@

SB273
I4M23

SB 273.14M23

How to improve the tobacco crop of India

3 1924 000 365 498

man

[illegible]

Library Bureau Cat. No. 1137

At Cornell University
Ithaca, N. D.

Library

@
SB273
I4M23

**HOW TO IMPROVE
THE TOBACCO CROP
== OF INDIA ==**

1915

BY
I. B. DE MAJUMDAR

Cornell University
Library

The original of this book is in
the Cornell University Library.

There are no known copyright restrictions in
the United States on the use of the text.

<http://www.archive.org/details/cu31924000365498>

To the library of the New York State Agricultural
College with all good wishes from

L. S. De Majumdar
Assistant Settlement Officer,
Cooch Behar, India
15th November, 1915

HOW TO IMPROVE THE TOBACCO CROP OF INDIA

BY

I. B. De Majumdar,

B.A., M.Sc. Agr. (Cornell, New York)

*Scholar of "the Association for the Advancement of
Scientific and Industrial Education of Indians,"
and late Superintendent of the Agricultural
Department of Cooch Behar*

WITH AN INTRODUCTION

BY

Maharaj-Kumar Victor N. Narayan

1915

Wf.

*Muhuraj-Kumar Victor N. Narayan
of Cooh Behar.*

To
Maharaj-Kumar Victor N. Narayan

OF COOCH BEHAR,

The first Indian Prince to go abroad to learn Scientific
Agriculture for the development of the resources of
his country, these few pages are dedicated, as a
token of esteem and regard, and in sweet
memory of the happy days spent with
him in the United States, and the
tobacco regions of Cuba.

@
SB 273
I 4 M 23

PRINTED BY N. MUKHERJEE, B.A., AT THE
ART PRESS, AND PUBLISHED BY GUPTA,
MUKHERJEE & CO., 1, WELLINGTON SQUARE

@ 55349

INTRODUCTION.

This short paper on tobacco was originally written by Mr. Majumdar for the tenth Session of the Indian Industrial Conference, held at Madras in the last week of December, 1914 ; and was published without any illustrations by the Conference together with their other papers. Photos selected from out of a hundred taken by the writer and myself, together with a few others have been inserted.

Tobacco is a principal crop of Cooch Behar ; and with a view to introduce in the State scientific methods of curing as followed in other countries, under the instructions of my father His late Highness Maharaja Sir Nripendra Narayan Bhup Bahadur, I went to Cornell University, New York, where I specialised in agriculture for some time ; and to Cuba, West Indies, where I observed the methods of the culture, curing, and manufacture of the famous Havana tobacco. Mr. Majumdar was deputed by my father to accompany me in my tours, and to specialise in tobacco ; and later visited the different tobacco-growing centres in Macedonia and Asia Minor, where the best Turkish tobacco comes from.

There are great possibilities for the improvement of Indian tobacco. The subject is a vast one, and cannot possibly be fully discussed in a small pamphlet. However, some of the fundamental principles of tobacco growing and curing have been concisely put down by the writer ; and I trust these few pages will be of some help to persons interested in the crop.

India is essentially a farming country, but her agriculture is left entirely in the hands of the poor and the ignorant ; and there being no proper combination of capital, labour and skill, the rural masses, who form by far the largest part of the population,

live from hand to mouth. It is no wonder, therefore, that there is a deep-rooted feeling among the young men looking for a living, and for the well-to-do amongst our countrymen, seeking for a good investment of their capital, that "agriculture does not pay in India." There are a good many instances, however, of people making money by horticulture, floriculture, kitchen-gardening, poultry and dairy farming in the neighbourhood of big towns. Of course in the culture of field crops, the pulses, and cereals, where individual skill does not come much into play, and where there is no great scope for specialised knowledge, the chances of making large profits are minimised. But the case is quite different in the production of such crops, as tobacco, tea, etc., which pass through various stages, and require expert and scientific handling before they are put on the market. We have quite a number of tea plantations, working successfully in India at the present time ; and we had a good many indigo plantations a few decades ago. But there is no tobacco plantation worth its name in India, working with improved machinery, and on up-to-date scientific principles ; although tobacco is one of our principal crops, and the annual outturn of tobacco in India is greater than that in any other country in the world, except the United States. Of course we cannot expect to make such fabulous profits by the growing and curing of tobacco in India, as in the plantations of Sumatra and the Vuelta Abajo regions of Cuba, because our soil and climatic conditions are not as favourable as in those islands. But still there are immense possibilities, and it is high time that the attention of our enterprising capitalists be drawn to this much neglected crop of India, which plays quite an important part in the economic condition of our country.

VICTOR N. NARAYAN

THE PALACE,

Cooch Behar, 15th June 1915.

HOW TO IMPROVE THE TOBACCO CROP OF INDIA.

India stands second among the tobacco-growing countries of the world as regards the quantity of the crop produced, the first in order of production being the United States of America. From this fact can be realised the great importance of tobacco in the agriculture of this country.

The writer, in order to study tobacco in its various phases of agriculture and manufacture, spent a few years in some of the principal tobacco-growing countries, as the United States, Turkey, and Cuba ; and visited some tobacco factories in those places, besides a few in England, France, and Egypt. In this short paper will be dealt with, as far as space permits, some of the broad principles which have been followed with success in the improvement of the tobacco crop in those countries, especially the United States, and which are worth trying in India.

The tobacco industry has become highly specialised ; and each kind of tobacco, whether grown for the manufacture of cigars or cigarettes, for smoking in pipes or for chewing purposes, needs special treatment regarding culture, curing, and preparation for the market before manufacture ; and requires different climatic conditions, soils, manures, and fertilizers to develop the respective properties in accordance with the respective

trade requirements. From tobacco grown in Cuba, which is an island in the West Indies, are manufactured the best cigars in the world. These are known as Havana cigars, Havana being the name of the capital of Cuba, where the tobacco factories of the island are located. The best cigarettes of the world, manufactured in Egypt, and known as Egyptian cigarettes, are to a great extent prepared from tobacco grown in Turkey. It may be remarked here that no tobacco is grown in Egypt ; and the reason why Turkish tobacco is manufactured so largely in Egypt is because, in the first place, the Turkish Imperial Regie has the sole monopoly of manufacturing tobacco in Turkey, and no private companies are allowed to establish tobacco factories there ; and secondly because Egypt is the most convenient place for the manufacturers of Turkish tobacco, on account of the proximity of Egypt to Turkey, and the dryness of the climate, which is favourable for its manufacture. In the United States different varieties of tobacco are grown in different parts ; and though the quality, except in some particular localities, is not as good as that of Cuba or Turkey, where to the soils and climatic conditions mainly are to be attributed the superior qualities of tobacco, the United States follows the most scientific and up-to-date methods of agriculture, and is undoubtedly the leading tobacco-growing country in the world.

Though tobacco is one of the principal crops of India, the quality turned out is rather inferior, and the market price of the product is considerably lower than that of most of the other countries. The improvement, therefore, of the crop, on the lines successfully followed in other countries, is of vital importance to the economic condition of this country. The object of this paper is

The above group was taken in the premises of the Larranaga factory, one of the biggest cigar factories in Havana. The figures beginning from the left are the senior proprietor of the factory, Maharajkumar Victor N. Narayan, Mr. I. B. De Majumdar, and the junior proprietor of the factory.

to show some of the aspects in which the improvement of the crop may be effected in India. The principal ones may be classified thus :—

- I. Improvement of the crop by breeding and selection.
- II. Adoption of up-to-date methods of curing.
- III. Introduction of superior varieties from other countries.

We shall deal with these points one by one. The duty on imported tobacco is greatly in favour of the development of the indigenous crop and the culture of foreign varieties. The great industrial crisis through which we are passing on account of the war has also given a fresh impetus to the development of our native resources, and so the present moment is quite opportune for enterprising capitalists to pay their attention to the improvement of the Indian tobacco. The writer of these pages hopes that his suggestions may be of some use to visitors interested in tobacco-growing, at the tenth Indian Industrial Conference at Madras, which by the way is a principal tobacco centre in India.

I. IMPROVEMENT BY BREEDING AND SELECTION

There is considerable scope for improvement in the yield and quality of tobacco as well as of other crops in India by breeding and selection. As there are several distinct types of tobacco, which have different trade requirements, it is essentially necessary for a tobacco grower to have an uniformity in his crop, as regards size, shape, etc., of the leaves ; and this cannot be effected if the purity of the seeds cannot be preserved. “The individual plant is the result of two forces :—environment (climate, soil, fertilizer, culture, etc.) and heredity

(parents, grand-parents, etc.). The improvement and increased yield of a crop by modification of environment, although a necessary process to successful agriculture, can only be accomplished at an expense, more or less considerable. Heredity, however, is a silent force, which acts without expense." Breeding and selection, therefore, are just as important in the vegetable as in the animal kingdom. This phase of agriculture is not

PHOTO TAKEN BY MAHARAJKUMAR VICTOR N. NARAYAN.

Residence of Mr. Holmes, an American tobacco planter in Pinor del Rio, Cuba. The figures from the left are Mr. Holmes (Jr.), a farm Assistant, the Mayor of Pinor del Rio, Mr. Holmes (Sr.), Miss Holmes, Mrs. Holmes, Mr. I. B. De Majumdar, and the Secretary to the Governor of Pinor del Rio.

as well understood by the Indian cultivators as by their fellow-workers in Europe and America. In the United States, seeds of tobacco as well as those of other crops are properly selected by seed merchants as well as by the Department of Agriculture, the latter sending the seeds free to the farmers who apply for them. The methods followed are briefly described here.

The tobacco plant is naturally self-fertile, but cross-fertilization is often effected among the plants by many species of bees and insects, which carry pollen from flower to flower. This condition results in a large proportion of the crop being hybrid plants in the following year, and leads to great variability. In some species of plants cross-fertilization is absolutely essential to seed production. In other species it produces more and better seeds than self-fertilization. But tobacco belongs to still another class of plants which are abundantly self-fertile, and in which self-fertilization has been proved by experiment to be more effective for seed production than cross-fertilization.

The United States Department of Agriculture resort to bagging the flower-heads of the selected plants to prevent cross-fertilization, and thus to secure uniformity among the leaves. The characters which are given the closest attention in selecting the seed-plants are the general habit of growth or type of plant :—the number, shape, size, and uniformity of leaves, the distance between the leaves, time and uniformity of ripening, height of plants, number of suckers, uniformity of colour of leaves, and freedom from diseases. It is of vital importance to select plants with a large number of marketable leaves, in order to secure an increased yield. The plants on which the lower leaves are over-ripe before those near the top begin to mature should be discarded. Seeds from plants shewing a few suckers will produce a small number of suckers the following year, and those shewing a large number will transmit this undesirable tendency to the progeny, provided other things are equal. After the selection of seed-plants has been made in the field, the flowering part of the plant is covered with an

ordinary paper bag, which is a very simple, cheap, and at the same time effective method of protecting the flower from cross-pollination and injurious insects. For this purpose the 12 lb size bags are found admirably suited, as they give sufficient room for the proper development of the flowerhead of an ordinary tobacco plant, and at the same time they are not heavy enough to injure the plant in any way. The bag with a roof-shaped bottom is

PHOTO TAKEN BY MAHARAJKUMAR VICTOR N. NARAYAN.

House of a tobacco grower who is a tenant in Senor Suarez's plantation in Puerto de Golpe, Cuba.

better than the square bottom shape because it sheds the rain better. The proper time for placing the bag over the plant is just before the earliest flowers begin to open. After five or six days the bag should be temporarily removed, and all suckers broken off. It should be replaced at once, and elevated a little above its original position, in order to give sufficient room for the develop-

ment of the seedhead. This operation should be repeated once a week for two or three weeks. When most of the seed capsules are turned brown indicating maturity, it is desirable to remove the bag, and cut off all the late flowers, flower-heads, and poorly developed capsules, leaving only the largest and best to mature seed. The bag should be replaced after this is done, and allowed to remain until the stalks have been cut and dried out. During the process of drying, the bags serve as a protection, and catch any seeds which may fall out.

It has been found that heavy tobacco seeds produce like other agricultural seeds more vigorous and productive plants than lighter seeds. This is because the heavy seed has a perfect embryo or plantlet in it and a large supply of available plant-food. Notwithstanding the exceedingly minute size of tobacco seed, the writer has seen that in the United States Department of Agriculture at Washington, D.C., a perfect separation of the tobacco seed into light and heavy grades is effected by means of a separator consisting of a glass tube one inch in diameter and five feet long, and a glass receptacle for holding the seed, having the diameter of the long glass tube. The receptacle is so arranged with a finely woven wire screen in the bottom as to hold the seed in the receptacle, and at the same time fully admit a current of air directly into the seed. The top of the receptacle is fitted with a coupling into which the long glass tube can be set and held in place. The current of air is generated by a common foot-bellows, and regulated with a valve inserted into the receptacle, and connected to the bellows with a rubber tube. The seed to be separated is poured into the receptacle, usually about one to two ounces at a time, the glass tube set in place, and a current of air pumped

into the seed. The lightest seeds and the chaff are first blown out of the tube, and next the small seeds. The materials necessary for constructing this kind of tobacco-seed-separator can be obtained in any chemical house.

II. ADOPTION OF UP-TO-DATE METHODS OF CURING

If a sample of tobacco taken from the field at the usual time of harvesting were dried out rapidly on an oven, and manufactured into appropriate forms for smok-

PHOTO TAKEN BY MAHARAJKUMAR VICTOR N. NARAYAN.

A cottage for labourers in Mr. Luis Marx's plantation, Alquizar, Cuba.

ing or chewing, it would be found to retain a green colour and a rough surface ; and when smoked would burn badly, leaving a black ash, giving off a tarry ill smelling smoke, and imparting a bitter burning flavour. Whereas a properly cured tobacco has a brown or yellow colour, a silky texture, burns with a smoke of delightful aroma, holds fire well, yields a white or light gray ash, and has

no sharp or unpleasant taste. In other words, it is evident that marked chemical changes have occurred, resulting in the destruction of substances which in burning give off undesirable compounds, and the formation of other materials that give off in burning substances of pleasant smell and taste. On the other hand, if the leaf be killed by chloroform or frost, the changes ordinarily observed to result from curing do not occur. Curing is partly a life process, and is to some extent due to the activity of the cells of the leaf.

The Ripening of Tobacco

Soon after the leaves of the tobacco plant reach maturity, they undergo marked changes in colour and other properties. The young growing leaf has an intense green colour, shewing that it is quite rich in nitrogenous constituents, which go to make up the living or vital part of the leaf, and which are active in building up the food supply of the plant. The object of topping (removal of the flower head) and suckering (removal of the suckers or offshoots) as practised by the tobacco-growers is that the food built up by the leaves may accumulate in the leaves themselves, instead of being carried away to the seedhead and the offshoots. The result is that both the size and thickness of the leaf are increased. The reserved food supply of the mature leaf is deposited in the leaf tissue in the form of starch granules, while the green colouring matters are dissolved and carried to the younger, growing parts. At this stage there is a decided change in the colour of the leaf. Moreover, the accumulation of the starch granules in the leaf causes it to become brittle, so that it snaps when folded between the fingers, another characteristic sign of ripeness.

Now the replacement of the complex nitrogenous constituents, including the green colouring matter, by the starchy ingredients has a most important effect on the colour, flavour, elasticity, and finish of the leaf. Indeed, much of the success in curing tobacco depends on harvesting it just at the right time, when it is neither

PHOTO TAKEN BY MAHARAJKUMAR VICTOR N. NARAYAN.

Female labourers harvesting tobacco leaves in Mr. Marx's plantation. Tobacco grown under shelter of cheese cloth. Mr. Marx's plantation is supposed to be the richest and the best equipped in Cuba.

too ripe nor too green. Thus, in the case of cigar* tobacco, the brightest, clearest, brown colour is obtained

*If a high class cigar be unrolled, it will be found that three kinds of leaves have been used in preparing it. The innermost tobacco in the cigar is called the 'filler'; the next leaf used is the 'binder', to keep the filler in the form or shape of a cigar; and the finishing or outside leaf is called the 'wrapper'. The filler leaf is generally selected for its taste, sweetness, and strength, and the wrapper for its light colour and fineness in appearance. The binder and wrapper leaves are usually neutral in taste, etc. It is not necessary that they should contribute to the flavour, aroma and strength of the cigar like the filler leaf, but they must not have any undesirable qualities rendering the cigar worthless. The Cuban tobacco yields the best fillers, and the Sumatra tobacco the best wrappers.

when the leaves are harvested just before they would be called fully ripe. A green leaf after curing will be tough and leathery, while an over ripe one will be "strawy" and lifeless to the touch. Finally, since the materials which develop the flavour and aroma are derived from the green nitrogenous compounds, the fully ripe leaf will be deficient in those qualities, while the green leaf will possess them much more fully developed. It is evident, then, that the lower, fully matured leaves of the plant when moderately ripe will be best suited for the production of cigar wrappers, bright in colour, and having the necessary elasticity, but neutral in flavour ; while the upper leaves harvested before they have fully matured will give the best fillers having the required flavour and aroma, but being much darker in colour than the wrappers. In curing the "yellow tobacco" for the manufacture of cigarettes, it is necessary that the leaf be fully ripe, for the content of the green colouring matter must be reduced to the minimum, consistent with the required toughness, in order to obtain the cured leaf free from green or brown discoloration.

Different methods of Harvesting, Hanging and Curing

The harvesting, hanging, and curing operations vary widely for different types of tobacco. They also vary in different countries for the same type of tobacco. A summary is given below of the different practices, in vogue in various tobacco-growing countries, in connection with these operations.

HARVESTING :

A. With the stalk.

1. By cutting off the whole stalk.

2. By cutting off two or three leaves with the corresponding portion of the stalk.
- B. Leaving out the stalk.
 1. Leaves taken singly as they ripen.
 2. All the leaves on the stalk taken at one time.

HANGING :

- A. When harvested with the whole stalk.

PHOTO TAKEN BY MR. I. B. DE MAJUMDAR.

Kiretcheli (Yaka), a village near Xanthi, Macedonia. Tobacco grown in these lands fetch the highest prices in Turkey.

1. Splitting the stalk and hanging on the laths or sticks, butts up.
2. Hanging over laths by means of the rib.
3. Tying to laths by means of twine.
4. Spearing upon laths. (A detachable iron spear-head is fitted at the end of a lath by means of which the stalk of the plant is pierced.

Four to six plants are placed on a lath four feet long.)

5. Hanging upon laths by means of wire or nail-hooks.
- B. When harvested with sections of the stalk.
 1. Hanging over the laths.
 2. Stringing on cords.
- C. When the leaves are harvested alone, without the stalks.
 1. Tying in pairs and hanging over the laths.
 2. Stitching upon strings.
 3. Spearing upon wires or nails on laths.
 4. Spearing upon metal rods. (Metal rods six to eight feet long, and strong enough to bear the weight of the leaves without bending, are used. They are pointed at one end or tipped with a metal knife, by means of which the midrib of the leaf may be pierced near the base. The leaves are speared back to back and face to face, and placed one or two inches apart.)

CURING :

- A. Sun curing. (Tobacco is exposed to the heat of the sun, but protected from rain by temporary shelters. Tobacco in Turkey is at first sun-cured for a few weeks, and then air-cured inside cottages to finish the curing.)
- B. Air-curing or Barn-curing.
 - (a) Wilting*
 1. Leaf wilted before being taken from the field.

*The tobacco leaves immediately after harvest are quite brittle. So they are left on the ground for a while, whereby they become limp and lose their brittleness. This withering of the leaves is called 'wilting'

2. Leaf partly sun-cured before being taken from the field.
 3. Leaf brought to the curing barn immediately after harvest.
- (b) Preliminary sweating*.
1. Leaf slightly sweated before hanging.

PHOTO TAKEN BY MR. I. B. DE MAJUMDAR.

Harvesting of tobacco leaves at Philippi, Macedonia. It will be observed that leaves of Turkish tobacco are very small in size, the lengths of different types varying from 2½ to 8 inches.

2. Leaf violently sweated before hanging.
 3. Leaf hung without previous sweating.
- (c) After-sweating or Fermentation.

*Leaves are collected in bundles and packed into moderate sized heaps to sweat. Matting is placed over the heaps, and a gradual rise of temperature begins. The increase in temperature is due to certain processes which are taking place within the leaves, whereby their more complex contents become broken down into simpler ones, with an evolution of heat and water. The water thus given off is in vapour form, but it condenses again on the cooler matting covering, and it is the presence of this water which gives rise to the idea of the heaps sweating. Care is needed at this time to prevent overheating, for if the temperature rises unduly, the leaves get darkened in colour.

C. Fire-curing.

(a) Wilting. Variations the same as air-curing.

(b) Time of using artificial heat.

1. Fire used only during very moist weather, to prevent pole-burn.
2. Fire used only after the leaves are coloured by air-curing.
3. Fire used to start a sweat, then drawn, and again used, after the desired colour is attained by air-curing.
4. Artificial heat applied continuously

(c) Method of applying heat.

1. By open fires.
2. By stoves and flues

(d) Kind of fuel.

1. Coal.
2. Wood.

Harvesting.—About the two kinds of harvesting, viz : (a) cutting off with the stalk, and (b) gathering the leaves singly, there has been much discussion from a practical as well as from a scientific stand-point. Each has its advantages and disadvantages. The second method is followed in the case of the Turkish, the Cuban, and other high priced varieties of Tobacco.

The advantage of the first method is that it saves labour, and is less expensive than the other. The chief disadvantage is that all the leaves on the plant do not ripen at the same time, so that the tobacco has to be harvested at such a time as will give the greatest number of the best leaves at the proper stage of ripeness, thus necessitating a considerable sacrifice in both bottom and

top leaves, since the former are over-ripe, and the latter immature.

The advantages of the second method are :—

- (1) The planter can begin to house his crop from two to four weeks earlier, as the bottom leaves which ripen first can be taken off and cured as soon as they are ripe.

PHOTO TAKEN BY MR. I. B. DE MAJUMDAR.

Leaves in strings hung for sun-curing on the walls of the building, and on scaffolds in the courtyard of one of the plantations (in Macedonia) of Hazi Saccara, a rich tobacco planter of Turkey. The leaves are covered with mats (which are shewn rolled up in the photo) in case of rains.

- (2) As the lower leaves are pulled off those left on the stalk ripen more rapidly, which enables the planter to get in his whole crop earlier in the season.
- (3) The tobacco can be cured in a much smaller space.

- (4) It is possible to harvest all the tobacco leaves at the right stage of maturity and so the tobacco can be cured with greater uniformity than when the leaves are harvested with the stalk.
- (5) In cases where fuel is required a less quantity will be necessary, and the risk of setting fire to the barn will be greatly lessened.
- (6) Although the handling of leaves separately entails more labour than harvesting with the whole stalk, yet the great part of it is of such a nature that it can be profitably done by children, and at various times during the season.

Besides the questions of expense, labour, space, etc., the two processes also give rise to difference in the character of the cured product. The leaves and the stalks remain alive after harvesting as long as they retain sufficient moisture, by means of the reserve food supply which has been stored up. The outer edges of the leaf are first killed by loss of moisture, and the unused portion of the food supply is withdrawn towards the midrib, which is the last part of the leaf to die. When the leaves are picked from the stalk, of course this transfer of the food materials can get no further than the midrib of the leaf ; but when the leaf remains attached to the stalk the food materials pass into the stalk to keep this alive. On account of the water contained in the stalk, which gradually passes into the leaf to replace that lost by evaporation, the leaf also under these conditions remains alive for a much longer period than when separated from the stalk, and itself uses up more of its accumulated food,

so that the leaves cured under these conditions are considerably lighter than those cured after being separated from the stalk. It has been found by experiment that picked leaves are about 11 per cent. heavier after curing than those cured on the stalk.

Space will not permit a full discussion of the various systems of curing. As cigars and cigarettes are manu-

PHOTO TAKEN BY MR. I. B. DE MAJUMDAR.

A labourer just entering the subterranean pit where tobacco is kept after curing in order that it may get soft by moisture before it is sorted ; as tobacco in a dry condition is brittle and likely to get injured at the time of handling. The farm of Mr. Newhall (a Scotch planter) in Smyrna.

factured in India to a large extent, this paper will, therefore, be confined to the principles* which are observed in the curing of cigar tobacco, and in the curing of the

*In the preparation of this part of the paper, it is gratefully acknowledged that free use has been made of "Principles and Practical Methods of Curing Tobacco", by Dr. W. W. Garner of the United States Department of Agriculture, in whose laboratory the writer most profitably spent a number of days.

“yellow” tobacco which is largely used for the manufacture of cigarettes : (1) Air-curing is followed for the former, and (2) Flue-curing for the latter kind of tobacco.

Air-curing

Tobacco used for the manufacture of cigars is generally air-cured, artificial heat being used only during very wet weather. The curing is controlled simply by opening or closing the ventilators as occasion demands. In considering the changes taking place in the leaf during the curing process, this may be divided into two periods, during the first of which the leaf remains alive, while in the second the changes which occur have no connection with its life activities.

The principal changes taking place in the first stage of curing are due directly to the activities of the living cells, while they are passing through a period of gradual starvation ; hence the conditions should be such as are most favourable to these activities. These cells are killed by bruising, so that it is important to avoid injury in this way in the harvesting as far as possible. Again, these cells are killed by excessively low or high temperatures, and by the rapid loss of water. The life activities of the tobacco plant practically cease at temperatures below 40° F, while they increase as the temperature rises, until at about 125° F the living cells are rapidly killed. These activities are also greatly lessened by loss of water, and cease as soon as the leaf becomes dry. In practice, the most favourable temperatures for curing lie between the limits of 60° F, and 100° F, and the relative humidity should be about 85 per cent. Under these conditions the leaf will gradually lose its

water, but will never be too dry ; and the curing will proceed smoothly. If the humidity becomes much higher, pole-sweat* will develop on the leaves most advanced in the curing ; while if the humidity falls much below this figure, the leaf will dry out too rapidly.

We have seen that the ripe leaf is very rich in starch. One of the important changes in the curing is the disappearance of this starch, which is consumed by the

PHOTO TAKEN BY MR. I. B. DE MAJUMDAR.

Armenian and Jewish girls sorting tobacco in Mr. Newhall's farm.

living portion of the leaf itself. Now if the leaf is killed by bruising, by excessive heat, or by too rapid drying out, there is no means of removing this starch, and the tobacco is harsh, lifeless, and "strawy". Along with the

*This is the chief tobacco-disease and occurs the world over, where tobacco is used without the use of heat. It first appears as dark spots near the midrib or vein, and then spreads rapidly discolouring and rotting the whole leaf.

changes in composition, the green colour is replaced by a lemon yellow. This change from green to yellow takes place in all tobacco whatever the method of curing may be, if it is properly conducted. The green colouring matter or chlorophyl of the tobacco leaf, is found in all green plants in very similar, but not identical forms. During the period in which the leaf issue is undergoing starvation, the green colouring matter is more or less completely changed into colourless substances ; and the appearance of the yellow colour marks the approaching death of the leaf. It must not be thought that the yellow colouring matter is formed during the curing process, directly from the green colouring material. The yellow colouring matter is contained in the green leaf before it is harvested, and also after it has turned brown. The yellow is simply obscured in these cases by the more intense green or brown.

In building a good barn for the air-curing of tobacco, the two principal considerations to be kept in mind are to construct it as nearly air-tight as possible, and at the same time to provide an efficient system of ventilation ; for in the absence of any method of supplying artificial heat, these constitute the only means of controlling curing conditions. The fundamental principle to be kept in mind during the first stage of the curing is to avoid too rapid drying out of the leaf. Many growers, in their anxiety to avoid damage from pole-sweat, caused by excessive moisture, injure their tobacco very seriously by going to the other extreme of drying out the leaf so rapidly as not to allow sufficient time for the changes to take place, which are essential to good curing, dependent on the life activities of the leaf, and are, therefore, stopped as soon as this is killed by loss of water. Consequently,

if the outside air is very dry, the barn should be kept closed during the day, and opened up at night. The object is to keep the moisture of the air in the barn quite high until the important changes in composition have taken place, as shewn by the change in the colour of the leaf from green to yellow. Of course, if the outside air is quite humid, the barn should be kept open during the day.

PHOTO TAKEN BY MR. I. B. DE MAJUMDAR.

Hand press for baling tobacco. The buildings of the Turkish Regie, Xanthi, Macedonia.

The full development of the yellow colour marks the end of the first period of curing. During the second stage the changes consist mainly in the further breaking up of the products formed in the first stage of the curing, and the development of the brown colour. Here again it must be understood that brown colouring matters are not derived from the yellow, nor are they derived directly

from the green colouring material. They are formed by a process of oxidation which does not take place till the cells of the leaf are dead. As soon, therefore, as portions of the leaf die, they at once begin to turn brown, provided sufficient moisture is present. The two essentials for the development of the brown colour are a supply of oxygen, which is obtained from the air, and a sufficient amount of moisture. This development of the brown colour, which is begun in the second stage of curing, is always completed in the fermentation of the tobacco; and the chief danger as regards the curing is that the development will proceed too far because of excessive moisture, causing the leaf to cure too dark.

As regards quantity, the most important change in the curing is the loss of water. The tobacco leaf normally loses about 75 per cent. of its green weight in the curing, and by far the greater portion of this loss is water. To cure tobacco successfully, this vast amount of water must be removed under such conditions and at such a rate as will best allow the other important changes to take place. In the second stage of the curing, when the leaf begins to turn brown, the relative humidity may be lowered from 85 per cent. of the first stage to about 80 per cent., and then the latter still further reduced to 70 or 65 per cent., until the stems are dry. If the humidity remains very high at this stage for any considerable period, pole-sweat will surely develop. This is to be especially feared if a season of warm, moist weather sets in, and may soon render the entire contents of the barn practically worthless. The only remedy lies in the use of artificial heat to keep down the humidity. Ventilation alone will be of little avail. Entirely aside from the danger of pole-sweat, however, there are other impor-

tant reasons why the humidity of the barn should be reduced as soon as the brown colour begins to develop.

PHOTO TAKEN BY MR. I. B. DE MAJUMDAR.

Turkish labourers carrying bales of tobacco on their backs, a common sight in the streets of Cavalla, Macedonia.

The leaf dies at this stage, and the further changes in composition and properties are such as can be better con-

trolled in the sweat-room (where the ventilation, temperature, and humidity can be easily regulated), than in the curing shed. At the present time the demand is for bright colour in wrapper leaf, and the longer the second stage of the cure is protracted by a relatively high humidity the darker will the leaf be. The rational method of procedure, therefore, is to maintain a high humidity during the first stage of the cure, and then, as soon as the colour has developed, to dry out the leaf comparatively rapidly.

After the cure is finished the leaves are tied into bundles, and arranged in bulks on an elevated platform. The bulks are covered with oil-cloth or other suitable material to prevent the leaves from drying out. They must be carefully watched to prevent their becoming heated, which is practically liable to occur if the leaf is packed down too moist. If heating does occur, the piles must be torn down, and rebuilt after the bundles have been shaken out.

Before the leaf is ready for the manufacturer, it must undergo a process of fermentation, commonly spoken of as "sweating". To carry out this process successfully requires a thoroughly equipped plant with adequate facilities for controlling ventilation, temperature, and humidity, so that as a rule the growers sell their leaf in the bundle to the dealers, who make a business of carrying on the fermentation on a large scale. The tobacco must also be very carefully assorted into grades, but the dealer generally prefers to do this himself in order to secure greater uniformity. The work of grading and fermenting cigar-leaf tobacco has become a highly specialised industry, quite distinct from the cur-

ing process, properly speaking, and so does not require further consideration in this short paper.

Flue-curing

For this method of curing the barn must be provided with a system of large pipes or flues, through which the heated air is passed throughout the curing period. The smoke does not come in contact with the tobacco, and the

PHOTO TAKEN BY MR. I. B. DE MAJUMDAR.

Cases containing bales of superior grades of Turkish tobacco, which are ready for shipment. The American Tobacco Company's buildings, Cavalla, Macedonia.

curing is completed in less than a week's time. One of the principal factors controlling the value of the leaf cured by this method is the colour, and the two prime conditions for success are the right kind of the soil and the proper control of the curing. The colour most desired is a characteristic bright lemon-yellow.

In the flue-curing method, just as in the air-curing

process, the principal changes in composition brought about in the curing are dependent on the life activities of the minute cells of the leaf, and the nature of the changes in the two methods is the same. The main difference lies in the extent or completeness of these changes. The typical bright yellow tobacco is harvested riper than tobacco which is cured without the use of heat. Partly on this account and also because of the character of the soil on which it is grown, this type of leaf is relatively richer in starchy matter and poorer in organic nitrogenous materials. Because of the difference in composition combined with the effects of high temperatures and more rapid drying, the green colour is removed much more rapidly. The rapid appearance of the yellow colour does not afford sufficient time for the transformation of all the starchy matter and as soon as this stage is reached the drying must be hastened so as to prevent any further change in colour. Evidently, then, the flue curing method consists essentially in the hastening and shortening of the first stage in the air-curing process, while the second stage of the cure, made apparent by the development of the brown colour in the case of cigar tobacco, is not allowed to take place at all.

The capacity of the air for holding moisture, and consequently its drying capacity, depends principally on its temperature ; and air which is already saturated has no drying power until its temperature is raised. Satisfactory curing can only be accomplished by proper regulation of the rate of drying ; and this depends chiefly on the humidity of the air in the barn. From these facts it is clear that in order to maintain a definite rate of drying by controlling the humidity, the temperature in the barn must bear a certain relation to that of the outside air ;

and the difference in temperature inside and outside the barn will be influenced by the humidity of the outside air. In warm weather the temperature inside the barn must be higher than in cool weather ; and in rainy or in foggy seasons it must be higher than in clear, dry weather. In addition to temperature there is another equally important factor in controlling the humidity in

PHOTO TAKEN BY KUMAR KAMALENDRA NARAYAN.

A field of country tobacco at Dinhata (Cooch Behar), partly harvested. The group consists of Maharajkumar Victor N. Narayan (fourth figure from the left), and some of the officers of the Cooch Behar State.

the barn, and consequently the rate of drying, and this is ventilation. If the barn were perfectly tight, the air within would, of course, soon be saturated ; and the inevitable result would be that tobacco would sweat ; that is, drops of water would collect on the surface of the leaves. The warm saturated air in the barn must, therefore, be constantly replaced by the cooler, less

humid outside air ; and hence proper means of ventilation should be provided.

The completion of the curing proper is marked by the development of the yellow colour. The transformation from a green to a yellow colour, along with other attendant changes, takes place while the leaf is still living and if the leaf is quickly killed by heat, or by being rapidly dried out, it will be impossible to remove the green colour. At temperature above 125° F the leaf is rapidly killed, so that this limit must not be exceeded during the yellowing process. The greatest danger in the first stage of the curing, however, is that the leaf will dry out so rapidly as to prematurely kill it. The yellowing process may be accomplished at any temperature ranging between 80° and 120° F, provided the humidity in the barn be properly managed. Care must be taken to avoid drying the leaf too rapidly during the first stage of the cure ; but as it begins to yellow, the humidity in the barn must be materially decreased, by slowly raising the temperature, and increasing the ventilation. As soon as the leaf has become yellow, the whole problem is to regulate the drying so as to prevent any further change in colour. This second stage of curing known as "fixing the colour", is the critical period and requires the closest attention. The appearance of the yellow colour indicates that the leaf has reached the dying stage, but it still contains a large amount of water. When the leaf tissue dies, all the moisture within the leaf is released, and will rapidly move to the surface, so that unless the moisture is promptly removed, the leaf will begin to turn a reddish brown colour. This is called "sponging". To avoid this injury to the tobacco, the heat must be raised very

slowly, so as to kill the leaf tissue gradually, and, more important still, plenty of ventilation must be provided to take away the moisture. If the heat is increased too rapidly while the leaf is still full of sap, a greenish black discoloration will develop, which is known as "scalding" or "blistering".

The temperature should be maintained at from 130° to 140° F until the leaf is completely dried out, which will require about ten to eighteen hours after the com-

PHOTO TAKEN BY MR. I. B. DE MAJUMDAR.

Flue curing sheds in the Cooch Behar State Tobacco Farm.

pletion of the yellowing process. All danger from sponging or scalding is now past, and it only remains to dry out the stems. The ventilators are now closed, and the temperature raised up to 165° or 175° F at the rate of about 5 degrees an hour. This latter temperature is maintained till all the stems are completely dried out.

III. INTRODUCTION OF SUPERIOR VARIETIES FROM OTHER COUNTRIES.

So far we have dealt with two phases of improvement, viz : (1) by breeding and selection, and (2) by the adoption of up-to-date methods of curing ; both of which directly apply to the indigenous crop, the cultivation of which has been going on in India for years. Now we shall deal with the question of introduction of superior varieties from other countries ; and growing and acclimatizing them in suitable soils, and under proper climatic conditions. There is a great demand for high class tobacco in India, both for the manufacture of cigars and cigarettes. The tobacco factories in Calcutta, Madras, Monghyr, Rangpur and other places are sure to provide ample markets for superior varieties of tobacco that may be introduced into this country. So far attempts have been made in India to grow foreign varieties of tobacco not on commercial but mostly on experimental scales. Several hundred maunds of "vellow tobacco" were successfully grown and cured from imported American seeds in the Cooch Behar Tobacco Farm, and sold to some of the above factories at an average price of Rs. 35 per maund (the best grades fetching Rs. 60 per maund), against Rs. 5 to 10 per maund of the indigenous product grown by the cultivators. Several maunds of Sumatra tobacco were also grown at the Government Experimental Farm at Burir Hat, Rangpur, and fetched as much as Rs. 100 per maund.

It must be observed that while the improvement of the indigenous product by proper curing, etc., is not a difficult affair, the introduction and acclimatization of foreign tobacco requires a lot of time and patience to

achieve success ; but finally the results obtained justify the experiments if judiciously carried on. The Cuban and Sumatra varieties have been successfully grown in the United States. The results obtained go beyond all expectations. In the Paris Exhibition of 1900, the jury voted to the Florida-grown leaf 20 points of merit, and to the Sumatra grown leaf 18 points. The Florida-grown leaf from Cuban seeds also received favourable consideration, being voted 18 points of merit against 18 points received by the Cuban product. The amount of patience and perseverance displayed by the tobacco growers of Florida, in their efforts to grow superior varieties from other countries, will be manifest from the following extracts* and their example may serve as an incentive to the tobacco-growers in this country :—

“In order to improve the tobacco and adapt it to the trade demands, these concerns have indulged in all sorts of experiments, some of which have proved quite expensive. However, they have met with such a degree of success as to warrant them in continuing the experimental work. There were many questions to be settled. First of all, What seed should be used ? To settle this question, seed was obtained and tried from every part of the country. This point, however, was soon determined, and now there are only two varieties—grown in the state—Sumatra and Cuban, the Sumatra giving the style required for the wrapper, and the Cuban giving the filler qualities nearest the requirements of the trade. As each of these kinds of tobacco possesses the quality needed, the kind of soil best suited to each was the next point to be settled ; then the proper fertilizer, the quantity necessary, and

*From report No. 62, United States Department of Agriculture, “Cultivation of Cigar Leaf Tobacco in Florida” pp. 21-22. Published 1899.

the proper cultivation had to be found out by numerous experiments. At first it was thought that but little fertilizer of any kind should be used. The tobacco was set out early, given a distance in the drill of about 24 inches, and topped low ; that is, not more than twelve or fourteen leaves were allowed to each stalk. The result was that the plants produced large, coarse, undesirable leaves. The next step was to give the tobacco less distance in the drill ; 18 inches were tried. The result was better but not satisfactory. From time to time changes were made until now the plant* is given 14 inches, the fertilizer is doubled, and the tobacco is topped higher, allowing at least sixteen leaves to each stalk. The result is that the leaves are of the desirable size and finer in quality and appearance.

“When the Sumatra seed was first introduced into Florida, the land selected, the amount of fertilizers used, and the methods of cultivation and harvesting employed, were the same as those practised in growing the Cuban variety. With this treatment, Sumatra proved to be an absolute failure ; many abandoned the seed, while others continued to experiment. It was soon found that the soil had to be exceedingly rich, the growth quick ; that low topping was ruinous, and that each stalk should have from twenty-four to thirty leaves, according to the strength of the soil. When the land was exceedingly rich, it was found best not to top at all, but to allow the plants to go to bloom. Then the leaves would be of desirable size, thin and smooth ; whereas if topped, the leaves would curl and thicken. This tobacco is also crowded into the drill, the plants being given only from 12 to 14

*The Florida grown Cuban plant is only meant. The Florida-grown Sumatra is dealt with in the next paragraph.

inches. The growth is rapid ; the top leaves soon serve as a shade for the middle and lower leaves, and the results have been most gratifying. New land proved to be more desirable for this variety of tobacco ; and it was noticed that when trees were left standing in the field, the plants shaded by trees were far superior to the plants not so shaded. From this the idea of building artificial shade had its birth. It was also found that no good results could be obtained if the plants were cut, but the leaves should be primed off* just as they ripen, and at a very early stage of ripeness."

*Harvesting the leaves singly without the stalk is called "priming".

Cornell University Library

SB 273.14M23

How to improve the tobacco crop of India

Cornell University Library

SB 273.I4M23

How to improve the tobacco crop of India

~~Pressboard~~
**Pamphlet
Binder**
Gaylord Bros. Inc.

Makers
Syracuse, N. Y.
PAT. JAN 21, 1909