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Farming will never be a success unless the farmer had more voice in the disposal of his produce—P. Morrel.

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BETEL VINE

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PART I.

Introductory

In more ways than one, the Betel vine is a peculiar and unique crop. Neither a food stuff nor a textile, it is yet, in our country as important as the cereals, the pulses, the millets, the sugarcane and the cotton. In a sense it is even more valuable than any of the aforementioned since it is an essential factor in the social and religious life of Indians. It is to Indians what the wine is to the Italians and the French. It is the token of hospitable welcome to the guest and emblem of good will at parting. No religious ceremony of the Hindu, whether it be a worship at an altar or festivity at home, is considered complete without the betel leaf functioning. It is the alpha and the omega of every ritual, performed by the pious Hindu.

Is it a marriage that you are celebrating with pomp and show? Then distribute pan to the assembled guests. Is it a Tea or a dinner you are giving to one to whom you manifest good will at a farewell function? Then let Betel leaf be the last item on the programme. Have you nothing else to give to the sweating labourer or the dirty scavenger? Then give him some betel, and he departs grinning his satisfaction, more pleased than if you had given him a blank cheque.

The Betel leaf knows no distinction of caste or creed. Curiously, it is one of the few items of consumption which is beyond the pale of pollution. It is sacred and held in veneration. It is a sign of prosperity and of Goddess Lakshmi smiling all her benignant favour. Between the timid bride and the nervous bridegroom on the nuptial night, it is a link of introduction for future

bliss and concord, and every Hindu wife feels proud of her right to give the leaf to her husband in preference to any other woman. The proud father announces his first born son through the medium of betel. In out of the way places and during dull journeys betel is the 'Sesame' that opens doors of strangers and starts new acquaintances. High or low, rich or poor, young or old, man or woman, the betel exerts the same fascination over all, and there is not one who is not pleased with a gift of *Thambulam*.

What indeed are the charms whereby betel holds sway over all. O, Betel, art thou indeed, yet another emblem of the mystic east, the land of charms and spells? So cheap and yet so dear, what indeed is the mysterious power that opens doors at your approach and pouring oil on troubled waters, knits again sundered friendships in peace. Thou dost leave a stain on teeth, it is true, but why is it men prefer thee in ailment and give the cold shoulder to the Dentist. Inexplicable, but none the less felt, are your powers, and oh that I were a De Quincy to immortalise you in the archives of literature with my 'Confessions of a Betel chewer'!

The Betel leaf is in fact one of the most readily available remedies in common ailments. Medical authorities say that is a stimulant, digestive, carminative, expectorant and a counter-irritant. It would be difficult to find another drug in British or Ayurvedic pharmacopœia, which has such various and diversified functions and such a cosmopolitan love for the eradication of different diseases. The Roman Emperors in their days of glory would never have had recourse to emetics, if they had known the soothing influence of betel after Bacchanalian feast. If the drowning man will catch at a straw, no less true that the indiscreet diner who has feasted well but not wisely, will as eagerly turn his longing eyes to Betel.

It is not indigestion, but cold and cough and congestion at the chest that the patient is suffering from. At once comes the grandmother's recipe, 'chew some betel, crush the juice out and take it in'. She believes, it is an infallible expectorant and will bring the phlegm out from the stuffed throat. It is neither indigestion nor cough, but an ulcer neglected on the foot that is the source of all the trouble. The betel now adapts itself to the changed conditions and functions with the co-operation of a little oil, as an excellent ointment. In fact there is no part of the human anatomy, external or internal, that in its disordered state cannot but be benefited by the requisition of Dr. Betel who soothes as he heals, and who available at all hours of day or night never sends his bills.

Besides all these traits enumerated, the Betel leaf is supposed to be an aphrodisiac. Possibly, the ancients recognised it and that is why, it is an emblem of married life and the privilege of chewing is denied to ascetics and widows. It is curious that the leaves should possess this property, for authorities say that the roots crushed in water and administered, cause sterility in women—an effect exactly contrary to that produced by the leaves. Can it be that during the flow of the sap from the root to the leaves, some internal rearrangement of molecules and atoms is brought about resulting in the possession and manifestation of different properties. Here is indeed a problem to the philosopher and the scientist. Yet one more aspect, which if unravelled will add another plume to man's feathers.

Botanically, the Betel vine plant affords great interest to the student. It belongs to the family *Piperaceæ*, a natural order that revels in the tropics where a bright sun with good rain and moist situations smiles. To the same family

belong pepper, long pepper and tailed pepper, spices for which the east and the Far East have been famous from the days of Vasco de Gama, and for which adventurous spirits of the West, have braved the danger of the sea and the storm. It only differs from the other members of the genera, in that, while they are cultivated for their fruits and seeds, betel vine is raised for its yield of leaves alone.

The Betel vine is a very graceful creeper, which requires a moist situation without undue waterlogged condition and with very good facilities for drainage. It is a perennial, but under cultivation the growth is limited to a number of years ranging from three to ten. Stem and branches are fairly stout, leaves are stipulate, cordate at base, and vary in length from 3 to 9 inches, petiole is thick and ½ to 1 inch long. Inflorescences are spikes called catkins, containing male or female flowers, the females being longer than the males. Most of the plants are female, fruit and ovary are undeveloped and are cylindric and pendulous. Evidently, like the pepper, the betel also originally must have developed and matured normal fruits and seeds, but ages of cultivation by man, and the vegetative reproduction to which it has been subjected, has probably killed or at least suppressed the instinct of propagation by seeds. If such should really be the case, it is a great piece of wonder, that a plant should have adapted itself to be of most service to mankind.

Except in the far north and north-west, Betel is grown in almost every province ; Bengal heads the list with about 50,000 acres under cultivation, while Madras follows next with 27,970 acres, Bombay and Central Provinces coming next in order, in total area under cultivation. In Bengal however, the chief variety grown along the Hoogly river is a coarse one, and a fine variety known as *Ramtek-karpuri* is grown only in a limited area. Central Provinces leaves are famous for their quality, and large quantities are even exported to Calcutta. In Bombay the chief centres of cultivation are Poona and Dharwar, and one variety known as the *Ramtek-karpuri* is valued very highly.

In Madras Betel is grown in almost every district although, Malabar, Tanjore, Coimbatore and Madura grow the largest amount, about one-half of the total area in the Presidency being covered by these four districts alone. Malabar 4,896, Madura 2,478, Coimbatore 2,190, Tanjore 2,160.

There are any number of varieties in betel leaves, depending on the colour, size, shape, feel, texture and chewing quality ; the last named is the most important and very often leaves of a particular chewing quality, carry with them the other factors mentioned. The chewing quality again depends on the consumer whether he uses tobacco with his chew or not, for, if he does, he usually prefer, a thick dark pungent type which gives the necessary volume in the mouth, even if half a betel leaf is used. Delicate mouths, however, prefer the light coloured and comparatively insipid quality.

The common varieties in the Coimbatore district are *Karpurakodi*, *Kallaskodi*, *Vattakodi*, and *Chittukodi*. The first named as its name implies smells like camphor, is light green to greenish yellow in colour, linear in shape, and is the most attractive to the novice. *Kallaskodi* is the most common variety in the market but even in this there are many grades; it is usually dark green, coarse-textured and very pungent, but leaves from an older crop get lighter in colour, finer to the feel and less pungent to the taste, so much so, that the usual vellai vettalai of the market are really leaves from an old garden of *Kallaskodi*. The Kallas leaves are much broader than the *Karpurakodi* which taper to the tip more suddenly.

The *Vattakodi* leaf is a big one in size, more circular in shape than the other varieties, and probably because it has a larger surface keeps much longer than the others. It is in fact valued for this keeping quality, and, in out of the way villages far from betel vine gardens, where the weekly shandy is the only source of replenishing stores it is the most common variety, beyond the village fairs, therefore, it rarely finds a market.

The *Chittukodi* is the most aristocratic leaf of the lot. It is small in size, velvety to the touch, and very agreeable to the taste, neither very insipid nor very pungent. It however does not keep long and unless there is a market immediately after the harvest it is not very profitable to cultivate.

There are other varieties grown in other districts but they are probably only types of the four in Coimbatore. Thus in Malabar, where almost every chewer uses tobacco, the variety mostly cultivated is very much like the *kallas* type, big, dark and thick. The famous Kumbakonam leaves available even in the Madras Market is very much like the *Chittukodi*, while similar is the case with the *Ravase Vettalai* of Madras which is supplied by the gardens of Poonamallee. Other places in the Presidency famous for their good quality leaves are Tiruppuvanam in Madura, Tenkasi in Tinnevelly and Nellimarla in Vizag. The leaves of Tiruppuvanam are famous for their thinness and soft texture, it being contended that even a hundred leaves could be chewed at a time, without inconvenience.

The methods of cultivation of Betel vine vary in details with the localities, but in the main, they depend upon the nature of the plant itself and the system of land tenure. Below is given a detailed account of the cultivation, as it is practised in Vellalore and adjoining villages of the Noyyal tract in the Coimbatore District.

Notes on Betel Vine Cultivation

Land

The cultivation of the Betel vine is a joint stock concern. The land is taken out on lease by one man, who takes into partnership with him, other individuals who are allotted the several pieces or '*pullis*' as they are called, by means of a lottery. By this system, each man is assigned from half to one 'pathi' according to his means; a *pulli* is the local unit and is roughly about 14 to 15 cents in area. The man who takes the land on lease, gets his portion free of rent, the rental value varying from 120 to 150 rupees, although in places near Singanallur it goes up to even Rs 200 per acre. If the rental value is high, the number of *pullis* per acre is increased thus enabling a greater number to participate in the concern. This is done by the rows being put nearer than usual. Consequently the number of *pullis*—which by the way is a linear unit measured along the rows—is increased. Sometimes, the nature of the soil also determines the space between the rows; in a clayey soil the ridges can stand firmly even when they are close, but in a loose soil a larger interspace will be required to keep the ridges intact.

Rotation

Betel vine usually follows paddy the usual local rotation being sugarcane one year, followed by paddy one year, followed by betel vine for three years.

Cultivation

No ploughing is given but rows are marked and therein the land is thoroughly dug with up mamotti; the clods are then broken, and the soil weeded and levelled, all by hand. This levelling is done about a week after the mamotti digging. Then about the month of *Adi* (July–August) *Agathi* seeds are sown in clusters of four or five, all along the rows, at a rate of about 10 to 12 m. m. per acre. It is usually supposed that a new moon day is best for sowing *Agathi*. Sometimes along with the *Agathi*, are sown also *Gogu* and *Moringa*, the former for fibre and the latter for standards, plantain suckers also are planted after this, generally one at each end of the row. The land is then fenced with thorn and cuttings of wild cane (*Saccharum*) are planted to mark off the fence.

After sowing the agathi seeds, the whole land is flooded and then drained, after the sprouts come up another watering is given, one point to be noted being that *agathi* in the early stages does not stand water-logged conditions.

Depending on the nature of the soil and the growth of the agathi, trenching is done fifteen days to one month before the planting of the vines. Then the agathi leaves at the lower nodes and axillary branches are plucked off to induce tall growth and this plucking is done about once a month.

Planting

This is done in *Aippasi* (November-December). Just before planting water is let in and after splashing over the rows, a digging is given close to the base of the *Agathi* stem. Cuttings from one year old gardens are preferred and about forty to forty-two thousand are required per acre, the cuttings have about three nodes each and are planted in doubles and water is splashed on to them immediately after planting (irrigation for betel vine is always done by splashing). A few days after, another trenching is done. Irrigation is then given on alternate days for about a week more and then as often as the crop requires, usually one per week in cold weather the crop requiring humid conditions, free drainage, and copious irrigation.

Manuring

Manure is not usually applied before planting but a fortnight later, a dressing of 15 cart loads of cattle manure is given, three or four doses are then applied during the growth of the crop the second dose in the following July-August just before the first picking, the third in December before pruning and the fourth sometime in the third year. Depending on market requirements, when it is necessary to keep the crop longer, another dose also may be applied. Calotropis leaves and green manure dressings are given also at four to six cartloads per acre per time, four or five times. *Kolinji* leaves are preferred to other dressings, because they are supposed to give a colour to the leaves. Three months after planting (in February-March) when the *agathis* are about twelve feet high they are pollarded and before the break of the south-west monsoon they are grouped and arched. Blanks in the *agathi* rows are filled up by bamboos. Weeding and irrigation have to be done as often as is necessary, the former usually one in two months.

It takes about a month after planting to know if there are any blanks and these are then filled up. As they grow the vines have to be tied at every node to the *agathi* stem. This is done very carefully keeping the vine at the

back of the *agathi*, and tying loosely the knot always coming on the *agathi* stem. After the first year the tying is not done.

The first picking—virgin picking as it is called—comes about July-August when the crop is about eight to nine months old, and then a picking is given once a month. In December, the crop is given a pruning to induce more axillary branches and leaves to be given off.

Yield

Usually the crop gives 4500 to 5000 palagais of leaves during the three years, a palagai consisting of 2000 leaves.

Economics

A rough balance sheet of the crop (appendix) shows a profit of about Rs. 1500, per acre for three years. This must mean very small profit per annum to the several participants in the concern. But, although the yield and the corresponding outturn, may not be much increased, the expenses in actual practice get diminished, for the cultivator does most of the work himself. The items shown under 'tying vines', 'watch' &c., in the cost of cultivation, are attended to by the ryot and other members of his family. Also, the ryot manages his labour to very efficient limits, by providing perquisites for the coolies. Most of the work in the betel vine garden like trenching etc., is done by contract. During the planting season, a cooly is given a midday meal for collecting 100 cuttings and planting them properly. During harvest, a cooly is given a 'cowley" (200 leaves) of leaves, for every 3 palagais of leaves, that he picks and packs ready for the harvest. Besides, the auxiliary crops like vegetables, which the ryot raises, are a by-product source of revenue for him, and some of the expenses like, cost of bamboos, fencing, thatties are permanent. Thus his profits are very much more than is actually seen on paper.

Diseases

Batel vine is subject to the attack of various diseases, which go by expressive names in the locality. The most common and disastrous is the one known as the '*Karunthal*' (black stalk—literally). The plant gets black and mouldy, and the whole vine dries up and dies. A garden badly affected by this disease presents a black appearance, with all the plants—foliage, stem and all—dried up and drooping. Another disease called the *Vellai Narakkai* (white greying disease) makes the plants stunted in growth and sickly; the leaves get quite pale and are attached very weakly to the nodes, a gust of wind sufficing to break them loose. A third disease which is not so common as these two and is rather sporadic in its appearance is known as the '*Kollikkattai Noi*' (firebrand disease). Plants attacked by this, look as if they have been scorched by fire; the lips and edges of the leaves first dry up, and then the withering spreads to the whole plant. These are the common diseases found in the Vellalur tract.

Reports have been received from Poonamallee of a serious disease, which causes wholesale destruction of betel-vine crops; this is supposed to be caused by a *phytophthera* fungus, and the disease and remedial measures are being investigated into by the Mycologist.

Insect pests. Insect ravages on betel vine, of a serious nature, have not so far been noticed in the south; but during recent years, reports have been

received from the Tungabhadra Valley, of the enormous amount of loss caused to the crop by a certain bug, which infests the tender portions of the plants in swarms and sap away the crop out of existence.

It has not been found to cause any damage to betel gardens in the south, although the bug has been noticed attacking the *Karpurakodi* variety alone, rather violently, during some seasons.

The cultivation of betel vine does not differ in its essentials, in other parts of the country from the method followed in Coimbatore district, as, it depends largely on the peculiar nature of the crop itself. Thus in Bombay, instead of *Agathi*, *Erythrina* stems are used as the standards, on which, the vines are trained and tied. In Bengal and in some parts of the northern circar, as also in some places in Malabar, bamboos are used exclusively as the standards. In North India, betel vine is not grown as a three year crop as in the south, but after three years the vines are released from the standards and the top portions coiled into the soil, and from these a fresh crop arises, thus having more or less a perennial growth.

Everywhere, irrigation is always done by splashing, as the crop is a delicate one and cannot stand water-logging to any extent. In certain parts of Central Provinces, it is reported that artificial shades are provided above the crop to protect it from the severe sun. It would appear, that betel vine gardens are so cool and comfortable that not infrequently cheetahs and tigers come in for a quiet slumber into the shade.

If there is one crop in India, about which there are superstitious associations, and which is treated with veneration, not only by the cultivators, but by the masses themselves, that surely is the betel vine. Throughout the country, north or south, the cultivation is done, with strict adherence to rules and ceremonies, and in Bombay and Central Provinces, only certain castes are allowed to grow the crop, and they are treated with great respect by the others. In Tanjore district, the crop is grown almost exclusively by Muhammadans. In certain parts of South India, Brahmins are not allowed entry into the betel-vine gardens, and most ryots do not allow shoes or sandals to be worn inside, by anyone. It is reported that in Central Provinces the vines soon after planting are given an unusual luxury—they are fed with milk. Many of these superstitious ideas are slowly disappearing, it is true, but still the idea of religious respect is yet there, the crop being considered as an incarnation of Goddess Lakshmi herself and any sacrilege perpetrated within the precincts of the garden, is supposed to bring positive punishment to the wrong doer.

Quaint and very expressive, are many of the terms used by ryots in the cultivation of the crop. *Sadaikkal* (garden with tresses when only the *agathis* have been planted), *Ilangal* (infant crop), *Muthikal* (mature crop), *Vaippuvai munn* (cuttings covering earth), *Kannippari* (virgin picking for the first harvest), *Kondai Vettuthayhai* (topping from *Agathis*), these and others terms, so self explanatory and suggestive, testify to the ability of the ryots to add to the vocabulary, convenient and intelligible words and phrases.

It is difficult to write with any great accuracy about betel trade. By its perishable nature, the trade in betel has necessarily to be confined to places within the country and that too to parts, which are reachable by Mail or fast passenger trains, by a two days' journey at the most, from the gardens. Two or three factors which govern marketing are however obvious. In cities like

Madras, Bombay and Calcutta, there is always a demand for nice and tender leaves, and no matter how far the gardens are, these towns get their requirements in any quantity. Other towns, where there is no such demand for such high grade leaves and which also have no gardens within easy reach, get thick, large leaves from distant places, as only this type of leaves keep for some time. Thus from Coimbatore, leaves are sent by train, to places like Sholapur, Hindupur and Tiruvannamalai.

As in the case of other crops, it is the merchants or middlemen (as they should be strictly called) that get much profit out of the crop. A little understanding between these middlemen, tells economically upon the poor ryots. The latter is compelled to harvest his leaves once every month, as, if he leaves them over even for two or three days, the leaves get rank, thick and wild and lose market value. He is therefore at the mercy of the merchants who dictate terms, and who sometimes even produce (by arrangement) telegrams from customers in distant places, cancelling orders and thus bring down a slump in the betel market. Other factors like growth of the crop during seasons, demand during the marriage months of the year and the age of the crop also operate to alter the price. Below is given a statement showing the price of betel leaves per palagai during the several months of the year 1926–27:

		Rs	A	P
September	1926	0	12	0
October	,,	0	9	0
November	,,	0	9	0
January	1927	1	4	0
February	,,	1	5	0
March	,,	0	15	0
April	,,	0	8	6
May	,,	1	4	0
June	,,	1	0	6
July	,,	0	12	0
August	,,	0	10	0
September	,,	0	14	0
October	,,	0	7	0
November	,,	0	6	0
Total ...		11	4	0
Average..		0	12	10

It will be seen that the price is lowest in October–November, rainy months, when the growth is quite luxuriant and there is not much demand. In December the crops get a pruning and in January and February, the leaves from the fresh flush get a higher price. During the dry months March–April, the leaves get also coarse and the price goes down again, although not so much as in September, October, as there will be more demand. During May, June and July there is again a rise as these are marriage months.

That betel leaf is bleached, is probably not known to many in South India, but bleached betel leaf is the chief ingredient in what is known as the 'Pucca Pan' in North India. The bleaching is done by a certain sect of people, who have developed the process almost to an art and keep their methods as a trade-secret. The process,—in outline—is very simple. A large number of healthy

leaves about 20,000 or more are neatly packed in baskets lined with wet plantain leaves or gunnies, with their petioles all cut off, and the baskets are then kept in a dark, but ventilated room for several days. Every day, the baskets are examined and leaves rotting or showing signs of rot are at once removed. In about a fortnight, the leaves get quite bleached and amber in colour. They are then removed, dried to drive off surface moisture and then stored; the leaves thus bleached keeping for quite a long time. Simple as it seems, great experience is required to select the healthy leaves, to sift and pick out the diseased one, and to regulate the temperature and moisture during the whole period. By bleaching, the chewing quality of the leaf is said to be improved and the bleached leaf is sold at a higher price—nearly double—than the unbleached one.

Dr. Mann and Messrs. Sahasrabudde and Patawardhan, of Poona, were interested in the bleaching of betel leaf and conducted elaborate investigations into the process and the chemical changes occurring therein. As a result of their experiments they found that during the bleaching, there is an increase in the percentage of essential oils and the diastatic activity of the leaf. The higher chewing value of the bleached leaf is evidently due to this increase.

Appendix

	Rs	A	P
Preparatory cultivation			
Digging in lines, with Mammatti, usually given by contract at 12 annas per *pulli*	5	4	0
Breaking clods and levelling, 10 men per acre ...	5	0	0
Total ...	10	4	0
Manures and Manuring			
60 cart loads of cattle manure at 2½ to 3 rupees per cartload inclusive of carthire (applied in 3 or 4 dozes) ...	160	0	0
Cost of application cleaning, powdering and spreading, 100 women per acre	30	0	0
Green leaves 25 to 30 cartloads at 5 rupees per cartload ...	150	0	0
Carrying and applying	10	0	0
Total ...	350	0	0
Seeds and Sowing			
Agathi seeds, 10 M.M.	15	0	0
Sowing *agathi*—8 men per acre	4	0	0
Auxiliary crops			
Plantains, 500 per acre at Rs. 2-8-0 per 100	12	8	0
Carrying and planting plantains	3	0	0
Wild canes for fence, 1,000 cuttings	7	8	0
Other crops	30	0	0
Betel vine cuttings 42,000 per acre at Rs. 5 per 1.000 ...	210	0	0
Planting	25	0	0
Filling up blanks and cost of planting (500)	2	8	0
Total ...	309	8	0

	Rs	A	P
After-cultivation			
15 to 15 weedings throughout the crop period, 100 women and 100 men per acre	75	0	0
Trenching and earthing up 12 to 15 times at 9 annas per pulli	50	0	0
Raising and trimming edges about 15 to 20 times, 10 annas per acre	90	0	0
Mammatti digging along the rows after planting at 6 annas per pulli	3	0	0
Tying vines	300	0	0
Tying *agathi* bowers 3 times	25	0	0
50 head loads of plantain fibre	100	0	0
3600 bamboos	200	0	0
Wind breaks			
200 *agathi* trees	20	0	0
40 men per acre	20	0	0
Coconut leaves 50 head loads	25	0	0
Fencing, bringing thorns	15	0	0
Total ...	923	0	0
Watchman for 1½ years (will look after 2 to 3 acres) ...	100	0	0
Irrigation			
Splashing 400 men for 3 years	200	0	0
Mhoting for 10 months for the 3 years	300	0	0
Total ...	500	0	0
Harvesting			
Harvesting, packing, sorting etc. 4,800 *palagais* for 3 years	800	0	0
Agathi leaves and topping off and on	75	0	0
Miscellaneous crops	50	0	0
Total ...	925	0	0
Cleaning of the land	15	0	0
Digging up and levelling—60 men	30	0	0

Expenditure

	Rs	A	P
Preparatory cultivation	10	4	0
Manures and manuring	350	0	0
Seeds and sowing	309	8	0
After-cultivation	923	0	0
Watch	100	0	0
Irrigation	500	0	0
Harvesting	925	0	0
Clearing and levelling of the land	45	0	0
Total ...	3,162	12	0

Receipts

	Rs	A	P
Betel leaves at 1 Rupee per palagai	4,000	0	0
Agathi leaves	200	0	0
Cuttings sold	200	0	0
Plantains	500	0	0
Vegetables	50	0	0
Agathi trees for fuel	75	0	0
Total ...	5,025	0	0

PART II

During recent years, there has been considerable deterioration in the quality and quantity of betel leaves produced in the gardens along the Noyyal river, in Coimbatore district : the outward manifestation of this deterioration, has been the prevalence of one or more diseases attacking the betel crop, the chief of them being the *Karunthal* disease, which has been responsible for the wholesale destruction of the crop in many gardens. With a view to investigate into the diseases and, if possible, to suggest remedies for checking, the Department opened the Betel-vine Experimental Station, at Vellalur in the year 1924.

Vellalur is a typical betel growing and betel trading village, about three miles to the east of Podanur Junction, and the site selected for conducting the experiments was one of the worst affected gardens in the locality. The cultural operations and the administrative work connected with the Station are under the immediate charge of the Deputy Director of Agriculture, VIII circle, while experiments are being conducted by the Mycologist, Entomologist and the Agricultural Chemist. While each is attacking the problem with special reference to his point of view, the three experts collaborate their results and are engaged in finding out what is responsible for the diseases and how they can be checked. It is proposed in this paper to give in detail, the nature of the experiments conducted by the Chemist and the results achieved so far.

One chief feature of betel-vine cultivation in this tract, is the extreme waterlogged nature of the soil. In close proximity to the tanks or the

channels of the Noyyal river, and consisting mostly of clayey soil, the land gets saturated with water, and it is not unusual during the moonsoon months when the tanks and water-ways are quite full, to see the fields submerged under water; and though betel-vine requires enormous quantities of water during its growth, it is quite possible that this excess of water and the defective drainage conditions that prevail have a great deal to do with the incidence of disease and the lowering of yield. The most important investigation, therefore, that was started by the Chemist was to study and improve the drainage facilities and see how the yield of leaves was affected thereby.

The drainage experiments

Before going into the details of the lay-out of the experiments in the several plots, it will be necessary to recall for a moment, some of the existing methods in the cultivation of betel-vine as adopted by the ryots locally. We have seen already, how the vines are planted on either side of the ridges at the bases of the *agathi* plants, and how as they grow, they are tied on at the nodes to the *agathi* stems, which have been arched together at the top to form a bower. Periodically the trenches between these ridges get deeper and deeper, as the soil from there is dug up and earthed on over the growing vines on the ridges. Thus the depth of the trenches, becomes in fact a gauge for measuring the age of the crop, for what at first was more or less level land with the *agathis* grown in was arched and gets at the end of the three years when the betel crop is pulled out, into a number of ridges and furrows.

It will thus be seen, that this essential feature of betel-vine cultivation which entails the cutting up of the land into ridges and trenches, is in itself an advantage, since, the vines are always grown on ridges, and the trenches in between afford facilities for drainage. But during the growth of the crop, there is a limit to the depth to which these trenches are dug, and consequently to the height to which the ridges could be raised with the earth so dug out.

Let us suppose that during the growth of a betel crop, these ridges get raised—as is followed locally—to a height of 2½ to 3 feet above the trench level. If side by side with these, we could have ridges raised with earth, to a height of two feet more, than is done locally, then by comparing the yields of betel grown on the local ridges with those grown on the 'raised' ridges, we have a means whereby we can say whether drainage is the defect for, by raising we improve drainage, and if raising gives a better yield, then bad drainage was the defect, that this raising cancelled the effects of.

It is this principle that is worked out in the lay-out of plot 5, in the betel-vine station. The whole plot is 35 cents in area, and consists of 31 ridges or 30 arches (*agathi*) running north to south, the ridges being numbered from west to east. Every three alternate ridges here have been raised with earth brought from outside, to a height of 1½ feet more than the others, which are of the height usually adopted in local practice. Thus we have three local ridges, then three 'raised' ridges, then again three 'local' ones and so on. But, for purposes of record of yield, the arches are our unit, each arch being made up of rows of vines grown on two ridges on either side of a trench. Thus we see that every third arch is made up of vines, one half from a 'local' ridge and the other half from a 'raised' ridge. These therefore have to be discarded for experimental interpretation. We are then reduced to this

2 L's—1 LR—2 R's—1 RL—2 L's and so on.

Rejecting the alternate ones, we have
2 L's—2 R's—2 L's and so on.

Thus we have 5 series of 'locals' and 5 series of 'Raised' each series consisting of two rows. The series have been numbered from west to east, and the first series in Plot 5, is a 'local'.

Thus in the end we have
* L I, R I, L II, R II, L III, R III, L IV, R IV, L V, R V.

In addition, the experimental rows have outskirts all round, and another cutting of them into two halves—the northern and the southern—while recording yields these halves are harvested separately and the advantages of this procedure are obvious. While serving as duplicate of the same treatment, they enable one to get an idea of the fertility of the land, not only as we go from west to east, but also from south to north. With these preliminary remarks about the lay out of the plot, we can now take up the monthly harvest yield and discuss the figures.

The crop on plot 5 was planted in December 1926 and the first picking was done in September 1927; from then onwards it was harvested every month (except in December when it was given a pruning) until December 1927 when it was pulled. Below are given the yields of the 'local' and the 'Raised' rows, for thirteen harvests:

STATEMENT I

Number of harvest	Month of harvest	Raised Rows R lbs.	Raised Rows R oz.	Local Rows L lbs.	Local Rows L oz.	Percentage increase of R over L
1	September 1926	14	11	10	6	41·6
2	October ,, ...	32	13¾	23	6½	40·4
3	November ,, ...	51	6½	33	2½	55·0
4	January 1927	55	9	38	5	45·0
5	February ,, ...	47	5	37	15½	24·4
6	March ,, ...	53	6½	44	11	19·5
7	April ,, ...	109	1	72	7	50·6
8	May ,, ...	159	2	103	14	53·2
9	June ,, ...	132	9	96	4	37·7
10	July ,, ...	160	14	132	4	21·6
11	August ,, ...	...	...	...	...	...
12	September ,, ...	137	10½	136	6	0·9
13	October ,, ...	105	8	100	5	5·2
14	November ,, ...	88	10	73	12½	20·1
	Total ...					

* L I=I series 'Locals'.
R I=I series 'Raised'.

It will be seen from the above statement that except in September and October 1927, all the other months the 'raised' rows shew a distinct percentage increase over the 'local' rows and for all the harvests together show a percentage increase of 27 over the 'locals'. The figures for the 12th and 13th harvest were when the crop had already reached the decadent stage, just before being removed from the field. Taking the other month's figures, it will be seen that superiority of the 'raised' rows to the 'local' rows is emphasised during the wet and rainy months, while during the dry months (February and March for example) the percentage increase of the 'raised' over the 'locals' is going down.

So far for the yields of all the 'raised' rows as compared with the yields of all the 'local' rows. Below is given a statement of yields from each series of 'raised' and 'local' in plot 5, for all the 13 harvests together:

STATEMENT II

Statement showing the yields of 13 harvests of each series 'raised' against corresponding series of 'locals'

Heading	Raised Rows lbs.	oz.	Local Rows lbs.	oz.	Percentage increase or decrease of R over L
1st series R–1 and L–1 ...	493	12	337	13½	45·88
2nd series R–2 and L–2 ...	360	14½	339	11	5· 9
3rd series R–3 and L–3 ...	143	0	157	10	—9· 5
4th series R–4 and L–4 ...	125	0	39	11	110· 3
5th series R–5 and L–5 ...	25	15¾	28	5½	—9· 9
Total ...	1148	10¼	903	3	27· 4

It will be seen from this statement, that the 3rd and the 5th series of the experiment give a negative result, and what proved to be a score for the 'raised'. When we considered all the 'raised' against all the 'locals' (as in statement I) appears to get a set back by the behaviour of these two series, 3rd and 5th. In other words, if we consider the experiment in Plot 5 as a pentaplicate repetition of 'raised' versus 'locals', we find that the 1st, 2nd and 4th series decide very favourably for the 'raised' while the 3rd and the 5th series show the 'locals' to be superior; but that this negative evidence is more than counterbalanced by the positive results of the other three series, so that on the whole the 'raised' show a percentage increase of 27 over the 'locals'.

This line of argument will lead to no strong evidence in favour of the 'raised' over the 'locals'; and the experiment must be considered a failure; at best it cannot be looked upon as a decided success. But when we scrutinize the figures and attempt to find a reason for the contrary behaviour of these two series alone (3rd and 5th) we shall see that this apparent negative result, is really a positive one and adds one more link to the chain of argument, whereby it is proved that the 'raiseds' are certainly better than the locals.

For this, we have to take the figures of harvest of plots 4 and 3 corresponding to those of plot 5. There the plots lie immediately to the south of and contiguous to plot 5, and contain exactly the same number of rows similarly laid out as in plot 5; only all the beds are of the same height, namely, that of the locals in plot 5. In a sense, therefore, these are control plots, and the variation in yields of the rows as we go from west to the east (i.e. from series to series) of these two plots should give an indication of the slope of fertility and a possible clue to the curious behaviour of series 3 and 5 in plot 5.

It has already been said that in plots 3 and 4, there are no experiments. But taking the rows in these, corresponding to the raised and the local rows in plot 5, and working out the percentage increase or decrease, exactly as we did in plot 5, we get the following statement:

Statement III—showing percentage increase or decrease of R over L—compared from the yields of Plots, 3, 4 and 5.

Heading	Plot 3	Plot 4	Plot 5
Whole plot ...	—6·1	—5·0	27·4
Southern half ...	—3·0	—6·3	26·7
Northern half ...	—9·6	—4·0	27·3
1st series ...	5·5	17·9	45·4
2nd ,, ...	—2·4	—13·4	5·9
3rd ,, ...	5·1	2·1	—9·5
4th ,, ...	—27·5	—28·7	110·3
5th ,, ...	—19·7	—65·7	—9·9

N.B.—Figures in negative are those where R has failed against L.

It will be seen at a glance, that the Raised's of plot 5 have scored distinctly against the corresponding rows in plots 3 and 4. Series 3, which gave a negative result (see statement II) need not disturb us any more, for the negative result is evidently not due to the experiment, as corresponding series in plots 3 and 4, show that something in the land itself is responsible; and as regards series 5 of plot 5 which gave a negative value (—9·9), scrutiny will show that is really much less negative than the 5th series of plots 3 and 4 and is thus positively indicative of the superiority of the Raiseds over the Locals.

The fact is, that, whether it be due to difference in level or slope of fertility of the land, in all the three plots 3, 4 and 5 the eastern half is poorer in yield than the west, and the further east the series, the poorer is its growth. Now in our methods of comparing every local series with the raised one near it, there is an error; for since the numbering of the rows is from west to east, and since (as can be seen from the sketch of plot 5) the locals start the experiment, in such a method of comparison the local series will have the advantage of position (being more to the west) when compared with the raised series immediately to the east of it; with this disadvantage the 1st, 2nd and 4th series have shown that the Raised's are better than the Locals; and we have seen that in series 5, the eastern most of the series, the negative result was really not negative but quite positive from comparison with the 5th

series of plots 3 and 4. We are thus left with the 3rd series where alone a negative result has been obtained. Let us examine this further

Now the 3rd series of Raised gave ... lbs. 143–0
While the 3rd series of Local gave ... ,, 157–10

Here bearing in mind that the local series is to the west of the raised and has thus the advantage of position. We shall try to allow for this, by taking the averages of the two local series on either side of the 3rd Raised series and comparing it with the yield of the 3rd Raised series. The two local series on either side of the 3rd Raised series are the 3rd locals (on the west) and the 4th local (on the east). The yields of these are :

3rd local series ... lbs. 157–10 }
4th local series ... ,, 39–11 } 197–5 : Average 98—10½
3rd Raised series ... ,, 143–0

Therefore percentage of increase of 3rd R over average of 3 L and 4 L.

$$\text{equals to } \frac{143-(98-10\frac{1}{2})\times 100}{98-10\frac{1}{2}}=44\cdot 8.$$

Now this result is positive and in perfect agreement with the results of the other series; only those series of Raised which even with the disadvantage of position showed themselves to be superior to the locals will be found to be much more so; if we apply the correction for position, that we have done in the case of the 3rd series.

Yet another way of looking at the figures of harvest of plots 3, 4 and 5, brings home clearly the positive superiority of the raised rows to the local rows. Below are given the total yields to the nearest point of the experimental portion of the three plots for all the thirteen harvests.

	lbs.		lbs.		lbs.
Plot 3	... 3,779	Plot 4	... 2,433	Plot 5	... 2,052

Now, all along plot 3 has given the highest yield and then comes plot 4, and last plot 5. This evidently is due to the slope of fertility of the land. The rate of fall of yield from plot 3 to plot 4 $=\frac{3779-2433}{3779}=\frac{1}{2\cdot 8}$ nearly.

If the same rate of fall had obtained from plot 4 to plot 5, plot 5 should have yielded $2433-\frac{1}{2\cdot 8}\times 2433=1563$ lbs. nearly. But plot 5 has actually yielded 2052 lbs. or 500 lbs. more, the rate of fall being $\frac{2433-2052}{2433}=\frac{1}{6\cdot 4}$ nearly and thus the rate of fall has been considerably lessened. What is this due to?

We will now take up the yields of the Locals rows alone in plot 5 and the corresponding rows in plots 3 and 4 and work out similarly the rates of fall

Local rows—yields of

	lbs.		lbs.		lbs.
Plot 3	... 1,949	Plot 4	... 1,248	Plot 5	... 903

The rate of fall here, from plot 3 to plot 4 is $\frac{1949-1248}{1949}=\frac{1}{2\cdot 8}$ and from plot 4 to 5 is $\frac{1248-903}{1248}=\frac{1}{3\cdot 6}$

Let us now take the Raised rows.

	lbs.		lbs.		lbs.
Plot 3	... 1,830	Plot 4	... 1,185	Plot 5	1,149

The rate of fall from plot 3 to plot 4 is $\frac{1830-1185}{1830} = \frac{1}{2\cdot8}$ and that from plot 4 to plot 5, $\frac{1185-1149}{1185} = \frac{1}{33}$

Putting all these figures together and converting rates of fall into percentages we have the following statement;

	Fall per 100 from plot 3 to plot 4	Fall per 100 from plot 4 to plot 5
Whole plot	... 35·7	15·6
Local rows	... 35·7	27·9
Raised rows	... 35·7	3

It is clear from this statement that while the tendency of the soil is to indicate poorer yield as we from south to north—which is lower in level—the raising of the rows has served to counteract this tendency; for while the rate of fall is very uniform in the local rows, the raised rows of plot 5 have been nearly equal to those of plot 4 in yield, so insignificant is the rate of fall (only 3 per cent.)

(*To be continued in the next issue*)

WHAT 'AGRICULTURE' MEANS:

A.—Acquire the best plants when planting your field.
G.—Give careful attention to select the best soil.
R.—Remember to plant at right distances apart.
I.—Inspect the early growth of your plants.
C.—Cure any mistake early by supplying defective growth with good plants.
U.—Use any manure that is near at hand.
L.—Listen to the advice of your Agricultural Inspector.
T.—Turn up the soil and fork in dry weather.
U.—Use any material nearby for mulching.
R.—Reap for sale only the best in your field.
E.—Endeavour to deliver at wharf without bruising.

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