially or fully, before drying, are points that require to be settled. It is suggested that the chips could be easily milled into flour and used as a partial or entire substitute for making *dosais*, *iddalies*, oil-fried cakes and various other preparations. When the use of flour as acceptable types of food is popularised in the ordinary household, the cultivation of sweet potato will increase, and successfully combat the shortage of food supply in the country.

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"Classification of the Bananas"—A Resume*

By

Dr. K. S. VENKATARAMANI

Although there seems little reason to doubt that the banana was one of the first foods of man and that it was one of the first plants cultivated, its specific and varietal relations have never been well defined. For want of a proper approach to the problem of classification and nomenclature, the various attempts to study these plants have only resulted in chaos. Based on the extensive collection of the species of *Musa* at the Imperial College of Tropical Agriculture, Trinidad, Cheesman (1947, 1948, 1949) has recently discussed the subject in a series of articles under the caption "Classification of the bananas". His publications really deal with the genus *Musa* as a whole and not on the edible bananas as such. It is, therefore, necessary to point out that the word 'banana' has been used by him in these papers in a very wide sense and it covers both the fertile (wild and seeded) and the parthenocarpic (edible) forms.

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* I have freely drawn from Prof. E. E. Cheesman's publications. He has been of guidance to me in some of my work and I wish to take this opportunity to express my indebtedness to him.

Many of the original publications on this genus are not easily accessible to every worker and Cheesman's revision of the genus *Musa* with extensive transcriptions of important material from the older works is, therefore, a mine of useful information. These papers place at one's hands the essence of the classification of a genus, which presents some peculiar difficulties to the student. Although of great economic importance, it remains very imperfectly known and classified. Its geographical distribution is rather wide, including Ceylon, India, Burma, Siam, S. China; Indo-China, the Malay Peninsula the whole of East Indian Archipelago, Queensland and many of the islands of the Pacific Ocean. Within this vast territory the ecological distribution of the fertile species is mainly in forest areas. Many species occur in inaccessible places where opportunities for collection are few. The plants do not lend themselves to the preparation of useful herbarium specimens; even after careful and laborious drying they only present a sadly distorted caricature of the living plant. The inflorescences are large, not generally available in numbers to enable a complete description and the size of the various parts is such that collection of more than a few fragments is not possible. Thus, the living specimen seems to be the only satisfactory material for study.

The determination of species and varieties appears to have depended largely on verbal descriptions and drawings of varying quality and unfortunately a bulky and confusing literature has resulted. The seedlessness of the cultivated bananas has proved a source of error to many and some have regarded the seedless forms as ranking with the fertile species. Advances in genetics have now modified our views about the origins and taxonomic status of crop plants. A modern view of the genetic system of the bananas has been presented by Dodds (1943) and cytogenetical studies have greatly aided the proper grouping of the various species of *Musa*.

The Genus Musa L.: The last good revision of this genus was made by Baker (1893) and it has remained the standard treatment for more than five decades. According to him the genus could be divided into three sub-genera, (i) *Physocaulis* (stem bottle-shaped; flowers many to a bract; petal usually tricuspidate; fruit inedible), (ii) *Eumusa* (cylindrical stem; many flowers to a bract; bract green, brown or dull violet; petal ovate-acuminate; fruit usually edible), and (iii) *Rhodochlamys* (stem cylindrical; few flowers to a bract; bract bright coloured, often red; petal linear; fruit usually not edible). Since Baker's last treatment of the subject, a number of new species has been added.

Undue emphasis on the cultivated forms is a weakness in Baker's treatment. Edibility in the bananas primarily depends on the occurrence of parthenocarpy, with which is always coupled a degree of female sterility and comparative seedlessness. There is no evidence that parthenocarpy

has ever occurred in more than a few *Musa* species and although of great economic importance, the numerous parthenocarpic forms are, therefore, of no taxonomic value. The classification of the edible varieties is a separate problem from the general taxonomy of the genus and needs almost a different technique for its solution, viz., a detailed description of the vegetative and fruit characters and carefully chosen sketches and photographs for readily distinguishing the well-known varieties (Venkataramani, 1946). Cytogenetical studies prosecuted during the last two decades and over, have provided an entirely different approach to the classification of the genus, especially with regard to the relationship of the cultivated forms to the wild. Cheesman has now revived Horaninow's neglected genus *Ensete*, to which he has also proposed the transfer of a group of *Musa* species, including the whole of Baker's sub-genus *Physocaulis*. To conform with the findings of cytogenetical studies of the material in the Trinidad collection of *Musa*, a regrouping of the remaining species has been suggested.

The revised grouping of the species: The different groups have been termed 'sections' rather than sub-genera in an attempt to avoid the implication that they are of equal rank. One division in this new classification has a cytological basis and falls between species having 11 pairs of chromosomes and those having 10 pairs. The difference involves fundamental differences in genetical behaviour and chromosome number in *Musa* appears to be not only a safe criterion of relationship but also the best. Each of these 'chromosome-groups' is again divided into sections.

The suggested division into sections:

A. Chromosome number X=11. Bracts usually more or less sulcate, often more or less glaucous, rarely or never polished, convolute or more or less imbricate in the bud, usually strongly revolute on fading. Seeds occasionally subglobose, more often dorsiventrally compressed, sometimes lenticular, smooth, tuberculate, or irregularly angulate, with a marked or obsolete umbo opposite to the hilum.

1. Inflorescence pendent or semi-pendent from the first, the fruits reflexing in development towards the base of the rachis. Flowers many to a bract, in two series. Bracts commonly dull-coloured, green, brownish or dull purple. Pseudostems commonly exceeding 3 metres high ..... Section *EUMUSA*

2. Inflorescence erect, at least at base, so that the fruits do not reflex in development but point towards the apex of the rachis. Flowers few to a bract, usually in single series. Bracts brightly coloured, often red. Pseudostems commonly less than three metres high ..... Section *RHODOCHLAMYS*

B. Chromosome number X=10. Bracts plane, firm in texture, polished on the outside, rarely or never glaucous, strongly imbricate in the bud, not or only slightly revolute on fading.

3. Seeds sub-globose or more or less dorsiventrally compressed, smooth, striate, tuberculate, or irregularly angulate, with a marked or obsolete umbo opposite to the hilum corresponding to a small perisperm chamber within..... Section *AUSTRALIMUSA*

4. Seeds cylindrical, barrel-shaped, or top-shaped, marked externally by a transverse line or groove, above which they are warted, tuberculate or variously patterned, below usually smooth; internally with a well-developed perisperm chamber above the same line, this chamber empty in the ripe seed. ..... Section *CALLIMUSA*"

Cheesman's "Classification of the bananas", as already mentioned is really a revision of the entire genus *Musa*. We shall, however, presently deal with the 'section' *Eumusa* to which can be ascribed all our edible, horticultural varieties and even in this section with only those which are or are supposed to be, the parent species of the numerous cultivated forms.

Section Eumusa: A revision of Baker's sub-genus *Eumusa* leaves the following fertile species in this section: *Musa acuminata* Colla, *M. banksii* F. M., *M. basjoo* Siebold and *M. balbisiana* Colla (included by Baker in *M. sapientum* L.). To this, of course, is added *M. nagensium* Prain, a species included since 1893. This section may be called the group of "true" bananas. It contains the two commonly occurring wild species, *M. acuminata* and *M. balbisiana*, and with them all the cultivated bananas that are believed to have been derived from them. The occurrence of parthenocarpy in *M. fehi* Bert. ex Vieill. (Section *Australimusa*) has to some extent obscured the position, as all edible bananas were considered in the past as fairly closely related. The 'fehis' are evidently distinct from the "true" bananas common in cultivation throughout the tropics and they are seldom cultivated, though edible.

Musa balbisiana Colla: This is the commonest and most widely distributed of all *Musa* species. Its identity has been badly muddled and it has been chiefly known as a variety of *Musa sapientum* L., "the most confounded and confusing combination in the whole literature of *Musa*." Colla was the first to recognize this as one distinct from any previously described species and his nomenclature, therefore, seems to be the valid one. A brief description of the species is as follows:

Plant suckering freely; pseudostems robust, green or pale green; leaf blades oblong, truncate at apex and rounded or slightly cordate at base; petioles long, their edges almost meeting over the adaxial channel, margins developed in the lower regions and closely appressed to the

pseudostem. Inflorescence is pendulous, 'heart' or male bud ovoid or ellipsoidal, bracts imbricate at the blunt apex; bracts rounded at apex, often with a green or yellow tip, more than one lifted at the same time, thus exposing a number of clusters of male (staminate) flowers simultaneously; bracts usually deciduous and occasionally persistent in a withered condition, especially in the later stages of blooming. Fruit bunch pendent and compact; individual fruits small, about 10 cm. in length and 4 cm. in diameter, angulate at maturity, abruptly narrowed at base into a short pedicel, and gradually at the stigmatic end into a short and broad beak; rind thick, pale-yellow in colour when ripe; pulp whitish and with seeds; seeds black, irregularly rounded, scarcely depressed, and about 5 mm. in size.

Distribution: Ceylon, S. India, Burma, Siam, Malaya, Java, Philippines and New Guinea.

2. **Musa acuminata Colla:** This is one of the important amongst the *Musa* species. It has also a rather wide distribution like *M. balbisiana*, but surpasses the latter species in its variability. Cheesman (1948) discusses this species in great detail, and a brief description of the species, as at present recognized, is as follows:

Plant stooling either sparsely or freely; pseudostems slender with varying development of brown-black markings from almost green to almost entirely black, sometimes reddish-brown in lower parts; leaf sheaths and petioles more or less glaucous or pruinose and extremely variable in the development of wax. Leaf blades oblong, truncate at apex, usually rounded at base, sometimes rounded on one side and acute on the other, varying from green or green tinged with purple to wholly purple on the lower surface, green above, with or without flecks or bars of purplish brown pigments, mid-ribs green, greenish yellow or more or less strongly tinged with red below; petioles long, slender or stout; petiole margins almost erect with an open adaxial channel, or strongly incurved over the channel and almost covering it, usually definitely developed where the petiole passes into the leaf sheath and closely appressed to the pseudostem, slightly bent outward away from the pseudostem occasionally, becoming scarious in this region, often bordered with a red line when young. Inflorescence sub-horizontal or pendent; peduncle and rachis usually more or less thickly pubescent, sometimes glabrous; male bud in advanced blooming ovoid to turbinate, usually acute; bracts convolute, imbricate at the extreme tip only, or rather strongly imbricate, various shades of purple or red, ovate, usually acute at apex, sometimes yellow at the extreme tip, outer surface more or less glaucous, faintly ribbed longitudinally, inner surface light red or yellowish, always paling towards the base; only one bract lifted at a time, bracts revolute on fading, and early deciduous. Fruit bunch

compact if borne vertically, assymmetrical if borne sub-horizontally, fruits exhibiting marked geotropic curvature; individual fruit 8–13 cm. long, 1·5–3 cm. in diameter, sub-cylindrical, angles or ridges almost disappearing at ripeness, rather abruptly narrowed at base into a short pedicel and at apex into a prominent beak about 1·5 cm. long; pericarp about 2 mm. thick, bright yellow at full ripeness; pulp whitish or cream to yellow; seeds, when present, dull black, smooth or more commonly minutely tuberculate, irregularly angulate and depressed, about 7 mm. across and 3 mm. high.

Distribution: Fairly wide—Assam, Burma, Indo-China, Siam, Malay Peninsula and Philippine Islands.

3. **Musa paradisiaca L:** Linnaeus's names *Musa paradisiaca* and *M. sapientum* have led to some confusion. However, the identity of the original *M. paradisiaca* is clear enough and has never been seriously disputed. What exactly Linnaeus had in mind when he described his *M. sapientum* is not clear and observations made during recent years tend to show that cultivated bananas grouped under *M. sapientum* appear to be mostly of a hybrid origin. Therefore, the combination *M. sapientum* is not quite valid.

A grouping of banana varieties according to their resemblances in botanical characters to Linnaeus's *M. paradisiaca* appears to correspond to a grouping on resemblances to the fertile diploid species, *M. acuminata* Colla. *Musa paradisiaca L.* may be regarded as the 'type species', although a seedless cultivated form, and *M. acuminata* as its most probable 'wild' form. Both the cultigen and the fertile species are extremely variable. There seems to be some relationship between them, yet till more is known about the gene-complex of *M. paradisiaca* it may be desirable to keep the 'type' and 'wild' species under different names.

In S. India the "Nendrans" with persistent bracts and male flowers represent this species. The deciduous or persistent nature of the male flowers on the rachis, which according to Linnaeus is the important character of this species, is not by itself a sufficient character on which to separate the species. The variety "Moongil" is similar to the 'Nendran", except that in the former no sterile flowers are produced and the inflorescence axis ends abruptly as a short, naked stump. This banana, which is akin to the "Horn plantain" known to occur in other banana tracts and previously recorded as *Musa corniculata*, is no more than a variety of *M. paradisiaca* (Venkataramani, 1948).

The Edible Bananas: The edible Musas have generally been classed either as "plantain" or "banana", depending on the edibility and palatability of the fruit—those eaten raw being called "bananas" and those used after cooking "plantains", these distinctions varying in

different regions. They have even gained specific status from some botanists, although they have never been well defined. The distinctions may have a genetic basis, but they may well be varietal rather than specific like similar differences, for example, in the mangoes. Such a distinction cannot, therefore, be valid, and just for the sake of convenience "banana" can be retained as representing all edible Musas. The two Linnean names, *M. paradisiaca* and *M. sapientum*, have largely influenced the nomenclature of the edible varieties and they need no further discussion at the moment. Latin binomials have been indiscriminately applied to many edible clones and their misuse has done much to confuse the study of the genus.

The edible forms of *Musa* appear to fall into four groups, one of which comprises the "fehis" of the Pacific Islands, which are evidently distinct from the bananas common in cultivation throughout the tropics. They are seldom cultivated, though edible, and are not regarded as "true" bananas. The cultivated varieties would, therefore, fall into three groups which can be associated with the two fertile *Eumusa* species, viz., *Musa acuminata* and *M. balbisiana*. One group comprises varieties showing predominantly the botanical characters of the former species and probably derived from it, the second group containing those showing the characters of the latter species and the third group consisting of those showing a blend of the characters of both species. Hybridization between these fertile species and synthesis, from this inter-specific cross, of an edible banana closely resembling an established horticultural variety have lent support to the hypothesis that at least some of the cultivated varieties are of hybrid origin (Dodds and Simmonds, 1948).

Cheesman (1948) interprets *M. paradisiaca* L. as a member of the group showing predominantly the botanical characters of *M. acuminata* Colla, and *M. sapientum* L. as a member of the third group with a blend of characters from the two fertile species. It may be of interest to add the following extracts regarding the *acuminata—paradisiaca* and *balbisiana* groups as propounded by Cheesman:

	Paradisiaca assemblage	*Balbisiana* assemblage
1.	Pseudostems slenderer than average.	Pseudostems robust.
2.	Varieties showing chocolate-brown bloches on the leaves, even if only on young leaves of suckers, are almost certainly referable to this group.	This character is not recorded in this.
3.	Margins of petiole often red-bordered and usually erect or spreading; at base where the petiole passes into the leaf-sheath they usually become scarious; if they remain alive, they may be slightly bent out away from the pseudostem.	Margins of petiole green or black-bordered and usually incurved, almost closing over the channel; at base they clasp the pseudostem very closely and do not become scarious.

	Paradisiaca assemblage	*Balbisiana* assemblage
4.	Peduncle most commonly pubescent.	Peduncle glabrous.
5.	Male bud in advanced blooming tends to be top-shaped and acute.	Ovate or lanceolate.
6.	Bracts often, though not always, convolute.	Nearly always imbricate.
7.	Bract generally lift one at a time.	Two or more at a time.
8.	Bract colour: usually reddish purple, though bluish - purple is not uncommon.	Generally bluish-purple.
	Inside: bracts nearly always paler at the base.	Uniform dark crimson to the base.
9.	Fruits usually longer and slenderer. Mature fruit nearly always curved.	Generally broader in proportion to their length than those of *paradisiaca* varieties. Geotropic response is confined to pedicel and the body of the mature fruit is straight.
10.	Seeds, when present, strongly flattened.	Almost rounded.

It must, however, be borne in mind that these differences "are mainly those small ones that go to make up *facies*, and when each is examined singly it is found unreliable for universal diagnosis".

With this classification in mind, I am inclined to include the "Nendrans" of S. India under the '*acuminata*' or '*paradisiaca*' group. *Musa balbisiana* does occur in these parts (Venkataramani, 1949) and some of our cultivated varieties, such as 'Peyan', 'Ney Mannan', 'Kali' and others, exhibit some of the characters of this fertile species; they may, therefore, either bear a close relationship to this species or be of a hybrid origin. The grouping of all edible bananas under one particular *Musa* species would, therefore, appear undesirable. As already mentioned, the classification of the edible forms is entirely different from the general taxonomy of the genus. Classification and nomenclature of horticultural varieties are, of course, necessary from many points of view but as long as confusion exists regarding varietal names and as long as there is a bewildering synonymy there can be no true classification or description. The object of classification of horticultural varieties should be to bring together all those varieties which have important characteristics in common and this means that a detailed descriptive study of each and every known variety is an absolute necessity. Descriptive studies of our bananas, such as those of Jacob (1934; 1942 a, b) are certainly beneficial and if detailed verbal descriptions are supplemented with carefully chosen drawings and photographs, they would serve to illustrate the limits of the different groups.

The genus *Musa*, which has apparently received the attention of plant-breeders for the past many years, can still furnish a great deal of valuable data throwing light on many important problems of heredity. It is a genus that is difficult to collect and to study, neverthe less one sufficiently interesting and important not only in its economic but also in its more strictly botanical aspects.

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Trees in and around Coimbatore

By

SRI S. N. CHANDRASEKHARA AYYAR, M.A.,

&

SRIMATHI GIRIJA LAKSHMAN, B.SC.,

(Department of Agriculture, Madras)

Introduction: Coimbatore town, the head-quarters of the district is fairly close to the Nilgiri hills on the Madras-Nilgiri railway line. The town is nearly 1,400 feet above sea level and has a very picturesque situation, with the lofty blue hills of the Western Ghats rising on the west, and the Noyyil river running to the south, while the east and the north are vast stretches of fields mainly of black soil. A marked feature of the district, which is also shared by the town, is the presence of numerous wells, with lift irrigation mostly by electric power. The town gets an annual rainfall of only about 25 inches but the industry of the ryots has enabled them to practise agriculture in a very efficient manner, so much so that one can see plenty of green vegetation everywhere. Since 1935 the town has been getting a good supply of Siruvani water, especially in the lower parts of the town. Siruvani water being obtained from a catchment area in the Western ghats by tunnel and pipe-line, is better suited for irrigation than well-water which tends to be brackish and is injurious to plants. It has no doubt helped in the growing of a good number of plants of varied nature, both indigenous and exotic. The municipal parks, and the gardens of some of the wealthy households show what is possible with a good water supply.

In this article an attempt has been been made to list about 100 tree species which are seen in the town. This indicates that, provided care is taken, Coimbatore climatic conditions are such that the growing of many ornamental and useful trees is quite practicable. It is the hope of the authors that this note will serve the purpose of stimulating interest in the flora of the town. It is not claimed that the list exhausts all the tree species in the town. The list gives the botanical name first, then its popular name, and then its special features and uses.

1. Acacia arabica, Willd. — Leguminosae (Mimosae)—Black Babool—*Karuvel*—A small tree with spreading branches and stipular thorns. Wood—Useful for fuel purposes; pods serve as good fodder for sheep and goats. Agricultural implements etc. Indigenous.

2. Acacia alba. Willd. — Leguminosae—White Babool—*Vel Vel*. A large tree with spreading branches and hard wood—Useful for fuel—Pods used for fodder. Good for paddocks. Indigenous.

3. Achras sapota, L. — Sapotaceae — Sapodilla — Sapota — A medium-sized symmetrical tree with dark-green, leathery, shining leaves — Native of Tropical America and West Indies. The fruits are very delicious.

4. Adenanthera pavonina, Linn. — Leguminosae—Bead tree—*Anai kundumani.* A tall, quick-growing, upright tree with small, pinnate leaves and light open foliage. The hard, bright red seeds are characteristic and ornamental. Introduced.

5. Aegle marmelos, Correa. — Rutaceae — Bael fruit — *Vilvam.* A medium-sized, spiny tree with small trifoliate leaves, native of India. The fruits are edible and are used in native medicine. The plant is sacred to Hindus. The young shoots and leaves are eaten by goats and cattle.

6. Ailanthus excelsa Roxb. — Simarubaceae—Tree of heaven—*Pee Maram*—A large, handsome, quick-growing tree with large pinnate leaves—Native of India. A striking tree for landscape effect. Wood light, soft.

7. Alangium salvifolium, Wang. — Alangiaceae—Alangi—A deciduous, slow-growing small tree with spines and white flowers—Wood good for fuel and for ornamental work. Indigenous.

8. Albizzia amara, Bow. — Leguminosae—*Usil, Uival*—A large tree which comes up well under dry conditions with a little care. The leaves form a good fodder for cattle, sheep and goats. Indigenous.

9. Albizzia Lebbeck, — Leguminosae—Parrot tree—*Vakai*—A large tree with fine foliage; native of Tropical Asia and Africa. Often planted for shade. Leaves form a good fodder. Excellent brown timber which does not readily warp. Leaves used for green manure.

10. Anona reticulata, Linn. — Anonaceae—Custard apple—Bullock's heart or *Seetha.* A small, bushy tree of Tropical America and West Indies. Grown for its edible fruits.

11. Anona muricata, Linn. — Anonaceae—Sour sop—*Sitha.* A small, quick-growing, shrubby tree with fragrant laurel-like leaves, native of West Indies and commonly grown in the Tropics. Pulp of the fruit edible.

12.	Anona squamosa, Linn.	Anonaceae—Sweet sop. Sugar apple—A small, diffuse tree. Native of West Indies, introduced for the sake of its edible fruit.
13.	Anogeissus latifolia, Wall.	Combretaceae—*Vella nagai.* A large tree which comes up well in plains and up to 4,000 ft. The wood is hard and valuable for timber and agricultural implements. The leaves form a good fodder. Indigenous.
14.	Artocarpus integrifolia, Linn.	Moraceae—*Pila.* A large, evergreen tree. Wood useful for many purposes. Ripe and unripe fruits useful as dessert and vegetable respectively. The leaves are much relished by animals. Indigenous.
15.	Auracaria excelsa, R. M.	Coniferae—Bunya Bunya pine—Monkey puzzle tree. A tall tree of Queensland. It bears branches down to the ground; the small leaves are stiff and closely-set ending in sharp points. Ornamental.
16.	Azadirachta indica A. Juss.	Meliaceae—Margosa—Neem. *Vembu*—A small or medium-sized evergreen with straight stem and small, pinnate leaves, highly medicinal. Indigenous.
17.	Bassia latifolia, Rox.	Sapotaceae—Indian Butter tree—*Mahuva, Illupai.* A large, spreading, handsome tree with broad leaves, common in Central India. Flowers edible. Leaves, flowers and fruits eaten by cattle. Spirit is extracted from flowers. The cake is a good fertiliser. Indigenous.
18.	Bassia longifolia, L.	Sapotaceae—Similar to the above, except for the leaves, which are narrower. Common in South India.
19.	Bambusa arundinacea, Willd.	Gramineae—Spiny Bamboo—A tall, gigantic grass, all the parts which are made use of for various domestic purposes. Indigenous.
20.	Bauhinia malabarica, Roxb.	Leguminosae Malaganthi—Planted as ornamental tree. Indigenous.
21.	Bauhinia purpurea, Linn.	Leguminosae—*Mandarais.* With a little care and watering comes up well and can be planted as ornamental tree. The leaves are eaten by cattle, sheep and goats. Indigenous.

22. Bauhinia variegata, Linn. — *Segapu manchori*. Comes up well under dry conditions as an ornamental tree. The leaves are relished by cattle, sheep and goats.

23. Borassus flabellifer, Linn. — Palmae—Palmyra—Tar palm or Brab palm—*Panai*—A tall palm with a crown of fanlike fronds. All the parts of the tree are very useful. Indigenous.

24. Bombax malabaricum, D. — Bombaceae—Red cotton tree—*Kattu imbul* or *Paruthi*—A very large, handsome upright quick-growing, deciduous tree. The soft wood is used for making tea chests and matches. Indigenous.

25. Bridelia retusa, Spr. — Euphorbiaceae—*Mulvengai*—Grows into a small and moderate-sized tree. This is useful as fuel and fodder. Indigenous.

26. Butea frondosa, Koen. — Leguminosae—*Porasu*—A well-spread, medium-sized tree which comes up well in heavy soils and in black cotton soil. The leaflets are large and serve as plates for taking food, also forms fodder for cattle, sheep and goats. Indigenous.

27. Calopyllum inophyllum; Linn. — Guttiferae—Alexandrian laurel, Common poon, *Pinnai*. A moderate-sized, evergreen tree with broadly elliptic, shiny, leathery, medicinal big leaves. A greenish-coloured oil is extracted from the seeds. Introduced.

28. Cassia fistula, Linn. — Leguminosae—Indian Laburnum—*Sarakkonai*. Avenue tree. Cattle relish the leaves. A small, upright tree, beautiful in blossom and indigenous in India. The bark used in tanning and medicine. The pods are useful as a laxative.

29. Cassia siamea, Linn. — Leguminosae — *Manjakkonnai*—Moderate-sized tree. Native of Malaya. The leaves are eaten by animals. The wood is used for shelves and walking sticks etc. due to its hardness and durability.

30. Carica papaya, Linn. — Caricaceae—The *papaw* or *Pappali*—A fast-growing, small, herbaceous, branchless and usually dioecious tree. Indigenous to Central America and West Indies. Cultivated throughout the tropics for its edible fruits.

31.	Casuarina equisetifolia, Forst.	Casuarinaceae — Casuarina tree, *Chavukku* — A tall, evergreen tree with needle-shaped stems—(Cladode) Very good for fuel and as wind-breaks. Introduced.
32.	Cananga odorata, H. F.	Anonaceae—A tall, quick-growing tree. Native of Malaya and cultivated for the scented flowers in gardens and houses.
33.	Caryota urens, L.	Palmae—Toddy palm—White palm. *Koondhal panai*. A very handsome palm with large, spreading, bipinnate leaves, indgenous to Malaya and India. Toddy and brown sugar can be extracted.
34.	Ceasalpinia coriaria,	Ceasalpinoideae—*Divi divi*—A small branching tree. Native of South America, cultivated for its pods which are valuable in tannery. It is also grown as an avenue tree.
35.	Chloroxylon swietenia Dc.	Rutaceae—Satin wood. *Purush*. A conspicuous and pretty tree with rough, yellowish corky bark and yellow, close-grained wood, valuable for turnery and furniture. Indigenous.
36.	Cordia sebestena, Forsk.	Boraginaceae—Rough-leaved sebeston. Native of West Indies. A small tree found in gardens. Introduced.
37.	Commiphora caudata, Eng.	Burseraceæ, *Kiluvai*—A deciduous tree with papery bark and greyish, soft wood used for pandals. Indigenous.
38.	Couroupita guianensis, Autle.	Myrtaceae—Cannon ball tree. *Nagalingam*—This is remarkable with its curious shaped, large pink and white fleshy flowers, crowded along the trunk from base upwards. Introduced.
39.	Cocos nucifera, L.	Palmae—Coconut palm—*Thennai*—A tall, tree, all parts of which are of great economic value. Indigenous.
40.	Crataeva religiosa, Forst.	Capparideae—*Mavinga*—A small or medium sized tree with broad, terminal corymbs of white flowers. Bark and leaves medicinal. Wood used for manufacture of drums. Indigenous.
41.	Dalbergia sisoo, Rox.	Leguminosae—Sisoo tree—*Yeeti*—A large, deciduous tree. Found throughout India. Cultivated as avenue tree. Yields a very strong timber for the manufacture of wheels. Introduced.

42.	Dalbergia paniculata, Rox.	Leguminosae—*Valagi*—A large deciduous tree of India. Cultivated as avenue tree. Leaves and twigs are used as green manure.
43.	Delonix regia, Ref.	Leguminosae—Flamboyant—*Gul Mohur*. Native of Madagascar, introduced in India. Cultivated as avenue tree.
44.	Delonix elata, Gamb.	Leguminosae—*Vadanarayan*—A pretty, medium-sized tree with yellowish-white wood. Planted as avenue tree. Leaves and branches are used as green manure. Introduced.
45.	Dichrostachys cinerea, W. & A.	Leguminosae—A thorny shrub or small tree. Leaves and branches are used as green manure. Introduced.
46	Enterolobium saman, Prain.	Leguminosae—Rain tree—Introduced from South America and grown as avenue tree—A quick-growing tree, producing plenty of foliage. Thrives well in places with moderate rainfall. Leaves form good fodder.
47.	Elaeodendron glaucum, Pers.	Celastraceae—A moderate-sized tree, occuring throughout the hotter parts of India.
48.	Erythrina indica, Lamk.	Leguminosae—Coral tree—*Kalyana Murungai*—A moderate-sized, deciduous tree with prickly stem and tall branches. Native of India. Leaves are very valuable for milch cows.
49.	Eucalyptus globulus, L. Herit.	Myrtaceae—Bluegum tree. *Karpura maram*. A lofty, gregarious tree native of Australia. Medicinal. The strong timber can be utilised for ship-building.
50.	Feronia elphantum, correa.	Rutaceae—Wood apple—*Vila*—A moderate-sized tree with sharp pickles. Pulp of the fruit edible. Native of Java. The leaves are eaten by sheep and goats.
51.	Ficus religiosa, L.	Moraceae—Pipal tree. *Arasu*—A large, deciduous tree. Epiphyte. Cultivated as avenue tree. Native of India, sacred to Hindus. The leaves are valuable fodder. Can be cultivated through cuttings. Indigenous.
52.	Ficus bengalensis, Lin.	Moraceae—*Alamaram*—A very large tree, which can be grown along roadsides under all conditions, on plains. The leaves are much relished by goats and also by sheep and cattle. Indigenous.

53. Ficus glomerata, Roxb. — Moraceae—*Athi*—This is found as shade or avenue tree—They are easily raised by cuttings. The leaves and the very young shoots are eaten by cattle, sheep and goats. Indigenous.

54. Filicum decipiens, Thwait. — Sapindaceae—False fern. *Kattu puvarasu*—A tree with elegant, fern-like leaves found in Western Ghats. Strong and valuable wood for building work. Indigenous.

55. Gliricidia maculata, H. B. & K. — Leguminosae - Madre or Madre de cocoa—A small, elegant, quick-growing tree introduced from W. Indies. The leaves are used as green manure It forms a good shade tree in plantations. Introduced.

56. Grevillea robusta, A. cum. — Proteaceae—Silver Oak, A moderately - sized handsome tree of Australia, has been much cultivated in India for its pretty-grained wood and in tea estates as shade plants. Introduced.

57. Guazuma tomentosa, Kunth. — Sterculiaeeae—*Rudhrakshakkai*–A tree, stellately hairy on the young twigs, generally distributed and frequently cultivated. Native of India.

58. Guaiacum officinale, L. — Zygophyllaceae—Lignum vitae. A evergreen tree with clusters of brilliant blue, umbellate flowers. Ornamental. Native of West Indies.

59. Gyrocarpus americanus, Jacq. — Hernandiaceae—A tall, deciduous tree common in South India. The seeds are made into rosaries and necklaces. Indigenous.

60. Hardwickia binata, Roxb. — Leguminosae—*Atcha* or *Kattidugu*—A tall tree, deciduous tree with small, yellowish flowers. Wood used for agricultural implements. Leaves useful for fodder and green manure. Indigenous.

61. Heterophragma adenophyllum, Seem. — Bignoniacea—A moderate - sized, deciduous tree. Native of Burma and Assam. Only timber is made use of. Introduced.

62. Holoptelia incgrifolia, Planch. — Ulmaceae–Indian elm–*Ayil* — A large, deciduous tree used for fuel. Useful for avenue planting. Introduced.

63. Jacaranda mimusaefolia Rox. — Bignoniacea—A very elegant, ornamental tree with mauve, bell - shaped flowers. Native of Tropical America. Introduced.

64. Kigelia pinnata, DC. Bignoniaceae—Sausage tree—A moderate sized, evergreen tree with a spreading crown. Native of America and cultivated in India as avenue tree.

65. Lagerstroemia flos-reginae, Retz. Lythraceae—Queen's flower. A moderate sized, deciduous tree grown for its flowers. Ornamental. Native of India.

66. Mangifera indica, Linn. Anacardiaceae—Mango tree—***Ma***—A large, spreading, evergreen tree with dark green leathery foliage. Native of India. Cultivated for the sake of edible fruits.

67. Manihot glaziovii, Euphorbiaceae—Ceara rubber—Sometimes cultivated in gardens for rubber. Introduced.

68. Michelia champaka Linn. Magnoliaceae—A tall, handsome, evergreen tree with fragrant yellow flowers. Native of India.

69. Millingtonia hortensis, Linn. Bignoniaceae—Indian cork tree. ***Maramalli.*** A tall, evergreen tree, with straight trunk with drooping branches and dark foliage. Native of Burma. Cultivated for the sake of its sweet-smelling flowers. Ornamental.

70. Mimusops elengi, L. Sapotaceae—Spanish cherry—***Mahilamaram***—A large, evergreen tree—with dense crown of dark-green, shining foliage and star-shaped flowers. Native of India. Cultivated for the sake of its fragrant flowers.

71. Moringa oleifera, Lank. Moringacea—Horse-radish tree—Drum-stick. A small, deciduous tree with brittle branches. Native of India—Cultivated for its unripe fruits.

72. Morinda tinctoria, Roxb. Rubiaceae–Dyeing Mulberry–***Nuna***–A moderate-sized, deciduous tree. Root yields yellow dye. Indigenous.

73. Murraya Koenigii, Spn. Rutaceae—Curry leaf. A small tree with very aromatic leaves which are added to curries. Indigenous.

74. Nyctanthes arbortristis Linn. Oleaceae—Coral jasmine. ***Pavala malli***—A small tree, rough with stiff hairs. An ornamental tree, sacred to Hindus. Introduced.

75. Odina Wodier, Roxb. Anacardiaceae—Indian Ash tree—***Odhya maram***–A small tree, native of Ceylon and India. A gum is obtained from the stems.

76. Parkinsonia aculeata, Linn. — Leguminosae—Jerusalem thorn—A small tree with showy, yellow flowers, a native of tropical America, often growing wild.

77. Peltophorum ferrugineum, Benth. — Leguminosae—Brazilletto wood. A large, quick-growing, symmetrical tree with a spreading top and fine, graceful, feathery foliage. Indigenous to Ceylon.

78. Pithecolobium dulce, Benth. — Leguminosae—Manilla Tamiarind—*Korukhkapuli*. A middle-sized, evergreen, prickly tree indigenous to America. Cultivated as ornamental tree in India. It is often pruned for hedges. The arilled fruits are edible. The pods are eaten by cattle, the tender shoots and leaves by goats.

79. Pisonia alba, Span. — Nyctagineae—Lettuce tree—Lady love, *Letchikottai*. A small, evergreen tree with striking, pale yellow leaves. Leaves used as fodder, medicine and vegetable. Indigenous.

80. Plumeria acutifolia, Poir. — Apocynaceae—Pagoda tree—A common, conspicuous garden plant with thick, fleshy branchlets and flowers, white with pale yellow centre and fragrant. One variety has large red flowers. Introduced.

81. Pongamia glabra, Vent. — Leguminosae—*Pungamaram*. A moderate-sized, deciduous tree. Native of India. Planted on roadsides. Oil is medicinal.

82. Polyalthia longifolia, var. pendula Benth. — Anonacea—Nettlingam or *Ashok*. A tall, handsome, evergreen tree with narrow lance-shaped and wavy margined leaves. Indigenous to Ceylon and planted in India as roadside tree.

83. Prosopis juliflora, L. — Leguminosae — Mesquite — Small, thorny tree of Mexico. Leaves, shoots and pods used fodder. An ideal live fence.

84. Psidium guajava, L. — Myrtaceae—Guava—*Koyya*—A small tree with thin, smooth bark. An American plant cultivated for its fruits, and often growing wild.

85. Pterocarpus marsupium, Roxb. — Leguminosae—*Vengai*—A large tree, the timber is useful and a gum called "Kino" useful in medicine is obtained from this tree. Cattle, sheep and goats relish the leaves. Indigenous.

86. Pterospermum suberifolium, Lank. — Sterculiaceae—Lance wood. ***Thadai.*** A large. handsome, evergreen tree with large, irregularly shaped leaves, green above and greyish-white beneath. Indigenous.

87. Pterospermum Heyneanum, Wall. — Sterculiaceae—***Polavu***—A beautiful, ornamental tree of India.

88. Punica multiflora, (Granatum) Hort. — Lythraceae — The pomegrante — ***Mathulai*** — Edible fruit. A medium-sized tree. Cultivated in most houses. Acclimatized.

89. Ravenala madagascariensis, som. — Musaceæ — Traveller's tree. A remarkable-looking tree with an appearance of a gigantic fan, grown in gardens. Native of Madagascar. Introduced.

90. Sapindus emarginatus, Wahl. — Sapindaceæ — Soapnut — ***Puchi kottai.*** A common, large-sized tree, the fruits of which are universally used as substitute for soap. Indigenous.

91. Santalum album, L. — Santalaceæ — Sandalwood tree. ***Chandanam.*** A small, evergreen, usually semi-parasitic, glabrous tree, cultivated for the sake of its scented heart-wood. Indigenous.

92. Sesbania grandiflora, Pers. — Leguminosæ — ***Agathi*** — A small, soft-wooded tree. Native of India and Australia. It is cultivated for the beautiful, showy flowers. Leaves are used as green manure and also as vegetable. The young shoots and leaves are greatly relished by cattle.

93. Spathodea campanulata, Beau. — Bignoniaceæ — An ornamental tree, introduced from tropical Africa, with large, orange, scarlet flowers.

94. Swietenia mahagoni. — Meliaceæ. Mahagony timber. A large, deciduous tree, native of Tropical America. Cultivated for the sake of the well-known timber, mahogany.

95. Syzigium jambolanum, Dc. — Myrtaceæ — Black plum — ***Naval.*** A large, evergreen tree with white flowers and purple fruit. Cultivated in avenues and topes for its edible fruit. Indigenous.

96. Tamarindus indica, L. — Leguminosæ — Tamarind tree — ***Puli.*** A large deciduous tree. Indigenous to Africa, grown for the fruits.

97. Terminalia catapa, L. — Combretaceæ — Indian Almond. ***Nattu badham.*** A tall, deciduous tree, with broad, leathery leaves. Native of Andaman islands. Cultivated for the sake of its edible fruits.

98. Terminalia bellerica, Roxb. — Combretaceæ — ***Thani.*** A large tree. The leaves are eaten by cattle, sheep and goats. Indigenous.

99. Thespesia populnea, Sand Cav. — Malvaceæ — Portia tree — ***Puvarasu.*** It is a small tree, with broad leaves and yellow flowers. Native of India. Planted on roadsides.

100. Zyziphus Jujuba, Lam. — Rhamnaceæ — Jujub tree — ***ber*** tree — ***Ilandai*** A small, well-branched, thorny tree cultivated for the sake of the wood, a good fuel. The leaves are relished by sheep and goats. Indigenous.

OBITUARY

It is with deep regret that we record the demise of Sri Ch. Venkatasaravayya Chetty, in October 1950, after a sudden illness. He was born in 1902. After graduating in agriculture in 1924, he took the Associateship of the then Imperial Agricultural Research Institute, Pusa. Later, he underwent special training in tobacco research in Sumatra, Java and in the United States of America. As a research worker, he has made a number of contributions to the knowledge of rice and tobacco.

He was a man of very pleasing manners, with great enthusiasm and industry in any work that he undertook.

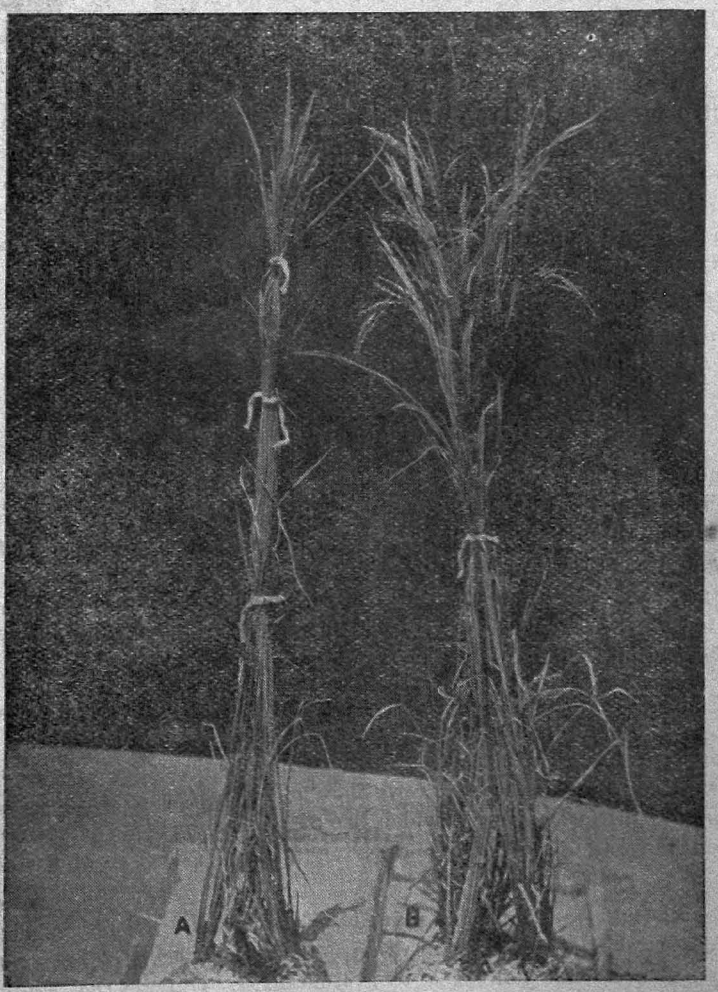
We offer our heartfelt sympathy to the members of the bereaved family.

Research Note

A method of artificial hybridization of rice

In the artificial hybridization of rice, the concomitant processes of emasculation and pollination have received considerable attention. Different workers have followed different methods and while working on these methods at the Agricultural Research Station, Pattambi, it has been possible to evolve a simple and rapid way of artificially opening and pollinating a large number of spikelets on the plant as a whole.

The method consists in combing up the leaves and tying the plant in two or three places in the form of a pyramid, taking care to see that all the panicles containing the maximum number of unfertilised spikelets are completely enclosed by the foliage between the knots. One single plant or two or three plants may be tied together in this manner about an hour before natural anthesis. (Plate I. A.).



In bright weather the knots could be untied after two or three minutes when all the spikelets would be ready to open and some would have already opened. The length of time the plants are kept tied is very important since if more time is allowed, the anthers would dehisce as they emerge, resulting in self-pollination. An interval of two to five minutes is found sufficient for the opening of the spikelets and a further eight to ten minutes for the dehiscence of the anthers. The actual

time required could be easily determined with a little experience in each tract. Emasculation is done by removing the anthers with a pair of forceps, holding them by the filaments, preferably under the shade of an umbrella.

As soon as the emasculation is over, all the unopened spikelets, young and old alike, are removed. For pollination six or seven panicles, depending upon the quantity of pollen required, have to be cut and brought from the male parent. The emasculated panicles are then held together and in between them the cut panicles are inserted and the plants tied again as before. After eight or ten minutes the knots are gently untied from the top leaving the bottom knot intact so that the plants have the appearance of a bouquet. (Plate I. B.). The spikelets on the cut panicles would have opened by this time with the anthers ready to dehisce and a few gentle shakes would ensure the discharge of a cloud of pollen as in the natural manner.

The method is most convenient where large-scale hybridization is envisaged. In a well-planned programme, the varieties to be crossed may be planted in the field itself side by side, preferably with the female parent surrounded by two or more male parents. The female parent alone may be tied up for the purpose of emasculation and after emasculation both the varieties may be tied together. The method of planting the male and female parents together, obviates the necessity of bringing cut panicles from a distance. Agronomic and other methods have, of course, to be resorted to, as usual, for making the blooming of the two varieties synchronise. The point to be remembered is that enough foliage should be there to cover the panicles completely. In special cases where, as in certain varieties, the panicles exsert far out above the plant, dummy plants of thick foliage or off-season varieties may be planted to surround both the male and female parents.

Agricultural Research Station,
Pattambi,
12—10—1950.

P. C. SAHADEVAN.

Note on an Abnormal Jasmine

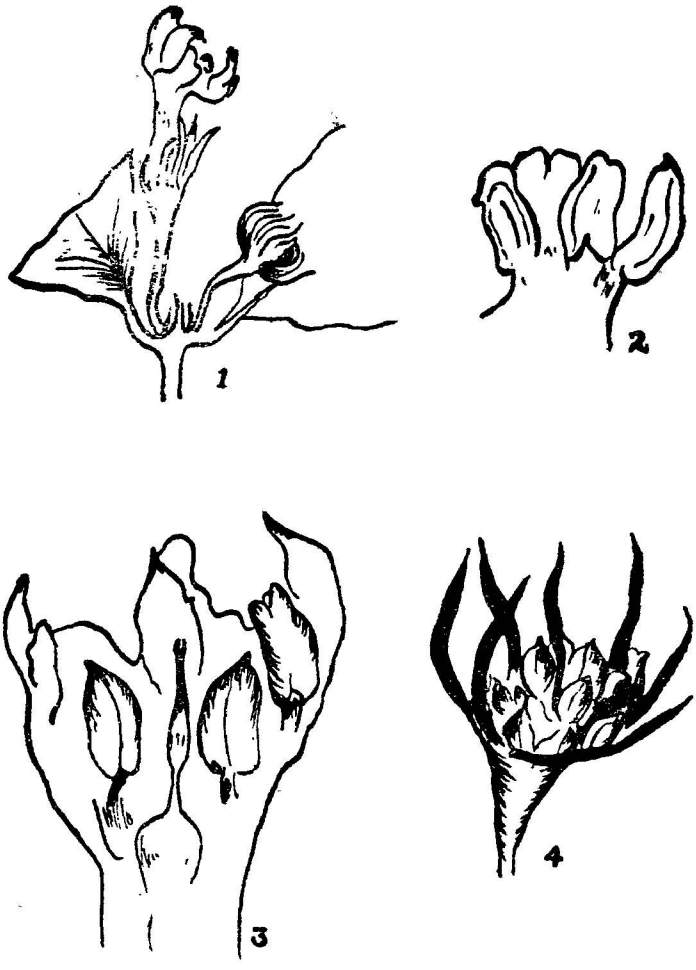
Amongst the cultivated jasmines, *J. Sambac* exhibits several floral abnormalities. A few of these have already been described by Krishnaswamy and Raman (1948). In the normal flower, the corolla is single-whorled with four to six lobes, regular, rotate with oblong or orbicular lobes. The corolla tube is as long as the lobes; Stamens two, rarely three—free, oblong, greenish yellow, epipetalous and inserted at the throat of the corolla tube. The stamens are slightly apiculate, dorsifixed with longitudinal dehiscence.

The abnormalities can take the form of (i) proliferation, where probably owing to fission, the number of the petals is increased, resulting in multiwhorled petals but with a single corolla tube, (ii) multiple flowers in which one flower is telescoped into another so that there are one or two tiers of flowers, each tier having its own *tubular corolla*, (iii) fasciation in which two or three stems fuse and consequently a number of flowers coalesce into one giving indefinite calyx, corolla, stamens, and stigma.

A fourth kind was found in a plant of *J. sambac var. Gundumalli* collected at the Fruit Research Station, Burliar, Nilgiris (elevation 4500 ft.) The variety was the usual horticultural one planted a long time back. Outside the Fruit Research Station on the opposite hill slope, the same variety planted long ago is now found to have run wild. Rooted stems from both of these were obtained and planted in the plains at the Millet Breeding Station, Coimbatore. In spite of the difference in elevation the plants grew well. The plant collected from outside the Fruit Research Station garden turned out to be the usual horticultural variety with a single whorl of petals.

The other sib gave a vigorously growing plant with a number of twiners. The leaves were normal and similar to those of the typical *Gundumalli* variety. During the flowering season however, it was noted that there were very few flowers and even these gave an appearance of stunted growth. On examination it became evident that numerous flower buds were produced, but only a few had the usual white petal, and that the petals in many cases had become modified into stamens. Several stages of this transformation were noticed, ranging from more or less normal flowers to flowers having a few greenish-white petals fringing a group of green anthers. In extreme cases the flower is completely devoid of petals and is made up of as many as ten anthers surrounded by the calyx, the lobes of which vary from 5 to 10.

Observation reveals that there is a distinct difference between the place of origin of the normal and the converted anthers. The latter occupy the place of the corolla lobes while the former are more lower down in the corolla tube. Most of the



flowers show transition stages where several petals are swollen at the edges on the way to becoming anther lobes. All the while the normal pair of anthers continue and function. The stages noticed are (Fig. 1):— 1. Flowers with one whorl of imperfectly formed, pale-green petals around a group of three to four anthers. 2. Several petals in the whorl showing swollen edges i. e. in the transition

stage. 3. Very few crumpled and malformed petals while the rest have turned into greenish anthers. 4. All the petals changed into anthers. The highest number noticed was ten. A vestige of corolla may be left adhering to one of the anthers.

These anthers were found often to behave like normal ones with lateral dehiscence and full of free pollen. The converted anthers do not have any scent but they give out the usual scent when a portion is petaloid and the other antheriferous. It became evident that the anthers increase by fission of the original tissue so that the inner whorl arises as a branch from the external whorl of petals. In spite of the numerous anthers the plant did not produce any seeds. The cytological examination showed the plant was triploid, 2n=39. No symptoms of fungoid diseases or pests were found. This condition could have arisen as a mutation. Stray cases of such tendencies resulting in partial suppression or even transition of petals are found in a plant producing normal flowers.

That these extra stamens in the jasmine have arisen adventitiously by the transformation of petals and not *de novo* is proved by the intermediate stages found in the plant. It has been held by morphologists that in the ontogeny, petals are later in origin than the stamens and that they are arrested stamens. In certain cases of gyno-dioecism, absence of stamens tends to be associated with a relatively poor development of the corolla (Arber. 1937). In the corolla-androecium system the corolla is held to have greater relationship with the stamens than with calyx. Hence the interchangeability of stamens and corolla. These two are supposed to form the male part of the flower. While in the petal the vegetative character predominates on male characters, in the anthers the vegetative character is latent and male character reaches full expression (Arber 1950). Salisbury (1931) finds negative correlation of stamens with petals in *Ranunculus parviflorus* and petals and stamens tend to replace each other. Further investigations are being continued on this plant. A few of the buds have also been treated with colchicine.

Acknowledgments.

My thanks are due to Dr. N. Krishnaswami for the material and guidance during this work and to Sri V. S. Raman for determining the chromosome numbers. My thanks are due to the Director of Agriculture, Madras for having permitted me to work in the Agricultural Institute.

Cytogenetics Laboratory,
Agricultural Research
Institute, Coimbatore.

Miss Nalini Nirodi.

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4 Salisbury. A. 1931. Ann. Bot., 45: 539.

Explanation of text figure:

Fig 1 Imperfectly formed corolla lobes. 2. Fringe of the corolla tube showing gradual transformation into anthers. 3. Transformed anthers around two normal epipetalous anthers. 4. Flower showing only the transformed anthers with the calyx teeth. (All figures magnified 1½ times).

Gleanings

Human Machines: Every person who is in charge of an office, institution or factory should develop as much skill in managing the "Human Machine" as he cultivates for driving a carriage or a motor car. The importance of the former is as vital as the latter. With our reason and understanding and our affinity to each other we present a greater problem than the soulless machine or instrument, however complicated.

The first qualification of a manager (I shall use this term to qualify those who are in charge of a particular office, institution or factory) is self-control. The next is confidence. Confidence begets confidence and trust displaces doubt. To break confidence is like breaking mercury. You may or may not get it together and if you do, it will be with the utmost difficulty and trouble. Self-control begets confidence; it embraces coolness; it nurtures courage, it establishes stability, it produces solidity and reliability. Give every man thine ear but few thy voice. Keep your intentions reserved These measures are aids to self-control. It is not wise to force the pace or show your hand. When things go wrong, keep cool and avoid as far as possible letting affairs worry you or get on your nerves. You must be qualified to meet any situation.

Punishment: The administration of punishment is an extremely difficult point. We are taught to be just in our dealings but our justice may also be tempered with mercy and by sometimes overlooking an offence. The operative feels that he is under an obligation to you for your generosity; he is much more submissive or subservient. Never threaten to discharge unless you mean to carry it out.

Prejudice and ignorance are two stubborn foes and strong barriers to conciliation. A manager should take every precaution to prevent his worker or co-officials becoming prejudiced against him.

Tale-bearing and anonymous letter-writing: An ideal manager should never encourage tale-bearers or anonymous letters. They are not conducive to the best feeling and relationship between the management and the workers. The manager who listens to the tale-bearer eventually dispises him. His mind becomes alienated against the individual who is slandered and the slanderer. The tale-bearer is generally a self-seeking person who is trying to gain some favour or advantage at the expense of his fellow-worker. As regards the anonymous letter-writer he is without doubt one of the most despicable things on earth. No action whatever should be taken on the contents of such a letter. Humanity has not yet attained the standard of perfection and even the best of us would fight shy at our every word or action being criticised or examined. To have our minds disturbed by tale-bearers or letters will be great hindrance to good management.

Familiarity: "Familiarity breeds contempt". No manager should get too familiar with the workers in his charge. Inside the works there must be a distinction; outside it is a different matter and must be governed by circumstances. The position must be respected if not the man. How does a manager who does not respect his own position expect others to respect it? Discipline, order and authority are lost and disorder is the result where distinctions do not exist.

These observations have no other object in view than that of helping you to take a rational view of of all things to act as a man to other men, to exercise patience and sound judgement for producing smooth relationship between the manager and the worker and consequently greater *efficiency*, better *discipline* and greater *success*. (From "Human Machine" by "Kamadhenu" Altech Journal of Alagappa Chettiar's College of Technology, Vol. I, No. i, July 1950). M. V.

Socialised Agriculture in Russia: The socialisation of Russian agriculture is a unique phenomenon. The huge size of the country and the brief span of time in which its agriculture was socialised make the experience particularly interesting. By and large over the world the family-operated general farm has proved the most economic form of agriculture production. Yet thousands of large state-owned farms were brought into existence in the U. S. S. R. Initially operated on a factory-like basis for the production of single commodities such as wheat, cattle or hogs. they still preserve this character to a large extent. Outside the U. S. S. R., attempts to combine small farms into large-scale production co-operatives have thus far proved less successful than the efforts of large farms to resist the encroachment of the small family farm. Yet almost overnight in the Soviet Union, some 20 million small family forms were merged into approximately 200,000 large collective farms.

These 20 million households, poorly supplied with the means of production and with technical knowledge were certainly a weak sector of an economy striving for rapid advancement. There is no question that improvement was needed. But was the chosen method — that of replacing the backward peasant farming system by state and collective farms — superior to the customary one? A closer scrutiny reveals that there was no advantage in collective farming. The only conclusion that can be reached on the basis of Soviet experience is that collectivasation of agriculture should never be attempted by the methods resorted to in the U. S. S. R.

Excessive speed in collectivisation and State appropriation of a large part of the collective output at inadequate prices were the two principal factors that prevented the Soviet experiment in collectivisation from constituting a fair trial. The adverse effects of the first of these had been largely. though not fully overcome by the end of the "thirties". The second handicap however, has persisted; indeed its detrimental effects increased as the States' grip on the operations and the output of the collective farms was strengthened.

In spite of the rapid expansion of industry of the urban sector almost, two-thirds of the population is still rural in the U. S. S. R. Soviet Industry reveals no great ability to sell its products competitively in foreign markets. The U. S. S. R. has to depend entirely on its agriculture for all its food and for practically all industrial raw materials of agricultural origin. Soviet agriculture still is and will continue to be, at least for a considerable time, the foundation for the country's economic structure. Now that the U. S. S. R. is playing on important a role in world affairs and since collectivised farming has been become an export commodity, a study of this nature will be quite revealing. In no part of the world and at no time in history has compulsory labour proved efficient, and Soviet Socialised Agriculture presents no exception. The economy based on such a foundation is neither efficient nor stable.

["The Socialised Agriculture of the U. S. S. R. plans and performance" — Stanford University Press.]

[Naum Jasny, was an Associate Member of the Supreme Food Council and one of the advisers of the Supreme Economic Council of the Russian Government till 1933.....

Editor.]

Saving Electricity at Home: It has been truly said that all domestic progress will take an electrically-lit path. Electricity came first as a new source

of lighting in the home, superseding oil and candles. But there is a world of difference between a house that is lit by electricity and the home that is run by electricity. Electricity is a force, a form of energy that can be used to replace human energy in a multitude of household tasks.

Where electric energy is used with intelligence in the home, comfort and efficiency are achieved with the minimum expenditure of human energy, and the house-wife has more time to devote to the art of home-making in its subtler and less tangible aspects and to play a part in the welfare of the community in which she lives.

However this electrically-lit path of domestic progress does not seem to be a smooth one. The house-wife has to be prepared for periods of power economy, some more stringent than others, which modify the enjoyment of the full electrical standard of life. Therefore it would be an advantage to look more closely at the purposes for which electricity is used in the home.

It is necessary to differentiate clearly between the use of electric current to fulfil the normal function of a fuel and its use as a force to operate motor-driven appliances, when it is used as an alternative to human energy.

It is an interesting fact that when the question of economising in the use of electric current is mentioned the first reaction of most of the people is to switch off the electric light, or to reduce the power of the lights in the house by substituting lamps of a lower wattage. But there are other appliances like the heaters, the refrigerators and so on, which consume a comparatively greater amount of electrical energy than lights.

In times of power shortage the chief aim should be maintenance of adequate standards of lighting. The use of power can certainly be drastically curtailed for advertisements and decorations.

The most effective economy is obtained by limiting the use of radiators and water-heating appliances. Nor only as their consumption of electricity per hour high but they are also in use for longer periods compared with irons, sewing-machines etc.

This is surely not too heavy a price to pay to keep the country's essential work in running order.

[New Zealand Journal of Agriculture, Vol. 81—2, August 1950, pp. 181—184] (M. V.)

ERRATA—October, 1950 Issue.

Page 401 — Line 31 insert a (.) after the world 'use'.
Page 402 — Line 19 Read "Weedanol" for 'weedanal'.
Page 402 — Line 33 Read "Derivatives" instead of 'Dervatives'.
Page 405 — Line 33-34 delete "are applied".
Page 409 — Line 9 Read "Solve ..... been" as "solve this problem and work in this direction has just been started".

Concessions for Cotton Growing.

The largest single industry in India is the textile industry and any shortage in the production and supply of raw cotton will seriously affect the economy of the country through inadequate exports, heavy drain on foreign exchange for import of cotton and industrial unemployment resulting from closure of mills. The Government of India therefore desire that all States must take the most urgent measures for increasing cotton production. In order to give the necessary fillip for cotton cultivation, they requested all State Governments (a) to remove all existing legislative and executive restrictions on growing of cotton (b) to extend to cotton lands all possible irrigation facilitites, and (c) to grant remission of land revenue for all additional area grown with cotton, and agreed to make good the loss in foodgrains arising out of such expansion and offered to give technical advice and help in the matter of supply of seeds and manures, extention of irrigation facilitites, reclamation of fallow lands, introduction and extension of intercropping and propaganda. They also raised the ceiling prices of all varieties by Rs. 150/- per candy of 784 lb. for the 1950–1951 crop and excluded certain medium and long-staple varieties from the purview of price control provided they were processed and certified under supervision.

2. The State Government in implementing the various suggestions have announced the following relaxations, concessions and compulsions.

(a) A special staff consisting of one Cotton Extension Officer, and three regional Assistant Cotton Extension Officers has been sanctioned for giving effect to the expansion work during 1950–1951.

(b) The prohibitory order on the cultivation of *mungari* cotton except as a mixed crop in the districts of Bellary, Anantapur, Kurnool and Cuddapah was rescinded.

(c) The order prohibiting the cultivation of *buradapathi* (*sannapathi*) cotton in Visakhapatnam district and Cocanada cotton except as a mixed crop in the Guntur district was withdrawn.

(d) The order relating to cultivation of cotton, tobacco, and groundnut in so far as it prohibits the cultivation of certain varieties of cotton except as a mixed crop was repealed.

(e) The Cotton Crop (Compulsory growth of chillies) Order 1950 was announced by which no person should cultivate a rainfed crop of chillies in any of the districts of Guntur, Krishna, East Godavari and West Godavari in the State of Madras except as a crop mixed with cotton in the proportion of not less than one line of cotton plant to every fourteen lines of chilli plants.

(f) The Government ordered that the loans granted to agriculturists for the purchase of chemical fertilisers for paddy cultivation be extended to cotton crop also in the districts of Coimbatore, Salem, South Arcot, Tiruchirapalli, Madhurai, Ramanathapuram and Tirunelveli so as to enable the cotton growers in these districts to apply ammonium sulphate to their cotton crop.

(g) The Government ordered that under the New Wells Subsidy Scheme 1949—1950, the grantees of subsidies were permitted to grow cotton in rotation and in the event of their not being able to grow foodcrops in the first year and instead grew cotton an equal area should be put under foodcrops during the second season.

(h) the Government have granted subsidies for bringing down the cost of seeds procured and sold to cultivators. In procurements from seedfarms, the establishment charges are excluded while in nonseed farm lots the difference between the local rates and purchase rates is excluded in fixing sale price.

Agriculture Newsletter

Rats damaging tender coconuts: The damage caused by rats to tender coconuts is one of the worst sources of loss to the coconut cultivator. Recently trials were conducted in a few places to study whether poison baiting with zinc phosphide would be of any use to control this pest. The results far exceeded the expectations.

An improved type of Kapok (*silk cotton tree*): The Kapok or silk cotton tree is known to most of the agriculturists in South India. The lint is useful for stuffing beds and pillows. These trees are usually grown along the fences in garden land areas and on high-lying places. A new variety reported to be Russian origin is being grown at the Agricultural Research Station, Koilpatti. The main advantage of this variety is that the dried-up pods seldom burst on the tree. A ten-cent area is being cultivated with these trees on the above Research Station under rain-fed conditions. There are seventeen trees about 18 years of age and the calculated annual acre-yield averages to about 270 lb. of lint priced at Re. 1 per lb. Seeds of this variety are available with the Superintendent, Agricultural Research Station, Koilpatti, Tirunelveli district.

Sunnhemp as a mixture in dry lands: It is a good practice to grow sunnhemp as a mixture with groundnut or cereals in rainfed lands. The roots of sunnhemp go deeper into the soil than that of cereals or groundnut, and while not competing for food with the other crops in the mixture, add nitrogen to the soil by fixation of atmospheric nitrogen. It thus adds fertility to the soil. The crop yields seeds which could be utilized for raising a green manure crop in wet lands or used as cattle food. After collecting the seeds, the rest of the plants would yield useful fibre for making ropes of several kinds for agricultural purposes. About 2 to 3 lb. of sunnhemp seed for an acre would be sufficient to contribute a a substantial sum to the dryland ryot. In good seasons about a bag of sunnhemp seed could be collected from an acre of mixed crop. When in short supply of seeds of green manure and for cattle food, the lakhs of acres of our drylands could be made to yield this useful product. In a similar manner indigo, dhaincha, sesbania, etc. could also be grown in drylands for seed and the seed production for these green manure crops augmented.

A promising paddy hybrid: A natural cross (NX. 60 bids fair to be a promising hybrid of paddy with a yield of 17 bags (1 bag = 196 lb.) of grain per acre at Narasapur and Tanuku (West Godavari district) and 15 bags per acre at Razole (East Godavari district) in the second crop of 1949—'50, which is characterised by prolonged unfavourable east winds. The yield was higher than that of MTU. 9, (which is an established coarse-grained *garikasannavari* strain) by 5 per cent at Narasapur, 30 per cent at Tanuku and 25 per cent at Razole. At Maruteru its yield was 32 per cent higher than that of *kasipichodi* one of the parent varieties from which it was derived. Its yield of 3,310 lb. per acre on the farm in the main crop season amply corroborates its high-yielding nature and its adaptability to the first and second crop seasons in the delta.

This hybrid is the progeny of a natural cross between a fine-grained, early variety *kasipichodi* (SLO.) 16 and a coarse-grained red rice, drought-resistant variety, *nallarulu*. which is 10 to 15 days later in maturity than SLO. 16. The hybrid combines the desirable features of the grain, white rice, earliness and drought-resistance. Being earlier than *nallarulu* and possessing, as it does an extremely attractive rice, its scope for wider extension in the second crop area of the Godavari delta is enormous.

Weather Review — For October 1950

RAINFALL DATA

Division	Station	Total for the month in inches	Departure from normal in inches	Total since January 1st in inches
Orissa & Circars.	Gopalpur	5·7	—2·9	38·8
	Calingapatnam	4·8	—3·1	25·6
	Vishakhapatnam	11·2	+3·4	32·9
	Anakapalle*	6·3	—2·3	29·1
	Samalkot*	8·4	+0·2	38·7
	Kakinada	9·5	+1·0	33·5
	Maruteru*	5·5	—2·4	48·8
	Masulipatnam	4·0	—4·6	32·4
	Guntur*	4·5	+0·2	30·5
	Agrl. College, Bapatla*	3·0	—4·1	27·0
	Rentachintala	3·1	—1·9	21·6
Ceded Dists.	Kurnool	2·6	—0·6	28·8
	Nandyal*	3·6	+0·7	25·5
	Hagari*	6·3	—2·8	21·1
	Siruguppa*	9·1	+5·2(a)	26·2
	Bellary	8·5	+4·3	22·5
	Cuddapah	4·0	—0·9	19·2
	Kodur*	7·9	+0·7	19·7
Carnatic.	Nellore	25·6	+16·0	43·4
	Buchireddipalem*	19·4	+11·6	34·6
	Madras (Meenambakkam)	5·3	—6·7	29·8
	Tirurkuppam*	10·3	(x) @	30·2
	Palur*	10·9	+4·1	29·2
	Tindivanam*	4·4	—2·0	19·8
	Cuddalore	4·8	—6·7	20·7
Central.	Vellore	3·1	—3·7	18·3
	Gudiyatham*	2·1	+4·0	13·4
	Salem	6·5	—0·1	27·8
	Coimbatore (A. C. R. I.)*	4.9	—1·3	18·0
Central—*Contd.*	Coimbatore (C. B. S.)*	4·2	—2·0	17·4
	Coimbatore	3·6	—2·7	14·0
	Tiruchirapalli	2·8	—3·5	20·3
South.	Nagapattinam	11·1	+0·5	30·6
	Aduturai*	4·4	+1·0	22·7
	Pattukottai*	4·7	—2·3	23·6
	Madhurai	11·1	+3·7	31·4
	Pamban	5·9	—2·6	14·6
	Koilpatti*	4·5	—2·1	16·7
	Palayamcottai	6·7	—0·4	17·9
	Ambasamudram*	5·0	—1·7	20·1
West Coast.	Trivandrum	7·2	—3·5	59·3
	Fort Cochin	14·6	+1·2	130·4
	Pattambi*	8·8	—0·5	152·8
	Taliparamba*			
	Nileshwar*	3·5	—2·2	170·7
	Pilicode*	3·4	-1·5@	141 8
	Mangalore	6·7	—0·6	146·2
	Kankanady*	6·5	—0·4	148·7
Mysore & Coorg.	Chitaldrug	3·5	—1·3	21·7
	Bangalore	7·1	+1·2	24·5
	Mysore	3·1	—2·8	24·2
	Mercara	5·6	—2·7	132·6
Hills.	Kodaikanal	8·1	—2·1	41·1
	Coonoor*	4·6	—5·2	32·7
	Ootacamund*	9·1	+1·6	38·8
	Nanjanad*	7·0	—0·1	51·5

Note:—

(1) * Meteorological Stations of the Madras Agricultural Department.

(2) @ Average of seven years' data for Tirurkuppam and eight years' data for Pilicode is given as normal.

(3) (a) Taluk office normal is 4·08" and rainfall is 9·16".

(4) (x) = Actual deviation is — 0·03.

Weather Review for October, 1950.

The month began with a trough of low pressure in the Bay of Bengal, off the Circars Coast. On 2—10—1950 the monsoon receded but two days later conditions became unsettled in the East Arabian Sea, off the Malabar—Kanara Coast.

On 10—10—1950 conditions became favourable for the establishment of the North-East Monsoon in the Bay of Bengal. On the 16th the monsoon became strong along the Coramandel Coast and the South of the Peninsula had the benefit of this. The next day the monsoon was active in Chingleput and Nellore districts and on 18—10—1950, an exceptionally heavy fall of 17·5" in twenty-four hours being recorded in Nellore. The next day, the depression off the Coromandel Coast moved northward but weakened, and a well-marked trough of low pressure over the West Central Bay was formed. Due to its subsequent development rainfall was widespread in West Bengal and Orissa. In the remaining portion of the month a number of low pressure waves formed and became unimportant later, but producing light to moderate rain in certain portions of the country.

Particulars about the zonal rainfall in the Madras State and noteworthy falls in the month are given below :—

S. No.	Name of the zone.	Total Precipitation.
1.	Orissa and Circars	Below Normal
2.	Ceded Districts	Above Normal
3.	Carnatic	Above Normal
4.	Central	Below Normal
5.	South	Below Normal
6.	West Coast	Below Normal
7.	Mysore and Coorg	Below Normal
8.	Hills	Below Normal

Noteworthy Falls

S. No.	Date	Place	Rainfall in inches in a period of 24 hours.
1.	4—10—50	Kozhikode	4·5
2.	5 & 15—10—50	Nagapattinam	2.9
3.	6—10—50	Bellary	3·5
4.	8—10—50	Fort Cochin	4·3
5.	12—10—50	Madhurai	3·8
6.	17—10—50	Madras (Nungambakkam)	4·1
7.	17—10—50	Madras (Meenambakkam)	3·1
8.	17—10—50	Mangalore	3·5
9.	18—10—50	Nellore	17·5*
10.	19—10—50	Kakinada	6·0
11.	19—10—50	Visakhapatnam	4·0

* Exceptionally heavy.

Summary of the Monsoon Rainfall (June to September, 1950)
Supplement to the Indian Daily Weather Report for 17—10—50.

S. No.	Sub-division	Actual inches	Departure from Normal in inches	Percentage Departure from Normal
1.	Coastal Andhradesa	18·8	—1·0	—5
2.	Rayalaseema	14·6	—0·7	—5
3.	Tamilnad	11·0	—0·4	—4
4.	Malabar and South Kanara	117·1	+16·8	+17

Agricultural Meteorology Section,
Lawley Road Post, Coimbatore
Dated, 10—11—1950.

M. B. V. N., C. B. M., & M. V. J.

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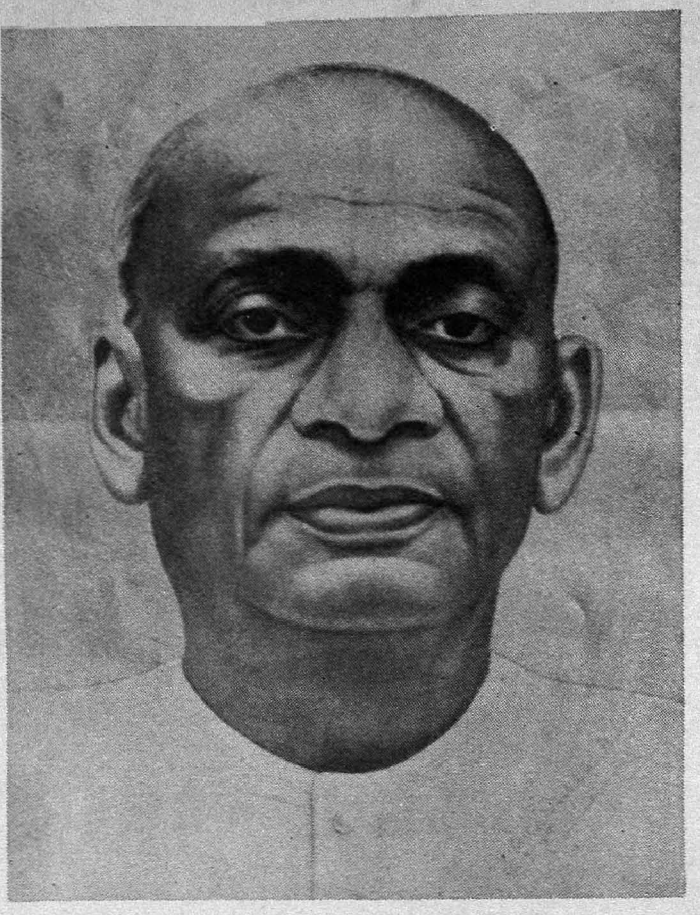
,, Sankaran, A.	On leave,	Asst in Chemistry, Coimbatore.

Agricultural College and Research Institute, Coimbatore

LIST OF ADDITIONS TO LIBRARY FOR NOVEMBER, 1950.

1. England : Commonwealth Economic Committee : 1950.
2. Farm Implements Buyers Guide, 1950. Harris McGreger & Goust Ltd., Leigh, England.
3. HUXLEY (Julian) : Soviet Genetics and World Science, 1949. Chatto & Windus Ltd.
4. India : Agricultural Marketing Series Bulletin on the marketing of Sannhemp in India, 1950. Manager of Publications, Civil Lines, New Delhi.
5. India : Agricultural Marketing Series Report on the marketing of rapeseed and mustard in India, 1950.



SARDAR VALLABHAI PATEL

Architect of India's Unity.

Born: 31—10—1875. Died: 15—12—1950.

It is with great sorrow that we record the death of one of India's foremost national leaders, Sardar Vallabhai Patel, Deputy Prime Minister of India. He crowned a lifetime of arduous struggle in the fight for India's freedom, by the truly astonishing achievement of merging six hundred and odd semi-independent states, into the framework of the Indian Nation. May his soul rest in peace and may we prove worthy of the precious legacy of unity he has bequeathed us.