TOBACCO GROWING AND RURAL WELFARE II[1])

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INTRODUCTION

This second part of "Tobacco growing and rural welfare" is not intended as a manual for the cultivation of tobacco. Rather its purpose is to guide to those who have read the first part and are trying now to improve tobacco-growing in the region where they have a position as local official or rural welfare worker.

If help cannot be obtained from an experienced tobacco grower, it is advisable to study also other papers on tobacco, such as are mentioned in the list of references.

In writing, no special country was kept in mind, but rather such circumstances as often prevail in tropical countries. In this connection some items have been treated in detail, whereas what can be found in general handbooks has been omitted.

RAISING OF SEEDLINGS

Primitive methods

If in tropical countries tobacco growing is not in the hands of companies, but done by the peasants themselves, each of them makes his own seedbeds. Although primitive, they may be suitable for the prevailing circumstances. Where mountains are near, the farmer takes the trouble to climb them and clear a plot of bush, because he will find a soil with much humus and hardly any weedseeds in it. Trees are not uprooted but only cut; no tillage is needed and drainage is no problem. The seed is broadcast and the nursery is left alone until the seedlings can be transplanted. If the weather is favourable all goes well, but if not, the farmer may be without seedlings when it is time to transplant.

It is evident that this method cannot be used where tobacco has to be transplanted at a special time, to obtain a certain quality. Other primitive methods can be seen, such as peasants taking some useless corner of field or yard or one of the little dikes which divide irrigated rice fields. The main reason why such simple ways cannot be used in commercial tobacco-growing is the danger of spreading diseases. To avoid this is so important that books on tobacco diseases, such as those of HOPKINS (6) and LUCAS (8) give ample consideration of seedbeds. Only a few additional remarks will be given here.

Seedbed site

It is recommended to choose a well-drained soil, which contains sufficient humus or enough clay and a site which is near uncontaminated water. It may be difficult to combine these two desiderata. The soil near a stream, although perhaps good for cultivating tobacco, may be unsuitable for raising seedlings. This may be the case when it contains silt which causes a thin crust on top of the seedbeds, impeding aeration and breaking the roots of the very young plants as soon as this crust dries out. If a suitable site can only be found far away from the stream, a well has to be dug. This will be worth doing if one large seedbed plot for many farmers has to be made. In this connection must be said that one can very well raise seedlings in another kind of soil as is available where the tobacco will be planted.

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Preparation of the beds

Although in tropical countries the soil should not be bare for a long time it will be good to do clearing and tillage several months before the time of sowing. To avoid deterioration of the soil in the mean time, a covercrop can be sown and either removed or turned under before it produces seed. If it is turned under, the soil will still be bare for a certain time, since the material has to decay before the tobacco seed is sown. If one wishes to avoid this fallow period, the artificial shade which is needed later on for the young plants could be used.

In such countries as the U.S.A. where the seedbed plot is prepared with a tractor one uses very broad beds but in other countries the width is one meter or 1,2 meter. In the HOPKINS book one sees photos of nurseries where the beds are not higher than the paths but separated from them by bricks. For most regions this method is not advisable. The surface should be some 10 to 20 cm higher than the paths to have a good drainage and aeration. This surface should be level, to avoid washing away of seed, but the soil should not be pulverised. Earth lumps with a diameter of about 3 cm may be seen on the top. When the base of the bed is 1,2 meter, the top will be about 1 meter wide. The length should not be more than 10 meter, specially when cloth is used for shading.

Regarding the sterilisation of the soil by fire it must be noted that the soil should not be too wet, but neither too dry. Also a warning is needed against the use of logs of hard wood, which would cause overheating. Other ways of destroying weed seeds and disease germs are sufficiently dealt with in the above-mentioned books.

Seed and sowing

For grading tobacco seeds an apparatus is needed of which a description together with good photos is given in the book of HOPKINS (6).

Since tobacco seed is so small, one cannot divide it regularly over the bed if not mixed with some powdery material. Woodash can be recommended since it is sterile and generally has a good specific gravity for mixing with tobacco seed. Ash of straw is too light and sand too heavy. The mixing can best be done on a large piece of paper. After mixing one lifts the paper on one side rolling the ashheap over to see if too many seeds have assembled between ash and paper, which can happen if the ash was lighter than normal.

The seed should not be mixed with insecticides or fertilisers. Some of them may kill the plantlets as soon as the seed germinates. One and a half gram of seed, mixed in two handfuls of ash gives a nice covering for 10 square meter.

The sowing itself is done by taking a handful of the mixture and moving the nearly closed hand to and fro, keeping it low above the seedbed surface. Attaining the end of the bed, one should still have enough ash and seed to go over the bed for a second time. The light colour of the ash indicates where sufficient seed has fallen.

When the seedbeds are made in the dry season another method of sowing can be used. The seed is first laid between wet cloths, until it just begins to germinate. This germinated seed is put in a watering can and while one keeps on stirring the water, it is divided over the bed with the water. A person

accustomed to this way, gets an even nicer division of the seed than with the ash mixture.

The method had also the advantage that ants do not eat tobacco seed which has germinated. When the dry-sowing method is used, ants have to be controlled during the first five days after sowing. Where irrigation water is available, one can fill the paths so that the beds are about five centimeter above the water level. If this is not possible, insecticides must be used.

Watering

One has to keep the soil moist during the first ten days after sowing, without wetting it too much. If the top layer dries out, the small roots cannot reach the water and the little plants die. When the plants have three leaflets, the root reaches deeper and watering can be reduced. Watering should be done in the early morning and in the afternoon. The rose of the watering can should have very narrow openings and one must not water the same spot too much at once. It is better to give a light sprinkling, going from one end of the bed to the other and then return for a second watering. When there is chance of appearance of diseases, as during cloudy days, one should be very careful in watering.

Shading

In many countries an inclining rooflet of palm leaves or other material is used. But this can not be opened and closed whenever needed; it gives too much shade when constructed tightly and causes rainwater to drip on certain spots of the bed when not so tight. The best shade is given by calico (unbleached cotton cloth). This lets through diffuse light and keeps heavy showers off the bed when passed over in the right way.

It rests on three iron wires, constructed over the full lengths of the bed, of which the one in the middle is about 20 cm higher than the two on the sides. The edges of the calico are fitted with loops, through which a thinner iron wire or a rope is put. This is fixed to the lower end of the posts which support the two wires on the sides and is kept down by some pegs so that the calico is stretched over the three original wires, forming a steep roof.

During the first six to ten days after sowing the shade is opened only for watering. Later on more light can be given by keeping the coverings open during the early morning and the afternoon. A few days before transplanting the seedlings may receive sunshine during the whole day. To give as much light as possible in an earlier stage, without direct sunrays on the bed, a row of long sticks can be put on one side of the bed for fixing one edge of the calico to it, so that it has an inclining position. When on the Northern hemisphere the beds lay east-west, the sticks should be on the North side. If the direction of the bed is North-South one needs two rows of sticks. But also when in the roofform, there should be sufficient air circulation under the cover. The edges of the calico should be at least 15 cm above the seedbed surface.

Calico is mostly sold in a width of 91 cm, which is insufficient, but widths of 1,05 and even 1,20 meters are to be had. New cotton very soon gets dark spots, caused by mould. To be able to use the covers for more than one year they must be treated with a special fungicide. HOPKINS recommends "Shirlan"

whereas the use of Mercury-phenil-oleate is described in "Il Tobacco" of Sept. 1957 (17).

Where calico would be too expensive or cannot be used for other reasons, one has to use a shade of palm leaves or grass. In some countries one does not make a rooflet but puts a layer of grass straight on the beds after sowing and thins this layer out when the tobacco seed starts to germinate. For details see Bulletin no. 5 of Tobacco Research Board of Rhodesia and Nyasaland (1956).

Quick growth

The shorter the seedbed period, the less are the chances of diseases and pests. Also the disturbance of the growth by transplanting is less but the seedlings cannot be transplanted with success when they are too small. They must have leaves of a length of 7 to 10 cm but the earlier they reach this stage the better. In tropical countries one can obtain seedlings ready for transplanting in 40 or even 35 days.

Where wrapper leaf is grown, the seedbeds are often thinned out until the distance between the seedlings is 5 cm. Bigger plants are brought to the field in this case, but they must be transplanted before they start to stretch.

Large quantities of fertilisers can be given, but these should be well balanced. If, for instance, too much nitrogen is given in relation to other elements, the plant may grow quickly but will not be strong. How much and in which ratio to give the fertilisers has to be found out separately for every type of soil. An amount equal to 500 grams of ammonium sulphate, plus one kg superphosphate and one kg potassium sulphate will often be needed for a seedbed of 10 square meters. The fertilizers are applied some three or four days before sowing the seed. The beds are kept moist from that time on.

Artificial fertilisers will, of course, not be of much use if the structure of the soil is not good. Sometimes stable manure or compost will have to be used. But this should be done before sterilising the beds. Only if compost is made in such a way that it is free of disease germs, it can be used later.

After heavy rains or too much watering, the seedlings may, at an age of 15 to 20 days, become yellowish because of lack of nitrogen.

A solution of a nitrate, watered over the beds can be a good remedy, but one should not use more than 100 grams dissolved in 10 liters of water per bed of 10 square meters, preferably divided over two or three days. To avoid burning of the leaves the plants must be watered with clean water after each treatment.

If seedlings stay more than fifty days on the beds, they get a long, thin, more or less woody stem. Such plants do not "catch up" quickly after transplanting. Counted from the time of setting, they flower earlier and stay smaller than plants which have been planted at the right moment.

Number of seedbeds needed for planting one hectare

A seed bed of ten square meters, which is not sown too thick nor too thin, will give about 2500 good seedlings. There will be more plants but one should not use backward ones. When a planting distance of 0,9 by 1,2 meter is chosen, a hectare will hold 14.300 plants, which can be supplied by six beds.

Since circumstances are not always favourable for transplanting and use of too old seedlings must be avoided, it pays to sow on different dates and have more seedbeds than exactly needed.

Suitable soils

That soils have on important influence on the kind of tobacco which will be harvested, can be seen from the large number of types of tobacco produced all over the world and from the fact that in a given region only certain soils are used for tobacco. Sometimes people exaggerate this influence and are sceptical if tobacco cultivation is started in a new area. They then forget that also other factors are important, such as the skill which was obtained in regions where tobacco has been grown for a long time.

Structure and texture of the soil, are more important than its chemical composition. It should be sufficiently porous to drain superfluous water and at the same time have a good water-holding capacity. Tobacco is therefore often grown on sandy loams or loamy sand, but also clay soils can be used, if kept in the right condition by good tillage. Sandy soils must have enough humus to give them water-holding capacity and the possibility of retaining plantfood.

Too fertile a soil would give big plants, but the product would lack quality, whereas to poorer soils the right balance of fertilisers can be given to obtain exactly the quality which is asked for.

It is generally accepted that tobacco needs a slightly acid soil (pH 5,8 to 6,5). There are, however, cases in which good cigar tobacco was produced on a soil with a pH of 7.

Keeping the soil in good condition

One may come across areas where tobacco culture was important in former times, but where it gives only meagre results nowadays. This can have different causes of which one is impoverishment of the soil. When leaching out of precious minerals is the reason, a better crop rotation or eventually returning to bush fallow will be needed. In other cases the store of minerals in the soil is sufficient, but the peasants did not feel the necessity to apply manure; they even kept on burning all weeds and remainders of crops. When this goes on for decades, organic material becomes short. In the tropics organic material is quickly decomposed. A little part of it, the real humus is more stable, but under the described conditions even this becomes less and less. To raise this humus content again is not easy, because only little of the organic matter which one applies will stay as real humus. A gift of 40 tons stable manure will only raise the humus content one pro mille.

Moreover, stable manure is seldom available in the tropics. But one can use green manures. After working in one crop of this, the organic matter will be high, but not yet the humus content. One will have to repeat it often and get the peasants accustomed to not burning organic material. Tobacco should not be grown directly after a greenmanure crop because the nitrogen content at that time may be too high, or if the organic material has not yet been decomposed, there may be for a short time not enough nitrogen because the decomposing microbes use it for building up their own bodies.

Regarding tillage the following must be said: In different parts of the world one meets local officials who oppose each form of ploughing. It may be that they have been influenced by booklets as "the ploughmans folly" of FAULKNER (11). This may be troublesome, especially in areas where one has to

teach the peasants to plough, such as in places where shifting cultivation has to be changed in settled farming.

Preparing new fields

A forest soil, although very suitable for the tobacco plant as such, cannot be used directly for obtaining cigarette tobacco because of its too high humus content. This would retard ripening and cause too high a protein content of the leaves. The land must be used for crops in which quality and homogenity are less important than in tobacco, until the soil is suitable for this crop. How long one should grow other crops depends on the richness of humus which, for tobacco, should be neither too high, nor too low.

There are three methods to clear a land of trees with roots and all. The first one is by heavy bulldozers, which are used where large areas have to be converted to arable land and where not enough labour is available. The second one is by handtools. This method will be described in detail because it will often have to be used in regions where community development is undertaken. It can be done more cheaply than by bulldozers if the labourers are accustomed to the work. One may discover that some strong and clever men like to do this job as taskwork since they know that much more can be earned than by daily wages if they use forethought.

They first cut away grass and shrubs, leaving all trees of which the stem has a diameter of more than 8 cm. These trees may be ringed but not cut off, as is the custom under shifting cultivation. After removing or burning the shrub, the men start to dig holes around the trees at a distance of a half to two meter from the stem. The roots are cut off at this distance and if needed also flat along the stem. Some kinds of trees will then start to lean over and can be pulled out by a group of men or with a winch. Other types have a strong taproot. More digging has then to be done to be able to cut it through at a depth of 40 cm below the surface of the field. When all the wood has been removed, the plot will look like a battle-field full of bomb craters. The work can than be delivered and a less specialised group of workmen could fill the holes. But if the diggers and cutters do also the filling, the person in charge of the work has first to ascertain that too large roots have not been missed. This can be done best by digging down the sides of the craters before throwing in the circular ridge. As a matter of course he must be at the job all the time, also if it has been given out as taskwork. After checking, he can, give permission to fill a hole with earth which comes out when a nearby tree has to be dealt with. Specially when the surface of the woodland is not level, supervision is needed to do as much levelling during the stumping as is possible.

When more or less level ground has been obtained, ploughing can start. No mould board but a disk plough has to be used since this will cut through the smaller roots which remain.

The third method consists of *using* the land first for grazing. Clearing can than be done as customary in shifting cultivation, but a fence has to be made, eventually an electric one. Next to cows, goats have to be kept inside, which by regularly eating the new sprouts, will kill the tree stumps. It will take some five years before all wood has rotted sufficiently to be able to plough.

Tillage before and after planting

In very sandy soils one should avoid deep ploughing, but heavy soils need it. Tobacco, more than other crops, reacts favourably to good aeration. Where the land is sloping, contour-ploughing has to be done and where it is flat, drains must be made from distance to distance to avoid waterlogged spots.

The choice between making ridges or planting in a flat field depends on the kind of soil and the amount of rain one expects. A soil in which the rainwater penetrates easily does not need ridging, but rather soon after transplanting one starts the first earthing-up. The ridges which are now obtained, should be broad and flat. In heavier soils steep ridges have to be made before transplanting. The seedlings can be set on the sloping side of the ridge, so that they will neither be drowned when a heavy shower comes nor be in too dry a place. Moreover, planting on top of a steep ridge would make earthing-up difficult.

Earthing-up, which is done twice or three times during the growing season, is beneficial because the tobacco plant forms new roots in the well aerated soil which is brought around the stem. This will enable it to grow without interruption when in a period of heavy rains the deeper roots do not function so well. But also in a dry season earthing-up, although done less high, is needed. The loose topsoil will than counteract evaporation. Weeding is done together with this earthing-up and the whole surface of the soil is kept open.

Use of fertilisers

The main reason why fertilisers are given to tobacco, is not to improve yield but quality. Therefore the amounts of the different elements must be well balanced. To be able to do this, field trials have to be made for each seperate kind of soil. One may still encounter the thought that a chemical analysis of the soil could give the answer, but only in regions where many analyses have been made and have been compared with the results of field trials, an analysis can give some indication regarding the fertiliser to use. In new areas one has to obtain the answer from nature by experimenting. And one has to experiment several years to find the right balance.

Chemical analysis of the plant also can not give the answer to the question of which fertilisers must be given, because the plant may have taken up of a certain element more than is beneficial for good quality. Still analyses done in different countries give an indication of the amounts with which one could start experiments. The amounts which may finally prove to be the right ones will as a rule not be higher than:

10 grams sulphate of ammonia per plant,

20 grams sulphate of potash per plant,

20 grams superphosphate per plant.

Quantities varying from none to 10 gram of the first, combined with none to 20 grams of the two following compounds will have to be tried. Several combinations are possible. One will therefore have to simplify and try for instance the following:

Treatment	Number of grams per plant
A	
B	5 sulphate of ammonia
C	10 superphosphate
D	10 sulphate of potassium
E	10 super and 10 sulphate of potassium
F	10 super, 10 sulphate of potassium and 5 sulphate of ammonia
G	10 super and 20 sulphate of potassium
H	20 super and 10 sulphate of potassium
I	20 super and 20 sulphate of potassium
J	20 super, 20 sulphate of potassium and 5 sulphate of ammonia.

According to the results of this trial, new combinations can be tried later, but one should not do this after only one season.

In laying out such a fertiliser trial for tobacco, one may deviate from the usual scientific way of randomised blocks, because not yield is the main point, but quality. Harvesting in the right way is of utmost importance and therefore it may be advisable to plant the different treatments in long rows in stead of small square plots. Ripening of the leaves may not be the same after applying of varying amounts and combinations of fertilisers and one will have to advise the harvesters, unless they are extremely well trained. If this is not the case, the mistakes in harvesting of a randomised block would have more influence than the scientific mistake which one makes on purpose when choosing rows in stead of square plots.

In tobacco culture fertilisers are not applied to the field by broadcasting before planting, but after planting in a row or to each plant individually. It can be done in a small furrow round each plant or in holes made by a planting stick.

Some people give the fertiliser in two parts, one shortly after planting and one later in the season. This cannot be recommended. Giving the second half too late, may retard ripening and specially in the case of cigarette tobacco, the nitrogen must have been consumed when the plant is full grown.

No fertilisers may be used which contain chlorine, because this has a bad influence on the burning qualities of tobacco. Only after many years when one has found the right combination and if one knows that the soil has a very low chlorine content, a small part of the sulphate of potassium may be exchanged by potassium chloride.

Experiments with calcium and magnesium are as a rule also something for later years, when the quality of the tobacco can be still further improved by finding a good calcium-potassium ratio. How this should be done, can be found in the handbooks.

In a region where an action for improvement of rural welfare is started, not enough money may be available to buy fertilisers whereas all sources of the region should be used. One might look for caves which contain guano, use all available animal manure and keep in mind that ashes of cotton hulls, coconut bolster and kapok hulls have a high content of potassium.

Transplanting

This must be done in the late afternoon unless the sky is clouded. In case of need one can transplant in the early morning, but then it is advisable to shade the little plants directly with some big leaf or similar material. Parts of the stolon of the banana are very suitable for this purpose. Plant holes can be made already before transplanting begins, but if done too long a time in advance the earth in and around these holes may become too dry. In loose crumbly soils one can easily make the hole with ones hand, during the act of planting. If one cannot put this hand with stretched fingers into the soil any tool which gives the planthole a steep side will do. This steep side is important because many persons are inclined to put the plantlet down in the middle of the hole. In such a way that the roots are bent up. The correct way is holding the seedling along the steep side so that the roots hang freely downward. Than one brings a handfull loose, moist earth in the hole and presses this gently against the roots from one side. By pressing the earth from above one pushes the whole plant downwards and still causes the roots to be bent up.

If the earth is to dry, watering has to be done before planting and just so much that the earth will be crumbly. It is important to teach untrained persons the right way of planting from the start. The planter should not do any movements which are not needed. With his left hand he takes the seedling which has been laid down on the spot by a plant distributing boy, whereas he makes the hole with his right hand. While the left handholds the plant at the correct height, the right hand pushes the earth on and presses. Holding the plant should be done by the tips of the leaves. This not only avoids damaging the stem, but also makes it easier to keep the plant along the steep side at the right height. One than sees more clearly what one is doing.

Number of seedlings to plant in one hectare

This depends of course on the size the plants will attain, which again depends on the variety used, the fertility of the soil etc. There is an optimum plant distance for yield, which in every separate case can be tried out.

But more important than yield is quality. Cigarette tobacco needs a larger plant distance than cigar tobacco because the first must form rather thick leaves; the sun must shine on the whole leaf. To obtain thin leaves in cigar tobacco planting is clone at such short distances that one plant shades the other. To be able to pass between the plants for cultivation and harvesting, one plants in rows. In the case of Virginia tobacco the distances used are often 1,2 meter between the rows and 0,9 between the plants in the row. Where the plants will not be tall, one takes 1 by 0,7 meter. In cigar tobacco the maximum distance between the rows is one meter and the distance in the rows about 40 cm, whereas often double rows are used.

Refilling and care of the plants

Even when good seedlings have been transplanted under favourable conditions, a few plants will die. This may be caused by insects which gnaw stem or roots. Often one finds the culprit in the soil quite near the plant and can destroy it. When many prevail in a field, an insecticide must be used before transplanting. Refilling aims at a regular stand. If done too late the filled in plants will remain backwards and spoil the homogenity of the harvest. To refill later than two weeks after planting has no sense unless one had directly planted

some extra seedlings at the end of each row, to be brought over to open spaces with a big lump of soil.

In general one should not touch the plants in the field more than necessary, to avoid spreading of diseases. Some people take away the very small leaves at the bottom of the plants, since these do not grow to a good size and are often covered with spots of fungi. If this is to be of any use, it should be done during dry weather and before the spores of the fungus spread to higher leaves.

When in an early stage a few plants are discovered which show a virus disease, it may be good to pull them out. But if this is not done by a man who takes care not to touch the other plants, it may do more harm than good.

Some tobacco plants develop suckers in the axes of the lower leaves. Since these suckers mostly do not grow out to long shoots, one can best leave them until the time when normal topping and suckering has to be done.

Topping and suckering

This starts when a few plants with open flowers are seen in the field. Of these plants the top is broken off together with two or three small leaves under the place where the flower branches start. Of the other plants those are topped of which the flowerbud is just emerging above the tips of the highest leaves. After three days one goes again through the field to take away the buds which then have emerged. At the same time one removes the small suckers which will have appeared on the first topped plants. Some six to nine days after topping began, the method used up till then must be changed. This is often forgotten but is important to obtain a more homogeneous product, certainly if there are vigourous plants next to backward ones. The first have to be topped high to avoid extreme thickness of leaves and the second ones must betopped low, even before the flowerbud can be seen. If a plant is small, people are inclined to leave it some time to develop more leaves, but these will not ripen together with the corresponding leaves of the other plants.

HARVESTING

Ripeness

In a harvestable cigarette leaf protein compounds should just start to break down, but the leaf should not be so old that assimilation has stopped. A leaf which is too old will, after curing, not only be poor in sugar content but also lack elasticity and hygroscopicity. Since these properties are very important in cigar tobacco, this is harvested earlier than cigarette tobacco. One can do this because the end product may contain more protein whereas the superfluous carbohydrates are eliminated during the long process of air-curing.

Bottom leaves, especially of cigarette tobacco, have to be harvested in a more vital stage than middle or top leaves, since they do not store assimilation products and soon after being full grown, start to get a lighter colour. While a delay of one or two days in harvesting bottom leaves can be detrimental, the harvest op topleaves can be postponed a few days after they are ripe. The highest leaves of a topped plant show quite different signs of ripeness from middle or bottom leaves. They become thick and obtain an uneven surface. The colour remains green for a long time but yellow patches appear between this dark green. Leaves in the middle of a plant of a cigarette tobacco variety must not be picked before they are clearly yellow whereas bottom leaves are harvested as soon as the colour changes to light green.

Methods of harvesting

Priming is practised for bright Virginia, Oriental tobacco and precious cigar tobaccos, whereas dark virginia types, intended for firecuring, and Burley tobaccos are stalk cut. When a cigar tobacco is grown to produce filler or binder, both methods can be used. But it is important to realise that changing the method will affect the type of the end product. When stalkcut plants hang close together in the drying shed, assimilation is not possible, but dissimilation and transport from the older leaves to the younger ones goes on. This is favourable because it keeps the younger leaves fresh so that they can mature. On the other hand, so many carbohydrates and nitrogen containing compounds are transported from the leaves to the stem and dissimilated in keeping the younger leaves alive, that about ten percent of the total weight of the tobacco is lost. It depends on several factors if the quality will be improved by changing the harvest method. The quality might improve if an excess of chlorine would go to the stem, but would deteriorate if too much potassium was lost.

How to do the priming

Untrained harvesters are inclined to bend the midrib down, when picking a leaf, whereas one should break it from the stem by moving it sideways. This not only avoids unnecessary bending of the body, but the midrib breaks cleaner off the stem and the leaf does not touch the ground or leaves of neighbouring plants. Another common mistake is to keep the harvested leaves in the hand, instead of laying them down carefully on the slightly bent left arm, while the right hand goes on harvesting. Without pressig or cracking the leaves, one can hold a rather large heap in this way. At the end of the row, this is neatly put in a basket. If one uses deep round baskets it is placed with the tips upward; if flat baskets or carriers are used, one puts the leaves flat. In planting a field of tobacco, the length of the rows should be made such that one harvest of it will give about one armfull. One person should harvest one row and not pick leaves from the rows on his left and right side. It may not be easy always to see if a leaf on the opposite side of the plant is ripe, but if the harvesters have been taught to pay attention to stalkposition and never to take a leaf if there is still another one inserted lower, no mistakes will be made. It is important to bring the harvested leaves as soon as possible into a sheltered place, out of sunshine and wind.

Time of harvesting

When thinking of the fact that carbohydrates are formed by assimilation during daytime, one would expect that the afternoon would be the best time, at least for harvesting cigarette tobacco. But investigations have shown that during the second part of the day as much of the carbohydrates is transported as has been produced. One could therefore as well harvest in the middle of the day to have a high content of it, but to do this would be wrong, for on a hot day this would result in too much wilting of the leaves. Moreover in the case of flue-curing one must start early to be able to fill the barn in one day. Harvesting of cigarette tobacco mostly starts as soon as the dew has disappeared from the leaves, whereas cigar tobacco can be picked still earlier.

Cigarette tobacco is harvested in a dry season. The assimilates are not easily transported then and heap up in the leaf. But if one shower falls in the time

the tobacco is ripening, the leaves will show some rejuvenation; the colour returns to a greener shade and more assimilates are used. After such an unexpected rain one is forced to harvest the same day, before too much changing takes place, or has to wait untill the tobacco ripens again.

Transport

If the curing barns and the stringing sheds are near the field, it will be easy to deliver the leaves in a fresh condition. If the distance is large, all possible means have to be used to avoid wilting, bruising or heating of the leaves. They should never be laid down in heaps higher than 20 cm, but better still is to avoid heaps all together, by transporting the leaves standing up, with the tips high. In some vehicles one can make two or three layers in this way, with the help of boards. But since loading and unloading of loose leaf takes much time and may cause damage, it is better to use deep baskets in which the leaves have been placed standing up.

Stringing

To be able to hang the leaves in the curing barn, they must be attached by a string to a stick, which usually has a length of 1,2 meter. There are different methods of stringing. The oldest method is by the use of a thin string and a large needle which is pushed through the lowest end of the midrib. To avoid curling around each other when drying, the leaves are strung alternatively with the front (uppersurface of the leaf) and the back (underside of the leaf) directed to the needle. A second method is without a needle but with a single string which makes loops around every two leaves, which two will hang alternatively to the right and the left side of the stick. The third method, the so called double string method, saves much time but makes rather rough work. It needs a stand to lay the stick on and another stand with a counterweight, to keep the double string streched. The two ends of the string are attached together to one end of the tobacco stick. The large loop which is formed in this way is hung over a board of 30 to 40 cm, which has V-formed carvings on both ends and is kept in its place by the counterweight. The string then forms a triangle. In the corner which is near the end of the tobacco stick, two or more leaves are pushed in from above and bent downward to the right so that the double string twists. These leaves are followed by others bent to the left and so on, until nearly the whole string is filled. The short board is than pulled forward, against the force of the counterweight, the string is taken off and fastened to the extreme end of the tobacco stick. Whereas using the older methods one places 30 to 40 leaves per stick, the double string method makes it necessary to load more, which is not always beneficial for good curing.

CURING

Flue-curing

The principles of flue-curing have been given in part I, but the process is more complicated than those few lines could describe. Attention has been drawn to the fact that leaves of a different stage of ripeness or leaves originating from different soils, from different stalkposition and from different varieties will not yellow in the same number of hours; that waiting for the slow yellowing ones would cause the already yellow ones to turn brown and

lose sugar, whereas not waiting would result in some of the leaves drying up green. But there is also the danger that leaves which take a long time to yellow, will spoil neighbouring leaves in a later stage of the curing, if this slow yellowing is connected with being thick.

One cannot lay too much stress on the necessity of filling the barn with homogeneous material. It is a well-known saying that one cannot cure poorly harvested leaves into a good product, but spoil a good harvest by bad curing. This can happen if one does not fill the barn in one day or fills it too tightly or irregularly. Also if the temperature is not kept constant during a certain period and if one does not choose the right time to change temperature or humidity. There is a theory regarding the regulation of temperature and humidity, but this can only be applied under ideal circumstances. In practice much depends upon the experience of the curer. Before dealing with the theory we will first describe the barn and how flue-curing is mostly done.

The barn is a stone building with a large ventilation opening in the top and smaller ones at the bottom of the walls. Outside is an oven, from which a flue comes, which runs, bent in one or more U forms along the floor and ends in a chimney. From about 2,3 meter above the floor crossbalks run from one wall to the other, about 1,2 meter separated and in five to eight layers. The distance of the layers is 60 to 70 cm. On these balks the sticks are put to which the tobacco has been tied.

The darker leaves, are hung in the top layers and the riper ones lower. Even after careful harvesting there will be a slight difference in colour of the leaves.

Depending on the size of the leaves, the sticks are placed 15 to 20 cm apart, but always so that the leaves of two sticks touch each other without pressing. Looking from beneath at a layer which has been filled, one should see one mass of leaves without holes through which one can see the roof but neither with spots where the leaves are pressed together.

When the barn is filled, a wet and drybulb hygrometer is hung in the middle of the lowest layer and the door is well closed. A few hours later one reads what the temperature is without the fire in the oven being started. In tropical countries this will often be between 26 and 32 degrees (89–90 Fahrenheit). If the harvest was not done at a day with hot dry winds, the leaves will cause the humidity in the barn to be 95 to 99 percent.

Before the night one lights the fire and keeps the temperature at 32 degrees for some 12 hours. This period may be prolonged, but mostly it is better to raise the temperature to 35 degrees rather soon. When the total impression which the leaves make is rather yellow or say when 80 percent of the leaves are yellow, one raises the temperature within five hours to 38 degrees (100° F). This temperature is kept until there is only a faint green strip along the midrib of the leaves.

After this one can try to keep 40 degrees (104° F) for a few hours, without ventilation, but now a dangerous period of the curing has been reached.

When the humidity is still high and the temperature drops for a short time, a discoloration may start, known as "sponging". The first signs of it are little gray spots; somewhat later it looks as if dust or a fungus was on the leaf surface. The colour of the leaf remains yellow but no longer bright. To avoid this one has to ventilate. Not full ventilation, but enough to bring the humidity down to 80 percent. At the same time one raises the temperature to 49

degrees (120° F) within a few hours and then full ventilation is given. These circumstances are kept a long time, often 20 hours, until the tips of the leaves curl up and become so dry that they are brittle. Raising the temperature earlier would cause another discoloration, called "scalding". A high temperature when there is still too much moisture in the leaves, will turn them brown and make them lose all elasticity.

About ten hours are needed to rise the temperature from 49 to 60 degrees (120 to 140). The temperature of 60 degrees is kept until the web of the leaves is fully dry. If one is sure of this, the temperature may be raised in the course of four hours, until 71 degrees (160° F) to dry the midribs. The amount of water in the nerves is only small then and the air in the barn is so dry that one can close the ventilation to economise on fuel. The curing may not be ended before all midribs are quite brittle. After the fire has been raked out and the door and all ventilations have been opened the tobacco will take up moisture during the coming night, so that it can be handled the next day.

The theory regarding flue-curing

The water which has to be evaporated is contained in the cells and cellwalls. This water can move only slowly to the surface. Moreover a thin layer of water mulecules adheres strongly to the surface, slowing down the movement from within. The evaporation rate out of this layer depends on the relative humidity of the air around and also on the movement of the air. We can accelerate the evaporation by rising the temperature of the air and by ventilation. The tobacco leaf, being a wet body, does not follow the temperature of the air. It will have more or less the temperature registered by the wetbulb thermometer. When we ventilate, keeping the air temperature constant by higher fire, we see drop the wet bulb thermometer. In other words also the tobacco leaf cools down. This should be avoided because the biological processes, the yellowing, will then slow down, whereas the drying of the leaf continues. And the difficulty in flue-curing is to have the leaf yellow, before it has lost too much water. The wet bulb temperature therefore should not drop, but it may neither rise much above 38 degrees (100° F) because a too high temperature inside the leaf will cause damage. The best results are obtained when one can keep the wetbulb temperature constant at a certain temperature between 35 and 38 degrees, during the whole curing period. But can only be applied this theoretically ideal procedure when the leaf is very homogeneous. In practice one may have to deviate from it, and let the wet bulb temperature raise very slowly. Keeping the wet bulb constant at any cost, would usually mean too much ventilation and too quick drying.

Difficult curing

Many tobacco varieties cannot be flue-cured because the yellowing goes too slowly, so that the race between losing moisture and yellowing is lost by the latter. This can also be the case with Virginia, when growing on a soil too rich in nitrogen or short in potassium. After several hours of yellowing at 38 degrees the wet bulb temperature will go down, which means that the air becomes too dry and the leaves lose water too quickly, before having yellowed sufficiently. If one has to deal with such dark tobacco, one can try to make the

best of it by keeping a low temperature of 32 degrees for a long time, hanging wet bags above the flues. By this the wet bulb can be kept at 31 degrees, but at 38 degrees the hot air would take up so much moisture that wet bags are insufficient. The only answer would then be to bring steam under pressure in the barn (1).

Capacity of flue-curing barns

This must be in accordance with the amount of tobacco of each harvest. Most common are barns of 4,8 by 4,8 meter and some 7 meter high, but when very large fields are not yet planted, one can better use barns of 3,6 by 3,6 meter, To build them still smaller cannot be recommended if a woodfire has to be used.

Since 1,7 meter must be free from the floor to the tips of the leaves of the lowest layer, there will be only space for five layers in the small barn, each of three rows, plus one row under the roof. These 16 rows give each place to 18 sticks, which makes 288 sticks in total. The bigger barn has 31 rows which each take 24 sticks. The total, 744 sticks, makes it possible to load about two and a half times as much tobacco. The small barn has accommodation for a little more than one hectare, but the larger one can take the harvest of three and a half hectare. Although it will be cheaper to build one large barn than two small ones, there are circumstances in which small barns are more adventageous, because one can fill them with more care and with homogeneous lots of tobacco leaves.

Regarding the construction of barns, good informations can be found in bulletin nr. 7 of the Tobacco Research Board of Rhodesia and Nyasaland (1).

Air-curing

This is always practised for cigar tobacco and sometimes for cigarette tobacco. No fixed rules can be given, since the results are much more dependent on outside conditions than in the case of flue-curing. Air-curing sheds are mostly thatch-roofed, wooden buildings. Their size and shape vary much in different countries. Large ones have the advantage that the temperature and humidity in the middle of the tobacco do not change so soon with outside conditions, but smaller ones if well constructed, can also give good results. During the night the ventilations have to be closed to keep the tobacco warm. After rain or mist they must be opened to aerate the tobacco. When the weather is so humid that rotting of the leaves would start, charcoal fires have to be burnt to get quicker drying. Raising the temperature 10 degrees is sufficient. Good air-curing consists in first avoiding too quick and later too slow drying. The chemical changes to obtain a brown colour need time, but if drying goes too slowly, the reactions go too far, with a too-dark colour as result.

The principles of air-curing are the same as those of flue-curing in so far as the leaf must first become more or less yellow, which can only happen if it has not lost too much moisture. A good practice would therefore be to hang the leaves or plants close together and later on to space the sticks. This is mostly not done because of the extra work involved. But often one can see the mistake by which exactly the opposite is done, to make place for a new harvest.

In cigar tobacco turning brown may start before all green has disappeared, but when cigarette tobacco is air-cured, one should take care that the leaves become yellow before turning brown.

Fire or smoke-curing

The product of this is a heavy tobacco, rich in nicotine, of nearly black colour and with a special smell. Only the leaves of certain varieties are smoke-cured. They are topped very deep and harvested by stalkcutting when nearly all leaves are ripe.

The curing shed can be as for air-curing, but often a stone wall is made inside since fires are used. Although the heat is much less than in flue-curing, one has to fill the barn in one day. The fires should not flame but give much smoke. Wet wood is used, or the fire is covered with saw dust. Certain kinds of wood are preferred to give the tobacco a special smell. Of the different methods which are used to ensure that the smoke is well incorporated in the leaves, some are described in bulletins 1420 and 1556 of the Ministry of Agriculture of Rhodesia (12).

Sun-curing

One speaks of sun-curing when the tobacco is not dried inside a building but in the open air. One can also make a combination of air and sun-curing to shorten the drying period. If small air-curing sheds are used, one can construct them in such a way that the sticks with leaves rest on rails or iron wires which protude over a long distance outside the shed. After the leaves inside the shed have yellowed, or if one aims at brown tobacco they have attained this colour, the sticks are pushed outside. To use this method the leaves must be of the same stage of ripeness, otherwise one obtains a product which is partly brown and partly yellow or even green. Yellow virginia can be obtained by this method only under very dry weather conditions; Oriental tobacco is always cured according to this or a similar method. In some tobaccos the bright yellow colour will turn dull when the sunrays fall on the lamina of the leaves. These must be hung rather close together.

Handling after curing

In part I has been said that grading will be facilitated when the successive harvests are kept separate. In the case of cigarette tobacco one does not need to distinghuish so many colours as in cigar tobacco, but one has to separate leaves with "body" from the dryer and thinner ones. This is done for a large part when keeping separate the harvests of lugs, cutters, leaf and tips.

Lugs are the three to five lowest leaves of a plant. They give a thin, mostly dry and often very ripe product, which has a dull colour. The last can be avoided by harvesting in a vital stage, as explained before.

Cutters are the following leaves; up to about the middle of the plant. They also give a thin product, but of brighter colour. They are the largest leaves of the plant, but their midribs are finer than those of "leaf".

Leaf are leaves from the midgle until near the top of the plant. The product of this has body, is waxy and of high colour.

Tips: these very high leaves often give a product which was not fully mature. The leaves are coarse, with heavy veins. If topping has been done high, the leaves are small.

If the tobacco on the field was not very regular, one has to divide the „lea f" into two groups. From plants which did not grow so well, the upper half gives a product which does not fit in the grade „leaf". But it can neither be put

together with cutters or lugs. It pays to harvest these leaves separately or select them out of the "leaf" harvest, because as a separate grade they will fetch a good price whereas mixed with the "leaf" they would only lower the price of this grade.

When grading flue-cured tobacco, it is important to keep in mind the difference between "fixed green" and "green cast". The last is ripe leaf which when curing was done a little too quickly, kept some green along the veins. These leaves, when put into a separate bulk, may turn out bright yellow. Fixed green however is caused if the leaves were harvested immature. Besides being more green, these leaves have a harsh appearance.

It may be mentioned here that flue-cured virginia is not always yellow. From some soils a light brown colour is obtained, specially from the higher leaves. This should not be mistaken for the brown colour which one obtains when trying, by extending the yellowing time very long, to cure leaves which were not sufficiently ripe. The first brownish leaves are "sweet", the second ones are of inferior quality.

In cigar tobacco, more grades are made than in cigarette tobacco. Sometimes two gradings are done, one before and one after fermentation. Uniform tobacco must be put in one fermentation heap, but because colours change during fermentation, it may be necessary to grade for a second time, be it by pulling out of the "hands" those leaves which do not show the right colour.

Regarding fermentation it must be said that one has kept for a long time the old fashioned method which needs much space and much time. After many trials one has now found the so-called forced or hot-room fermentation, of which a description can be found in the book of GISQUET et HITIER (5).

BREEDING

Selection done by farmers

In improving the tobacco production of a certain region, it may be necessary to introduce new varieties or to select from the tobacco which is grown, the best types. In some of such regions one will see a mixture of types in the same field, in others all tobacco plants are similar. The last may be caused by a simple way of selection carried out by the farmers of that area. The method can be as follows: When the crop nearly starts to blossom, they go through the field to select and mark some plants which represent the type they want. A few days later the whole field is topped. But when suckering starts, one sucker is left on the marked plants. When these suckers produce flowers, nowhere else in the field flowers are to be seen. The possibility of cross-fertilising with undesirable types is now practically non-existent, especially when all farmers use this method. They have the knowledge of the best type from their fathers and will not make mistakes. But when a new tobacco has been introduced, or when the farmers do not use such a clever method of breeding, this must be done for them by qualified persons.

Breeding will as a rule be carried out at an agricultural experimental station but this may be a large distance from the region where rural welfare work is under way or the soil of the station may not be suitable for tobacco. Funds will not generally make it possible to establish a new experiment station for the area and appoint a qualified plantbreeder.

The following shows what can be done in the initial stage without his help.

Facts by which breeding of tobacco differs from that of other crops

In tobacco, differences in yield sink into insignificance beside differences in quality. To measure this quality is not easy. Only after a sufficient large amount of the cured product has been graded, the percentage of first qualities will show if one variety or strain has to be preferred above others. All those varieties must of course have been harvested and cured in the same way.

In the breeding of cigar tobacco, the leaf of selected numbers is hung between the other tobacco in a large curing barn. If the selected types do not differ too much in character from the tobacco grown in the area, it may be assumed that the conditions under which they dry, are normal and a judgement can be made. The same can be done with cigarette tobacco if it is air-cured, but not when flue-cured. This has to do with the critical point, by which one switches over from yellowing to fixing the colour. If a harvest of different varieties is hung in one flue-curing barn, temperature and humidity of the air will be the same for all of them, but they will not react on it in the same way. Just as explained before in connection with regularity of plantations, the quick yellowing varieties will turn brown while waiting for the other ones and the slow yellowing ones will dry up green, if one does not wait. Each of the varieties might have produced a good quality, if it had been given the right period of time to yellow; in other words if it had been cured separately. To do this, one must have several flue-curing barns and grow of each variety enough to fill a barn with each successive harvest. Where this is not possible, one can try to overcome the difficulty to some extent by harvesting the slower yellowing tobacco in a stage of fuller ripeness, but the final decision can only be made by curing the most promising strains under optimal conditions.

Another item which must be kept in mind is that one does not need randomised blocks, but can better use rows as described in connection with the fertiliser trials.

Selecting one out of a mixture of types

Different types in the same field will be seen of course only where the tobacco is air-cured. This tobacco may have a certain market, but the quality can be improved by only growing the best type. The work to be done is then as follows; mark with a number some fifty to a hundred good plants, belonging to types which predominate in the field. When they start to blossom, cover the flowerheads so as to be able to harvest self-pollinated seed. Of these selected plants one may harvest leaves up to the middle, mark these and hang them between the other tobacco to be able to judge the quality of the dry product. But too much value should not be set on this judgement, for outside influences may alter the product of one plant.

It is better to judge the progeny. To do this, the harvested seeds of every selected plant must be kept separate. The following year a large number of small seedbeds is made, each having the same number as was given to the mother plant. The notes which have been made the foregoing year regarding each plant can now be extended by observations regarding germination and growth of the seedlings. Some number may be discarded and the others planted out in separate rows of at least fifty plants. If possible the rows are alternated with rows of one very pure variety, to discern better the influence of irregularities in the soil or replications are used. All observations made on

the growing plants will be noted down, but the most important is to see if the plants of one row are uniform. As a rule a number which is not uniform will be discarded although there might be some good plants in it. The rows are harvested separately and the sticks with the leaves of one row, marked with the appropiate number, are placed in the curing shed between other tobacco. The results of the curing are compared to select the best numbers.

But before one has obtained these results, it is necessary again to cover plants to obtain self-fertilised seed for next year. One chooses these plants out of the best rows, but the number of rows to be regarded as the best should not be too small, for the judgement of the cured leaf may make it necessary to eliminate some of those which looked well in the field.

The same work is repeated the following year and the number of rows to be tested becomes less and less. If one had started with crossbred plants one would have to repeat it some seven times, but if one starts from peasant-grown tobacco, one will as a rule, soon have a very constant type.

Introduction of a new variety

After having determined by the study of soil, climate and market position if the new crop should be a cigar or a cigarette tobacco, one must import seed of many varieties and of many origins to find the one that will best suit the local soil and climate. If obtained from a reliable seedgrower the imported strains will be purebred. This may facilitate the work, because one can discard very soon the varieties which do not grow well in the new environment. But it entails the possibility that none of the varieties gives satisfying results. Then crosses have to be made and starting with the second generation, selection of better adapted types will start. For this work it is good to have the help of an experienced tobacco breeder.

But if one has obtained a pure variety in one way or the other, this must be kept pure. This is very important when a new vafiety has been introduced. Some people believe that one must import every year fresh seed from the original country. They say: the tobacco will degenerate in the new country. This may happen if it is propagated without any selection.

Not only are mutations rather frequent in tobacco and a strain which was considered to be pure, can prove not to be so when brought in a new environment, but where seed distribution is not well-organised, cross fertilisation by other tobacco which is still grown by some persons, can take place.

To keep a tobacco which is well adapted to the new circumstances and which gives a quality comparable with that of the country from where the variety was imported, one should have a centre from where every year fresh seed is distributed to the growers.

Permanent selection

To keep a strain pure is something which can be done by anyone, who works conscientiously and knows what is good tobacco. It can be done according to the so-called "thirty row method".

One need not harvest selfpollinated seed of more than thirty plants. The seed of these motherplants is sown separately and the seedlings are planted in numbered rows, as described before. Out of the three to five best rows, again thirty plants are selected to repeat the process. One has to do this every year,

even if not much difference is to be seen anymore between the rows. Yield and quality are checked every time.

When rows of fifty plants with four replications are planted, these 200 plants of one number give sufficient leaf to judge the quality in case of air-curing. But in flue-curing a harvest from 200 plants is only a small part of a barn-filling. As these 200 plants differ in some respect from the others, their leaves may come out of the curing worse than the others, although they are potentially better. A check is therefore needed. This can be done by harvesting self-pollinated seed of more plants of the best rows and making large plantings with the mixed seed of each of these rows. The harvests of these plantings say one and a half hectare each, are then cured in separate barns. In judging the result of these curings one checks the breeding work done in the foregoing year. Mostly a conformation of former judgement is found but sometimes the separate curing shows that one of the numbers and also what in the meantime has been selected out of it, has to be discarded. One should therefore never select all thirty plants out of one row.

As an illustration of the scheme, let us consider the way of numbering which can be used: The first selected plants get the numbers 1 to 30. Suppose of next years rows the best ones are number 7, 15 and 20. Out of these three rows thirty plants are selected, e.g. eight out of row number 7, thirteen out of row number 15 and nine out of row number 20. These plants receive the following numbers.

7/1, 7/2, 7/3, 7/4, 7/5, 7/6, 7/7 and 7/8.
15/1, 15/2, etc. up to 15/13.
20/1, 20/2 etc. up to 20/9.

The rows of the following year have the same numbers as these mother-plants and there is a good chance that all those of which the number begins with 7 have some property in common. Suppose most best rows are found in the "seven series". We will not put then all our eggs in one basket, but if there are good rows in the other series, we will also select out of them. We might take:

7/4/1, 7/4/2 etc. up to 7/4/9.
7/6/1, 7/6/2 tc. up to 7/6/8.
20/3/1, 20/3/2 etc. up to 20/3/12.

In this way every year thirty plants are selected.

Next to the plot which contains the rows, there will be a planting of several hectares, consisting of two or more fields of tobacco, grown out of the seed of one row, to ascertain that one is not selecting in a wrong direction. An isolated plot of the number which at the time is considered as the best one can be used for supplying seed to the growers.

Bagging plants

For the purpose of this publication it will not be necessary to give more details regarding selection. More informations can be found in handbooks, in which also the making of artificial crosses and the obtaining of self pollinated seed is described. Only for the last some hints will be given here.

Ordinary brown paper bags are quite sufficient for covering the flowerheads, although some people prefer transparant paper. The safest way to obtain self-pollinated seed would be to put the covers before any flowers have opened, but

the stalk is very tender than and will break in case of hard winds. If already some of the flowers are open, the stalk is strong enough to hold the bag. But than the open flowers and eventually seedpods which have been formed already, must be taken away. This work must be done under strict control, because to untrained persons the very young seedpods look like flowerbuds.

If one has to obtain seed in a rainy season, paper bags will not do. Plastic bags can be used, but if these are too airtight, the flowers will die off. But one can easily perforate them e.g. by hitting with a steelbrush. For selection work small amounts of seed are sufficient. For the "thirty-row-system" three good seedpods of one selected plant are enough. Pollution with seed of other plants must be avoided. Therefore no grading of this seed is done and also disinfection is omitted if one is sure that no disease-causing fungus is on the seedpods. One does not even thresh the pods but keeps them in little cotton bags, above silicagel.

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