

Corolla 8 mm-1.2 cm. long, yellow. Pods 55 cm. long, slightly compressed straight, clothed with short reddish-brown hairs. Seeds 8-12, oblong with truncate ends, 2-3 mm. long, dark-brown and mottled.

This promises to be a very useful green manure plant suitable to be grown both in dry and wet lands. Cattle readily graze this even though it is beset with hairs. It therefore deserves to be tried under diverse conditions of soil and climate.

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Better Methods of Virginia Tobacco Cultivation in Guntur District.

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Introduction. Guntur district has nearly 50 per cent of the total area under tobacco in the Madras Presidency. During the past decade, as a result of persistent efforts of the India Leaf Tobacco Development Company, ryots have taken to the cultivation of Virginia tobacco and its curing in barns. The present area extends over 1,00,000 acres, fetching a return of about one and a half to two crores of rupees to the District. The country tobacco (*Natu*) extends over 50,000 acres and it may fetch another half a crore of rupees every year. Virginia tobacco produced in the Guntur, Kistna and Godavari districts forms the bulk of cigarette tobacco produced in and exported from India. With proper methods of cultivation, curing and marketing, it is possible in course of time to find a steady market in foreign countries especially the United Kingdom for a fairly large quantity of high class leaf. Tobacco is at present the main 'money' crop in the Guntur district. Unless proper steps are taken to increase the yield and improve the quality of leaf and rectify some defects in other respects, the trade is likely to suffer in a very short time.

Importance of quality in Virginia Tobacco. Unlike other agricultural commodities, and other varieties of tobacco, the range of variation in the market price of Virginia tobacco, even on the same day, may be anywhere between Rs. 10 to 350 per candy of 500 lb. This indicates the extent to which quality is important in the crop. The aim of the Virginia tobacco grower should therefore be to produce as much of the high grade leaf as

possible to obtain better prices. There is always a good demand for high grade leaf for which remunerative prices are offered. Steps are being taken in several parts of India to introduce and extend Virginia tobacco cultivation. Naturally Guntur District is not likely to enjoy its present monopoly of trade in the commodity for long. It has also to be mentioned that of late Virginia tobacco in the district has been showing considerable deterioration in quality and yield. On the other hand, it is behaving very well in some of the new areas along the Godavari and Kistna rivers. There is no doubt that Guntur District is one of the few places where good quality Virginia tobacco can be grown. Hence Guntur can still hold the monopoly if the ryots adopt judicious methods of cultivation and curing.

Factors affecting quality in Virginia tobacco. The quality of cured leaf obtained is determined by a number of factors and they can be classified as follows:—

(a) Field factors affecting the development of proper colour of the leaf.

1. Rainfall before and after-planting.
2. Nature of previous crop.
3. Manuring given to previous and present crop.
4. Time of planting.
5. Nature of seeds and seedling used.
6. Season during the growth of the crop.
7. Prevalence of pests and diseases.

(b) Those affecting quality of cured leaf during the process of harvest and curing:—

1. Method of harvest and handling.
2. Method of curing and handling.

A good quality leaf from the barn is obtained from the crop that matures uniformly and produces the right type of yellowish green colour in the leaf. Factors such as rainfall are beyond control while the occurrence of pests and diseases are to some extent within human control. Proper methods of rotation and manuring, timely planting and use of pure seed can, however, be followed and they go a long way in producing the proper type of crop.

To produce good colour in the green leaf, Virginia tobacco should not be grown on the same field more often than once in three years. It should not be preceded by a pulse crop or groundnut or by a heavily manured crop like chillies. Cereal crops have been found to be the best to precede it. If for any reason, cereals could not be sown in the preceding *pyru* season, the land should be manured liberally and a fodder crop (e.g. maize) raised from June to August. Tobacco can be planted in October–November following. In brief, the preceding crop should not be one that will enrich the soil in its nitrogen content, a factor that will adversely affect proper colour development in the green leaf. Raising tobacco too frequently on the same land will favour the spread of pests and diseases. Early planting (September end or early October) is good, wherever it is possible. Planting later than 15th December is undesirable as the resulting crop will not ordinarily develop sufficiently good colour in the green

leaf. Late planting is however, inevitable in some of the low-lying *Badava* lands. It is inadvisable to attempt planting in heavy deep clays, where good drainage facilities do not exist, before the cessation of the North East monsoon.

The most important factors adversely affecting the quality of leaf during harvest and curing are the following.

- i. Entrusting harvest and subsequent processes on a contract basis to a gang of coolies who pick over-ripe, ripe and un-ripe leaf together, and cause mechanical injury to the leaf while handling it.
- ii. The absence of sufficient attention paid to curing methods by curers who do not understand the technique of curing.
- iii. Curing over-ripe, ripe and under-ripe leaves together.
- iv. Over loading the barn.

Contract work is usually cheap but the results are usually disappointing. If the grower exercises sufficient supervision in the field and at the barn, several defects of the system can be remedied. As bad curing results in loss of 25 to 50 percent of his profits, the grower would do well to learn the art and do the barn curing himself. If he cannot do it, he should at least procure the services of a good curer. It does not pay the cost of coal to cure the over-ripe, ripe and under-ripe leaves together.

Since two to four leaves are picked from each plant at a time, the stage of maturity will be different in each case. Experience has shown that it is desirable to sort out the green leaf after picking, into three grades with reference to their colour, and string them separately. The darker green leaf should be arranged on the top tiers the light green on the middle tiers and yellowish leaf on the lower tiers. The higher temperature near the flue pipes gives the over-ripe leaf at the bottom a chance to cure without sponging and the lower temperature and higher humidity at the top allows the dark green leaf to turn yellow quicker. The usual blemishes noticed in the cured leaf such as 'sponging', scalding, etc. are the result of over loading the barn with too many sticks, a habit which is almost universal in the district at present. By overloading, the leaves are kept so closely packed that some of them will not have the full benefit of the changes in temperature, aeration, and humidity to the right extent and at the right time, with the result, that they fail to cure well. The more thinly the barn is loaded the greater the possibility for the uniform distribution of temperature, aeration and humidity in it. What is gained in fuel consumption by loading the barn with too many sticks is many times lost in the quality of the cured leaf produced. It is known by experience that about 600 sticks in the small barn (16' x 16') and about 1,000 sticks in the big barn (20' x 20') form the optimum load.

How best to manure a Virginia tobacco crop:—To maintain yields at a high level and produce the right quality of leaf, it is necessary to manure the land in the right manner. Cattle manure in sufficient quantities is not available in the tract as nearly 15 to 20 acres are cultivated with a pair of

cattle. Heavy application of cattle manure induces rank growth resulting in dark-coloured coarse leaf which is totally unfit for barn curing. The use of artificials to supplement the natural resources of the soil, is therefore inevitable.

Nitrogen, besides assisting in the vigour and growth of the plant, has a marked effect on the quality of leaf. If a soil is poor particularly in its nitrogen content, light coloured leaf is produced. If heavy doses are applied, big coarse, dark green leaf with prominent veins is produced. Cattle manure, oil cakes, ammonium sulphate and nitrate of soda are the usual nitrogenous manures now available in the market. Black soils are generally rich in total potash. But as tobacco is a heavy potash feeder (about 100—150 lb. K_2O per acre per year) and as potash influences the quality of leaf, the available potash in the soil will not fully meet the needs of the crop. Potash manuring is, therefore quite essential for tobacco. A crop suffering from potash starvation will have in the leaves yellow mottling, dead specks, hobby-surface, and downward incurving tips and margins when green. Such leaves become harsh, dry, short and non-elastic when dry. Potash helps to improve the elasticity and fire-holding capacity of the leaf. The sugar content of the leaf is also improved by the supply of potash. Potash in the soil is rendered available by the application of sodium nitrate; hence the suggestion to apply half the quantity of nitrogen to the crop in the form of sodium nitrate. But there is the inevitable danger of leaching out of the nitrate during the heavy rains of September—October. Too much of potash turns the ash dark in colour. Phosphoric acid assists in an early, healthy development of the crop, regulates the rank growth resulting from too much nitrogenous manuring, hastens maturity and aids in the general colour development of the leaf. Lime is not required in Guntur soils which are rich in lime. If the burning quality (closer burn) is bad and snow-white ash does not result, about 30 lb. of magnesite (MgO) with half of it at least in a soluble form, may be applied. Tobacco does not ordinarily require any other manure to improve its yield or quality. Under Guntur conditions manuring with about 10 to 15 lb. of nitrogen (N), 50 lb. of potash (K_2O) and 75 lb. of phosphoric acid (P_2O_5) in addition to 5 to 10 cart loads of cattle manure per acre appears to be the best dose. Some fields do grow good tobacco without manuring or with moderate quantities of cattle manure in certain seasons, but to ensure good crops of tobacco over a length of time, systematic manuring with artificials is inevitable.

Nitrogen is best applied as ammonium sulphate and sodium nitrate in equal proportions (25 to 40 lb. ammonium sulphate and 32 to 48 lb. sodium nitrate per acre), potash as sulphate (100 lb. potassium sulphate per acre), and phosphoric acid as superphosphate (450 lb. super-phosphate per acre.) Undue proportion of chlorides should not be included in the mixture. The above suggestions are based on the general conclusions drawn from the elaborate manurial trials carried out over a number of years and on various soil types by the Indian Leaf Tobacco Development Company. Cattle manure

is best ploughed in, in June—July and artificials drilled deep into the soil or spread over the soil and ploughed in whenever there is a dry spell of weather in August, i. e., about two months before planting. As tobacco is grown dry in the district, the full benefit of the manure applied cannot always be realised by the crop unless it is applied sufficiently early and well worked in.

Use of pure seed. The purity of the Virginia tobacco crop in the district is poor. With a mixture of indifferent types the cured leaf will be far from satisfactory. The use of pure seed (strain) of proved merit results in a pure crop that matures uniformly. This will naturally result in the production of a uniform quality of cured leaf. In no other crop does purity of seed play such an important part. Harrison special No. 9 has been found to meet the needs of the district very well. It grows well, has an ideal type of leaf and develops good colour wherever conditions are favourable. Growers have reported favourably on it. As compared to the local bulk crop, it fetches them an additional net profit of at least Rs. 25 per candy of produce. As natural crossing is very common in this crop, it is not always the most vigorous plant in the field that is to be selected for seed purposes. Till a uniformly good quality crop is raised by the ryots themselves, they are advised to purchase their seed requirements from the Agricultural Department which is multiplying the pure strain and doing its best to supply as much seed as is wanted by growers. The price of pure seed required for an acre of planted crop is about 2 annas.

Raising nurseries. Under the present system of cultivation in the District, though a few big ryots raise their own nurseries nearly 75 per cent of the ryot population entirely depend upon the nurseries raised by professional nurserymen. This system has come into vogue for the following two reasons :—

- i. Nurseries have of late been failing in black soils due to 'damping off'.
- ii. It is easier to raise nurseries with success in the sandy soils and light loams, and seedlings from these areas establish much better on planting than those from the black soils.

In Guntur virginia tobacco cultivation has, assumed such industrial proportions that the man that raises the nursery is very often different from the man that grows the crop, the grower different from the barn owner and the barn owner different from the grader and ultimate exporter. As purity in the seedling stage cannot be easily determined, nursery men take little care to use good seed and the man that grows the crop pays the penalty. It is therefore highly desirable that this system vanishes soon. The next question is how best to raise tobacco nurseries in black soils. Before the I. L. T. D. company thought of raising nurseries in the Chirala sands, ryots were raising their nurseries in the black soils with success. Similarly, on the Agricultural Research Station, Guntur representing a typical black soil area, good nurseries are being raised with success from year to year. It

should therefore be possible to raise nurseries in the black soil areas. To achieve success, the present methods of raising the nurseries have to be modified and any amount of attention bestowed on them will not be too much.

The following are some of the precautions to be taken while raising a tobacco nursery in heavy black soils :—

- i. Select a fertile high level sloping bit of land with a good water source such as a tank, pond or well near at hand. The water table should be so low that there is absolutely no danger of inundation or bad drainage even in the heavy rainy season.
- ii. Make the soil permanently lighter in physical texture by heavy application of sand, tank silt, organic matter and green manures, to facilitate free movement of soil moisture.
- iii. If chillies are also raised, tobacco and chilli nurseries should be rotated. Otherwise two plots may be set apart for tobacco and alternately put under tobacco nurseries.
- iv. Plough the land deep after the North-east monsoon and apply liberal quantities of cattle manure, in December or January, and work it in well with the plough.
- v. Keep the land ploughed till the end of July, then lay it out into a number of long beds, 4 to 5 feet wide with intervening drainage channels $2\frac{1}{2}$ feet wide and about 1 foot deep ranged along the slope, to facilitate quick drainage. The length of the bed may be adjusted with reference to the length of the field and general slope of the land. Periodical deepening of the drains and earthing up of the beds are necessary.
- vi. About 3 or 4 days before the proposed date of sowing the seed beds, a fairly thick layer of cotton or red gram stalks, rejected cattle fodder, organic rubbish from the manure heap, casuarina twig, groundnut husk or any other type of inflammable materials may be spread evenly over the prepared nursery beds, and set fire to. This is best done when the air is still. The beds should not be burnt when they are too wet. As soon as the bed cools down, the ashes may be worked in lightly with hand hoes to prevent the ashes being blown off by wind. The beds are then ready for sowing.

Sowing of nursery beds. The beds should be raked and moderately compacted. The seed should be mixed with plenty of ashes or fine sand and sown evenly, distributing it twice across at the rate of about an ounce for a bed measuring 5' x 150'. An ounce of tobacco seed contains about 3 lakhs of seed. The seed should then be pressed down with the palm of the hand or a flat board after sprinkling a small quantity of burnt soil on the sown beds. The practise of applying powdered cattle or sheep manure to cover the seed or just before sowing seed should be avoided as the manure may infect the soil with the fungus responsible for "damping off."

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Watering should be done with a fine rose-can till the plants are about three weeks old. Covering seed beds temporarily with casuarina leaf in the stages as adopted by ryots at Bapatla and Chirala is a practice worth copying.

After-care of nursery beds. Burning is done to kill the soil organisms that cause 'damping off' 'blackleg' etc. With favorable weather conditions, they attack the seedlings causing rotting and death. To avoid these diseases the beds should be thinned out wherever they are too thick. The thinnings may be planted where the beds are patchy. Such transplanting can be done when the leaves are the size of an eight-anna piece. If the seedlings are very weak or fail to do reasonable progress, sulphate of ammonia may be applied at about 5 to 20 ounces for a bed of 250 feet length. Similarly when the rate of growth of the seedlings has to be accelerated after a batch of seedlings are removed from the bed, the bed may be manured at 12 to 25 ounces ammonium sulphate for a bed of 250 feet length. The manure should be well mixed with sand or dry earth and evenly broadcast over the beds in the evenings. A heavy watering should be immediately given. As the plants usually become soft after manuring, at least a week should elapse before the seedlings so manured are ready for planting out. Even when manure is not applied, the seedlings should similarly harden off for about a week before being pulled out for planting. If proper attention is paid to weeding, control of insect and fungus attacks, an acre of nursery is expected to supply seedlings sufficient to plant at least 100 acres with sufficient seedlings left over for subsequent filling up of gaps. In black soils, many more seedlings can be expected from a unit area of nursery. At present ryots use at least five times the above seed rate to start with and sow more seed in the same beds whenever the nursery looks thin according to their own standard of judgment. In the majority of cases it is this thick sowing that encourages 'damping off'. In addition to the precautions mentioned above a weekly spraying with a suitable spray mixture containing a fungicide and insecticide is found useful to protect the tiny seedlings from diseases and pests. The first spraying should be done when the leaves of seedlings have attained the size of one's finger nail. The following mixture is recommended for the first two sprayings:—

Bouisol (Colloidal copper)	1 oz.
Lead arsenate	$\frac{1}{4}$ oz.
Agral (spreader)	$\frac{1}{2}$ oz.
Water	1 gallon.

If the above preparations are difficult to obtain, the following spray mixture is recommended.

Copper sulphate	1 lb.
Quick lime	1 lb.
Lead arsenate	4 oz.
Water	12 $\frac{1}{2}$ gallons.

The copper sulphate is dissolved in half the quantity of water. The quick lime is first slaked and then diluted in the remaining quantity of water. Copper sulphate solution is added to the lime solution slowly and the

mixture thoroughly stirred during the process. Lead arsenate is added to the mixture and thoroughly stirred.

Periodical sowings. For convenience of planting and to reduce risks to the minimum, big cultivators are advised to sow their nurseries at intervals of a week or so, preferably in different places, so that, if for any exceptionally unfavourable weather conditions at a particular time one sowing cannot be saved, at least the others may be saved.

Watering. The amount and frequency of watering to be given to the seed beds in the black soil areas are different from those in the sandy soils, and ryots should use their judgement in this respect. They are more often damaging their nurseries by over-watering in these soils. Water thoroughly at longer intervals rather than frequently.

The following additional hints are helpful for raising a good crop.

1. Do not use any tobacco refuse or sweepings from barn yards for the nurseries. Diseases like mosaic powdery mildew etc. and seed contamination may take place through this source.

2. Reject beds that show mixtures and rogue out off-types if they are few and can be detected in the nurseries.

3. Use seedlings of the same age for planting a field as otherwise all plants do not come to maturity at the same time.

4. Reserve enough seedlings in the seed beds for gap-filling as the resulting crop will be uneven and impure if seedlings for this purpose are obtained from another source.

5. Try to fill up gaps as early as possible to get a uniform crop at maturity.

Tobacco seed a useful bye-product. An acre of Virginia tobacco on an average gives 200 lb. of seed and most of it is at present wasted. Recent investigations have shown that tobacco seed yields 25 to 30 per cent oil in country wooden mills as against 40 per cent yield of gingelly seeds. The quality of oil compares favourably with high class gingelly oil in colour, taste and flavour when extracted in the country mill. Oil extracted by the hot drawn process tastes somewhat bitter. Sheep and goats freely eat the seed without any untoward consequences. Cattle also seem to relish the seed, but these are rarely fed with it for fear of bad consequences.

From the reports received so far, it is clear that the oil and cake are free from harmful substances. The cake compares well with castor cake as manure. The oil can be classed as a semi-drying oil with some special properties of its own. At a modest estimate, valuing the oil on a par with linseed oil and the cake with castor cake, an acre of tobacco may yield a net return of Rs. 12 deducting Re. 1 for harvest and threshing the fruit capsules and Rs. 5 for the extraction of oil.

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A. Pests. Appendix—Pests and Diseases of Virginia Tobacco in Guntur.

Name.	Nature of injury.	Control measures.
1. Tobacco Caterpillar (<i>Prodenia litura</i> F.)	A severe pest of the planted crop. Caterpillars feed on the foliage both in the nurseries and transplanted areas.	Spraying of lead arsenate at a strength of one oz. in two gallons of water. Hand picking of caterpillars wherever possible.
2. Tobacco nursery caterpillar (<i>Laphygma exigua</i> Hb.)	A severe pest of the nurseries at Chirala where large scale nurseries are raised. Caterpillars devastate the nursery beds by feeding on the newly formed leaves of the sprouting seedlings in the nursery beds.	Growing a trap crop of <i>ragi</i> all round the tobacco beds and pulling it out at 5 to 6 days interval for the destruction of the egg masses and caterpillars on them. Alternate sowing and pulling out has to be done at 6 days intervals.
3 Plant lice (<i>Myzus persicae</i> S.)	A pest of planted crops. Severe in the lankhas of E Godavary. Colonies of insects infest the leaves, suck the sap and affect the vigour of the plant. Causes curling of leaves.	Spraying with tobacco decoction plus soap.
B. Diseases etc.		
1. Damping off, (<i>Pythium</i> Spp. <i>Rhizoctonia</i> Sp.)	Occurs in the nursery. Seedlings attacked at ground level. They fall over and rot. Seedlings are destroyed in patches.	Use of raised, well-drained seed beds. Burning of nursery beds by open fire method. Thin sowing. Regulated watering. Periodical spraying with a fungicide (see text).
2 Black leg. (<i>Bacillus aroideae</i>)	Occurs in the nursery. Blackening of the seedling and death. Seedlings are destroyed in patches.	do
3. Powdery mildew. (<i>Erysiphe cichoracearum</i>).	Occurs in the transplanted crop. Rare in the nursery. Forms a white powdery layer over both surfaces of leaves; favoured by dry weather and cold nights and shady situations.	Dusting with flowers of sulphur in the nursery stage. Priming (removal of lower leaves) the grown up plants up to height of 12 to 15 in. from the ground level. Application of ground sulphur to the soil immediately around the stem.
4. Orobanche. (a flowering root parasite)	Causes stunted growth due to the parasite sending its roots into the roots of tobacco.	Pulling out the parasite as soon as the shoots appear above the ground. Burn or bury deep the pulled out plants. Avoid feeding the pulled out parasite to farm animals and prevent them grazing on the parasite.
5. Mosaic. (Virus disease).	Mottling of leaves caused by alternate light and dark green patches. Blistering in severe cases. Stunted growth and production of narrow leaves lacking in 'body'. Poor quality of cured product.	Sterilisation of seed bed soil or yearly change of site for nursery beds; thorough cleaning of the seed. Cleaning up of stems, trash &c. from the site of beds. Weeding out of ratoon tillers, stubbles and solanaceous weeds from the field. Examining nursery beds and roguing out mosaic infected seedlings. Roguing of plants at the first cultivation of the transplanted field.