

Experiments at the Betel Vine Station, Vellalur.

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Betel vine is an important money crop in some localities and it occupies an area of about 23,800 acres in this Presidency. About 8% of this area is accounted for by Coimbatore District. It is a very delicate crop and requires an enormous amount of care and tending. This is possibly the reason for the comparatively small percentage of the area under the crop. Without being one of the necessities of life betel leaf is all the same an essential and inevitable factor in the social and religious fabric of Indian life.

Since 1911 complaints were received now and then about some diseases on betel vine in the Noyyal valley which were said to affect the produce of the crop very seriously. The nature of the disease as complained of is neither very definite nor confined to any one particular aspect. The diseased vines have generally stunted growth, put forth only a limited number of branches and leaves and such leaves are very much undersized and poor in quality. This, in common, is the main complaint, and the cause is attributed locally to earthworms. Occasionally instances are also brought forward where failures of vines occur due to one or more specific reasons. These are chiefly in the nature of diseases which would appear to be either fungoid or bacterial. Three such diseases are known here and go by local names as follows:—

(i) *Vellainerkkai*:—a disease which affects young vines where the plants assume a pale and unhealthy appearance and have a lengthy and struggling existence. Here the growth gets permanently arrested and the leaves have an insipid taste—quite unlike the aromatic pungent one one is familiar with. The plants when touched break off very easily at the nodes.

(ii) *Karunthal*:—So named on account of a black collar developed round the stem of plants. This appears on the vines below ground or on the parts above near to the surface. The result is that the plant at first

assumes a drooping appearance and later dries up completely above the seat of attack. Even in the early period of attack the underground portions of the vines are rotten and very often shredded; and the aerial stem when split longitudinally reveals black streaks. The damages on account of this disease are sometimes very heavy.

(iii) *Kollikattainovu* :—This is a disease which is neither so largely harmful nor as widely distributed as either of the other two diseases. Something like a scorched up appearance from the tip to about the middle of the leaves would go to indicate this disease.

In earlier years some investigations were carried on in the fields of ryots themselves to study this problem, and as all of them were not quite as successful as could be desired a betel vine station was started in 1925 at Vellalur one of the several villages wherein the diseases were noticed. The previous investigations were largely helpful in directing the course of investigation at the Betel Vine Station and based on the observations thereof the problem is thought to rest on two broad factors viz., physical and biological.

Physical Betel gardens here have a tendency to get water logged and conditions are such that proper aeration is wanting in most cases with the result that the roots and rootlets have little chance to develop sufficiently. As an instance the sketch shown here (omitted) may be studied. It represents diagrammatically the relative levels of the tank, the channels and the betel plots at the Vellalur Station. It may be observed that the bed level of the tank itself is about a foot higher than the plots and when the tank is full there is a head of seven feet and over of water above the level of the plots. In addition the level of water in the channels is also higher than the field levels. Naturally there is a considerable amount of water getting into the plots by seepage, and its effective drainage is indeed a problem. It has further been noticed that the crop suffers most in wet weather. It would therefore be obvious that by improving such conditions it should be possible to get over the diseases, which may after all be only after-effects. In the experiments at the Betel Vine Station this is sought to be achieved in two ways.

- (i) Improvement of drainage by artificial means.
- (ii) Improvement of the soil by application of lime.

Drainage Experiments :—So far the method adopted to provide better drainage has been to grow betel on beds raised $\frac{1}{2}$ to 1 foot higher than the local beds. Such an experiment was started in plot V during 1925 and was repeated again in plot I the next year. The first experiment has run its course and full figures are now available. The second one continues still and will be completed in the coming year.

In each of the above two experiments comparison was made between 5 raised series and 5 local series each consisting of two rows of arches and the series alternating with each other.

In plot V the value of uneven conditions was brought about by a large number of failures of vines due to Karunthal. In the other plot 11 harvests have thus far been made and the results there are more trustworthy as the crop has been fairly uniform. The yields from the two plots are shown in the graph (omitted) here. In plot V, with the exception of the few yields at the fag end of the crop, the raised beds have, in all instances, given appreciably higher yields than the locals. The same could be said of the yields in plot I also. In both the cases the differences between the locals and the raised are less during the dry months, and more during wet weather. On the whole there has been an increased yield of 28% in the case of plot V and 22% in plot I.

Apart from a mere increased quantity the raised beds have also given a superior quality of leaves as judged by the local standard, where large thick and heavy leaves are always priced more than small thin and slender ones. In plot V out of 500 there has been an increased length of 26.4 " and a like width of 26.3 " in favour of the raised beds. Similar increases for the raised beds in plot I for 1, 100 leaves have 131 " and 84 " respectively,

This superiority of the raised beds in producing larger quantity and better quality of leaves has been proved beyond any possible doubt by a very thorough scrutiny of

the figure and allowing for probable error in the experiments, the results are also quite significant.

Soil improvement by application of lime is dealt with elsewhere in this paper.

Biological factors:—Here the problem centres chiefly round the effects of earthworms and fungi on betelvine. Incidentally some observations are also made of other organisms like eelworms and insects which may be affecting the crop.

Earthworms:—It is common knowledge that moist soils with a plentiful supply of organic matter afford easy breeding ground for earthworms. This is the case in almost all betel gardens in the Noyyal valley. Possibly the cool shady condition and the frequent irrigations and manurings done to the betel crop are just about the conditions necessary for the worms to thrive. During wet weather the soil is completely covered by earthworm castings and when it is dug into there is a net work of earthworm burrows presenting a characteristically-reticulated appearance. Earthworms in large numbers are also found wriggling into their holes. Such large numbers of these worms are not generally met with in fields under other crops; nor are they so largely found in the very same betel gardens. It is mostly in the wet months that severe damages on vines are noticed and at that time large numbers of earthworms are also to be found very near to the surface. Ryots naturally associate the two together and attribute the damages to earthworms. What harm the earthworms do exactly no one is able to say very definitely but suggestions are made that they directly rob the crop of its plant food by eating away the organic matter viz., cattle dung and green leaves applied as manures, cut off roots and root-lets of the vine while burrowing in the soil and affording places for stagnation of water in their burrow holes during the wet months. These causes, it is said, affect, either individually or severally, the general growth of the vines and thereby make them susceptible to very many diseases. We cannot pass our verdict on the role of the earthworms in the vine gardens without first making a detailed study of the problem in all its aspects.

Since the time of starting the Station at Vellalur a study is being made into the life history of the earthworms by the Government Entomologist, at the College Insectary. Side by side with such a study certain field trials are also being conducted to see how far the earthworms are responsible for any damage observed on the vine.

These trials include a direct counting of the population of earthworms in the several experimental bits at the Betel Vine Station and another experiment which is in the nature of being manurial.

The manurial experiment is an indirect method of judging the damage, if any, caused by earthworms. Plot II goes under this experiment and the crop there was started in 1926. The plot has been divided into two halves with 30 rows in each. One half has been limed at 1000 lbs. per acre. The 30 rows in each of the two halves have been grouped into 10 units of 3 rows each. Every alternate unit receives a complete mineral manure and the others remain as control receiving the usual organic manures as applied in the locality. Till March last the mineral manures applied consisted of a mixture of 9 cwts. of super phosphate and 6 cwts. of Nitrate of Potash per acre. Subsequently they have been changed to two separate mixtures Nitro-chalk Basic Super and Nitrate of Potash constituting a basic mixture and Sulphate of Ammonia, Super and Sulphate of Potash forming an acid mixture. These two mixtures are to be applied alternately once in 3 months. 195 lbs. of mixtures of Super and Nitrate of Potash and 68 lbs. of the basic mixture have thus far been applied to the crop in 8 doses.

The object of this experiment is to find out whether, by cutting off food supply to earthworms and substituting manures in the shape of minerals to meet the needs of the crop, it would not be possible to reduce the earthworm population of the soil and thereby increase the production.

So far only 11 harvests have been made from the crop and the yields are as shown-below :—

The limed half has given distinctly better yields than the unlimed one and in each of the two halves the organic manure portions have almost always given slightly increased yields over the mineral manure beds. At this stage it would be desirable to consider the earthworms population of the different treatments so that they could be correlated with the harvest figures.

Counts were taken of earthworms in 1 cubic foot of soil in 24 places in each of plots I and II in places as follows :-

Plot I	Raised beds	12	@	4	per series in i, iii & v.
	Local	12	@	"	" "
Plot II	Lime Organic				
	manure.	6	"	2	" " "
"	" Mineral				
	Manure	6	"	"	" " "
"	Organic				
	Manure only	6	"	"	" " "
"	Mineral				
	manures only	6	"	"	" " "
	Total	48	Counts.		

Starting in December 1927 these countings were repeated once in every month, and from the figures so far available the following conclusions are apparent:—

(i) Raised beds in Plot I have more earthworms in them than the corresponding locals.

(ii) Organic Manure beds also have a considerably greater number of earthworms in them than the corresponding Mineral manure beds.

(iii) The effect of liming has been to reduce the earthworm population in the soil.

If now, side by side with the above we consider the leaf yields we could come at the following conclusions:—

(i) The raised beds which have a greater earthworm population have also given increased yields over the locals.

(ii) The organic manure beds, which also have quite a larger number of earthworms than the mineral manure beds, have at the same time given slightly better yields.

(iii) Liming has tended to reduce the earthworm population and increase production.

Thus it would appear that a phenomenally large earthworm population in the soil does not in any way affect yields. But before adopting such a conclusion in its entirety it would also seem desirable to account for

(i) the lower population in plot I as against Plot II with the corresponding high yield of Plot I against the lower production in Plot II.

(ii) The greater preponderance of earthworms in the last of the three series examined in plot II and their strikingly low yields as against either of the two other series higher above. It is here that the difficulty comes in. For one thing the set of observations now before us require to be amplified still further which is possible only at the end of the experiment; and another thing would be that some further experimenting may be necessary before a definite judgment is pronounced. Such experiments are now in contemplation.

Fungi.—In all the diseases noticed on betel vine there is the possibility that fungi play a great part. The probabilities are that these are externally parasitic attacking the plants either above the ground level or below in the soil. If these were true it should be possible to get over the diseases by one or more spraying with Bordeaux mixture externally on the plants, and disinfecting the soil by fungicides. In 1926 when a large number of vines began to fail on account of Karunthal and Vellainerakkai at the Betel Vine Station sprayings were started on the diseased plants and healthy plants near by: In all, three sprayings were done with a period of 2 months, and these were noticed to have no effect, either good or bad, on the plants. Obviously there are no external parasitic fungi, attacking plants from outside. This has also been tried by application of lime about which mention has already been made.

The Government Mycologist has also been examining periodically, a number of specimens collected from the Vellalur station. So far it has not been possible to stamp out the disease or diseases. At first two fungi viz., *Gleosporium* sp and *Diplodia* sp were detected and isolated from diseased vines. But these failed to produce infection when inoculated into healthy plants. Possibly they were more saprophytic than parasitic. Recently another fungus belonging to a species of *Phytophthora* has also been detected and this one is now under culture and its parasitism or otherwise remains to be proved by further inoculation experiments which are to be carried at the College pot culture house. It would perhaps be interesting here to note that a similar fungus has been found to be the cause of an enormous amount of damage to betelvine in Bengal, Central Provinces, Poonamalle near Madras, and Malaya Peninsula.

Eelworms:—In some of the previous investigations carried on before the starting of the Betel Vine Station at Vellalur the roots of vines in some gardens were found to be attacked with eelworms, which when mature produce characteristic swellings on the roots. The roots of a large number of plants—both healthy and diseased ones—were examined, and curiously enough the attack was distributed as much in the healthy vines as in the diseased ones.

Summary.—The results of the experiments at the Betel Vine Station at they now stand could be summarised as follows:—

Investigations were made into the physical and biological factors contributing to promote disease and diminish production in betelvine and experiments designed for the purpose show that

- (i) The improvement of drainage alone will result in at least 25% increase of production
- and (ii) The application of lime to betel soil is attended with benefits which are both physical and biological in effects.

It is not possible to say at this stage as to what the earthworms do in betelvine gardens and how far and to what extent the diseases are due to fungi or other organisms.