MANURIAL AND OTHER TRIALS OF FLUE CURED

CIGARETTE TOBACCO IN TRINIDAD.

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The history of tobacco growing in Trinidad and at I.C.T.A. has been briefly outlined. Hitherto the emphasis has been solely on the growing of dark air cured leaf for low quality pipe and cigar tobacco, but at the beginning of the 1953-54 crop season a small flue barn was built at the Old Farm to test the possibilities of growing and curing flue cured tobacco suitable for cigarettes.

Two fertiliser trials were carried out to determine approximately the optimum amounts of pen manure, N, P$_2$O$_5$, and K$_2$O necessary to produce high quality leaf. Both trials received almost identical treatments, but the first was sown on Oct. 23rd., and the second on Dec. 17th. The aim of the second trial was to confirm any results from the first experiment, and to enable a comparison between early and late sowings. For various reasons the first experiment was a partial failure, while the results from the second one were not fully available when this dissertation had to be prepared. A third pilot trial was also attempted to compare methods of planting, but again the results were not ready in time. It is hoped to add a postscript at a later date, but meanwhile certain claims can be made with a fair degree of accuracy.

Good quality flue cured tobacco can be grown and cured in Trinidad, but it is a skilled business with many practical difficulties, particularly as regards curing. Most of these difficulties can be eliminated given suitable soil, good management, and sufficient practical experience.

Sturdy, uniform seedlings in ample numbers are of permanent importance. Hence cloth covered nursery beds built well in the open are more likely to produce good seedlings than more elaborate beds built in shaded and sheltered surroundings.
Tobacco should not be transplanted on prepared ridges, particularly a dry season crop. A better method is to plant on a flat surface, and then mould up afterwards with each successive weeding.

Late sown crops yield as well as early ones if irrigation is available in a dry year, but if sown too late the harvest may coincide with the onset of the rainy season.

No information is yet available on the best combination of fertilisers, but will be added later.

Field 3 of the Old Farm is not suitable for growing good tobacco, or for experimental work.

Detailed practical suggestions applicable to I.C.T.A. are included, besides photographs of the harvesting equipment.

Brief mention is made of trials on flue cured tobacco carried out by the Tobacco Leaf Development Company of Jamaica.
INTRODUCTION

TOBACCO IN TRINIDAD

Tobacco is a native of the New World and probably originated somewhere between what is now Brazil and Mexico, although it has never been discovered growing really wild and apparently would not now survive without the help of man. This suggests it has been cultivated for centuries. It was possibly indigenous to the West Indies, and was certainly widely grown and appreciated by the aboriginal Indians when Columbus first visited Cuba in 1492. Historians agree that it was not simply used by the Indians as a narcotic for personal use, but had an important place in their national and religious ceremonies, besides being used for medicinal purposes. The Indians called it "yoli" and smoked it in rolls, rather like the present day cigar. The Spaniards were not slow to realise its potentialities and it was not long before several distinct types had been developed. Its popularity spread rapidly, and as all Europe's requirements had to pass via Spain and Portugal it must have been a profitable trade to those two countries, that is until English settlers started tobacco growing in Virginia in 1612, and broke the monopoly. (Garner, 1951).

It is now grown all over the world.

Exactly when tobacco was first grown in Trinidad is very hard to say since it may have been almost indigenous to the Island. Good quality "pipe" tobacco was certainly grown in the early 17th century when Trinidad was a Spanish colony (Garner, 1951), but later it was considered to be contraband and its cultivation was prohibited by the Spaniards (Wood, 1932). Since then there is little mention
of it until fairly recently. In 1888, and again in 1889 and 1900, the Trinidad Government sponsored the publication of a bulletin on tobacco growing written by a Cuban refugee, so presumably it was grown on some scale by them. (Espin, 1900). At any rate prior to 1907 cigar tobacco of good quality was grown in the Siparia district, but its production for cigarettes ceased by 1912 (W.I.Bull.). Tobago too was exporting cigar filler leaf to Trinidad in 1911, where there was a good market for it, but smoking habits changed and the trade languished. (Thornton, 1912). Since then air cured leaf has been grown on a limited scale in both Trinidad and Tobago by peasant producers, and sold to makers of hand made cigars, for which there has been a limited local demand. It is not known how much exactly is grown in this way, but it cannot be a great deal as very few cigars are hand made nowadays in Trinidad due to a shortage of suitable leaf.

From time to time a few estates and private individuals other than peasants have tried to grow tobacco, but so far nothing has come of these attempts, at least on any scale. However just recently the Tobacco Leaf Development Co. (Jamaica) have conducted a series of fairly large scale trials on the growing of cigarette tobacco. Their findings are discussed in greater detail in Appendix I.

**TOBACCO AT I.C.T.A.**

Tobacco was first grown at I.C.T.A. in 1923 for demonstration purposes, and by 1926 good plants were being produced. In 1927 an acre and a half was grown, and even more in subsequent years. (Dash, 1927). Yields were satisfactory and the crop was a profitable one, while samples sent to the Imperial Tobacco Co. in Bristol and the local cigarette factory produced encouraging replies. Quality was not
particularly good and only pipe and the darker cigarette tobaccoes were produced (Wood, 1932), although in 1929 a special air curing barn had been put up to remedy this. (Davidson, 1930).

Between 1930 and 1933 several post graduates experimented with planting, spacing, manuring, priming, topping, curing, varieties, and the economics of tobacco growing. They are Davidson (1930), Kerr (1930), Baker (1931), Charles (1932), Moon (1932), Kerkham (1933), Stewart (1933), and finally Williams (1933). In fact quite a lot of work was done on tobacco in the early 1930's, although in each case the tobacco was air cured, presumably because in 1929 the Imperial Institute had reported that "the Island is essentially suited for growing cigar tobacco" (Imp.Inst.1929). This agreed with local practice and tradition, and moreover the 1930 College crop was made into cigars of a reasonable quality, although their flavour was rank due to inadequate fermentation and ageing.

Nevertheless, as early as 1930 Davidson suggested that bright cigarette tobacco might be grown. He pointed out that Mauritius - where cigarette tobacco is successfully grown - has a rather similar climate to that of Trinidad, and then quoted Corbett as saying that if a variety such as Hickory Prior could be brought to a reasonably bright colour by air curing, then there was no reason why cigarette tobacco could not be produced from it by flue curing. Davidson tested this variety and found it did produce quite a bright sample, but could go no further as there was no flue barn available. He recommended that a flue barn be built to decide the matter, but unfortunately his plea was ignored.
On the contrary all experimental work on tobacco ceased abruptly after 1933 and the air curing barn was pulled down, presumably due to staff transfers and a change of interest from tobacco to other crops. After that very little tobacco was grown and then only for demonstration purposes, despite the fact that it has been one of the few crops grown at the Old Farm that has regularly made a profit. This profit was anything up to $500 an acre, in spite of criticisms regarding its quality. For instance Williams (1932) calculated that between 1928 and 1933 the average profit was nearly $300 an acre, by no means a small sum in those days.

In 1951 interest in tobacco was revived and a trial to compare imported and local varieties was laid down. Good quality leaf was produced, but there was still no flue barn. (Campbell 1952). The following year Dunbar conducted a second variety trial, but in addition he introduced the possibility of growing a succession of crops in a year, the later ones to be grown in the dry season with the help of irrigation. The results were very promising but again the work was hampered by the lack of a flue barn, particularly when it came to curing the late sown tobacco because by then the rains had arrived and the humidity was too high for successful air curing (Dunbar, 1953).

By then the Tobacco Leaf Development Co. (Jamaica) were also interested in the prospects of growing bright cigarette tobacco in Trinidad, and as there was sufficient money available the College decided to build a small flue barn for the 1953-54 season, and perhaps expand tobacco experimentation if the results were favourable.
The manuring of flue cured tobacco

As a general rule flue cured tobacco cannot be successfully grown without fertilisers (Murray, 1949). It is said that an acre of tobacco may grow at the rate of 114 lbs. of dry matter per day, so obviously ample nutrients must be available, although at the same time it is important to remember that over-fertilising can be more harmful than under-fertilising (Thompson, 1948). This is particularly true as regards quality. Really fertile soils are not needed, in fact they are not usually suitable for good quality leaf. Deep sandy soils with good drainage and ample humus content are preferred, and in such circumstances the soil acts as a rooting medium to which the correct amount of nutrients can be added artificially.

The crop requires relatively little nitrogen, usually not more than 24 lbs. per acre for high quality leaf; or otherwise there is a tendency for the leaf to become heavy, dark in colour, and coarse. Phosphate too is only taken up in small quantities, but to ensure prompt ripening and good quality the "average soil" requires the addition of 80 lbs. P₂O₅ per acre. Potash on the other hand is needed in large quantities, and from 60 lbs. to 100 lbs. of K₂O are usually added. Without it the leaf lacks body, is more susceptible to drought and disease, and does not burn well. An excessive amount of chloride also affects the flame holding qualities of the leaf, so for this reason it is customary to apply potash in the sulphate rather than the muriate form. Liming is not recommended unless the pH falls below 5.0, in which case dolomite limestone is best since it adds magnesia (MgO) which the plant requires.
In other words from 800 lbs. to 1200 lbs. of a 3-10-12 fertiliser would suffice, but in addition the fertiliser should carry 2% MgO, half of which should be water soluble, at least 6% CaO, and 2% Cl. (Garner, 1951). Trace element deficiencies, should they occur, can be remedied individually by the application of the appropriate element in short supply. Organic manures, if well rotted, usually give good results since they add humus to the soil.

These remarks are simply broad generalisations, because tobacco is so sensitive to different fertilisers that its requirements vary from district to district and from soil series to soil series. It is for this reason that even adjoining areas very seldom produce an identical grade of leaf, despite every attempt to standardise the environment. A vast amount of work has been done on the subject by the major producing countries. In the United States for instance very comprehensive recommendations covering many different soil types have been worked out, and fertilizer manufacturers have even established special formulae to suit these recommendations. (Garner, 1951).

Unfortunately in Trinidad no such information is available because flue cured tobacco has not been grown before. Admittedly work has been done in the past at I.C.T.A., but only on air cured leaf, so the results have little or no application to the present experiments.

**REASONS FOR FURTHER WORK ON TOBACCO**

In Trinidad the average consumption of cigarettes is 1000 per head per year, for every man, woman and child in the island. This is about twice as high as anywhere else in the West Indies, and is probably still rising. Yet virtually
no suitable tobacco is grown locally, and the cigarette factory at Champs Fleurs depends entirely on imported leaf. Except for a negligible amount of Turkish leaf all this tobacco comes from either Canada or the United States, and represents an outlay of some $3,000,000. a year. Admittedly the Trinidad Government has a useful source of revenue from these imports, since the duty is approximately $1.87 per lb. of leaf, but at the same time it does mean a severe drain on the island's hard currency resources. (Outridge, 1954).

Local peasant produced leaf has been tried, but found to be of little value. It is said to be satisfactory as regards texture and elasticity, but has obviously been ruined by ignorance and bad management. Nevertheless the inherent possibilities exist, and if flue curing were possible, and if the management could be improved, there might be a place for tobacco in the pattern of local agriculture.

Tobacco would provide a very useful additional cash crop for the peasant, for as Dash (1927) and Huggins (1931) pointed out years ago, it is a crop that is very suited to small scale production since it needs much individual attention and is best grown in comparatively small acreages. It might also lead to reduced dollar expenditure, although it is most unlikely that it would completely replace imported leaf.

Some might argue that it would be wiser to attempt the growing of cigar tobacco. The answer is that there is now very little local demand, while the world demand for cigars has also been declining since the 1920's. (F.A.O. 1952).

In any case it is a highly specialised business that is now confined to certain areas where growers have perfected their techniques to a high state of proficiency. This particularly applies to wrapper leaf, as for example in certain areas of
Jamaica, the Connecticut valley in the United States, and in the districts of Partido, San Luis and San Juan in Cuba. There the leaf is grown under cheese cloth, which requires much capital and skill, and in all probability is beyond the resources of the average Trinidadian peasant.

Assuming however that there are prospects for bright cigarette tobacco in Trinidad, a great deal more information is required before conjecture can be translated into fact, and before more ambitious ideas can be considered.

AIMS OF THE EXPERIMENT

1. Firstly to find out whether or not bright cigarette tobacco can be grown in Trinidad, and if so to make a preliminary study of the best methods of doing it.

2. Secondly to work out approximately the best manurai treatments for cigarette tobacco under local conditions.

3. Thirdly to follow up Dunbar's (1953) suggestion of a succession of planting dates, the later sowings to be grown with the aid of overhead irrigation. If this were possible it would make for a more efficient and continuous use of the curing barn, and a greater overall production.

4. Fourthly to study any incidental problems that might, and probably would, arise from the experiments.

GENERAL PROCEDURE

Originally two experiments were planned. Both were to have the same manurai treatments and statistical design, the aim of the second one being to confirm any results from the first one. The first was to be sown late in October, as is the usual custom in Trinidad, but the second one was to be sown in the middle of December. This allowed a comparison between two sowing dates and two harvests.
Later, since both the space and the plants were available, a rather crude pilot trial was laid down to compare two methods of cultivation. One or two sidelines such as diseases, nursery techniques, and different methods of curing, were also examined.
EXPÉRIMENT I

TREATMENTS AND STATISTICAL METHODS

Little was known about the manuring of tobacco under local conditions and nothing about the requirements of cigarette tobacco, so it was decided that the treatments should have as wide a scope as possible, leaving the more detailed aspects to be worked out in future trials. With this in mind a 2 by 4 factorial design was chosen, with 4 main treatments each at 2 levels, as follows:

- **D₀** = No pen manure.
- **D₁** = 12 tons of pen manure per acre.
- **N₁** = 10 lbs. N, or 50 lbs. sulphate of ammonia per acre.
- **N₂** = 20 lbs. N, or 100 lbs.
- **P₁** = 50 lbs. P₂O₅, or 250 lbs. superphosphate per acre.
- **P₂** = 100 lbs. P₂O₅, or 500 lbs.
- **K₁** = 60 lbs. K₂O, or 120 lbs. sulphate of potash per acre.
- **K₂** = 120 lbs. K₂O, or 240 lbs.

It was taken for granted that fertilisers of some sort were essential - an assumption based on the nature of the soil, and experimental results in many other tobacco growing areas of the world - so there was no point in including a control treatment. This argument does not however apply with equal force to pen manure, as there are many places where it is not used and opinions vary as to whether or not it is of benefit. It was for this reason that no pen manure was compared with a moderate dressing of pen manure, rather than a comparison made between two dressings of it as was the case with the other three nutrients. These treatments were thought to be reasonable ones.
A factorial design was chosen because each plot yields information on several treatments, thus saving time, labour and space in a crop that is expensive to grow. The weakness of the design is that it is relatively complicated and requires much personal supervision at all stages, particularly in a crop like tobacco where the harvesting and curing raise problems in field experimentation not encountered in many other crops. It was for this reason, and for the sake of simplicity, that the experiment was not enlarged to include 3 or 4 levels of each main treatment. Such a design would have yielded far more detailed information but would have been extremely complicated, particularly as neither the labour nor the management had any previous experience of cigarette tobacco.

In this experiment there were two replications, both of which were confounded to cut down the effects of soil heterogeneity which were thought to exist, and which are discussed in greater detail later. This meant dividing each replication or block of 16 plots into two sub-blocks of 8 plots each (Cochrane & Cox, 1953). The plots were randomised within the sub-blocks, as also were the sub-blocks within the blocks. A third order interaction was lost but such an interaction was not likely to be significant.

**SITUATION AND LAYOUT**

The experiment was situated in Field 4 at the Old Farm, since it happened to be conveniently near the site of the proposed flue barn. The field was 1.54 acres, divided into almost equal halves by an earth bank running approximately East to West. Part of the field was already occupied by grass plots so only an acre was available at the railway end. One
replication was placed on either side of the bank, allowing
discards at the railway end of each block to facilitate
tractor cultivations, and to ensure that each plot received
exactly the same degree of cultivation. Had these discards
been ignored the end plots would have been excessively
cultivated and compacted by repeated turnings of the tractor.
At the other end discards were not needed as the tractor
could turn on the grass.

Each block contained 16 plots, while each plot was
almost exactly 1/40 of an acre (i.e. 21 ft. by 52 ft.).
Therefore the experimental area under tobacco was 4/5 of an
acre. There were also the discards at the railway end, and
four complete discard rows in each block, all of which it was
intended to plant to increase the area to a full acre. From
the experimental point of view the plots could have been
smaller, but to ensure proper curing the barn had to be
completely filled, and to do that in the College barn re­
quired at least an acre of crop. Hence there was no advan­
tage in smaller plots.

The plot dimensions were chosen to allow for 7 rows
3 ft. apart, with the plants 2 ft. apart within the rows,
since such a spacing has been found to be the best for
Trinidad (Kerr, 1930), (Davidson, 1930). Each plot there­
fore contained 7 x 26 plants, or a total of 182 plants per
plot.

SOILS

A soil map of the Old Farm showed that by a most un­
fortunate chance the experimental area was neatly dissected
by the boundary between two separate soil series, namely
St. Augustine Loam and River Estate Loam. Both these series
have been examined and described by Shenery (1952). They
are similar in that both have been derived from material washed down from the Northern Range, but major differences do exist.

Knowing this Field 4 was a most unsuitable place for any form of experimental work, particularly a fertiliser trial. Nor was it possible to put one block on each soil series, and thus keep the differences to between rather than within blocks, since the boundary between the two was only a rather arbitrary line on a soil map. In practice no hard and fast boundary existed as the two series gradually merged into one another.

Obviously a good deal of soil heterogeneity was to be expected, particularly after examining the results of previous post graduate trials on the adjoining Field 3. There both Webb (1938) and Phillips (1938) had their experimental results upset due to soil differences, while a year later Paine (1939) conducted a uniformity trial to measure these differences. Paine found them to be very marked, and were due he thought to a variety of factors such as localised water-logging, the distribution of gravel at different depths in the soil profile, variations in the depth of the humic layer, and variations in soil texture.

SOIL ANALYSIS

Soon after the previous crop of maize had been harvested four small soil pits were dug, two per block, (See map in Appendix 2), and samples were taken at different depths in the soil profile for analysis. Even before the analyses were available these pits showed visually that soil differences did in fact exist between and within the two blocks. All four differed from one another in at least one respect, par-
particularly as regards the depth of the humic layer and the depth at which gravel and soil parent material were encountered. In addition to the pits auger samples were taken at 6 inches and 12 inches from each block, again for analysis.

The detailed soil analyses are included in Appendix 3, and to interpret the various figures the reader should consult Hardy & Rodrigues (1949). Naturally they vary, despite the fact that in previous years the field was planted to sugar cane which should have ironed out many of the differences. However a generalised description is attempted.

The topsoil had virtually no coarse sand, very little medium sand, but did include a fair amount of fine sand. It could perhaps be called a sandy loam. The reaction was slightly acid to acid. The C:N ratio figures indicated complete humification, and the organic matter content was very low to medium low. There was a low to medium low base status (Comber number), and the available nutrients were also low.

The total N was low to medium low, as also was the available P2O5. The available K2O was low. The porosity was on the whole good, while the degree of aeration was good in places and very bad in others.

If anything the soil was nearer the St. Augustine Loam than the River Estate Loam. It was a poor soil in all nutrients, lacking in structure and with indifferent drainage, probably due to a high silt and fine sand content coupled with a low humus status. It was difficult to work when wet and set in lumps when dry, and in short could hardly be called a good tobacco soil, either physically or chemically.
TOPOGRAPHY AND DRAINAGE

Field 4 is on the 40 ft. contour. It slopes very gently to the West, enabling furrow irrigation if necessary, the water being pumped from a nearby pond.

VARIETY

Gold Dollar was the variety chosen. It is still a leading variety in the United States and is successfully grown in Canada and many other countries. It is widely grown in Jamaica where it is preferred to all other varieties, with the possible exception of Dixie Bright (Hasse, 1954). In Trinidad it was found to be the most promising of the varieties grown in the 1951/52 trial (Campbell, 1952). Samples were sent to the Tobacco Leaf Development Co. (Jamaica) from the 1952/53 crop, and they reported that it was the variety most likely to produce a good sample of cigarette tobacco. (Dunbar, 1953).

It has however two possible disadvantages, since Dunbar (1953) found that it was more susceptible to Black Shank (Phytophthera parasitica var. nicotianae) and required a higher percentage of supplies than the other varieties he had grown.

Canadian seed of 76% germination was used.

PREVIOUS CROPPING

The previous crop was maize, while prior to that Field 4 had been under sugar cane for a number of years. After the maize had been harvested a dense coverage of kudzu developed, particularly on Block A, and this together with a miscellaneous collection of weeds was ploughed in some weeks before the tobacco was planted out.
A 12' x 12' x 16' flue barn was built according to an approved Jamaican pattern. The plans were given to the College by Mr. Haase of the Tobacco Leaf Development Co. (Jamaica) after he had already built a rather similar barn near Couva.

The barn was built of brick, with a cement floor, and had a wooden roof covered with a rubberoid waterproof felting. It cost $628.34 to build and allowed for 5 tiers of rails to be hung in it. Four banks of oil burners, each with 4 individual burners, were imported from the United States from the C.L. Hardy Curing Corporation, Maury, North Carolina. They cost $274.36, including transport, crating and duty charges, making a grand total of $902.70 (B.W.I.) for the completed barn.

**HISTORY OF EXPERIMENT I**

**NURSERY BEDS**

Two nursery beds were built at the Market Garden section of the New Farm. Each bed was 4 ft. wide, 30 ft. long, and 9 ins. high, the sides being contained by split bamboo rails. A sloping framework of bamboo poles was built some 3 to 6 ft. above each bed and covered with "Windowlite." This is a transparent plastic material reinforced with fine meshed netting. It protected the beds from heavy rain without shading them too much. The beds were in the lee of a tall belt of bamboos because the site happened to be sheltered and convenient.

Topsoil from the nearby bamboo area was collected, sifted, steam sterilised, and then used to fill the beds. Samples of this bamboo soil were taken for analysis and the results are tabulated in Appendix 5. The figures showed
that it was highly acid, but had a high organic matter content, some of which had not been completely humified. The total nitrogen was medium high, but both available P₂O₅ and available K₂O were very high. The structure, degree of aeration, water holding capacity, and drainage were good; in fact it seemed an excellent soil for growing tobacco seedlings. It might have been improved by liming, but this was not done because it was thought tobacco preferred rather acid conditions. No fertilisers were added since all the major nutrients were present in ample quantities.

The beds were allowed to settle for a couple of days before the seed was sown on Oct. 23rd. One and a half gms. of seed were sown per bed, which was rather more than was necessary and had the germination been 100% 1 gm. would have sufficed, or possibly even less. The seed was mixed with water and sprinkled on with a watering can. A teaspoonful of Shell Aldrex 2 was added to each 2 gallon can of water to control soil pests, particularly ants.

Five days later, on Oct. 28th., the seedlings began to appear and a good thick stand developed. Mole-cricketts and Rhinoceros beetles did a little damage with their burrows, but both were controlled by a second and stronger application of Shell Andrex 2. (i.e. 1 tablespoonful in 1 gal. of water). This did not damage the seedlings. When 3 days old the seedlings were sprayed with a dilute mixture of Perenox to prevent damping off (5 gms, of Perenox per 1 gal. of water), and this was continued on alternate days for the next fortnight. It proved very effective and was later stopped as there were no signs of disease, despite a thick stand. At one stage a few plants showed signs of caterpillar damage, but they were easily controlled by a single application of lead arsenate.
Despite soil sterilisation a few weeds appeared but were removed without disturbing the seedlings, thanks to the loose structure of the soil.

When a fortnight old the plants were thinned, using a pair of tweezers. This was necessary to produce strong seedlings, but unfortunately it was not realised at the time that by doing so not enough plants were left for the acreage in mind. It would have been far better to have had at least double the area of nursery beds, and at the same time to have perhaps cut the seeding rate.

Ideally it would have been even better to have sown the seed in boxes, and to have pricked out the seedlings at 3 x 3 ins., in much the same way as one would with lettuce or tomatoes. This would have produced extremely good plants (Dunbar, 1953), but would have been impracticable on a large scale, since an acre of tobacco planted at 3 ft. x 2 ft. requires 7,260 plants, not to mention supplies. In practice the figure might well have been 10,000 plants per acre.

The beds were watered two or three times a day, but there was a tendency to make a fixed routine for it regardless of the weather. This was a mistake for it almost always led to faulty watering; a very important point to watch in growing good seedlings. However by and large the plants grew well and were remarkably free from pests and diseases, despite the rainy season. Conditions were in fact too good for plant growth and the seedlings grew too fast, partly due to the rich bamboo soil but mostly due to the shady and sheltered site of the beds. The result was a thick stand of leggy and etiolated plants, despite the thinning, with stems and leaves that were far too tender.
PREPARATORY CULTIVATIONS ON FIELD 4.

The residues from the previous maize crop, together with the tropical kudzu and weeds that sprang up afterwards, were all ploughed in as soon as soil samples had been taken, and at about the time the seed was sown in the nursery beds. A second crop of weeds rapidly grew, but were in turn ploughed under a few days before transplanting was due to begin. Unfortunately there was then a very marked spell of wet weather that prevented any further tractor cultivations and seriously delayed transplanting.

As soon as the land was dry enough it was repeatedly disced, but the soil properties were such that a fine tilth was impossible to obtain. However the field was then marked out according to the experimental plan and the pen manure applied to those plots that were due to receive it. The next operation was ridging. This was done initially by a tractor, great care being taken that the ridges coincided correctly with the plot boundaries, since the pen manure had already been applied. Accuracy was essential as any errors would have been multiplied several times by the time the field was finished (Hardy, 1952). The ridges were finally trimmed and finished by hand.

Ridges, as opposed to flat cultivation, were chosen because they were thought to aid drainage during the wet season and enable furrow irrigation in the dry season, but in practice they did not help the drainage problem as much as they might have done. Water certainly drained off the ridges, but then simply remained in the hollows in between. This was well illustrated just after the ridging had been finished when a torrential shower transformed the field into a quagmire.
in a matter of minutes. Furthermore in dry weather there was a far greater tendency for the land to dry out around the rooting zone. All that could be said for the method is that it did facilitate furrow irrigation at a later date.

TRANSPLANTING

Transplanting began on Dec. 12th., 50 days after the seed had been sown. But for the bad weather it would have started a week earlier when the plants were about 6 ins. tall. As it was they were at least 8 ins. to 9 ins. tall and very etiolated, far removed from the hardy rosette shaped plants they should have been. They were planted 2 ft. apart on the ridges, the method being to lay out a surveying chain along the ridge and put a plant in at alternate links. Women were used to do the transplanting.

It was soon obvious that there were not enough plants, so the discards remained untouched. Even so there were still not enough plants for the whole experiment, and in fact only Block A and half of block B could be completed. Fortunately the statistical layout allowed for something like this to happen and the experiment was not completely ruined, although it did reduce its accuracy.

The weather was overcast and showery but many of the plants died. A quarter of one nursery bed had been reserved for supplies, but these were not enough and only Block A was supplied adequately. Block B was barely touched and there were many gaps. Those that lived later developed a very marked kink in their stalks, due to the fact that they wilted badly and did not recover their upright position at the same point at which they collapsed. Attempts were made to prevent this by buttressing the plants with clods of earth, but with-
out much success. Deeper planting would perhaps have helped, but the real answer lay in producing hardier seedlings.

**FERTILISER TREATMENTS**

The fertiliser treatments were applied about a week after transplanting when most of the living plants had recovered. Individual plot requirements were weighed out and mixed according to the experimental design, and then divided into seven equal portions, one for each of the seven rows in a plot. These portions were then subdivided equally among the 26 plants in each row. Each plant was ringed with its share of fertiliser, care being taken to avoid contact with the leaves for fear of scorching, and then lightly forked in with a trowel.

It was a laborious process and is not to be recommended for large scale growers but it was the only way that the fertiliser could be applied really accurately. However it did mean efficient use of fertilisers and would be suitable for peasant farmers growing a small acreage without elaborate equipment. A more practical method would be to plough out a furrow, spread the fertiliser in it, cover lightly with soil, and then plant on top, taking care that the roots did not come into direct contact with the fertiliser. This method is used in Jamaica (Haase, 1954), but was not suitable in this case as the tobacco was grown on prepared ridges. It might be possible, however, to lay out the fertiliser in lines on the flat, and to then throw up a ridge on top of it, either with a tractor or a hand hoe. Alternatively fertiliser could be sown between prepared ridges, which could then be split over the fertilisers, as in the cultivation of potatoes in parts of Great Britain.
SUBSEQUENT OPERATIONS

Three weeks after transplanting the tobacco was weeded by a gang of women. A week later the field was irrigated, since there had been a marked dry spell and the ridges had dried out to a considerable depth. Water was pumped from the nearby pond to the Eastern end of the field, the flow being sufficient to irrigate two furrows at a time. Prior to this small "bunds" of loose earth were scraped at 10 ft. intervals along the furrows. Their purpose was to check any erosion and enable water to soak in evenly along the rows. At no time was the water level allowed to reach too high up the ridges, otherwise the fertiliser would have been rapidly leached into neighbouring plots. The process was repeated a fortnight later, followed by a second and final weeding.

PRIMING

Opinions vary as to whether or not priming is essential. It is said to reduce the spread of Mildew (Poronospora tabacina) and Frog Eye Spot (Cercospora nicotianae) (Purseglove, 1951), (Baker, 1951), but on the other hand some authorities claim that it results in a marked greening up coinciding with a check in growth, and renders the plant more susceptible to bacterial diseases. (Brown, 1946). It certainly helps to spread mosaic mechanically. Representatives of the Tobacco Leaf Development Co. (Jamaica) stated that early priming is not necessary, and pointed out that in Jamaica priming is left until just before harvest, and then only to prevent low quality leaf from being picked and cured (Kyle, 1954).

In this case the pros and cons were about even. There was a good deal of mosaic present in the field which might have spread rapidly had the crop been primed early, but on the other hand the beginning of the dry season was much wetter than usual and there was the danger of a severe attack of Frog
Eye Spot if it was delayed too long. A compromise was indicated so priming was left as late as possible, by which time the plants were well grown and not likely to be so severely affected by wholesale virus transmission.

As it happened there was a severe attack of Frog Eye Spot, but whether it could have been avoided by early priming is doubtful due to the unusually wet weather.

**Topping and Suckerling**

The plants were topped soon after the inflorescence had appeared and the flower buds had only partially developed, which according to Kyle (1954) was the correct stage at which to top Gold Dollar. Had it been a variety such as Dixie Bright the topping could have been delayed until the flowers were well open. Hence the time to top depends to a certain extent on variety, but even more on the type of tobacco required, the vigour of the plant, and local soil and weather conditions. It is a most important operation from the point of view of ultimate quality and requires much practical experience to time correctly. Moreover it is impossible to decide to top back to a certain number of leaves and to then stick rigidly to that number - there are far too many variables. In this case the number of leaves left per plant varied from 8 to 18, due largely to the variation in plant growth.

Soon after topping shoots appeared in the axils of the leaves, and were removed by hand at weekly intervals.

**General Development**

Throughout its life the crop grew extremely unevenly. Obviously variations were to be expected in a fertiliser trial, but unfortunately the differences that did exist bore no relation to the plot boundaries. In other words they were not due to treatment differences but to soil differences. The type of seedling probably also had a lot to do with it, since good ones well planted/infinitely better than poor
ones carelessly planted. In fact the gap between the two widened instead of narrowed as they developed, regardless of the fertiliser application, illustrating yet again the fundamental importance of producing hardy, uniform seedlings and planting them correctly.

For some unknown reason, possibly related to soil and drainage differences, Block A was always better than Block B and grew about twice as well. There were also a considerable number of gaps in both blocks, thanks to an inadequate number of supplies in the first place. It was decided therefore to abandon the trial from the experimental point of view, since any conclusions reached after statistical analysis would have been misleading, even if significant. This was unfortunate in some respects, but on the other hand it did provide enough leaf for several cures, and some valuable experience.

**Harvesting**

When harvesting flue cured tobacco it is usual to pick the leaves individually as they ripen, beginning at the bottom leaves or sand lugs and working upwards. As a rule the leaves ripen in pairs so to achieve the maximum degree of uniformity, which is essential for successful curing, only two leaves are plucked at a time. Unfortunately such perfection was impossible in this case because the acreage was not big enough. It is important that the barn be filled completely at one picking and in one day, and to make certain of this harvesting had to be delayed until there were at least four ripe leaves per plant. That was on February 18th., 70 days after transplanting, although strictly speaking the very bottom pair of sand lugs per plant could have been harvested a week earlier.
This meant there was a fair degree of variation in ripening, from just under-ripe to well over-ripe. There was also a great deal of variation in body and texture, due largely to the different soil and fertiliser effects. For instance a plant low in nitrogen will produce leaves having comparatively little body which turn a uniform light yellowish green when ripe, or even before they are properly ripe, whereas a plant rich in nitrogen will produce much heavier leaves that crinkle and mottle when mature and which do not turn a uniform light green. Hence the appearance of a ripe leaf can vary a great deal, depending not only on soil and fertiliser effects but also on height of topping, variety, and so on. In this case, where the variation was considerable, it was not easy to explain to the women in simple language what was really meant by "ripeness". The position was further complicated by the presence of various mosaic symptoms in some of the plants that showed a yellow mottling not unlike that seen on ripe heavy textured leaf, at least to the inexperienced eye. Finally there was always the fear of not having enough leaf to fill the barn, which meant there was a tendency to pick too high up the plants at any one time. All these factors between them necessitated trying to cure a very uneven sample, which events later proved to be quite impossible.

The leaves were picked into open baskets and carried direct to a nearby barn where they were sorted and stacked ready for stringing. The sorting was an attempt to even out some of the variation in ripeness, since the more unripe leaves could then be hung at the top of the barn where the temperatures would tend to be higher and the yellowing more rapid. The Jamaican method of stringing was used (Hqase, 1954)
It is not easy to describe verbally but simply consists of selecting pairs of leaves, placing them back to back, and then twisting a length of string round their butts and allowing them to hang alternately on either side of the rail. It is not quite as simple as it looks, but given a modicum of manual dexterity and half an hour's practice it can soon be mastered. It should then be done almost automatically and extremely rapidly. Nevertheless it took some of the women a long time to learn, while some never managed it however long they tried. Men were much easier to teach and did the job quicker.

The labour worked in pairs, one placing the pairs of leaves back to back, while the other did the actual stringing. For convenience the rails were placed in supports 4 to 5 ft. apart and 3 ft. above floor level while being strung. Afterwards they were moved and hung close together between two long trestles, until there were a sufficient number of completed rails to justify taking over to the barn. About 250 rails were needed in all.

At the first picking 16 to 20 pairs of leaves were hung on each rail, 8 to 10 pairs on either side, while the rails themselves were placed 10 ins. apart in the barn. It should have been much closer, and in subsequent pickings 30 pairs were strung per rail, while the rails were placed about 8 ins. apart in the barn with their leaves just touching. At first progress was extremely slow, firstly because there was not enough labour and secondly because the labour were not accustomed to the job. Only 80 rails were completed in the first day, compared to 500 or 600 which is what an experienced American stringer can do (Garner, 1951), so the barn took two days to fill. This should be avoided at all costs. Failure
to do so means uneven yellowing, and a high proportion of the cure will have to be sacrificed in order to cure the remainder properly. Subsequently it was possible to avoid this by employing at least 14 men and women, 6 to pick, 2 to carry leaf from the field, and 6 to string. By American standards this was extremely wasteful of labour, but it was the only way to get the barn filled by 4 p.m.

**CURING**

Flue curing is perhaps the most difficult method of curing tobacco. It is an art that requires several seasons experience to perfect, although fairly good results can be achieved by the beginner. Given good leaf in the first place and constant supervision at all hours of the day and night, there is no reason why there should be many failures after an initial mistake or two. A great deal has been written on the subject, and, as Brown (1946) says "There are many formulae advanced for this method of curing, and any one may be correct under certain conditions, but they cannot all be correct at one and the same time." Good descriptions are given by both Garner (1951) and Purseglove (1951), to name but two authorities, but from the practical point of view the two best accounts are by Collins (1951) and Carr (1950), both dealing with Virginia tobacco in Northern Rhodesia. It is not proposed to discuss the subject in any detail at this stage for that very reason, but there are recommendations that apply specifically to the College barn, principally for the benefit of future workers on tobacco.

Briefly, the process consists of keeping the leaf at a temperature of 90°F under maximum humidity until it begins to yellow at the edges. As yellowing develops towards the
mid-ribs the temperature is raised to 95°F., and later to 100°F. By the time the leaf is completely yellow the temperature is around 110°F., but the humidity is still extremely high. The colour is then "fixed" by raising the temperature to 120°F., at the same time gradually reducing the humidity by opening the ventilators. As the leaf dries the temperature is further increased to 140°F., and kept there until the lamina is completely dry. Finally the mid-ribs are dried out by closing up the ventilators again and raising the temperature to 160°F., but never beyond that.

Each barn varies in its reactions and no two cures are exactly the same, as the various stages take differing lengths of time to complete. No hard and fast rules of procedure are possible since a cure may take from 70 to 140 hours, the time depending on a great many factors.

The first cure was essentially one of trial and error since the barn and its burners were brand new. Besides lacking in uniformity the leaf was of poor quality because it was mainly sand lugs and had been heavily attacked by Frog Eye Spot. The cure was a quick one and was finished in 3 days, as is usually the case with sand lugs as they yellow rapidly. The results were more/less what was to be expected. In other words the 80 odd rails that had been strung and hung in the barn on the first day were completely ruined, as the leaf had yellowed too much and had subsequently turned brown, illustrating only too well the importance of filling the barn in a day. The remainder of the leaf was very variable in quality, due to the original variations in the green leaf, but by and large the results were promising since some of the leaf was quite good.
The second cure started on Feb. 24th. More labour was used for the harvesting (14 in all) and the barn was filled in the day. Much closer stringing was adopted and a lot more leaf was packed into the barn than for the first cure, but again there was far too much unavoidable variation in the leaf. For some reason, the yellowing stage took 70 hours to complete and even then the barn had not yellowed properly. It was thought to be due to inadequate humidity so fairly large quantities of water were sprinkled on the floor, but this was probably a mistake as it resulted in a certain amount of "sponging" later on. Unripe leaf was a more likely reason. The entire cure took 102 hours and the results were again extremely variable, ranging from badly mottled green and brown leaf to clear lemon yellow leaf of quite good quality.

Much the same thing happened during the third cure, which started on March 10th, and again took just over 100 hours to complete. The lack of uniformity in the green leaf was obviously the major stumbling block, so for the fourth and final cure the leaf was exposed to acetylene gas in an attempt to even out some of the variation.

The technique was copied from Purseglove (1951). The barn was filled in the usual way, the top ventilators were closed and the bottom ventilators were sealed with wet mud. Two saucers were placed in the barn, each containing approximately 2 ozs. of ordinary calcium carbide, and over each was set up a burette full of water so adjusted that the water dripped out very slowly. Acetylene gas was given off as the water came in contact with the carbide, but not all at once due to the setting of the two burettes. The door was then closed and sealed with wet mud, and the barn left overnight. The following morning the barn was opened for half an hour,
a fresh change of carbide was then put in, the burettes were refilled and the barn again sealed up, this time for a full 24 hours. Next day the barn was opened for the second time and the ventilators were fully opened for half an hour to remove all traces of the acetylene gas, which happens to be extremely explosive in the presence of a naked flame. After that the ventilators were closed again, the burners were lit, and the barn was cured in the usual way.

The effects of the acetylene were most marked. The leaf tended to yellow far more uniformly and at that stage the cure looked as if it was a good one. Unfortunately however the colour was "fixed" in the standard textbook way, in other words it was done gradually as the temperature was stepped up. That is the recommended way for an ordinary cure, but after the acetylene treatment it would probably have been wiser to run the temperature up rapidly and dry the lamina as quickly as possible without scorching it. At the time this fact was not known, and because the fixing and drying was done rather slowly the leaf yellowed too much and later turned brown. The result was a very poor cure of dark leaf, but it was a most interesting experiment and illustrated the possibilities of acetylene, provided the standard curing techniques were slightly altered.

STORING

After each cure the leaf was left hanging in the barn so as to reabsorb sufficient moisture to enable it to be handled without shattering. The rails were then removed and the tobacco unstrung, sorted into "good" and "bad" leaf, tied into hands, and stacked in piles with the butts outermost; the leaf was not graded in the true sense because there was
not enough of it and because it is a skilled operation. The "bad" leaf consisted of dark over yellowed leaf, really green unripe leaf, and leaf heavily attacked with *Cercospora*. Leaf with only a tinge of green around the midribs was included, amongst the "good" leaf, as the green colouring tended to disappear as the tobacco aged in the heap.

**YIELDS**

The total yield of cured leaf was 467 lbs. at 12% moisture. Of this 196 lbs. were classed as "good" leaf and 271 lbs. as spoilt leaf. This was from 3/5 of an acre of crop, since it will be remembered that the remaining 2/5 of an acre could not be planted due to a shortage of plants. Nor was it a full stand by any manner of means due to heavy casualties at transplanting and inadequate supplies. It therefore represents a total yield of 778 lbs. of cured leaf per acre, which in the circumstances was better than expected although by no stretch of the imagination could it be called a good crop, or the best that can be grown in Trinidad.

**PESTS**

There was very little insect damage in the nursery beds, as has already been mentioned. At transplanting a number of plants were eaten at ground level, possibly by mole-cricketes, but the numbers were few as the ridging system does not favour large scale attacks by these pests. Bachac ants (*Atta cephalotes*) were troublesome and a number of nests were found and destroyed. Large leaf eating grasshoppers were to be found occasionally and severely damaged a few individual plants, but again their attacks were not widespread. Noctuid larvae (*Prodenia spp.*) did a little damage but what few there were were removed by hand. No Horn Worm larvae (*Protoparce spp.*) were found.
The most serious pest was a small black flea beetle \textit{Epitrix parvula). At first their damage appeared insignificant as it only consisted of minute perforations of the leaves, the number depending on the severity of the attack. However as the leaves grew the holes grew too, until they eventually reached anything up to an inch in diameter, thus spoiling the appearance of the leaf. Agrocide dust was recommended as a control measure, and unfortunately the advice was accepted. The crop was duly dusted, but some time later it was realised that it had caused a certain amount of damage, characterised by a marked distortion of the leaves and a "banded" form of chlorosis. The distortion rather resembled that seen with calcium deficiency.

DISEASES AND DEFICIENCIES

Several weeks after transplanting various rather confusing signs of ill health developed. They varied a great deal between plants, but broadly speaking four distinct types of leaf mottle and distortion were recognisable, apart from the Agrocide damage.

Various experts were consulted. Mineral deficiencies were suspected but at first considered unlikely as the symptoms were found in isolated plants whose neighbours appeared quite normal. Mosaic was the most obvious suspect but the position was complicated by the fact that in some plants only a few of the middle leaves showed the symptoms, suggesting that the malady had affected the plants at a certain stage of their development and that they had subsequently recovered. If that were so a physiological disturbance associated with poor drainage or even drought might have been responsible.
In an attempt to settle the question samples of the four sets of symptoms were ground up in separate pestles and mortars, and the sap extracts used to infect healthy tobacco plants growing in a greenhouse. The carborundum method of infection was used. Only one of the four leaf patterns was reproduced, which was a very fine mottle followed by necrosis but without any severe leaf distortion. This proved that at least one virus was present that could be mechanically transmitted, but in the case of the other three leaf patterns it was still possible that some form of mineral deficiency was responsible, or perhaps a virus that could only be transmitted by an insect vector. Both magnesium and potash deficiencies were suspected (McMurtrey, 1951), and it is worth noting that dwarf beans planted in discard rows did extremely badly and suggested similar deficiencies (Wallace, 1951).

Frog Eye Spot (Cercospora nicotianae) was very troublesome indeed. The disease appeared early and was widespread, nor was it confined to the ripe or bottom leaves alone. Instead the whole plant was attacked. One would have thought that the disease would have declined once the bottom half dozen leaves had been removed from each plant for the first two cures, but this was not so. Even the topmost leaves were severely marked, right up to the final picking.

It was even more troublesome in the barn than in the field. Very often what appeared to be perfectly clean leaf developed a heavy spotting while it was yellowing, due to latent infection in the field that later developed rapidly with the high humidity and temperature during the early stages of curing. A great deal of leaf was spolit in this way. The spread of the disease was undoubtedly due to the abnormally wet
weather in January, February and March, but was perhaps helped by the plants being in poor condition from other causes, such as a potash deficiency.

Periodically occasional plants were seen to wilt and die, particularly when near harvest, and were characterised by a marked discolouration of the stems below ground level. Two causative organisms were isolated and identified, one as *Fusarium* species and the other *Sclerotinia rolfsii*. The latter organism has never before been reported as causing a wilt on tobacco (Piening, 1954). Not many plants were lost in this way.

A great many plants when dug up showed signs of attack by eelworm (*Heterodera marioni*). This was perhaps one of the main reasons why the crop failed to reach any height. The symptoms were root distortion, and a withering and chlorosis of the leaf tips rather resembling potash deficiency. They were very noticeable by the time the crop was ready for harvest, and were more so in the ratoon suckers that were allowed to develop after the final picking. No ratoon crop was possible for this reason, for by then every single plant showed very severe signs of nematode infection. This was not surprising as the field has been under cultivation for many years, and the nematodes have numerous alternate host plants.
EXPERIMENT II

TREATMENTS AND STATISTICAL METHOD.

Since the second experiment when it was laid down was intended to confirm any results from the first one, both the treatments and the statistical method were virtually the same as before. The same 2 by 4 factorial design, confounded in exactly the same way (Cochrane & Cox, 1953), was chosen. The only difference was that the pen manure dressing was 10 tons instead of 12 tons per acre, and was applied in a rather different way.

The treatments were as follows:

- **D<sub>0</sub>** = No pen manure.
- **D<sub>1</sub>** = 10 tons of pen manure per acre.
- **N<sub>1</sub>** = 10 lbs. N, or 50 lbs. sulphate of ammonia per acre.
- **N<sub>2</sub>** = 20 lbs. N, or 100 lbs. of ammonium per acre.
- **P<sub>1</sub>** = 50 lbs. P<sub>2O<sub>5</sub></sub>, or 250 lbs. superphosphate per acre.
- **P<sub>2</sub>** = 100 lbs. of P<sub>2O<sub>5</sub></sub>, or 500 lbs. superphosphate per acre.
- **K<sub>1</sub>** = 60 lbs. K<sub>2O</sub>, or 120 lbs. sulphate of potash per acre.
- **K<sub>2</sub>** = 120 lbs. of K<sub>2O</sub>, or 240 lbs. sulphate of potash per acre.

There were again two replications, each with 16 plots.

SITUATION AND LAYOUT

Beds number 22, 23, 24 and 25 of the Market Garden area of the New Farm were used. They were made originally by a bulldozer when the land was cleared of bamboo, and although they varied in size each could accommodate 8 rows of tobacco if the rows were 3 ft. apart, the rows running approximately East to West. There was a 3 ft. drain with sloping sides between each bed.

As there were four beds and two replications, two beds went to make up one replication. This was very convenient as
each replication of 16 plots had been confounded into two sub-blocks of 8 plots, it meant that each bed could accommodate one of the sub-blocks. In other words each bed was divided into 8 plots.

Each plot was 24 ft. x 34 ft., or just under 1/50 of an acre. As the plants were again placed at 2 ft. intervals with the rows 3 ft. apart this allowed for 8 x 17 plants, or a total of 136 plants per plot. The total acreage was slightly more than 3/5 of an acre. Appendix 6 contains a sketch map of the layout, the allocation of treatments, and the plot dimensions. The treatments were of course, allocated to the various plots at random, but within the limits imposed by the confounding of the experiment.

It will be noted that again there was not really a big enough acreage for the barn. For this reason, and because both plants and space were available, a further three beds were planted up at the same time. One of these three beds constituted the third experiment which is discussed later, but the other two were not used for any experiments.

SOILS

The soil of the Market Garden is River Estate loam whose general characteristics have already been described (Chenery, 1952). In this particular area the soil series is said to be in a fine sand phase, which means the structure is not very stable and may form a crust after heavy rain. It is a poor soil from the nutrient point of view, but being of a sandy nature it can grow good crops of tobacco if well fertilised and watered. It is definitely not an ideal tobacco soil nevertheless.
SOIL ANALYSIS

On Jan. 12th., and after the previous crop of Sunn Hemp (Crotalaria spp.) had been removed the stubble lightly disced, twenty auger samples were taken from each bed. Ten were from 0 - 6 ins. and ten were from 6 - 12 ins. No pits were dug for more elaborate physical analysis because it was thought that all four beds were fairly uniform.

The detailed analysis figures are quoted in Appendix 8. The figures show that the soil contained virtually no coarse sand, very little medium sand, but a good deal of fine sand. It could be called a loam, or more accurately a sandy silty loam. It was markedly acid. The organic matter content in the first 6 ins. of topsoil was medium low, and even lower further down, despite the previous crop of crotalaria. The total N was slightly higher in the top 6 ins. than in the next 6 ins., but was medium low at both horizons. There was a similar gradation with the C:N ratio figures but humification was complete throughout. The available nutrients ranged from medium low to medium high, being highest in the 6 - 12 ins. level in all cases, while the rate of solution was low to medium low. The available P2O5 was medium low to medium, and the available K2O was uniformly low.

PREVIOUS HISTORY AND CROPPING

Prior to 1950 the Market Garden, like the rest of the New Farm, was planted to bamboo for paper making. For various reasons the bamboo failed and the land was handed over to the College. The land was then cleared by bulldozer, but in doing so the old drainage system was destroyed and a new one had to be built. This disturbed the natural soil profile considerably.
The previous crop was Sunn Hemp which was allowed to seed and was then cut and carted off; the trash together with a mass of weeds, was then cutlassed and ploughed in.

**TOPOGRAPHY**

The land is 110 ft. above sea level. It is flat, but the natural drainage is to the S.W.

**VARIETY**

Bold Dollar was again grown.

**HISTORY OF THE EXPERIMENT**

**NURSERY BEDS**

As soon as the plants for the first experiment had been removed the two nursery beds already described were emptied of their soil, and a fresh supply of sterilised bamboo soil put in. The beds were allowed to settle, and a day or two later on Dec. 17th., the seed was sown. The same technique was used. Each bed received 1½ gms. of seed, sprinkled on in a dilute solution of Shell Aldrex 2. No fertilisers were added.

The first experiment had shown that two 30 ft. x 4 ft. nursery beds were not significant to produce enough plants for an acre of crop, at least if they were thinned out. Accordingly it was decided to double the number of nursery beds and two new ones were built.

These two new beds were built to a very different pattern from the existing ones, the aim being to try and find a better way of growing good seedlings and to compare it with the older method. Each new bed was simply a concave mound of ordinary unsterilised soil, about 6 ins. high,
30 ft. long, and 4 ft. wide at the base. A little sterilised bamboo soil was available so a 3 ins. layer of it was spread over each bed. This was to facilitate even sowing and even germination, and to allow the tobacco seedlings to get well away before they had to compete with seeds germinating from the unsterilised soil below.

Bent semicircular hoops of split bamboo were pushed in at 2 ft. intervals along each bed, and over them was stretched a strip of special cloth lent to the writer by Mr. Haase of the Tobacco Leaf Development Co. (Jamaica). This cloth was of a special weave that shed 80% of any rain that fell but allowed the remainder to pass through a fine mist, thus protecting the seedlings from violent storms. The cloth was kept tightly stretched over the bamboo framework by means of lengths of nylon sown into the edges of the cloth and then looped over small pegs driven into the ground between the bamboo hoops. (See photos and sketch in Appendix 12 of both types of nursery beds). Wire was not used instead of nylon because it tended to rust and spoil the cloth.

No fertilisers were added because it was thought the sterilised surface layer contained sufficient nutrients, and because the previous failure to produce strong plants was partially attributed to lush growth following an abundant food supply. It will be remembered that the analysis figures showed the sterilised bamboo soil to be extremely rich. Excessive shade and shelter were probably other contributory factors, so the new beds were built facing East to West out in the open well away from the strip of bamboos.

The beds were sown on Dec. 18th., using 1½ gms. of seed per bed sprinkled on in a dilute solution of Shell
Aldrex 2. A much stronger solution of Shell Aldrex 2 was sprinkled around the beds to discourage bachac ants. The beds were watered twice a day, the covers being removed when this was done, but again it was not done as carefully as it should have been.

Germination was rapid in all four beds but it was noticeably better under the cloth covers, and the seedlings grew faster under them. The difference disappeared as the seedlings grew bigger, perhaps due to incorrect watering, or perhaps due to a scarcity of nutrients as their roots reached the unsterilised soil below.

All four beds were sprayed with Perenox as a preventative against damping off, and the disease did not appear. There was very little insect damage of any sort, apart from a few Rhinoceros beetle burrows in the older beds which were of little importance. There were rather more weeds in the newer beds but they were easily and rapidly removed without disturbing the seedlings, thanks to the friable structure of the topsoil.

As the plants grew those in the new beds were gradually hardened off by removing the covers for longer and longer periods every day. At first it was only for an hour or so in the early morning but later they could stand the full force of the midday sun. The covers were replaced as soon as the seedlings began to wilt, but eventually they were removed completely. The seedlings in the old beds could not be hardened off in the same way, but it was partly done by removing the windowlite protection fairly early on, which certainly did help. None of the beds were thinned for fear of not having sufficient seedlings.
At transplanting the seedlings in the old beds were again noticeably etiolated and "soft", but not to the same extent as in the first seedlings because they were transplanted rather earlier. Those under the cloth covers were not as tall or as advanced, although in the early stages their growth had been faster, but they were much hardier, of a better "rosette" type, and were probably better transplanting material. Had they been fertilised or grown in pure sterilised soil their growth would no doubt have been even better, a point that would be worth further study as the production of good seedlings is of very great importance.

PREPARATORY CULTIVATIONS

All the beds were disc ploughed with a tractor, and a good tilth prepared by the repeated use of disc harrows. The tilth was a really good one.

TRANSPANTING

Transplanting began on Jan, 26th., when the plants were 5½ weeks old. The nursery beds were well soaked before the seedlings were pulled to avoid damage to their roots. They were sorted out and only the best and strongest were used since there was ample planting material. They were planted on the flat and rather deeper than before, particularly the taller ones, with their crowns some 2 ins. above the ground level.

Where the labour, in this case men, were personally supervised the results were quite good, but otherwise there was a tendency to plant poor seedlings of which many died. Women do the job better as they are usually more conscientious.

Supplying had to be done several times, particularly in the badly planted areas, although the weather was overcast and showery and ideal for transplanting.
The fertiliser treatments were applied when the plants were well established about a fortnight after transplanting. Individual plot requirements were weighed out according to the experimental design, mixed, divided into portions corresponding to the number of rows per plot, and applied by hand in the same way as before.

Immediately afterwards the pen manure was applied to those plots that were due to receive it, because it had not been applied before transplanting as in the first experiment. The manure was carefully placed within the rows at the base of the plants so it acted as a mulch. It did not require a great deal more labour than the other method. The manure was probably better utilised that way, and it is a method likely to be popular with peasant farmers who are well aware of the value of pen manure and apply it in a similar manner when growing vegetables.

After the pen manure had been applied all the plots, including those that had not had pen manure, were hard hoed to kill the weeds and loosen the topsoil. The loose soil was then drawn up around the plants in the form of a ridge, the idea being to encourage the development of adventitious roots from the base of the stem. The roots thus formed would then feed on the pen manure mulch, so in theory the plant ought to grow better.

Overhead irrigation was practised, using light easily transportable aluminium pipes and revolving sprinklers. Five sprinklers, each with a delivery rate of 10 gallons per minute,
were used, and two beds were irrigated at a time. Since each pair of beds were irrigated for three hours this represented 1 inch of rain. Irrigation was approximately at weekly intervals and was done six times in all.

As it happened the dry season was not particularly dry and in all probability a crop could have been grown without irrigation, although probably not as well. The method was simple and economical of water, but there is the possibility - although there is no definite evidence - that it favoured the spread of Frog Eye Spot.

PESTS

Soon after transplanting the crop was attacked by flea beetle (Epitrix parvula). At that time the dangers of using Agrocide had not been appreciated, since the first experiment had only recently been dusted. Accordingly Agrocide was also used on the second crop, but with even more disastrous results because the plants were much smaller. The leaves were severely distorted, and as the growing point was damaged this distortion was to be seen for some weeks as the young leaves grew bigger. What was more serious was the formation of numerous secondary shoots as if the apical buds had been deliberately pinched out; instead of growing upright the plants began to bush, with several laterals and numerous small leaves, which obviously would have ruined the crop had they been allowed to grow unchecked. The remedy was to carefully go through the crop and remove all but one of the shoots by hand. This had to be done several times before all the plants were "back to normal". Why it should have happened is not known for certain, but a likely explanation is that some ingredient in the Agrocide, said to be lime by Kyle (1954) upset the apical dominance of the plants' hormone system. A 5% D.D.T. dust had to be used instead.
From the practical point of view it meant the additional expense of removing the shoots several times, and of re-dusting with D.D.T. There must have been a very definite check in growth, but to what extent this affected the final yield is not known. It almost certainly delayed the harvest, and perhaps made it more uneven since not all the plants were affected to the same extent. Had it happened to a commercial grower with a big acreage the monetary loss might have been serious, in terms of additional labour, retarded growth, and loss of leaf.

Apart from this mishap there was remarkably little insect damage of any sort.

DISEASES AND DEFICIENCIES

The most serious disease was again Frog Eye Spot, both in the field and in the barn. A dry season crop like this one should normally avoid a heavy attack, but due to the abnormally wet dry season the crop suffered heavily.

There were scattered signs of eelworm infection but the effects were hardly noticeable, due to the fact that the plants were well grown, had ample water and fertilisers, and could make good any root damage.

A few scattered plants were lost through fungal attack causing wilting. The causative organism was probably a Fusarium species. There was very little mosaic.

No obvious mineral deficiencies were noticeable on any of the treatments. At one stage just before topping some of the plants' young leaves showed a marked inter veinal chlorosis, suggesting an iron deficiency although it is very rare on the field scale. Diagnosis tests were made but the results were not conclusive. It was of no importance as the young tips were pinched out when topping took place.
**PRIMING**

The crop was not primed, mainly because there was not much evidence of Frog Eye Spot at the time it would normally be done. Instead the bottom leaves were allowed to ripen and constituted the first cure.

**TOPPING**

Topping was left rather later than was previously recommended, that is until the inflorescence was well formed. The aim was to avoid secondary leaf growth and heavy textured leaf, which had been the tendency in the previous experiment.

**GENERAL DEVELOPMENT**

Despite the Agrocide episode the crop grew extremely well and reached a height of over 5 feet after topping. The plants carried from 16 to 24 leaves apiece, and these were of a good size while the best were really big. (See photos in Appendix 12). According to Haase (1954) it was as good as a good crop in Jamaica, and better than most, bearing in mind that Gold Dollar is not a particularly tall variety as a rule.

One would have expected very marked differences to be seen between the plots but this was not so. There was however a general tendency for the growth to be much better at the Easterly end of the field than at the Westerly end. Whether this was a soil fertility gradation, or a shelter effect from the bamboos was not known. The various fertiliser treatments did not seem to alter the appearance of the crop in the field, in fact growth was remarkably uniform apart from the general effect already mentioned. Other factors such as height of topping and type of seedling planted seemed to have more effect.
HARVESTING AND CURING

The first picking had to be delayed until April 15th., but the first leaves were ripe a week previously. The previous picking arrangements were followed, but this time it was complicated by having to pick and weigh the leaf from each plot separately, and also in having to transport the leaf from the Market Garden to the Old Farm. Twelve women were used for picking, and as soon as they had finished they were all taken up to the Old Farm for the stringing and filling of the barn.

Much of the leaf picked for the first cure was over ripe, and although rapid the cure was not a very good one. Exactly a week later the crop was picked for a second time, but again it was too ripe, and the tobacco showed signs of "growing away from the pickers", illustrating that once a field is beginning to ripen it must be picked immediately. Any delay at the beginning simply means that at every picking the leaf gets progressively riper, and the finished results poorer.

This point was realised when it came to the third cure on April 29th., and a rather difficult method of picking was adopted. Instead of picking all the leaf, both over ripe and ripe, at one time, the women were sent through the crop twice. At the first time through they only picked the really yellow over ripe leaves, while on the second occasion they picked normally. The two grades of leaf from any one plot were weighed together, but later separated and the yellow leaf put on one side. The barn was filled in the normal way with the ripe leaf, but not with the over ripe unless there was not enough of the other available, in which case the yellow leaf was placed over the burners on the bottom tier. The rest was thrown away. This may appear wasteful but there was no other way out of it. It meant that the pickers had at last "caught up with the tobacco in the field", and in any case the lack of uniformity made it impossible to cure both the grades of leaf properly.
Mr. Haase of the Tobacco Leaf Development Company (Jamaica) was present. He pointed out that much of the poor leaf in past cures had been due not only to lack of uniformity, but also to bruising during picking and transport to the barn. This had not been previously appreciated, but once realised more care was taken.

The third cure was a success. This was almost entirely due to a fairly uniform barnful of leaf, little of it over ripe, and relatively little damage from bruising. The only fault was that the leaf lacked body, presumably because it had been picked soon after heavy rain which had washed away much of the gum from the leaves. The results were encouraging because they suggested that the actual curing had been learnt fairly successfully, but that better results depended on attention to numerous practical points previously unsuspected.

The fourth cure began on May 4th. By then the labour had had more experience of tobacco harvesting, so it was thought it was time the job was done more efficiently. Only eight women were used for picking and the same number for stringing, and by introducing an element of competition it was still possible to fill the barn in the day. The results of the cure were disappointing.

**COSTS**

No costs are included although the information is available in the Market Garden records, because such figures based on an experiment bear no relation to the costs of commercial tobacco growing.
At this point the description of the experiment ends unfortunately. After the fourth cure it was obvious that barely a half of the potential crop had been harvested. There was in all probability a month's more work before the experiment could be finished, but this manuscript had to be submitted before then.

It is hoped to add a postscript at a later date after the results are available and have been analysed. It is also hoped to send samples to the Imperial Institute and the Tobacco Leaf Development Co. (Jamaica) for their opinions, and until their replies are available one or two points remain unanswered, particularly as regards the quality of the leaf.
EXPERIMENT III

HISTORY OF EXPERIMENT

The third experiment was only a crude trial without any statistical design, and laid down because there happened to be both space and plants available after Experiment II had been planted. The idea behind it was based on Smith's (1954) results with tomatoes, in which he compared different methods of cultivation.

There were two treatments. Firstly, plants transplanted and grown entirely on flat ground, and secondly, plants transplanted on to a flat seed bed and then moulded up with each successive weeding. A third treatment using prepared ridges was not included, because it had already proved to be undesirable, particularly as Experiment III was a dry season crop which would accentuate the faults.

Bed number 26 of the Market Garden was used. It was divided into eight plots, each of a fraction under 1/40 acre, in the same way as for Experiment II. The cultivations, the seedlings, and the time of planting were also the same. Both treatments were given the same fertiliser dressing of 20 lbs. N, 100 lbs. P₂O₅, and 120 lbs. K₂O per acre (N₂P₂K₂), but not the same dressing of pen manure. Those plots due to be moulded were given pen manure at the rate of 10 tons per acre applied within the rows, but the others were only given half that amount. A plan of the layout is included in Appendix 10.

The crop was weeded twice by hand, and each time the plants were either moulded or not according to which plot they were in. Overhead irrigation was used whenever the adjoining beds of Experiment II were being irrigated, while at harvest the crop was picked and cured along with the other four beds of that experiment.
The weights of the green leaf at each picking are listed in Appendix 11, but there again the final results were not available in time to be included. Hence no accurate results can be given, but up to the fifth cure there was no apparent difference between the two treatments. By then each moulded plot had yielded an average of 143 lbs. of green leaf, whereas the unmoulded ones had averaged 142 lbs. of green leaf.

The only visible difference was in weed control, for in that respect the moulded plots were very much freer of weeds than the unmoulded plots. However this did not seem to affect the final yield of green leaf. The moulded plants did tend to produce adventitious roots from their stem bases, but again their effect was not noticed. It should however be noted that these results are not conclusive, because at no time during the plants' life was water a limiting factor. Had the crop been grown without irrigation the results might well have been different.
PROVISIONAL RESULTS

1. Bright cigarette tobacco can be successfully grown in Trinidad, given a suitable soil and skilled management, but its exact characteristics and quality are not yet known. This information will be available after samples have been examined by the Imperial Institute and the Tobacco Leaf Development Co. (Jamaica).

2. A succession of sowing dates between October and December are perfectly feasible, provided irrigation is available for the later sowings in a dry year.

3. The following table shows the time taken to complete the various stages of growth for the three experiments.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Experiment I</th>
<th>Experiments II &amp; III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sowing to transplanting</td>
<td>48 days</td>
<td>45 days</td>
</tr>
<tr>
<td>Transplanting to beginning of harvest</td>
<td>70 &quot;</td>
<td>78 &quot;</td>
</tr>
<tr>
<td>Beginning to end of harvest</td>
<td>28 &quot;</td>
<td>40 &quot; (approx.)</td>
</tr>
<tr>
<td></td>
<td>146 &quot;</td>
<td>163 &quot;</td>
</tr>
</tbody>
</table>

It will be noted that all three experiments reached harvest in approximately the same number of days, but whereas the plants in Experiment I only reached an average height of 3 ft. 6 ins., those in the other two experiments grew to an average of over 5 ft., in the same length of time. Moreover the first experiment only yielded four cures, while the other two promised to yield eight, or in other words approximately twice as much leaf per acre.

However such a comparison is not really fair, and one cannot therefore conclude that later sown crops are better than earlier ones. It may well be so but these experiments do not prove it. It should be noted that the first experiment was planted on unsuitable land, in all probability
already heavily infested with eelworm, poor transplanting material was used, and finally the cultivations were not suitable. The other two experiments received much better treatment on better land.

4. No costings were kept but there again a comparison would not be reliable for exactly the same reasons.

5. Nor did it follow that later sown crops suffered less from pests and diseases. Again it may well be so in a normal year, but not in a wet one, at least as far as Frog Eye Spot is concerned. With that disease it is the weather that governs the incidence of attack, and if conditions are favourable the later sown crops will suffer just as severely as earlier ones. It should be noted that even in the dry season the humidity at night still remains sufficiently high to favour the germination of Cercospora spores. (Baker, 1954).

6. Of the two methods of raising seedlings, the raised, cloth covered bed, situated well in the open was the most promising. This method produces sturdier plants and is much cheaper. For example each cloth cover costs $5, and is said to last 4 or 5 years, whereas the "windowlite" alone for one of the other beds costs $20, and is not likely to last as long. There is also the expense of the bamboo staging and roof for the "windowlite" method.

7. Tobacco should not be planted on prepared ridges, at least in Trinidad. It is better to plant on the flat and ridge up after each successive weeding. This encourages the growth of adventitious roots from the base of the stem. Planting on the flat without subsequent moulding is perhaps as good, but it does not result in such effective weed control. This point requires more detailed study.

8. Acetylene gas is a useful aid to curing, but a better approach is to improve the uniformity of the leaf.
9. No recommendations can yet be made as regards the manurial requirements of bright cigarette tobacco in Trinidad.

There now follow a detailed set of recommendations that may help future workers. They are not complete and can certainly be improved upon.
GENERAL

Choose a deep sandy soil with good drainage.

A 12' x 12' x 16' flue barn requires one acre of tobacco to ensure uniform leaf for curing.

Sow seed in early to mid-October for an early crop. Successive crops are possible, and can be sown as late as the end of December if irrigation is available in the dry season, but if the rains arrive early there may be harvesting and disease difficulties.

As a general rule the later sown plants suffer less from pests and diseases and are cheaper to grow.

NURSERY BEDS

Cloth covered beds, built well in the open, are best. Always water carefully. "Shell Aldrex 2" is very effective against insect pests, and "Perenox" against damping off.

Gold Dollar is a good variety that grows well in Trinidad.

At least four beds, each 4 ft. x 30 ft. are required to plant one acre of tobacco, with ample plants for supplies. Spare no effort or expense to produce really good plants.

TRANSPLANTING

Only plant good strong seedlings about 6 ins. high. Discard weak or damaged plants. Water nursery beds really thoroughly before pulling seedlings. Transplant in the afternoon, or on a dull or showery day, and supervise carefully. Space at 3 ft. x 2 ft. Plant deep and do not bend the tap root.

CULTIVATIONS

A good tilth is very important. Plant on the flat, and then ridge up after each weeding.
PRIMING

Probably a good thing, unless there is the likelihood of spreading mosaic. Early priming may help prevent Frog Eye Spot, but not appreciably in a very wet season.

TOPPING

It depends on variety, season, type of tobacco required etc. No definite recommendation, but for Gold Dollar it is best when the inflorescence has just appeared, not after the first flowers have opened.

MISCELLANEOUS

Never use "Agrocide" against insect pests, particularly on a hot sunny day. Use a 5% D.D.T. dust instead. Overhead irrigation is very satisfactory.

HARVESTING: Before starting there are several preliminaries:

1. Cut 250 rails for the barn, and tie a 10 ft. length of string on one end of each one.

2. Make four pairs of stringing supports, to enable four persons to string if need be.

3. Make two 12 ft. to 15 ft. wooden trestles to carry the rails after they have been strung and before they have been placed in the barn.

4. Make four light but rigid bamboo stretches for carrying picked leaf.

5. Provide two light "tables" to carry the piles of leaf prior to stringing.

6. Make sure there are at least 3-forty gallon drums of kerosene on the spot.

7. Check the burners and accurately adjust the oil levels in each one until they are all exactly the same. A suitable depth of oil when the adjuster handles are fully
down is 1 cm., but the level must be the same all the way round the oil trough to ensure an even flame. This allows for ample flame adjustment. Have a trial run with an empty barn to gain experience.

8. Examine the barn. Seal any cracks in the roof or door. Make sure the ventilators work properly. Check thermometers.

Wait until there is sufficient ripe leaf to fill the barn. It is wasteful of labour, time, and fuel to attempt a half barn, nor will the results be as good. This may mean losing some of the first leaf, unless there is a big enough acreage to justify an extra early cure.

Successful curing depends largely on three factors:-

(a) The leaf must be uniform.

(b) The leaf must never be bruised. Every bruise, however slight, will result in brown discolourations.

(c) Picked leaf must never be left in the sun to scorch.

On a tobacco plant the leaves tend to ripen in pairs, so ideally only one pair should be picked from each plant at a time. With a small acreage or with a poor crop it may be necessary to pick more, but if so the uniformity suffers and the results cannot be so good.

As a rule it is not worth trying to cure leaf that has yellowed on the plant, unless there is enough of it to fill a barn. Such leaf is over ripe. It is a good plan when picking to send the labour through the field to remove all the yellow leaf only, and place it in separate piles. They can then return and pick normally. If this is not done the yellow leaf will only have to be sorted out before stringing, and the more the leaf is handled the more likely it is to bruise.
String all the ripe leaf first and put it into the barn; then if there is still not enough leaf it is worth stringing the yellow green ripe leaf and placing it on the bottom tiers. The chances are it will be useless after the cure but that cannot be helped; its purpose is simply to fill the barn completely and help raise the humidity in the early stages. Never judge the progress of the cure by this leaf; be guided by the bulk of ripe leaf above it and be prepared to sacrifice some. The skill lies in cutting such losses to a minimum.

There is a right and a wrong way to pick tobacco. It should be picked with the right hand and laid carefully over the forearm of the left arm, with the butts towards the picker's chest, or vice versa if the picker is left-handed. When a pile of say 30 or 40 leaves have been picked they are placed direct onto the sack provided at the end of the row. Never pick roughly or handle the leaves in fistfuls - it will severely bruise the leaf although perhaps not visibly at first. (See photos at end of text.)

Do not take the leaf off the sacks for weighing; weigh them together and subtract the already known weight of the sack. If possible load the sacks of leaf direct into the trailer. All this cuts down handling time and reduces the risks of bruising. If there are not enough sacks transfer the leaf to the trailer with care. Place it in rows with the butts of the rows facing each other, but not touching. Never pile it deeper than the sides of the trailer, say 18 ins. Then cover the load with a tarpaulin to prevent wind damage in transit.

Unload with equal care and place the leaf on the stringing tables in alternate piles, one pile with the leaves' top surface uppermost, the other with the bottom
surface uppermost. This facilitates speedier stringing, because the person handing to the stringer simply passes her hand over each pile and takes the topmost leaf from each. The leaves are then automatically back to back without any unnecessary twisting of the wrists and leaf.

The whole aim of these details is to promote quick and efficient use of labour, the minimum of handling of the leaf, and the minimum amount of damage by bruising. They are very well worth watching, but no doubt can be improved upon.

String 30 pairs of leaves, back to back, on each rail. If there is a possibility of too much leaf, or if the leaves are small, it can be strung in threes. It is very difficult to describe the method of stringing verbally, but the labour on the farm have been taught and it is to be hoped that they remember it.

Place the rails about 8 ins. apart in the barn, with the leaves touching to form a dense canopy one cannot see through. Each section of a tier will therefore take about 16 rails, each tier 3 x 16 or 48 rails, and the entire barn 5 x 48 or 240 rails. If there is abundant leaf more rails can be packed in, say 20 rails per section.

Try and put the riper leaf at the bottom tiers, assuming the uniformity is not perfect, and the less ripe in the top of the barn where the temperatures tend to be a bit higher.

CURING

No two cures are exactly the same. Hence the following system suitable for beginners is only a rough guide. After some experience a more orthodox and elaborate technique can be followed. (Carr, 1950), (Collins, 1951).
METHOD

Pick leaf that will yellow in 48 to 60 hours. Maintain a temperature of about 95°F. until the leaf has almost fully coloured. All ventilators are closed at this stage. If the glass inspection panel is misted over the humidity within is correct; if not water the floor, but not too much. One single burner is sufficient, say number 4 or 13, (see sketch at end). If numbers 5, 6, 7 or 8 are lit the thermometer behind the glass inspection panel will register a higher temperature than exists elsewhere in the barn. Hence it is advisable to hang a second thermometer in the middle of the barn suspended from a rail. This second one is more likely to be accurate, but both should be watched. The carburettor outside should be adjusted to the numeral 2 or 3.

When the leaf has almost fully coloured start raising the temperature by lighting more and more burners, say in the order 5, 12, 13, 8, 9 and so on. At the same time gradually increase the ventilation. The aim is to fix the already existing yellow colour without letting it go too far and turn brown. As the leaf transpires the water should be removed as quickly as possible via the top ventilators, but if the process is forced by raising the temperature too fast and too high the leaf will scorch. This is the most crucial stage of the cure. As the leaf dries the temperature will automatically tend to rise, so watch it carefully.

Eventually it will have risen to 140°F. Keep it there until the lamina is thoroughly dry and crisp. In deciding this feel the leaf through the upper inspection panel; do not trust the feel of the lower leaves alone. At this stage the top ventilators are fully open, the bottom ones about 6 ins. open, and anything up to 14 burners are alight. When the lamina is
thoroughly dry shut all the ventilators, top and bottom, and raise the temperature to 160°F. to dry out the mid-ribs. Turn the carburettor back to 4 and later 3. If the barn is shut up while there is still water in the lamina the humidity will rise and much leaf will be discoloured by "sponging", i.e. it will turn brown as water enters the leaf cells again.

Maintain at 160 F., but never beyond it, until the mid ribs are so dry that they crack sharply when bent over; if not they are not dry enough. A useful tip is to string a rail with particularly big leaves with large fleshy mid ribs, place it on the bottom tier near the door, and use it as a guide. When it is ready the remainder of the barn will be ready.

Turn the fuel off when the cure is finished. Allow the leaf to cool, and then water the floor to enable the leaf to pick up sufficient moisture to make it pliable and easy to handle without shattering.

At all stages of the cure be guided by a particular set of rails, or even a single representative rail. A completely uniform barn is virtually impossible to obtain, and almost invariably some of the leaf will have to be sacrificed to cure the majority properly. If the leaf is very uneven try using acetylene.

**METHOD**

Fill the barn in the usual way by 4 p.m., Close the top ventilators and seal the bottom ones with wet mud. Place 2 oz. of ordinary calcium carbide in each of two saucers. Place the saucers in the barn with burettes of water fixed above them, so adjusted that the water drips out slowly. Water the floor. Close the door and seal it with mud.
Leave the barn overnight. Open the door and top ventilators for 30 minutes the following morning. Recharge the saucers with a similar quantity of carbide and the burettes with water. Close the door and the top ventilators. Leave it for 24 hours. Then open all the ventilators and air the barn thoroughly. Finally close the ventilators again and in start curing/the usual way. Beware of sparks, matches, etc., when the barn is full of acetylene.

There are two other details worth noting. Remember the prevailing direction of the wind when using the bottom ventilators: those facing the wind should not be as fully open as those on the opposite side of the building. Be careful not to let the leaf get fully coloured before starting to fix and dry, because it will continue to colour after ventilation has been started and until the temperature reaches 120°F. This is particularly important with sand lugs and light textured leaf. With heavy leaf, or leaf from the top of the plant the yellowing can and should be prolonged longer until almost full colour is reached. Failure to watch this will result in much spoilt brown leaf.

Supervision must be continuous day and night once a cure has started. Provided the burners are correctly set the early stages of yellowing do not need much personal supervision, nor when the temperature has reached 140°F, and the lamina is being dried out. The critical periods are the later stages of yellowing, and a little later when the temperature is being progressively built up to 140°F. It is no use doing this automatically every hour because it may be necessary to hold the barn at say 110°F, for more than an hour, perhaps for 3 or 4 hours or even longer. It is all a matter of personal experience, but however lengthy this stage may be it should be watched and checked every 20 minutes or so. Care
should also be taken to see that the temperature never exceeds 160°F, when the mid ribs are being dried out.

Avoid picking after a heavy shower of rain. It washes the green of the leaves and results in papery leaf with reduced body. It is better to wait a day or two until fresh gums have been formed.

Each cure uses about half a drum of parafin or about 25 gallons.

**DIAGRAM OF BURNERS IN THE BARN**
RECOMMENDATIONS FOR FUTURE EXPERIMENTAL WORK

1. The first prerequisite would be to decide exactly what type of flue cured tobacco is required. Having done so it would then provide a fixed and specific yardstick with which to measure results, the aim of all experimental work - be it a variety or manurial trial - to reach this ideal.

2. More variety trials with imported varieties, particularly a comparison between Gold Dollar and Dixie Bright (R.53).

3. Further fertiliser trials. Having ascertained their effect on quantity, which is relatively simple, their effect on quality should be examined.

4. Cultivation experiments. A comparison between spacing at 3 ft. x 2 ft. with 3 ft. x 1½ ft. would be useful. The same applies to the desirability or otherwise of priming, and the height at which to top. These are but three examples.

5. Since the production of good seedlings is of such paramount importance a profitable line of research would be to determine the best way of doing so, using different fertilisers, different potting mixtures, and different weaves of cloth.

6. Accurate costings of a commercial crop of say one acre.

7. Disease control. Frog Eye Spot being the most serious disease its control would be a major step forward. A copper spray would probably control the disease, but whether it would taint the tobacco, whether it would be economical, or what would be the best time to spray, are all interesting questions that remain unanswered.
8. All experiments would profit by being extremely simple in design, and above all with a strictly limited objective. Complicated factorial designs are theoretically attractive but require far too much supervision and labour, while the experience of the past season has clearly shown the folly of trying to do too much in one experiment. Part time experimentalists require part time experiments, and if the work is to be expanded more than one post graduate is needed.

9. Several experiments would mean much variation in leaf and considerable curing difficulties. The answer might be to grow an acre of crop commercially, which would be costed, and give it all one treatment. This would provide the bulk of the material for curing. The experimental material would then be included whenever it was convenient, provided the plot size was not too big and there was not too much of it.

For example, grow an acre of variety A, its harvest beginning in early March. Run a variety trial alongside, with varieties B, C, D, and E. Now it might well happen that varieties C and E are ready with variety A, in which case variety A will form the bulk of the first cure, with just a few rails of C and E. Varieties B and D on the other hand might not be ready then, so they need not be included until the second or perhaps the third cure. In this way several experiments could be cured together.

10. Field 3 of the Old Farm is definitely not suited to tobacco, nor is it suitable for experiments. This may well apply to the entire Old Farm.

11. Field layout. If the plots in a block are laid out end to end in chain formation, it would be as well to provide
an unplanted strip of say 3 or 4 ft. between each plot. (See sketch below). Otherwise the pickers find difficulty in deciding where one plot ends and the next begins, unless of course string is stretched between. What is more important is that if there is no gap the pickers must walk across the rows to deposit the picked leaf in separate piles, and in doing so they bruise and break a lot of unpicked leaf.

Good Design.

Bad Design.

Each cross signifies a pile of picked leaf. With the good layout each picker takes 2 rows and deposits the picked leaf at the end of each plot. Hence there is no need to walk across the rows and cause damage, as is the case with a bad layout.
The future of tobacco growing in Trinidad is uncertain. Suitable leaf for cigarettes can undoubtedly be grown, but the position is complicated by the difficulties of growing and curing it successfully. Future development would seem to lie in one or more directions.

Firstly the crop might be taken up by existing estates, or by other concerns with ample capital resources, who could afford to import skilled management until the local people had been trained and a tradition of tobacco growing established.

Secondly peasant farmers could be encouraged by government to grow the crop, for which the curing facilities would be provided on a cooperative basis. Such a scheme would require supervision from the local Agricultural Department and perhaps a fair measure of disciplinary control, besides of course a considerable sum of public money.

Thirdly, and in the writer's opinion the soundest method, concerns such as the Tobacco Leaf Development Company of Jamaica could be encouraged to pioneer the growing of the crop. Such firms already possess the resources, the knowledge, the skilled staff, and the possible markets for the cured leaf. They could either grow the leaf themselves on their own land, or alternatively could arrange for the local peasants to grow under contract, the peasant providing the land and the labour, and the company providing the seed, the curing facilities, and the technical advice.

This suggestion would not necessitate the spending of public money, or more work for the local Agricultural Department, and the chances are the growers would be far more likely to accept and implement advice from a Company's representative.
in the field, than they would from a Government official without the same practical knowledge. Moreover the Company would be in a much better position because they would know exactly what quality of leaf they required, how to produce that quality, and exactly what it was worth.

A start has been made at I.C.T.A., but much more is to be learnt and there is a great deal of room for improvement. The results have been promising, but they have emphasised that tobacco for cigarettes is a highly specialised crop that requires much practical skill and experience, particularly at curing. Its cultivation should not lightly be undertaken until it has been fully realised that half hearted attempts are fatal. To be grown successfully the crop requires never ending supervision, for a single mistake can be a costly one. It most emphatically cannot be left to look after itself, but given suitable conditions and an industrious peasantry there ought to be a place for it in the pattern of local agriculture.
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The writer would like to thank Mr. J.S. Campbell for his advice as supervisor, and for his help in the harvesting and curing of the crop. His thanks are also offered to Professor Hardy for his assistance with the soil analysis; to Professor Baker, Dr. Hutchinson and Dr. Murray for their diagnosis of various disease and deficiency symptoms; to Dr. Jolly for statistical advice; and to the numerous members of the Farm staff who made the project possible, particularly Mr. Bally the overseer of the Old Farm.

The writer is especially indebted to Mr. Haase of the Tobacco Leaf Development Company (Jamaica) for his most valuable suggestions, advice, and assistance, so freely given, and for his keen interest throughout the course of the year. His help is very much appreciated, for without it the pitfalls would have been extremely numerous.
During the 1952-53 crop season the Company began a small exploratory trial to see whether cigarette tobacco could be grown in Trinidad. The results were encouraging, so the following season the Company sent down one of their field managers, Mr. Haase, to carry out a larger trial.

Mr. Haase used the raised, cloth covered, type of nursery beds, and sowed his seed on Oct. 16th. He used pure unsterilised rather silty topsoil for his beds, because there was nothing else available, but gave each bed 4½ lbs. of the following fertiliser mixture: 3 lbs. sulphate of ammonia, 3 lbs. sulphate of potash, and 7½ lbs. of superphosphate, i.e. a 4-10-10 mixture. Each bed was 30 ft. x 3 ft., and there were three of them. Three varieties were grown, Gold Dollar Dixie Bright, and Delcrest.

There were enough seedlings for about 2 acres of crop. This 2 acres was made up of several scattered plots, at Esperanza, Longdenville, and one or two other localities, but they were all chosen for the sandy nature of their soil and were all in the neighbourhood of Couva.

The writer did not see all these plots, but did see the two near Longdenville from time to time. There the tobacco was planted immediately after the bush had been cut and cleared, and judging by the height of the bush it was the first time the land had been cultivated for 15-20 years, if at all. The soil was almost a pure quartz sand, but it had a high organic matter content, excellent drainage, and a good water holding capacity.
Planting was at 3½ ft. x 2 ft. The fertiliser dressing was approximately 1000 lbs. per acre of a 2-10-12 mixture (20 lbs. N, 100 lbs. P₂O₅ and 120 lbs. K₂O per acre) applied before planting.

The tobacco grown near Longdenville did extremely well. Very few supplies were necessary, but the growth was not very even, presumably due to shade effects. Dixie Bright grew the best and reached a height of about 3 ft., each plant with an average of 26 really large leaves. It was a magnificent sight. There were few signs of disease and no Frog Eye Spot. Later there were symptoms of eelworm attack, although the tobacco was on almost virgin land. The writer did not see the other plots but was told they had not all done so well, while some of them had suffered very severely from eelworm.

A barn was built to a similar pattern to that of the College barn except that it was made of mud and wattle instead of bricks and cost about $300, excluding the cost of a set of imported American burners. It proved very satisfactory.

The results were very promising indeed and some excellent looking tobacco was produced, due in part to Mr. Haase's skill at curing. The average yield was said to be about 1,000 lbs. per acre, despite the severe losses though eelworm attack on some of the plots. Those at Longdenville must have yielded considerably more although the leaf was rather light bodied.

CONCLUSIONS

The results supported the view that good bright cigarette tobacco can be grown in Trinidad, given a suitable soil and skilled management. Whether the quality of this particular leaf was what the Company were after is not known to the writer at this stage. A final opinion will of course not be possible
until after the leaf has been aged, fermented, and smoked. All that can be said is that the Company were very favourably impressed by the growth and yield of their crop, and provisionally by its quality, but they were very disturbed by the possibilities of eelworm damage. Whether or not they decide to continue with their trials, and perhaps go into commercial production remains to be seen. The decision has not yet been made.

Samples of cigarettes have been made from this leaf alone by the local factory at Champs Fleurs. From the trade point of view the results were quite good although the leaf had not been aged. It held its ash well but was lacking in flavour, but was quite as good as similar Jamaican leaf which in fact it resembled.
APPENDIX. 2.

Layout and Treatment Allocation of Experiment I.

**Key.**

- **D0**: No Pen Manure.
- **D1**: 12 tons " per acre.
- **N1**: 10 lbs. N "
- **N2**: 20 lbs. N "
- **P1**: 50 lbs. P2O5 "
- **P2**: 100 lbs. P2O5 "
- **K1**: 60 lbs. K2O "
- **K2**: 120 lbs. K2O "

- **Discard.** Block B:
  - N1.P.K.D1
  - N2.P.K.D1
  - N2.P.K.D2
  - N2.P.K.D2
  - N2.P.K.D2

- **Discard.** Block A:
  - N1.P.K.D1
  - N2.P.K.D1
  - N2.P.K.D2
  - N2.P.K.D2
  - N2.P.K.D2

**River Estate Loam.**

**St. Augustine Loam.**

- **Discards**: Vc., "n-t&c.> Witw
- **Beans**: (* a£ t<»
- **or Sufici£nt s££vt-img>3^ 
- **S.**

**Pencil Lines = Plant Rows.**

**Yellow Shading = Plots Actually Planted. Remainder and Discards Planted with Dwarf Beans. (Due to Lack of Sufficient Seedlings)**

**N - S**
## Appendix 3.A

### Soil Analysis Figures for Experiment 1

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# APPENDIX 3B.

## SOIL ANALYSIS FIGURES FOR EXPERIMENT I.

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### APPENDIX 4

**ANALYSIS OF PEN MANURE USED IN EXPERIMENT I**

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### TYPICAL TRINIDAD AND ENGLISH PEN MANURES

*PERCENTAGE OVER DRY WEIGHT*

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These figures illustrate that the pen manure used in Experiment I was low in nutrients by Trinidad standards, which in turn are low by English standards. (Hardy, 1953).

### APPENDIX 5

**ANALYSIS OF BAMBOO SOIL IN NURSERY BEDS**

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APPENDIX 6.

LAYOUT AND TREATMENT ALLOCATION OF EXPERIMENT II.

KEY.

- Do = No Pen Manure
- D1 = 10 tons ' per acre.
- N1 = 10 lbs. N
- N2 = 20 lbs. N
- P1 = 50 lbs. P2O5
- P2 = 100 lbs. P2O5
- K1 = 60 lbs. K2O
- K2 = 120 lbs. K2O

Pencil Lines = Plant Rows.

BED NO. 25. 24. 23. 22.

N1 3587
N2 4070
P1 3782
P2 3875
K1 3938
K2 3719.
## Weight of Green Leaf from Experiment II

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<td>0.13</td>
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</tr>
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<td>6-12</td>
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<td>0</td>
<td>1</td>
<td>46</td>
<td>23</td>
<td>5.6</td>
<td>1.5</td>
<td>0.11</td>
<td>8.2</td>
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</table>
APPENDIX 9

ANALYSIS OF PEN MANURE USED IN EXPERIMENT II

<table>
<thead>
<tr>
<th></th>
<th>Percentage Fresh Wt.</th>
<th>Percentage Dry Wt.</th>
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<tbody>
<tr>
<td>Water</td>
<td>68.06</td>
<td>-</td>
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<tr>
<td>Organic Matter</td>
<td>15.17</td>
<td>47.49</td>
</tr>
<tr>
<td>Total Ash</td>
<td>16.77</td>
<td>52.51</td>
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<tr>
<td>Total N</td>
<td>0.61</td>
<td>1.90</td>
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<tr>
<td>Total P₂O₅</td>
<td>0.56</td>
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<tr>
<td>Total K₂O</td>
<td>0.31</td>
<td>1.97</td>
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</table>

These figures show that the pen manure was higher in organic matter, and all plant nutrients than the manure used in Experiment I. It was as good as the average figures for local manure but still lower than English standards. (See Appendix 4).
APPENDIX 10.

LAYOUT AND TREATMENT ALLOCATION FOR EXPERIMENT III.

KEY:

F = FLAT CULTIVATION
M = MOULDED CULTIVATION.

PENCIL LINES = PLANT ROWS.

BED No. 26
## Appendix II.

### Weight of Green Leaf from Experiment III. (lbs)

<table>
<thead>
<tr>
<th>Plot No.</th>
<th>Cure No. 1</th>
<th>Cure No. 2</th>
<th>Cure No. 3</th>
<th>Cure No. 4</th>
<th>Cure No. 5</th>
<th>Cure No. 6</th>
<th>Cure No. 7</th>
<th>Cure No. 8</th>
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<td>23</td>
<td>66</td>
<td>60</td>
<td></td>
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</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>198</strong></td>
<td><strong>240</strong></td>
<td><strong>329</strong></td>
<td><strong>391</strong></td>
<td><strong>277</strong></td>
<td><strong>403</strong></td>
<td><strong>417</strong></td>
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</table>
APPENDIX. 12.

Old Style Nursery Beds With "Windowlite" Roof.

New Style Nursery Beds With Cloth Covers.

NOTE:— This Material can be Bought From:—
Commercial, Industrial and Engineering Fabrics Ltd,
Bridge Hall Lane,
Bury.
APPENDIX. 12.

BEFORE HARVEST.

PICKING. WRONG WAY (LEFT),
CORRECT WAY (RIGHT).

CARRYING TO SCALES. NOTE STAFFCHER.

LOADING. LEAF SHOULD NOT BE LOADED
HAPHAZARDLY LIKE THIS.
Weighing. Note Sack and Extension to Weighing Platform.

Stringing.

Stringing. Note Trestles.

Fuel Arrangements.

Flue Barn.