

IMPERIAL  
DEPARTMENT OF AGRICULTURE  
FOR THE WEST INDIES.



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REPORT  
ON THE  
AGRICULTURAL DEPARTMENT,  
DOMINICA,

1919-20.

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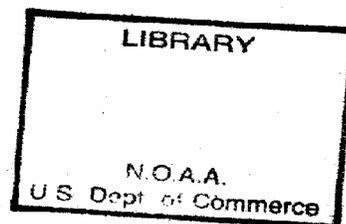
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1920.

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## LETTER OF TRANSMITTAL

*Commissioner of Agriculture—to His Honour The Administrator, Dominica.*

No. D. 302

Barbados,

February 2, 1921.

Sir,

1. I have the honour to forward herewith, the Report on the Agricultural Department, Dominica, for the year ended March 31, 1920.

2. The introduction into the Botanic Gardens of interesting and valuable trees from other tropical countries continues, and the collection there of such trees is becoming more and more important.

3. The demand for lime plants and other plants of economic value has increased during the year under report; especially is this the case with cacao and vanilla.

4. The possibilities of an extension in onion cultivation, and of the results which will probably ensue on more careful attention in the island to fruit crops other than limes, form a subject of discussion in the report.

5. It is pleasing to note that the lime crop of the year under review was considerably in excess of the average for several years previous.

6. With regard to other crops, it is noticed that progress seems to have been made with cacao and coco-nuts.

7. The section of the report dealing with the present agricultural situation in the island deserves careful consideration, as it records conclusions reached after many years' observation.

8. The various experiments carried out at the Lime Experiment Station are not only of great interest, but are also of permanent value to those interested in the cultivation of this crop.

9. The manurial experiments conducted on cacao trees are also of value, as showing the benefits to be derived from proper cultural methods in increasing the yield from the trees.

10. In conclusion I desire to express my appreciation of the good work done by the Staff of the Agricultural Department in Dominica, and my belief that it is appreciated by the community.

I have, etc.,

(Sgd.) FRANCIS WATTS,

Commissioner of Agriculture  
for the West Indies.

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# REPORT ON THE AGRICULTURAL DEPARTMENT, DOMINICA, 1919-20.

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## Work in the Gardens and Observations on Plants.

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Owing to the increasing cost of labour, it was not possible to do more than carry on the routine work of the Gardens. For several years past the annual vote for maintenance has remained at the same figure. Under present conditions it is barely sufficient for ordinary routine, and does not allow of meeting expenses of desirable improvements. An increase has now been allowed, and appears on the Estimates for 1920-21, in order to maintain the standard of work and to meet the steady rise of workmen's wages.

Amongst the many fine, flowering trees grown in the Gardens, one of the most conspicuous is *Baikiaea insignis*, native to Tropical Africa. This specimen was received from Kew Gardens in 1903. Grown in an open situation on one of the lawns, it has, under these somewhat hard conditions, remained small in size, but it is wonderfully floriferous. During the flowering season, which is irregular and may extend over five or six months of the year, from fifty to 100 large, delicately scented flowers open between 4 and 5 o'clock each afternoon. The flowers fade early next morning. As no seed has been borne, owing no doubt to the absence of the insect which effects pollination in its native habitat, hand-pollination has been carried out this season in the hope of raising a crop of seeds for local growth, and for distribution to other Botanic Gardens in the West Indies.

A plant of *Baikiaea Eminii* was received from Uganda by way of Kew, in 1910. Planted in good soil, and in a sheltered situation, it has already attained to a larger size than *B. insignis*. Up to the present it has flowered but sparsely.

Another plant of great interest, which now flowers regularly, is *Amherstia nobilis*, native to Burma. Great difficulty was found in establishing this tree. It now does well in a sheltered corner where surrounding large trees afford a considerable amount of shade. Six young plants of this species have been placed in this area, which, in time, and during the flowering season of the trees, should become one of the attractive spots of the Garden.

Two other interesting trees, which flowered for the first time in the Garden, are the Indian beech (*Pongamia glabra*), a handsome tree with glossy green leaves, and *Deguelia microphylla*. Seed of the latter was received a few years ago, from Java in which place it is used in coffee plantations for the purpose of affording shade, and of supplying mulch. *Deguelia* is a synonym for *Derris*, and it is probable that a mistake has also arisen in respect to the specific name. It is an ornamental tree, especially attractive with its masses of purplish flowers, and is a desirable addition to the collection of flowering trees in Dominica.

## WORK IN THE NURSERIES.

Botanical specimens of a herb, known locally by the name of 'semen contre,' were sent to Kew for identification. It proved to be *Chenopodium ambrosioides*, L., a widely spread weed. It is known in the United States as Mexican tea.

This plant, which grows wild in the island, is also to be found in corners of many gardens, as it is highly prized for making an infusion which is used extensively as a stomachic, and, in the case of children, as a vermifuge.

Conditions during recent years have not been favourable for exchanges of plants and seeds between tropical Botanic Gardens. Consequently there is little to report in the way of new plant introductions. Among the more interesting of the few recent importations are *Araucaria brasiliensis*, *Lysidice rhodostigma*, *Mesua ferrea*, *Trachytobium verrucosum*, and *Congea tomentosa*.

## Work in the Nurseries and Distribution of Plants.

This branch of departmental work is one which requires a good deal of forethought and considerable preparatory effort, in order to produce with smoothness a constant succession of seedlings and budded and grafted plants practically all the year round.

The area worked as nurseries by the Department is several acres in extent, and, in the early stages, the chief problem to be dealt with was the maintenance of the fertility of the soil, in order to allow of the production of large crops of seedlings of various plants in rapid succession on the same ground. This was satisfactorily solved, and the nurseries have been in continuous use for about twenty years.

It is only those who are closely acquainted with nursery work that can understand the heavy drain made upon the soil by a crop of lime seedlings. An area of land measuring 200 feet by 160 feet, or approximately  $\frac{3}{4}$ -acre, will, after allowing for paths between beds, produce about 30,000 lime plants. When it is considered that every part—roots, stem, and leaves—with the exception of a few inches of the top, is lifted and carried off, the heavy drain on the land will be better understood. It is such that, while a second lot of seedlings can be raised from the soil without special measures being taken, they are very inferior, and if a third crop is attempted, the poor growth, yellow leaves, and subsequent infestation of scale insects render them unfit for sale.

The method employed in maintaining the fertility of the soil in the nurseries is a simple one, and largely a matter of routine. It is usual to make the beds from 4 feet 6 inches to 5 feet wide, leaving paths between them from 3 feet to 3 feet 6 inches in width. After the beds have been planted, it is customary from time to time to collect weeds, grass, and leaves, and to place this material in the paths. By the time the plants in the beds are ready for sale, considerable accumulations have been made, and on reworking the land after the disposal of the seedlings, the portions which were formerly paths now become beds. By this system of alternation, the same area is capable of producing healthy plants as long as the practice of supplying sufficient humus is kept up.

Another line of departmental nursery enterprise is that of budding and grafting—work which, if success is to be achieved, requires a good deal of forethought and patience. Although these methods of propagation have been carried on for many years (Dominica was the first of the smaller West Indian islands in which the budding of citrus plants was practised), it cannot be said that this island has benefited to the extent it should have done. In the case of grafted mangoes, it is no exaggeration to state that nine out of every ten plants sold by the Department are sent out of the island, chiefly to the sugar- and cotton-growing islands, in which there is a great demand for selected varieties of fruit trees; but unfortunately, in those places, the right conditions for growing and fruiting mangoes successfully, and on any scale, are seldom found. Consequently further losses occur, and the whole work may be said to yield very poor results in proportion to the efforts and expense required to produce the plants.

## DISTRIBUTION OF PLANTS.

It is somewhat strange that the average planter in Dominica should take so little interest in the growing of choice fruits, such as selected mangoes, avocados, and various kinds of citrus. Since the starting of the Agricultural Department, nearly thirty years ago, the number of growers who have been sufficiently interested to set aside an acre or two of land on their estates for the production of various fruits for home use does not exceed a dozen. This is regrettable in an island in which choice mangoes, etc. can be grown to perfection. Many require the fruits, but few, very few, are prepared to put forward the efforts which are necessary to produce them.

When it is remembered that of the small number of grafted mango plants established in Dominica, a proportion has been planted in wet districts, where good results cannot be expected, the extremely poor showing which has followed departmental efforts to stimulate fruit production will be more easily understood. Even in this island the mango is generally thought to be a tree which will thrive and fruit in any district, and under any conditions. Grow it will, even in the wettest places, but it cannot be depended upon to yield fruit regularly, except in localities in which the weather conditions are fairly dry during the flowering period. This means, for practical purposes, that successful mango cultivation is limited to a strip of coast round the island, narrow on the windward and northern coasts, and varying from 2 to 3 miles in depth on the leeward coast.

In regard to the raising and distribution of citrus plants, the efforts of the Department have met with more local appreciation than in the case of mango plants, but even here the planter will have to show a good deal more interest before the island can benefit as it should from departmental efforts to help forward fruit production. As long as the considerable demand exists for this class of plants in other islands, coupled with the great willingness of members of every class in Dominica to do their utmost to meet that demand, progress will be slow, as great numbers of budded plants cannot be raised, owing to the cost of this exacting work, and the length of time required.

Under present circumstances, the price of asexually propagated plants at the Government nurseries is about 50 per cent. below cost of production. It would therefore surely appear that the price of such plants should be at least doubled; this by way of assisting the Department towards becoming a self-supporting institution, and further, such plants are likely to be better cared for, and a larger percentage established if a higher price is paid for them. Plants, like many other things, are valued in proportion to the effort required to obtain them, and those supplied cheaply are only too often handled in such a way as to lead to what is, to those who know the cost and trouble of nursery work, appalling wastage. The view held by some that, in the case of orchard cultivation the best way of helping to establish new areas in limes and cacao is by distributing large supplies of plants free, or at very cheap rates, is not borne out by results. Apart from the rough handling and general neglect accorded to seedlings which cost nothing, or very little, sooner or later the practice of transferring large numbers to other islands commences, and a preference, intended for local application only, becomes general.

The distribution of plants, which for a number of years past has been on a declining scale, has, during the current period, shown considerable expansion, due no doubt to the more settled state of things, and the brighter outlook.

The number of plants sent out during the year was as follows:—

Limes	...	...	...	49,275
Budded Washington Navel oranges	...	...	...	200
„ grape fruit	...	...	...	46
„ limes	...	...	...	120
„ Portugal oranges	...	...	...	13
„ tangerines	...	...	...	35
„ sweet limes	...	...	...	15
Grafted mango	...	...	...	35
Cacao	...	...	...	1,017
Vanilla	...	...	...	4,400
Nutmegs	...	...	...	75
Male bamboo	...	...	...	70
Pois doux	...	...	...	100
Camphor	...	...	...	30
Miscellaneous	...	...	...	405
Total	...	...	...	55,837

## PLANT IMPORTATIONS.

The following supplies of miscellaneous seeds, seedlings and cuttings were also distributed:—

Vegetable seeds	---	...	...	1,818 packets
Onion seeds	...	...	...	60 lb.
“ seedlings	...	...	...	49,200
Horse beans	...	...	...	18 lb.
Tephrosia candida	...	...	...	15 „
Galba seeds	...	...	...	50 „
Congo coffee seeds	...	...	...	6 „
Kola nuts	...	...	...	25 „
Cane cuttings	...	...	...	11,200 „
Shade tree cuttings	...	...	...	2,350 „

## PLANT IMPORTATIONS.

*Lecythis Zabuccajo*. The single individual in the Botanic Gardens, and the eight specimens at Morne Bruce may now be said to be established. The best plants have attained a height of from 12 to 14 feet. Growth has been exceedingly slow up to the present, but their general appearance now indicates that they may be expected, with care, to succeed in our climate.

*Nephelium lappaceum*. The single specimen of the Rambutan, raised from seed received from Java, has made good progress. Other species of this genus, namely, *N. Longana*, and *N. mutabile*, are needed for the collection. Repeated importations of seeds having failed, arrangements have been made with Dr. Cramer, of the Botanic Gardens, Buitenzorg, Java, for seed to be sent to the United States Department of Agriculture, Washington, in which place plants will be raised, and forwarded to Dominica later. By these means it is hoped to introduce these much desired fruit trees.

*Pouteria uavi*. Four specimens of this species exist in the Gardens, all of which are in a healthy condition. This tree is native to Uruguay, and is said to yield an agreeable fruit. The seed was received from Kew Gardens in 1915.

*Myrciaria cauliflora*, the Jaboticaba of the Brazilians. Two plants of this fruit tree, although not in first class condition, are distinctly better than they were a year ago. It is still hoped that success will attend the efforts to establish them.

*Macadamia ternifolia*, commonly known as the Queensland nut. The plant, raised from seed received from Trinidad in 1914, has now reached a fair size, is in a healthy condition, and may be expected to flower and fruit in due course.

*Quebrachia Lorentzii*. Two specimens of the Quebracho, native to Argentina, and raised from seed supplied by Kew, have made good progress, being now 12 to 14 feet in height. A small plot of these plants growing at Morne Bruce is now doing well so far. A number of seedlings were distributed to planters, but no reports respecting their progress have yet come to hand.

*Lansium domesticum*. A single plant of the Langsat was raised from seed received from Java, which it is hoped will be grown successfully, and thus add a new fruit tree to the garden collection.

A plant of *Zizyphus Jujuba* (large fruited variety from China), supplied by the United States Department of Agriculture, failed to succeed under local conditions.

Plants of the Date Plum, *Diospyros Kaki*, and *Diospyros Lotus*, exist in the Gardens, but do not thrive. A few fruits have been borne by the first named.

## Plot Experiments at the Botanic and Experiment Stations.

In the Report for 1918-19, it was stated that plants of the Tagasaste (*Cytisus palmensis*), Gacia (*Cytisus stenopetalus*), and Gacia Blanca (*Cytisus pallidus*)—all of which are used for forage and garden plants in the Canary Islands—had been raised from seeds, and would be planted out for trial on the approach of the wet season. This was done, but, under the damp conditions of climate of this island, all died. Similar results were recorded in other islands possessing a heavy rainfall. It is clear that the species under trial are not suited to humid conditions, and any chances of their successful cultivation must be sought for in the drier islands.

Seeds of the Sarawak bean *Dolicho's Hosei*, received from the Agricultural Department, St. Lucia, failed to germinate. Attempts to obtain plants or seeds are again being made, as this plant is said to afford a dense growth, and is able, unlike most leguminous plants used as a green dressing, to suppress weeds, and to maintain a good ground cover over considerable periods.

A number of plants of *Momordica cochinchinensis*, mentioned in the last Report as having been raised from seeds, were brought successfully to the fruiting stage in the course of a year.

The seeds, which are said to yield an oil remarkable for its drying properties, came from Hong Kong by way of the Royal Botanic Gardens, Kew.

Of the seeds received only a few germinated, and the plants made little progress until the wet season commenced. When rain fell, vigorous growth followed, and male and female flowers were produced on separate plants at the same time. These were hand pollinated, and four months later the first fruit ripened. This weighed  $3\frac{3}{4}$  lb., contained forty-two seeds, the total weight of the latter being 6 oz., or one-tenth of that of the fruit.

The flowers, which are pale yellow in colour, are rather striking, particularly the staminate ones, which are larger than the pistillate or female flowers.

Apart from its economic possibilities, this plant is a desirable introduction as a climbing ornamental, owing to its vigour, which enables it to cover arbors or old walls in a short time; also on account of its striking flowers, and the intense colouration of the large spiny fruits.

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## Notes on Economic Plants.

### FRUIT TREES.

The needs of the many and increasing millions of prosperous people, who form the population of the eastern Provinces and States of Canada and the United States for all forms of tropical products, should alone be sufficient to secure to the West Indian islands a future welfare surpassing anything that has been attained in the past. Different islands produce different products, and as far as Dominica is concerned, there are possibilities, in addition to the expansion of present lines of business, of the development of a trade in choice fruits, such as mangoes and avocados, as it is certain, that as time goes on and trade increases, the length of the voyage to New York and Canada will be less than it is at present, while improvements in the carrying facilities for delicate fruits are practically certain.

For many years past selected varieties of the best mangoes have been grown in the Gardens, and propagated in the nurseries for sale to planters, but, as men-

## FRUIT TREES.

tioned under the head of nursery work, this island has derived but little good in this respect, owing chiefly to the keen desire on the part of buyers to export to neighbouring islands every grafted and budded plant that can be obtained.

In order to meet the requirements of a possible fruit trade, the type of mango to be grown must possess the desirable qualities of attractive appearance, good flavour, and be able to keep in good condition from the time of picking for a period of from ten to twelve days or longer, if carefully handled and packed. This desirable combination is rare in known varieties of this fruit, and there is need of much work in investigating, selecting, and propagating those kinds which promise to be best suited for export purposes.

Many of our best mangoes such as Julie, Divine, Gordon, and others, are generally unsuitable for shipping, owing to their being very poor keepers. One of the best, firm-fleshed mangoes grown in the Botanic Gardens is known by the name of Ceylon No. 1, but it is a poor flavoured fruit, and not likely to be popular. Mangoes which possess a good flavour combined with good keeping qualities are said to exist, and some of these are being investigated with a view to their propagation in the future.

Of the six varieties of selected Indian mangoes, introduced during 1910 and 1911, one, the variety Alfonse from Bombay, was lost in the hurricane of 1916. but, as a few plants of the variety had already been propagated, it was possible to replace it. Only one of the six kinds has fruited up to date, that being the variety Bhadoorea, which yielded firm-fleshed fruits of good flavour, averaging 16 oz. each in weight, and, as far as could be seen, gave some promise of being a good keeping kind.

Other varieties under observation are Haden and Mulgoba, both of which were presented by the United States Department of Agriculture. It is hoped to introduce other desirable kinds for trial in the near future.

In the Annual Report for 1911-12, mention was made of the importation of seeds of two types of Mexican avocado pears from Mr. T. W. Popenoe, Altadena, California. Six plants were raised, and these were further increased by budding. The plants in the Gardens have grown well, but no fruit has been produced by either kind up to date. It is probable that varieties from the highlands of Mexico are not altogether suited to the seaboard conditions of climate in the West Indian islands, and that the best line of investigation is to select types of local varieties which recommend themselves for shipping purposes, that is to say, the firm-fleshed, hard-skinned types, with a small cavity which is completely filled by the seed.

Many of the best local avocados are thin-skinned, and possess a large cavity in which the seed rattles every time the fruit is shaken. This type is not suited for shipping, although some of these are probably the best of their kind, and highly prized for local consumption.

Planters who possess, or know of the existence of trees which bear fruit of a type suitable for export would greatly assist by bringing the facts to the notice of the Department, with a view to securing their propagation by means of budding. A collection of the best local kinds could soon be formed by these means, a proceeding upon which much useful work could soon be based in future.

While it is desirable to form a collection of local avocados, it is also necessary to import for trial the best types grown in other countries. A plant of the well-known 'Taft' avocado was obtained last year from the United States Department of Agriculture, and it is hoped that a few other leading kinds will shortly be added to the departmental collection.

## ONION GROWING.

A large number of seedlings were distributed by the Department to persons who desired to make experiments, and the success which followed these efforts has convinced many that excellent returns are possible, if this line of work is followed up with care and method.

The original trials with this cultivation were made by the Agricultural Department as far back as 1900-5, and good results were shown by growing

## ONIONS AND CAMPHOR.

onions both from seeds and sets. Shipments were made to New York, which promised well, but although the results were published, the experiments failed to attract any local interest, and matters in this connexion remained in abeyance until a few years ago.

As stated in previous reports, Mr. E. J. Seignoret, of Spring Hill estate, has been highly successful in this work. The growing interest in onion cultivation is mainly due to his efforts, and to the sound advice which he tenders freely to those who ask for it. Onion cultivation at Spring Hill has been carried on for five years past on a fairly large scale; the yield during the past season amounted to 30,000 lb., the bulk of which was grown as a catch crop amongst plant canes and young lime and cacao cultivation.

At present the requirements of growers in Dominica and in the sugar-growing islands in which onions are grown, are dependent upon the annual importation of seeds from Teneriffe, a work which has been undertaken by the Imperial Department of Agriculture for many years past. Growers should note carefully that orders must reach the Agricultural Superintendent not later than the end of April, and that the seed is due to arrive about the end of September, by which time preparations should be well in hand for the initial sowings.

On the arrival of the seeds, it is not necessary, as in some islands, to sow all at once. At Spring Hill the practice is followed of making a succession of sowings from early in October until the following January, due precautions being taken to store the unsown seed under sound conditions. Such proportion of the seedlings as are required can then be transplanted for ripening in succession from February onwards to May, and the remainder can be allowed to become sets, which, if stored carefully and attended to properly, will be available for planting with the rains in May, and in succession monthly until the end of the year. It will be seen that onion growing in Dominica, owing to favourable climatic conditions, can be made to afford, if the grower wishes, an all-the-year-round occupation, instead of one of a few months only each season.

It may also be mentioned that, if it is intended to produce a proportion of the onion crop in the shortest possible time, it is desirable to prepare specially the seed beds, to sow thinly, and to allow the crop to mature in the same beds without transplanting. Given favourable weather conditions, good marketable onions can be obtained by these means in four and a half months after sowing.

The fact that onions can be got to produce seeds in Dominica was mentioned in previous reports, but it is not possible to report further progress at present. It is hoped this line of investigation will be followed up, and definite information obtained in regard to this important matter.

Considering the widespread interest now being taken in the cultivation of this important food product, it may be hoped that before long sufficient supplies will be raised in the island to meet the local demand. There are, of course, considerable possibilities beyond the supplying of local markets, but in the meantime the most important matter before growers is the need of acquiring thoroughly the mastery of all cultural details in this connexion, in order to ensure continuation of effort, and an increasing annual output of this necessary and health giving vegetable.

CAMPHOR (*CINNAMOMUM CAMPHORA*).

Experimental propagation of camphor, undertaken by the Department during the year under report with a view to ascertaining the best and quickest means of obtaining stock for distribution, is still in progress.

## TRIALS WITH IMPORTED SEED.

Supplies of seed for germination purposes were obtained through the Imperial Department of Agriculture from Trinidad, Florida, and Japan.

The seeds were sown in boxes, and carefully tended, but the results obtained were not satisfactory. It will be seen from the table given below that the percentage of seeds germinated was very low, being only 9.6.

PROGRESS IN CHIEF INDUSTRIES.

Table showing the number of seeds germinated from supplies received from Florida, Trinidad, and Japan :—

Country.	No. of seeds sown.	No. of seeds germinated.	No. of seeds germinated, per cent.	Remarks.
Florida ...	291	38	13.0	Seeds arrived un pulped.
Trinidad ...	42	9	21.4	
Japan ...	234	18	7.7	Seeds pulped.
" ...	784	98	12.5	
" ...	571	23	4.0	Seeds pulped and packed in powdered charcoal.

Total No. of seeds sown = 1,922

" " " " germinated = 186

" " " " " per cent. = 9.6

All seed soaked in water for three days before sowing.

Ordinary means of propagating from cuttings have so far failed. Further trials with cuttings specially treated are being carried out.

Layers and root cuttings are also being given a trial.

## Progress in the Chief Industries.

### LIME INDUSTRY.

#### GENERAL CONDITIONS.

The crop for 1919, calculated in barrels of a capacity of 4.55 cubic feet, amounted to 401,923 barrels of fruit, or 83,000 barrels over the output of 1918. As, however, the crop of the latter year was 71,000 barrels of fruit below the average crops of the previous five years, 1913-17, production during 1919 is therefore 12,000 barrels in excess of the average annual output of the crop for several years prior to 1918.

As it is certain that the returns have been confused to some extent during the past two years by shipping and other difficulties, the actual position of the lime industry is better shown by referring to the five-year period 1913 to 1917, during which the annual output averaged, in round numbers, 390,000 barrels of fruit. During 1918 and 1919, the crops averaged 360,000 barrels, or a falling off of 30,000 barrels of fruit each year. It will be seen that during the early part of the war production was maintained, but a considerable drop has occurred during the past two years.

In spite of this, it is probable that the outlook in several ways is brighter now than for some years past. Planters of military age, who left the island in the early years of the war, have now returned to their estates, greater attention is being paid to the manuring of plantations, while the increasing demand for lime plants indicates a more general interest in development work.

The evidence of a more hopeful feeling, at present stimulated by good prices for lime products, is overshadowed and discounted by the conditions of the labour market. It is clear that if the shortage of labour, now said to be acute in some districts, becomes general, the maintenance of the lime industry, as it exists at present, will be very difficult, and all hopes of further development will have to be given up.

## LIMES.

The lime crop for the past five years, calculated in barrels of fruit is recorded below :—

1915	...	...	390,000
1916	...	...	384,000
1917	...	...	396,000
1918	...	...	318,000
1919	...	...	402,000

The following table, calculated on the usual basis,\* shows the disposal of the crop under the various heads :—

Product.	Barrels of fruit.	Approximate percentage of total crop.
Concentrated juice ...	250,077	62
Raw juice ...	39,774	10
Fresh limes ...	21,361	5
Citrate of lime ...	90,068	22

Comparison with the figures of last year's disposal of crop shows the following changes. The proportion shipped as concentrated juice declined from 70 to 62 per cent., and that shipped as raw juice from 24 to 10 per cent. Fresh limes showed an improvement, having risen from 2 to 5 per cent. The great change of the year occurred in connexion with citrate of lime, which rose from 3 to 22 per cent. The business in lime juice cordial and pickled limes was again on a small scale, the requirements under both heads being met by 643 barrels of limes.

The weather conditions may be accounted generally favourable. Torrential rains fell on the Leeward Coast on September 1, and again on November 29 and 30, but from an agricultural standpoint no great harm was done on either occasion. Reports from the Inland and Windward Districts indicated normal conditions of weather.

\* Note.—Fifty gallons of concentrated juice represent 75 barrels of lime fruits; 7½ gallons of raw juice represent 1 barrel of lime fruits; 1 con of citrate of lime is equivalent to 266 barrels of lime fruits.

## LIME JUICES.

## CONCENTRATED JUICE.

The shipment of this product was the highest recorded, and totalled 166,718 gallons, of which 72,424 gallons went to the United Kingdom, and 94,294 gallons to the United States. Market conditions were generally good, there being a fair demand at remunerative rates throughout the year.

The shipments during the past five years were as follows :—

1915	...	...	153,292 gallons
1916	...	...	152,603 „
1917	...	...	149,775 „
1918	...	...	148,939 „
1919	...	...	166,718 „

## RAW JUICE.

The heavy shipments of raw juice to London, which have been such a feature in this trade during the war, have now ceased. The total export was 298,321

## LIMES.

gallons, of which 116,591 gallons went to London, 57,717 gallons to Canada, 122,392 gallons to New York, and 1,612 gallons to other countries.

The following table shows the export of raw juice since 1915 :—

1915	...	...	777,064 gallons
1916	...	...	574,109 ..
1917	...	...	778,133 ..
1918	...	...	575,985 ..
1919	...	...	298,312 ..

## CITRATE OF LIME.

There was a considerable demand for this product at good rates, and the quantity exported constitutes a record. Of the three factories which are equipped for making citrate of lime, one only is entirely devoted to its manufacture; the other two can turn out either concentrated juice or citrate of lime as desired, and the line of work in these instances is determined by market conditions.

The output of this product, which fell to a very low figure during 1918, has now reached the highest point since the industry was started in 1906. It is unlikely that production will increase much beyond the present point, unless other factories are equipped for this purpose. Here, as under other heads, the United States has been the greatest purchaser, no less than 4,213 cwt. having gone to New York, against 2,559 cwt. to London. The exports during the past five years are as follows :—

1915	...	...	1,102 cwt.
1916	...	..	2,959 ..
1917	...	...	1,960 ..
1918	...	—	800 ..
1919	...	...	6,772 ..

## GREEN OR FRESH LIMES.

Shipments since 1915 were as follows :—

1915	...	...	41,494 barrels
1916	...	...	39,916 ..
1917	...	...	41,243 ..
1918	...	...	7,670 ..
1919	...	...	21,361 ..

Of the number of barrels of fruit exported in 1919, no less than 20,810 went to New York.

The heavy falling off in exports during 1918 was due to the United States embargo on green limes, which was in force over a considerable part of that year. Some improvement in the position was brought about during 1919, but the exports are still much below those of the several years previous to that of the embargo. No doubt this is largely due to the effect of prohibition in the United States.

As a good deal is heard from time to time of the production of limes in Florida, and the effect on the New York trade in this fruit, the following information, culled from the Biennial Report of the Department of Agriculture of

## CACAO.

the State of Florida, regarding output, may be of interest to planters in this island :—

Output of green limes in Florida, expressed in cubic feet.			Green limes shipped from Dominica, expressed in cubic feet.		
1914	...	107,968	1914	—	203,773
1918	...	31,164	1919	—	34,515

The number of limes trees growing in Florida is stated in the Report to be 75,950. As the number of non-bearing trees and stock in nurseries is not given in this instance, as in other citrus industries, such as grape fruits and oranges, it would appear that lime growing is at a standstill, and is by no means the developing industry as we are sometimes led to believe by visitors to this island. Further, the lime in Florida is grown for shipment and use as fresh limes, the production of raw and concentrated juice being unknown. The output stated above therefore represents the total of the industry, while in Dominica the green limes shipped during 1918 amounted to only 2 per cent. of the crop of that year. The above information will afford planters some idea of the relative position of the lime industries in the respective countries.

## LIME OILS.

The business in lime oils also constitutes a record. These products are used chiefly in perfumery, and for soap making, etc. Latterly it has become customary to add a few drops of lime oil to many of the 'soft drinks' in vogue in the United States, this addition imparting a flavour to the beverage which is much appreciated.

The shipments of these products over a five-year period are detailed below :—

	Output of limes, lb.		Essential oil of limes, lb.
1915	8,557	1915	35,945
1916	5,950	1916	48,160
1917	10,004	1917	45,141
1918	13,676	1918	25,096
1919	16,964	1919	68,787

The total value of lime products exported during 1919 was £196,401.

## CACAO.

The growing of cacao has been carried on for a long period in Dominica. It first appears on the official returns as an export in the year 1838, at which time 2,354 lb. were shipped from the island. For many years it was solely a peasants' industry. During the past half-century a number of estates commenced this cultivation, but development to any considerable extent has been accomplished only by a few. To this day the peasants remain the largest producers of this article.

The cacao situation has always been a difficult one to discuss, owing to surreptitious shipments of this product to neighbouring foreign islands; this being a state of affairs which it is well known has existed over a long period, and which was understood to be highly profitable during the war. Under such conditions, even an approximate estimate of production was impossible.

Latterly, however, owing to several causes, the position has been reversed, with the result that it has become more profitable to make shipments through the Port of Roseau than to continue an unlawful business with its occasional risks.

## COCO-NUTS.

Should this fortunate state of affairs continue for twelve months, it will be possible for the first time to obtain a fairly good idea of the yearly production, while a continuance for several years should allow of a close approximate estimate being made of the average annual output.

Owing to the hurricanes of 1915 and 1916, which caused considerable damage to plantations, and owing also to the illicit export of this article, the official returns of shipments of cacao fell very low during 1917 and 1918, and for eleven months (January to November) during 1919. As it is well known that but little attention is being paid to the planting of new areas, also that the losses of trees caused by the hurricanes have not been replaced, it was inferred that cacao production was failing for good, and that little hope existed of its recovery. The favourable combination of circumstances which resulted in attracting the bulk of the Christmas crop to Roseau in December 1919, had the effect of modifying this view, as it proved the position to be stronger than was thought. The returns for 1919, when compared with those of the three previous years, show the comparatively favourable output of 7,387 cwt. This is considerably below the shipments during 1909-12, a four-year period, over which, according to official figures, an average annual output of over 11,000 cwt. was maintained. As we now know, actual production must have been considerably in excess of that amount. After several lean years, as far as official returns are concerned, the position has been elucidated sufficiently to create hopes that, by careful nursing, the industry may yet be brought to a position of greater importance than at any previous time

The shipments of cacao since 1915 are recorded below:—

	Quantity, cwt.	Value, £.
1915	10,810	39,301
1916	5,707	17,151
1917	3,169	8,842
1918	4,239	14,735
1919	7,387	37,293

## COCO-NUTS.

The position in regard to this product has greatly improved. During 1917 and 1918 the exports fell to a low figure, owing to measures that had to be taken locally in connexion with the the food supply, and also to some extent to lack of shipping facilities. It is pleasing to note the rapid return to the position held a few years ago.

The island is very well suited for the requirements of coco-nut palms. Of late years considerable areas have been planted in the northern district, but little has been done elsewhere. It is regrettable that this valuable plant, so well suited to local conditions, both seaboard and inland, receives so little consideration generally from both planters and peasants.

The great falling off in the exports during 1917 and 1918, and the recovery during 1919, are shown in the following table:—

	Quantity.	Value, £.
1915	506,360	1,582
1916	408,007	1,275
1917	133,234	416
1918	89,676	467
1919	492,426	4,103

## AGRICULTURAL REPORTS.

TABLE OF AGRICULTURAL REPORTS FOR THE TRIENNIAL PERIOD  
1917 TO 1919.

	1917.	1918.	1919.
<i>Lime Products.</i>			
Concentrated juice ... ..	149,775 galls.	148,639 galls.	166,718 galls.
Raw juice ... ..	778,133 "	575,985 "	298,312 "
Lime juice cordial ... ..	469 "	oil	3,965 "
Distilled lime oil ... ..	45,141 lb.	25,096 lb.	68,787 lb.
Essenced oil of limes ... ..	10,001 "	13,676 "	16,964 "
Citrate of lime ... ..	1,960 cwt.	800 cwt.	6,772 cwt.
Green limes ... ..	41,243 brls.	7,670 brls.	21,384 brls.
Pickled limes ... ..	350 "	8 "	485 "
<i>Cacao Products.</i>			
Cacao ... ..	3,169 cwt.	4,239 cwt.	7,387 cwt.
Chocolate ... ..	2,800 lb.	1,266 lb.	704 lb.
<i>Coco-nut Products.</i>			
Coco-nuts ... ..	133,234	89,676	492,426
<i>Coffee Products.</i>			
Coffee ... ..	10 cwt.	15 cwt.	8 cwt.
<i>Sugar Products.</i>			
Rum ... ..	308 galls.	18 galls.	51 galls.
Syrup ... ..	nil	nil	56 "
<i>Spices.</i>			
Vanilla ... ..	£47 worth	796 lb.	2,444 lb.
Nutmegs ... ..	£13 "	£43 worth	£18 worth.
<i>Honey Products.</i>			
Honey ... ..	£12 worth	675 galls.	162 galls.
Bees wax ... ..	nil	nil	191 lb.
<i>Various Products.</i>			
Bananas ... ..	39 bunches	712 bunches	2,397 bunches
Oranges ... ..	533 brls.	1,226 brls.	2,030 brls.
Mangoes ... ..	£228 worth	£67 worth	£318 worth.
Miscellaneous fruits ... ..	£106 "	£116 "	£111 "
Bay leaves ... ..	784 cwt.	31 cwt.	54 cwt.
Bay oil ... ..	1,050 lb.	1,627 lb.	2,356 lb.
Orange oil ... ..	2,809 "	153 "	1,431 "
Kola nuts ... ..	£12 worth	£19 worth	1,991 "
Cassia fistula ... ..	£11 "	£23 "	£61 worth.
Tamarinds ... ..	32 brls.	18 brls.	64 brls.
Ginger ... ..	£6 worth	13 "	25 "
Farine ... ..	nil	nil	34 bushels.
Hides and skins ... ..	£243 worth	£155 worth	442 (No.)
Plants, bulbs and seeds ... ..	£97 "	£93 "	£22 worth
Fruits, jam, and jellies ... ..	39 lb.	97 lb.	45 lb.
<i>Forest Products.</i>			
Hardwood ... ..	51,204 feet	213,550 feet	48,817 feet.
Firewood ... ..	361 cords	631 cords	712 cords
Logwood ... ..	nil	14 "	5 "
Cance shells ... ..	52	82 "	137 "
Hoops ... ..	nil	1,517 bundles	18,960 hoops.
Shingles ... ..	nil	nil	21,000
Other wooden manufactures ... ..	£233 worth	£3 worth	£3 worth.
Charcoal ... ..	£12 "	£20 "	£36 "
Total values ... ..	£218,961	£184,394	£245,469

**PRESENT CONDITIONS.**

It has become a commonplace in Dominica to assume that the condition of the agricultural industries is sound, and that rapid progress is being made in all directions. No doubt the chief industries are generally in a sound state, but in the matter of progress there has been nothing to record for several years past. Probably the optimistic view in regard to the last named has been arrived at by referring to the values of exports, which are rising rapidly, while the more important matter of quantities, in some cases stationary, and in others falling, has not received that attention which is so necessary before an accurate conclusion can be reached.

The causes of this lack of progress, several in number, are attributed chiefly to the Great War and the difficulties caused thereby, many of which have operated to lower the standard of work on plantations, to bring about a cessation of development work, and to hold up indefinitely much wished for improvements in lime factories. The result is a falling off in production at a time when the chief hope of carrying on successfully lies in ability to increase the output, in order to meet the high cost of living, rising rates of labour, and inflated charges for all estate requisites.

And matters in many instances have not improved since the war ceased. The labour question grows worse, other agricultural expenses tend to increase conditions which operate in compelling the planter in some cases, and in bringing about a desire in others to do less on estates on which but little has been done in the way of cultivation at any time. As any reduction of effort is practically certain to be followed by a falling off in output, the position of planters without financial reserves will, in this event, become difficult and uncertain, and this in spite of possible good prices for lime products.

Another reason of this lack of progress during recent years is the aftermath of the hurricanes of 1915 and 1916. These occurrences destroyed considerable areas under limes and cacao, and also blew over large numbers of lime trees, which latter, under the best treatment possible, take several years to recover. As far as lime cultivation is concerned, the loss has been made good by new plantings. In fact the lime plants sent out from the Government nurseries since 1916 are sufficient to plant the area destroyed several times over. In this connexion it is necessary to state that many thousands of seedlings are, under present conditions, wasted annually by planters in their efforts to renovate old lime estates by planting between and beneath the mature trees which are slowly dying, owing chiefly to unfavourable soil conditions. It is difficult to see how young plants are to thrive in soils in which mature trees are failing. The filling up of vacancies in orchards, and success in growing the plants present no special difficulties where soil conditions are favourable. On the other hand, when the soil of an estate becomes unbalanced, and the majority of trees diseased, owing to bad treatment, improvement can be effected only by special measures. Yet these attempts, at renovation by planting are continued without results year after year on the same ground, with a cheerfulness on the part of planters only possible by ignoring costs, with a persistence that in well directed agricultural work would merit high praise, and with a faith which the continued absence of results fails to shatter. There was a time when the distribution of lime plants, after allowing a percentage for failures and for supplies in established cultivations, afforded some indication of the area of land opened. That period has now past.

It is held by some that high market prices for lime products are all sufficient to meet and adjust present difficulties. If this is so, then the present phase may gradually verge into a normal one, though on a much higher standard than formerly. But this view overlooks the serious matter of falling production, and it further presupposes that good market rates for lime products will be permanent. It is necessary in this case to point out that the market for concentrated juice and citrate of lime, the staples of the island, is a small one, entirely controlled by a few persons in London and the United States, and therefore not likely to operate in favour of the producer to any great extent beyond that which is necessary to keep him in the business. It is almost impossible for planters to obtain information as to present and future market prospects, such as is available to the growers of staples like sugar and cotton. The market position in regard to other products of the lime, such as raw juice and green limes, is clearer; but it should be remembered in discussing this question that concentrated juice and citrate of lime formed no less than 84 per cent. of the total crop of 1919.

## AGRICULTURAL CONDITIONS.

As a means of meeting and overcoming the difficulties which now beset the planter, authorities reiterate unceasingly the great need of spending little individually, and of working harder in order to produce more wealth. In this respect it may be said that the average person in Dominica, possessed of some money, fulfils the first requirement; but this state, which might mean so much under present conditions, is usually unaccompanied by any desire for special and further effort in the direction of agricultural improvements and developments.

During recent years money has been made in this island, but, unlike other tropical countries, there are no signs of any considerable sums having been spent in improving and extending local agriculture. This is one of the results of the low level of contentment which, generally speaking, obtains in Dominica, a condition which often leads men to cease working at a time when they should be developing their interests with all the vigour at their command. And this low standard of living, accompanied as it is by a low standard of production, is an effective bar to progress. Amongst other drawbacks, it is to-day the chief cause of the dwindling population of able-bodied manhood and womanhood. Under such conditions as now exist, regular employment and a decent rate of wages are alike impossible. Consequently the more intelligent of the young men and women proceed to countries which offer a wider scope for their energies. And this exodus means more than a reduction in numbers and a loss of labour. This continued disappearance of the more active minds is a drain on the intelligence of the working classes. If continued over a considerable period, the level of intelligence in village communities may tend to fall, and this at a time when the planter is crying out for labour of a better class than is obtainable at present.

If the island is to regain a place on the path of progress, it is practically certain that cultural and manurial measures, quickly applied and vigorously carried out, are needed on plantations. The requirement necessary is increased production; a doubling of the output of lime products within the next two or three years. Great as this would appear to the planter, it is nevertheless a possibility if certain conditions can be fulfilled. Only by these means can the present situation be met fully, and the future position of the planter be made financially sound, and in accord with the changed conditions of the times.

The quickest means of increasing production in orchard cultivation is by applying manures, and carrying out sound cultural measures. By taking this course, the output from the present area could be rapidly increased. To continue progress, this work should be followed wherever possible by the planting of new areas. It has to be remembered that adjustment to a new set of conditions must take longer in the case of permanent cultivations like limes, cacao, and coco-nuts, all of which require a steady outlay of capital for six or eight years before returns can be expected. Orchardists are therefore at a considerable disadvantage in these circumstances, when compared with the growers in other islands of annual crops, such as sugar and cotton.

In discussing this matter it has to be allowed that the price of concentrated manures is now very high, and likely to remain so; also that delivery is uncertain. Under these circumstances, the planter's best course is to endeavour to raise more stock, and by the provision of pens, to secure all the manure possible for plantation work. This could be supplemented by the abundant use of mulches. There is no country in the world in which the supply of green material is so readily available as in Dominica. It may be stated with equal truth that in no country is there a greater reluctance to utilize these natural supplies. This is accounted for generally by the actions of owners of estates who, when buying concentrated manures do it as a special matter, but who, it is said, in the case of mulching, make no special allotment of funds per acre, but expect the managers and overseers to carry on the work out of the usual allowances for estate expenses. Thus a class who should have been brought to see the double value of mulching, both as a manure and as a means of affording work locally, are antagonised, and dislike intensely any reference to the utilization of green or dry vegetable material in the place of imported manures. In cases in which it is decided to apply mulch, an allotment of funds at the rate of £1 to £5 per acre should be made for the work.

It is well known that the average crop returns per acre on lime estates are very low. This is to be expected when it is remembered how little many plantations receive in the matter of cultivation. In some cases an occasional cutting of weeds and grass is all that is done. This effort is made during crop in order to enable the fruit to be collected from the ground with greater ease and not with

## AGRICULTURAL CONDITIONS.

the direct intention of benefiting the trees. While the margin in some instances between present conditions and abandonment is small, the margin on the side of possible improvement is great. Given right conditions, it is to be hoped that attempts to exploit these considerable possibilities will be undertaken.

But, as the planter will quickly point out, the matter of increase of production is intimately bound up with the question of labour supply. More work means more man-power, which latter is difficult to obtain, except in a few favoured localities. Further, it is stated that the reason why so little is done in the way of cultural work on some estates is due to this shortage, and to the poor return given in work by the labourer. On the other hand, labourers are leaving the island owing to low wages and lack of regular employment. It would appear that the less work done on estates, the larger will be the exodus of able-bodied manhood, and matters in this respect, bad enough now, will become worse. Conversely it would also appear that regular employment at higher rates would check this tendency, and gradually bring about an increase in the number of men willing to work on estates.

For many years past the local labour supply has been supplemented by arrivals from Montserrat, Antigua, and St. Kitts. Owing to the development of the sugar and cotton industries in those islands, this source of supply has practically ceased. Suggestions have been made that a portion of the surplus labouring population of Barbados might be attracted to Dominica, with a view to their settlement on Crown Lands. This matter is now under discussion. Such a scheme, if carried out, would be largely of the nature of an experiment. People accustomed to an open country and a dry climate like Barbados, do not, as a rule, take kindly to forest conditions, and an excessive rainfall. A scheme of this kind will require to be carefully directed in its early stages. If successful, it would, in the long run, add to the labour supply of the island.

A number of planters are of the opinion that relief of the present situation can be accomplished by the introduction of coolie labour from India. Those who advocate this measure can hardly be acquainted with events in connexion with Indian immigration during several years past. Even if immigration is again permitted, the conditions likely to be imposed, and the responsibilities to be undertaken will probably be such as to make them impossible of acceptance by Colonial Governments with very small resources.

In connexion with the need of more regular employment on estates as a factor in improving the situation, many hold that the conditions surrounding lime growing do not permit of regular working operations all the year round. Under present methods, labour is in great demand during the crop season, June to December, with a great slackening off during the other half of the year. Up to the present the situation as regards unemployment has been eased by the fact that a considerable proportion of working men are possessed of gardens. Thus, when they are not employed, attention is paid to some extent to food production. This system of gardens has operated and is operating to the benefit of both planter and peasant, and of every one else in the island. But while this fact relieves the situation, it does not change it. The need still remains of a good deal more employment than is now given.

The contention put forward by some that lime estates cannot be expected to employ a regular labour force all the year round does not meet with the support of the more experienced planters. The work on a lime estate, if properly carried on, is exacting, and affords no close time at any season of the year. During the main crop period, June to December, which is also the wet season, practically the whole time is taken up in collecting limes, preparing the products for market, and in keeping the fields clean, either by weeding or cutlassing. During the other half of the year, the pruning of trees, applications of manures, improvement of drainage system, attention to wind-belts, repairs to estate roads, and preparations for dealing with the coming crop, will occupy a good deal of time. In cases in which there is a close season as regards labour on estates—and they are many—it follows that much work essential to the well being of the plantation is not done.

It would appear under conditions of labour that, in the face of good market rates, production can be increased only in countries like Cuba, where the chief branches of agricultural industry are highly organized, and new lands are available for opening up. These conditions permit of high rates of wages being paid, an attraction which usually produces the labour required.

## AGRICULTURAL CONDITIONS.

Again, in islands like Grenada and Montserrat, the output is growing. No doubt this is largely due to the presence of a large body of peasant proprietors who supplement the efforts of planters, and in turn furnish a portion of the labour supply necessary to keep estates working in an efficient manner. In islands like Dominica, where there is little in the way of specialization or organization of industry, and where a considerable body of peasants, without encouragement or assistance of any kind, merely exist, matters, instead of improving, have stagnated over a period of several years. If the Dominica peasant had received the assistance which has been freely given over a long period by the Windward Islands Government to the small growers of Grenada, St. Vincent, and St. Lucia, there is every reason to believe that the economic situation of this island would be much stronger than it is to-day. The encouragement accorded to peasants in the neighbouring colony takes such forms as Co-operative Lime Factories, Agricultural Credit Societies, Land Settlement Schemes, Government Cotton Factories, Prize Holdings Competitions, etc., etc.

Dominica greatly needs co-operative factories for dealing with peasants' lime products in those districts in which the production of limes warrants such steps. Unfortunately the matter has been left over too long. The situation to-day is difficult in this respect, owing to the extremely high charges now being paid for machinery, etc. Again, there are other peculiar local difficulties in connexion with this matter, to overcome which satisfactorily would require very careful handling.

Agricultural Credit Societies are proving a success in those countries in which the main crops grown by peasants are of an annual character. In the case of orchard crops, like limes and cacao, it would appear that little in the way of success has been achieved. In the former, the money for the crop is paid to the peasant in a lump sum, consequently repayment of the loan to the Society is easy. Where orchard cultivation is concerned the money usually comes to the growers in small sums, extending over a period of several months. In consequence, the peasants, many of whom are improvident, find it extremely hard to repay their loans, and failure of the Society results. It is questionable if Agricultural Credit Societies are suited to conditions in Dominica where orchard crops are grown, and where the holdings are isolated, thus making supervision by the officers of the Society arduous and difficult.

Any reference to a Land Settlement Scheme in Dominica would appear to be unnecessary in view of the large extent of Crown lands available for settlers. These are said to extend over 70,000 acres. Owing to altitude and exposure in some instances, inaccessibility and unsuitability in others, and to the existence of considerable tracts of forest land possessing a thin soil overlying sheet rock, only a small percentage of this area is available for cultivation. There is also another drawback in the form of excessive rainfall in certain districts. A number of lots of Crown lands adjoining or nearby cleared areas are applied for and sold to peasants each year. It is doubtful if much good in the way of permanent cultivation results from these acquisitions. Situated far from the settlements on or near the coast, their possession involves long journeys to and fro. In most instances it would appear that after the possibilities as regards timber and charcoal have been exploited, and a few crops of native vegetables raised, little else results. Here it is necessary to mention that the native population will not live in the very wet districts. In the whole of Dominica two small settlements only exist under such conditions. The rest of the population lives on or near to the coast.

As the peasant cannot get land near to the coast, he must, if he remains in the island, be pressed into the wet hinterland. Under such conditions his chances of success in regard to permanent cultivations decrease as the distance from the coast increases.

About thirty years ago the Berricoa Estate in the Grand Bay District was divided in small lots, and sold to peasants. That course, so far as peasants' output of lime is concerned, has made Grand Bay the most productive area in the island. Also it is understood that estates in the vicinity have been and are to-day better supplied with labour than those in any other part of the island. It is a matter for regret that this division of estates situated on the coast, especially in the Windward and Lasoye Districts, was not carried further at a time when those properties were changing hands after the failure of the sugar industry. Had such

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a course been followed, the producing capacity of the island would now in all probability have been much greater than it is to-day; while the existence of considerable bodies of peasants would have tended to increase the labour supply available for estates.

There can be no doubt that two or three Land Settlement Schemes, on or near to the coast, are a requirement in Dominica. By this is meant the acquisition of estates, well situated for the purpose, by the Government; their division in small lots, and resale to peasants at a price so fixed as to recoup the Government's initial outlay together with subsequent survey fees and other expenses. The producing capacity of a compact body of small holders occupying a few hundred acres of land in a suitable locality is enormously greater than that from a similar acreage of isolated gardens or lots in forest areas. Like the planter on his estate, the peasant, in order to get the best out of his holding, must live on the land. Apart from the matter of agriculture, by which the people must live, compact settlements also permit of administrative efficiency, and of social benefits not otherwise possible.

That the body of peasant proprietors is a first class asset in the country is shown by their productions, which are estimated at more than 50 per cent. of the cacao crop, about one-fifth of the lime crop of 400,000 barrels of fruit, a considerable contribution to the output of coco-nuts, and a share in the minor industries. Further, they raise a large proportion of their own food, and furnish considerable supplies of native vegetables to local markets. With organization and assistance in the form of co-operative lime-factories and Land Settlement Schemes, this class could in time play a great part in the future of the island.

Whilst it is necessary for the community to increase the output of agricultural products in order to face successfully new conditions, it is by no means clear how it is to be done as quickly as is desirable. From the planters' point of view, the purchase of manures and their application, together with improvements in cultural methods, are, under existing conditions, very difficult to carry into effect in a great many instances, owing to financial reasons and to labour shortage. For the same reason development work on any scale on estates is out of the question. The arrival of young men with capital, with the object of planting, which was expected by some after the war, has not come about; indeed new capital is not to be expected until labour conditions improve. Only one course remains, and that is the perfectly natural, but long delayed one, of increasing local wealth by the active encouragement of small growers. The more numerous the settlements of peasants, the more important will be the future of this Colony, while the existence of such communities should go a long way towards furnishing estates with the labour service required for all lines of development.

As there is little hope of recruiting labour from outside, either from neighbouring islands or other countries, it remains for the planter to do his utmost to retain and build up the native labour supply by the offer of more regular employment than obtains at present, at such rates of pay as the times demand, and the granting of such privileges as may be valued by the labourer. Further, it is desirable in the supreme interests of the island that planters should give sympathetic consideration and support to considered measures which may be brought forward with the object of improving the position of the small grower. By those means the present labour supply may be kept at home, and gradually increased as the youths of the island grow up, and the hopes for new communities are formed. The conservation and care of labour adds another burden on to the shoulders of the planters in Dominica, who, as a class, are now experiencing a number of new difficulties, in addition to their usual anxieties, in their efforts to carry on during a very trying period.

## Work Connected with Insect and Fungus Pests and their Control.

With the exception of an outbreak of scale insects in lime trees on the south side of the island, there is very little to report under this head.

The outbreak of scale insects on limes referred to above occurred in the Soufrière district, and to a less extent on the leeward coast; a few trees in the Lime Experiment Station being also affected.

It may be of interest to give a few extracts from the report by the Entomologist on his visit to Dominica in connexion with the above outbreak of scale insects (*Orthezia insignis*) on lime trees.

'The principal object of my visit to Dominica was to enquire into the occurrence of *Orthezia insignis* on lime trees, which had been reported from the Soufrière district and an estate on the leeward coast.

'In the Soufrière district I found the *Orthezia* attack severe along the coast. The limes at this place were growing on a very steep hillside, where the soil gave the impression of being little more than a mass of loose stones and rocks. The whole appearance was that of a washed-out and exhausted soil.

'Spraying with an oily wash, such as Scalco, would be useful for reducing the number of the insects and checking the attack, but this would be only a measure for temporary benefit. Any permanent or real improvement in the condition of the trees must be brought about by amelioration of the soil by purely agricultural methods.

'At the Lime Experiment plot I saw *Orthezia* in small numbers on the lime trees, and it was reported as occurring on an estate on the leeward coast. This insect is generally distributed in Dominica, but has not often been reported in serious abundance.

'The situation in the Soufrière district is one that calls for the application of sound agricultural methods, in regard to which the officers of the local Department of Agriculture are in a position to give the necessary advice.

'I have not recommended spraying, because I believe that, while it might do some good, it would not be worth what it would cost, and would divert attention, and, most likely, funds also, from the real work in hand, namely the improvement of the soil conditions, and perhaps also the protection from wind.

'The use of mulch in certain situations, and protection from wind where this is necessary, are the lines of work that should be undertaken in connexion with those lime cultivations.

'The effects of the hurricanes of 1915 and 1916 were strikingly demonstrated where the destruction of a wind-break on the crest of a ridge had resulted in the lime trees being severely battered by the wind. These trees were, as might be expected, in a very bad state, and in some cases mere stumps remained. They had been attacked by the white scale (*Chionaspis citri*) and the purple scale (*Lepidosaphes beckii*). The purple scale had been completely overcome by the red-headed fungus (*Sphaerostilbe coccophila*).

## Plant Legislation in Dominica.

The first step in the direction of plant protection was taken in 1898, when Act No. 3 was passed to provide against the importation of articles likely to introduce diseases among plants. Under the authority of this Act, a Proclamation dated August 27, 1898, prohibited the importation from Ceylon of plants, seeds, berries, earth, and soil. This Act was suspended by Law No. 9 of 1904, in which provision is made for the fumigation and disinfection of imported plants, cuttings, buds, grafts, bulbs, roots, and seeds, and their packages; also fruit and vegetables intended for propagation, and not for consumption as food.

Under Law No. 6 of 1907, power is conferred to prohibit by proclamation the importation of plants, cuttings, bulbs, roots, seeds, or berries, or any earth or soil, or any articles packed therein, or any packages, or other articles or things likely to be the means of introducing any plant disease.

A Proclamation dated February 5, 1909, under No. 6 of 1907, prohibits the importation into Dominica of all plants from Dutch Guiana, which are likely to be a means of introducing disease from that country.

A Proclamation dated October 26, 1910, prohibits the importation of banana plants and suckers from all countries of Central or South America, and from the island of Trinidad, also of coco-nuts in husk, and all growing plants or parts of plants of coco-nuts, from Cuba, Jamaica, Trinidad, and all countries of Central or South America.

A Proclamation dated August 7, 1915, prohibits the importation of citrus plants and citrus budwood from the United States of America. This is superseded by a Proclamation dated October 9, 1916, which applies to citrus plants, citrus budwood, or citrus fruit, or any parts of such plants, from the United States of America, Cuba, Jamaica, Haiti, San Domingo, and Porto Rico.

A second Proclamation of the same date restricts, under certain conditions the entry of rooted plants from the countries named in the above Proclamation.

A Proclamation dated October 29, 1917, prohibits the importation of seed-cotton or cotton seed from all countries or places outside the Colony of the Leeward Islands, save and except from some other Presidency of the Colony, or from the Colony of Trinidad and Tobago and its dependencies, or from the Colonies of Grenada, St. Vincent, and St. Lucia, provided, however, that small quantities of cotton seed for experimental purposes may be imported into the Presidency of Dominica, on the written permission of the Superintendent of Agriculture, on such terms and conditions as he may prescribe.

A Proclamation dated March 8, 1919, prohibits the importation from any country, save and except the islands of Montserrat, St. Lucia, and Grenada, of any citrus plants, or parts thereof, including the fruits thereof, as these are likely to be a means of introducing the plant disease known as 'Blossom Blight' and 'Wither Tip Disease.' It is, however, allowed that the Curator or Agricultural Officer shall have the power to import for scientific purposes, anything thus prohibited, on his making a report of such importation for the information of the Governor.

A Proclamation dated March 8, 1919, prohibits the importation from the islands of Trinidad and Grenada of growing and sprouting coco-nuts, as likely to be a means of introducing the plant disease known hitherto as 'Root disease of coco-nuts' but to be called in future the 'Red Ring disease of coco-nuts.'

With regard to the export of plants, it is only necessary to state that such cannot be admitted into the United States unless accompanied by a certificate showing that they have been inspected by a duly authorized official, and found free from injurious plant diseases or insect pests.

## LIME EXPERIMENT STATION.

Persons wishing to export plants to the United States from Dominica should notify the Curator of the Botanic Gardens, who will arrange for the inspection, and the issue of the necessary certificates.

The importation of nursery stock into the United States by mail is prohibited.

## CROP YIELDS AT THE GARDENS.

The cacao crop for the year ended June 30, 1920, was 72 cwt. The average annual crop for a period of five years, 1916-20, was 80 cwt., from an area estimated at 7½ acres.

The rainfall for the year ended June 30, 1920, was 74.74 inches.

Four bags of kola nuts, of a total weight of 774 lb., and 2 barrels of nutmegs, of a total weight of 358 lb., were also shipped to London.

There were also sold locally 1,730 barrels of limes, as well as considerable quantities of mangoes and citrus fruits.

## Lime Experiment Station.

This Station was started in April 1913, and the first planting of limes was made in July of the same year. A statement showing the expenditure and receipts during the seven-year period is given below:—

	Expenditure.			Receipts.		
	£	s.	d.	£	s.	d.
1913-14	50	0	0	17	9	7
1914-15	70	0	0	61	1	5
1915-16	120	0	0	86	9	10
1916-17	175	0	0	121	2	11
1917-18	175	0	0	180	12	2
1918-19	200	0	0	233	12	8
1919-20	250	0	0	625	6	7
Cost of manures to date	100	0	0			
Cost of drainage (from Special Services Grant)	48	3	0			
Head labourer's house	60	0	0			
Shed for housing mill, etc.	100	0	0			
	£1,348	3	0	£1,325	15	2

Supervision, always a considerable charge, has cost nothing in this instance, the work having been done by the agricultural officers. A fair amount of assistance has also been given by the two or three agricultural pupils who have been under training during recent years. These were from time to time engaged in sowing green dressings, in applying manures, pruning trees, and other work of a light character.

## LIME EXPERIMENT STATION.

A shed for housing a mill having been built during 1918, provision was made on the Estimates for 1919-20 to the extent of £200 for the purchase of a mill and oil engine. Owing to the existence of high prices, the amount named was found to be sufficient only for an oil engine of the power required, delivered in Dominica. Consequently the matter of proceeding immediately with the erection of a factory had to be postponed.

His Honour the Acting Administrator, Dr. H. A. A. Nicholls, C.M.G., in addressing the Legislative Council on this subject, stated that the Experiment Station was now advanced sufficiently to warrant the building of a factory, and that probably within a short time the Council would be approached for a grant of money for that purpose. The Experiment Station, His Honour said, already furnished to planters valuable information in regard to manurial and cultural matters, and the provision of a factory would enable research work to be undertaken in connexion with the manufacture of the products of the lime, and would provide means for training young planters and agricultural pupils in sound methods of preparing those products for the market.

During the seven years of its existence the Experiment Station, as far as the disposal of the crop is concerned, has been in the position of a small grower, that is, the ripe and green limes have had to be sold in the open market at the current ruling prices. For purposes of record, a table has been prepared which shows the local market rates per barrel of fruit since 1914-15 :-

## RIPE LIMES.

Year.	Barrels of fruit.	Amount received.			Rate per barrel.		
		£	s.	d.	£	s.	d.
1914-15	222	61	1	5	5	6	
1915-16	315	86	9	10	5	6	
1916-17	541	121	1	1	4	5½	
1917-18	619	180	12	2	5	6¾	
1918-19	1,070	221	2	8	4	1½	
1919-20	1,539	498	1	6	6	5½	

## GREEN LIMES.

Year.	Barrels of fruit.	Amount received.			Rate per barrel.		
		£	s.	d.	£	s.	d.
1918-19	10	12	10	0	1	5 0	
1919-20	191	127	5	1	13	3½	

The total crop for the year was 1,730 barrels of limes, all of which were sold in the local market, and realized £625 6s. 7d. This gives an average return of 7s. 2¼d. per barrel.

## MANURIAL EXPERIMENTS WITH LIMES.

The main manurial experiments now carried on consist of five plots, three times repeated, two series with young limes, and one series with old limes. They are as follows :-

- A. Complete manure of nitrogen, phosphates and potash.
- B. Control. No manure.
- C. Mulch of grass. 5 tons per acre.
- D. Nitrogen and phosphates.
- E. Nitrogen and potash.

## MANURIAL EXPERIMENTS WITH LIMES.

In each case the nitrogen was originally supplied in the form of Swifts' manure, 8 per cent. ammonia, at the rate of 4 cwt. per acre, but during the year under review this manure could not be obtained, and the equivalent in the form of cotton-seed meal was applied instead.

The mulch applied is mainly in the form of lemon grass, supplemented by leaves and young shoots of *Gliricidia maculata*. Both forms of mulch are specially grown on what would otherwise be waste ground in the vicinity of the plots. This system of utilizing odd corners, steep hillsides, and the banks of streams for growing material for application to cultivated areas is strongly recommended in Dominica.

The phosphatic requirements of the plots are furnished in the form of basic slag, applied at the rate of 4 cwt. per acre, and the potash, by sulphate of potash at  $1\frac{1}{2}$  cwt. per acre.

The yields of these plots, in barrels of fruit, during 1917-18 and 1919-20 are given below:—

## THREE YEARS' RESULTS OF MANURIAL EXPERIMENTS WITH LIMES.

## ORIGINAL SERIES.

Trees planted July 1913.

Year.	Size of plots.	A.		B.		C.		D.		E.	
		Complete manure		Control		Mulch		Nitrogen and phosphates		Nitrogen and potash	
		per plot.	per acre.	per plot.	per acre.	per plot.	per acre.	per plot.	per acre.	per plot.	per acre.
1917-18	$\frac{1}{4}$ -acre	15 $\frac{1}{2}$	63	14	56	23 $\frac{1}{2}$	95	24	96	7 $\frac{1}{2}$	31
1918-19	$\frac{1}{4}$ -acre	59	236	46	184	68 $\frac{1}{2}$	274	58 $\frac{1}{2}$	235	34 $\frac{1}{2}$	137
1919-20	$\frac{1}{4}$ -acre	85	340	89	356	99	396	88	352	60	240

## DUPLICATE SERIES.

Trees planted July 1913.

Year.	Size of plots.	A.		B.		C.		D.		E.	
		Complete manure		Control		Mulch		Nitrogen and phosphates		Nitrogen and potash	
		per plot.	per acre.	per plot.	per acre.	per plot.	per acre.	per plot.	per acre.	per plot.	per acre.
1917-18	$\frac{1}{4}$ -acre	6 $\frac{1}{2}$	27	10 $\frac{1}{2}$	41	18	72	6 $\frac{1}{2}$	27	10 $\frac{1}{2}$	43
1918-19	$\frac{1}{4}$ acre	35	140	22 $\frac{1}{2}$	89	42 $\frac{1}{2}$	170	30	120	38 $\frac{1}{2}$	154
1919-20	$\frac{1}{4}$ -acre	58	232	38	152	70	280	60	240	72	288

## MANURIAL EXPERIMENTS WITH LIMES.

## TRIPPLICATE SERIES.

Old Trees planted 1893.

Year.	Size of plots.	A.		B.		C.		D.		E.	
		Complete manure		Control		Mulch		Nitrogen and phosphates		Nitrogen and potash	
		per plot.	per acre.	per plot.	per acre.	per plot.	per acre.	per plot.	per acre.	per plot.	per acre.
1917-18	$\frac{1}{4}$ -acre	45	180	30	120	25 $\frac{1}{2}$	103	27 $\frac{1}{2}$	110	23	92
1918-19	$\frac{1}{4}$ -acre	60	240	32 $\frac{1}{2}$	129	23	92	52 $\frac{1}{2}$	210	31	136
1919-20	$\frac{1}{4}$ -acre	90	360	48	192	32	128	67	268	50	200

It would be unwise to attempt to draw any conclusions in orchard cultivation from the results of a series of plots on a three-years' term of manurial experiments, but this need not prevent consideration of the yields of the plots collectively. The ten plots of young limes, which cover an area of 2 $\frac{1}{2}$  acres, were planted in July 1913, and are therefore, at the end of March 1920, six years and nine months old from the time of being placed out in the field. The crop returns during this period are as follows :—

1917-18	...	...	137 $\frac{1}{2}$ barrels or	55 barrels per acre.
1918-19	...	...	434 $\frac{1}{2}$ „ „	174 „ „ „
1919-20	...	...	719 „ „	288 „ „ „

These returns are very high from trees which, during their third year, suffered severely from attacks of scale insects, which led to the growth being retarded over a period of some months.

The effect of the various manures and good cultural measures carried on, may also be shown by grouping the yields of the three plots which received identical treatment in the three series of experiments. By these means we arrive at the following interesting results :—

Three plots,  $\frac{1}{4}$ -acre each, receiving complete manure, yielded 233 barrels of fruit.

Three plots,  $\frac{1}{4}$ -acre each, receiving mulch, yielded 201 barrels of fruit.

Three plots,  $\frac{1}{4}$ -acre each, receiving nitrogen and phosphates, yielded 215 barrels of fruit.

Three plots,  $\frac{1}{4}$ -acre each, receiving nitrogen and potash, yielded 182 barrels of fruit.

Three control plots,  $\frac{1}{4}$ -acre each, yielded 175 barrels of fruit.

Owing to high and fluctuating prices, it is not possible to state with any accuracy the cost of applying a complete manure per acre, but, if we assume the amount to be in the vicinity of £8, we find, by taking the value of a barrel of limes at 6s. 8d. that an increase in crop per acre of about 24 barrels is sufficient to cover the cost of the application. It will be seen that a complete fertilizer has, in the above instance, covered the cost of manures, and yielded a considerable profit in addition, at a time in the life of plantation when the effect of manures is probably least felt, that is, in the vigorous youthful period of the plants.

## EXPERIMENTS WITH BUDDED LIMES.

Experiments with budded limes are also in progress. In this section there are two plots, each  $\frac{1}{4}$ -acre, of common limes budded on sour orange stocks, and one plot of the same area of spineless limes on the same kind of stocks. Adjoining this is a plot of ordinary seedling limes for comparison. During 1917-18 and 1918-19 the trees in each section have received a small dressing of organic nitrogen at the rate of 4 cwt. per acre. During the first three years of their existence one of the budded plots was grown with Tephrosia as a green dressing, the other in the usual way with weeds and grass, which was weeded occasionally; the spineless limes had green dressings of horse beans, and the seedling limes were clean weeded. Early in 1919-20 each plot received a complete manure of nitrogen, phosphates, and potash, and it is intended to maintain this series as complete manure plots. The crop yields of the plots since fruiting commenced are as follows:—

THREE YEARS' RESULTS OF EXPERIMENTS CONDUCTED WITH SPINELESS AND COMMON LIMES, BUDDED ON SOUR ORANGE STOCKS, AND WITH COMMON SEEDLING LIMES.

PLANTED JULY 1914.

SPINELESS LIMES BUDDED ON SOUR ORANGE STOCKS, GROWN WITH HORSE BEANS.

Year.	Size of plot.	Actual yield in barrels per plot.	Calculated yield in barrels per acre.
1917-18 ...	$\frac{1}{4}$ acre	8 $\frac{1}{2}$	34
1918-19 ...	$\frac{1}{4}$ acre	18	72
1919-20 ...	$\frac{1}{4}$ acre	34	136

COMMON LIMES BUDDED ON SOUR ORANGE STOCKS, GROWN WITH TEPHROSIA.

Year.	Size of plot.	Actual yield in barrels per plot.	Calculated yield in barrels per acre.
1917-18 ...	$\frac{1}{4}$ acre	8 $\frac{1}{2}$	33
1918-19 ...	$\frac{1}{4}$ acre	34 $\frac{1}{2}$	139
1919-20 ...	$\frac{1}{4}$ acre	40	160

BUDDED LIMES.

COMMON LIMES BUDDED ON SOUR ORANGE STOCKS, GROWN WITHOUT GREEN DRESSINGS.

Year.	Size of plot.	Actual yield in barrels per plot.	Calculated yield in barrels per acre.
1917-18 ...	$\frac{1}{4}$ acre	6	24
1918-19 ...	$\frac{1}{4}$ acre	13 $\frac{1}{2}$	54
1919-20 ...	$\frac{1}{4}$ acre	31	124

COMMON SEEDLING LIMES CLEAN-WEEDED.

Year.	Size of plot.	Actual yield in barrels per plot.	Calculated yield in barrels per acre.
1917-18 ...	$\frac{1}{4}$ acre	nil	nil
1918-19 ...	$\frac{1}{4}$ acre	16 $\frac{1}{2}$	67
1919-20 ...	$\frac{1}{4}$ acre	23	92

## EXPERIMENTS WITH BUDDED LIMES.

The returns from the four plots, 1 acre in extent, since bearing commenced, are as follows :—

1917-18	...	...	...	22 barrels of limes.
1918-19	...	....	...	83 " " "
1918-20	...	...	...	126 " " "

In this particular experiment the budded plants have done better than seedling limes, but whether the lead will be maintained is a matter which future work will be able to determine.

The results show clearly the tendency to early bearing which is characteristic of budded and grafted plants; but whether this is an advantage in the case of limes remains to be shown. Early bearing in this case tends to arrest growth, stunts the trees, and may bring about a state of ill health, unless the trees are highly manured. Generally speaking, it may be said that budding is the first step in the direction of intensive cultivation, and full advantage of its application will not be obtained unless intensive methods are applied throughout the lifetime of the plants.

The second point brought out is that a green dressing like Tephrosia, which affords a good ground cover as well as lateral protection over a period of two years or more, is very helpful to limes in their early stages.

The experiments made in budding the lime on the M'gergeb stock, a variety of citron obtained from Algeria by way of the Royal Botanic Gardens, Kew, and on the common citron, and their subsequent testing in the field were brought to an end. After four years in the field with the same attention as that accorded to seedling limes, and those budded on sour orange stocks, the plant may be said to have merely existed, and but little growth was made. This line of work has proved that the citron is of no use as a stock for the lime. The experiments in budding have shown, so far, that the sour orange is a good stock for this purpose, and that the grape fruit seedling is likely to rival the sour orange in this respect.

## PROPOSED NEW PLOTS.

With the development of the middle portion of the valley, it will soon be possible to start a new series of plots. It is to be hoped that such, when laid out, will be on the lines suggested in the Annual Report for 1918-19, that is, with complete manures in varying forms, and also a series intended to receive bi-yearly methods of treatment. By the latter is meant an application of mulch one year, followed by a complete concentrated manure the next. There is a strong probability that bi-annual treatment in orchard cultivation will yield good and lasting results, but, strange to say, this form of experiment appears never to have been tried in the British West Indies.

Should the lower part of the valley be planted shortly, it would also be a matter for consideration whether experiments consisting of plots drained and undrained, plots forked and not forked, and some weeded or outlashed twice a year, and others five or six times a year, should not be started. To each plot a certain complete manure should be applied, and the yields in each instance recorded.

The suggestions outlined above are dependent upon the erection of a factory to deal with the crop, and on the appointment of a competent manager for the Experiment Station. As matters are at present, it is not possible to initiate new experiments of any kind. It was pointed out in the Annual Report for 1918-19, that the twenty-one experiment plots now running, involved no less than from 1,260 to 1,470 separate measurements and records in the course of a year. With new experiments in view, it will be seen that this work, which requires great care, and has to be carried out in many cases under miserable conditions of weather, may easily be doubled. To attend to the manurial requirements of the

## LIME EXPERIMENT STATION.

plots, to manage labour, to carry on the routine cultural work of the Station, to plant and bring on new cultivation, to supervise the collection of limes and the manufacture of their products for market, to record the yields of the plots, and to meet in an efficient manner all the minor details arising out of this work, will afford constant employment all the year round to the most hard working and keenly interested person that can be found to fill the post.

## GENERAL REMARKS.

The acreage of the Experiment Station now established in bearing limes cannot be stated with accuracy; but it is about 9 acres in extent. A further 9 acres of land have been planted, and, now that the lower part of the valley has been placed under the control of the Agricultural Department, it should be possible in course of time to plant another 6 or 8 acres in this product. Generally speaking, the establishment of an area of 25 acres of limes should be aimed at.

The upper part of the valley now under bearing limes is formed of both steep and easy-sloping land, the middle, now under young cultivation, is mainly composed of steep hillsides with a shallow soil, and the lower part, which has still to be planted, is a little less steep than the middle portion. It will be observed that there are no flat lands.

On the starting of the Experiment Station an experienced planter expressed his doubts as to the outcome, owing to the ill usage which the soil had received over a long period; and another planter described the situation as being the most forbidding looking small valley in the whole of Dominica. It is probable that since the settlement of the island, these lands, until lately known as the 'Free Grounds,' were used by the peasants for raising garden crops, and that these were carried on for a year or two, and then abandoned, this process being repeated at intervals over a long period. During the same time, every piece of wood, as soon as large enough for firewood, was cut. Thus the soil was exhausted by cropping, baked by the sun, washed by the heavy rains, and swept by the wind without a single mitigating circumstance. Yet enough has been done in the few years to show that such lands, if carefully handled, can be made remunerative. There appears to be no reason why this valley, the soil of which has been subjected to every form of ill treatment, should not in time become one of the most fertile spots in the island.

The yield per acre from the 9 acres of bearing limes works out at 191 barrels of fruit, a good, but not a particularly high yield. Of the above area,  $5\frac{1}{2}$  acres are made up of old limes planted in 1893 by the boys of a Reformatory School which existed in those days at Morne Bruce. These plants were practically abandoned at the end of 1895, and remained in bush until again taken in hand early in 1913. These now form what may be called good average cultivation.

In July 1913,  $2\frac{1}{2}$  acres of young plants were placed out, and in July 1914, a further 1-acre was planted, three-fourths of the latter being planted with limes budded on sour orange stocks as an experiment.

The returns in crop from the  $2\frac{1}{2}$  acres of seedling limes are remarkable. Planted in July 1913, these were on March 31, 1920, six years and nine months old from planting in the field. In their early stages they were severely attacked by scale insects, which prevented the plants from making any progress in growth over a period of several months. During 1917-18 the crop per acre in barrels of limes was 55, during 1918-19, 175, and during 1919-20, 288.

These considerable yields within seven years from planting are high, and at the first glance may be thought by some to be the result of the application of quick-acting manures. This however, is not so. Of the area mentioned,  $\frac{1}{2}$ -acre receives no manure, and another  $\frac{1}{2}$ -acre receives mulch, the latter by no means a quick-acting and forcing agent. The nitrogen applied to the rest of the plots was in the form of Swift's organic manure, .003 grade, which contains 8 per cent. ammonia. As this could not be obtained early in 1919, the equivalent had to be applied in the form of the still slower-acting cotton-seed meal. It will be seen that the high yields in this instance are not due to quick-acting nitrogenous

manures, such as nitrate of soda and sulphate of ammonia, indeed not one pound of either has been used in the Experiment Station in the present series, so that the early and good returns have not been obtained in this case, as it is in some instances on estates, by drawing a heavy draft on the future of the cultivation.

Considering the poor nature of the soil in the first instance, it is reasonable to suppose that other influences, besides that of manures, have contributed to the results obtained. These contributory causes are to be found in the application of such measures as draining, taking steps to mitigate the effect of the wind, and keeping the fields free from weeds to a greater degree than is generally practised on estates. There can be no doubt that good cultural measures, as stated above, are necessary, if the trees are to obtain the maximum benefit of the manures applied.

It is by no means unusual to hear planters state that no visible results in the appearance of the trees or in increase of crop have followed the application of organic nitrogenous manures. This may be quite true, without the manure being of inferior quality or in any way at fault. When it is remembered that applications are made to fields, some situated on flat lands and some on slopes, in which there is no system of drainage, it is easy to understand what follows in the event of heavy rains falling a few days after the application.

Another reason why concentrated nitrogenous manures give but poor results, is due to failure on the part of the planter to keep the fields free of weeds. Application of these manures should be made about April-May, the spring time of the year. The light showers which usually herald the approach of the wet season should be the signal to do this work. In fields which are not kept clean, the manure is usually taken up by the crop of weeds, and the trees derive little benefit from it. In due course the weeds have to be outlasted or hoed, and their decay should result in a slow improvement of the soil. But this does not always follow, as much of this humus, especially in undrained lands, is washed away during the periodic torrential rains which are a somewhat frequent feature in the climatic condition of this island. It is possible in some instances, owing to a favourable situation, for the trees to get the indirect benefit of manures in this way on undrained lands, but in some cases, owing to a lack of sound cultural measures, there is, as is so often stated by planters, none or very little result. It is clear that direct, speedy, and profitable action is to be obtained only on plantations in which a good system of drainage has preceded the use of manures, and in which there are frequent weedings throughout the wet season.

The system of drainage carried out in the Experiment Station, which is being improved upon yearly, though perhaps far from perfect, should serve an object-lesson to planters in the chief points to be observed in draining fields. This essential work is seldom attempted in Dominica with the amount of care and forethought which is necessary to ensure success. Many planters are obsessed with the idea that water must be got off the land as quickly as possible, and therefore consider that the means of effecting this purpose is to run all the drains down hill. In such cases the rush of water during heavy rains leads to partial denudation and dispersal of the best soil in the field, a loss which affects the health of the trees, and shortens the life of the plantation.

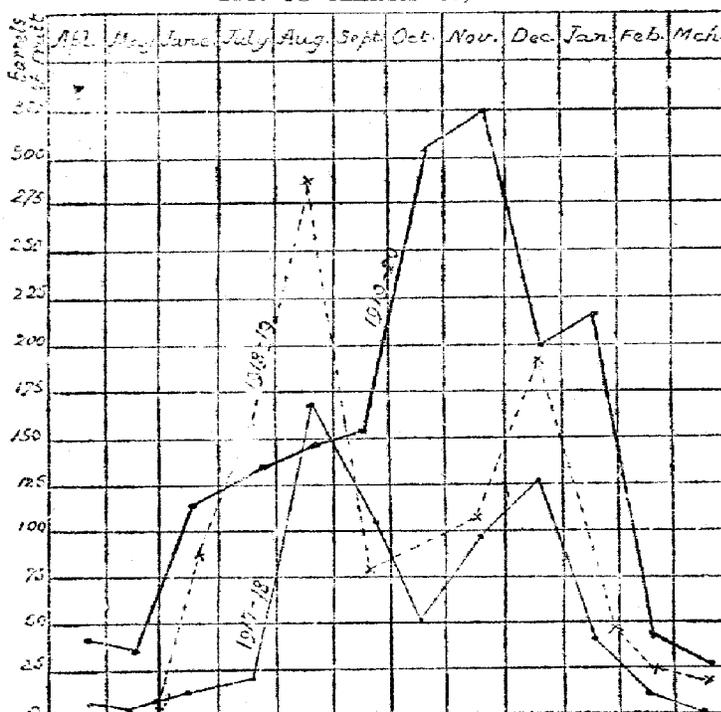
In orchard cultivation in Dominica drains should be run between each row of trees where possible, and always across the fall of the land, with the drains deepened sufficiently towards the outlet to ensure delivery to the main drain, which is usually, in our hilly and much broken country, a ravine, stream, or natural depression in the land. If the natural features of the locality are carefully studied, it will be found but rarely necessary to make main drains running down hill. In a sound system of drainage the soil is protected and conserved; when badly planned, the surface or fertile soil of the field is swept away to the sea.

In this connexion, another matter, which is often overlooked, is the failure to cut off by a large drain the cultivated fields lying at the foot of slopes from the catchment areas above. Sufficient rain falls on the land in the island for all requirements of plant life, and it is unnecessary and neglectful to allow cultivated areas to be flooded and washed periodically to their detriment by the surface water from catchment areas situated above them.

## CULTIVATION OF LIMES.

Apart from the question of purchasing concentrated manures for a plantation, there is the important matter of how to apply them. On this point there is much diversity of opinion. In the good old sugar days, it was customary in Dominica to apply concentrated manures by making three or four small holes around the cane plants, placing therein the allotted amount of manure, and covering it with soil. This appears to be a poor way of applying manure, even to a fibrous rooted plant which occupies no more than a root area of a few square feet of soil for its development. Unfortunately this practice has persisted in some instances, and we find to-day the same treatment being applied to the lime tree, a totally different plant, the roots of which ramify over an area of from 400 to 500 square feet or more, while the manure applied is confined to a space of a few square inches.

DIAGRAM SHOWING MONTHLY LIME CROP OF EXPERIMENT STATION FROM APRIL 1, 1917 TO MARCH 31, 1920.



Other planters, while favouring the distribution of fertilizers over the surface, decline to do so unless the land has been previously forked, the broken ground giving a feeling of security that, in the event of heavy rains, loss by wash or leaching will be mitigated.

The practice at the Cacao Experiment Station is to draw together in heaps the leaves which cover the ground, at the period of the year, May-June, and then to apply the manure over the surface, afterwards scattering the leaves again. In the Lime Experiment Station the manures are applied over the surface of the ground, and the scrapings of the drains scattered over them. These methods have given good results, and, pending further experiments, may be recommended for general use.

The question of forking the soil of plantations is another much debated point. In this connexion it is well to remember that the soils of Dominica fall under two heads; that is, the rich dark soils of the valleys, and the reddish soils of the uplands. The former are not easily compacted, and if a drain is run between each row of

trees, thus forming the 'bank' or 'bed' system of cultivation, and manures are applied regularly, such lands can go for a long period without the need of forking. On the other hand, the upland soils, especially under the conditions of a lime plantation in which there is a considerable amount of trampling over the soil to collect the fruit, tend to compact, and it would appear that occasional forkings are necessary in these instances to keep the trees in a healthy condition. But it is also desirable to make experiments with a view of finding out if vertical forking, that is driving a fork in the soil, and then moving the handle backwards and forwards in order to crack and thus aerate the land, would not be better than the turning over of the soil, which causes wholesale breaking of the roots. It cannot be doubted that a good deal of the forking done at present, while it may improve the mechanical condition of the soil, gives a severe set-back to the trees. Experiments are needed to find out if the necessary aeration cannot be effected without injury to the cultivation.

One of the best means of reducing the need of forking would be the general adoption of the 'bank' or 'bed' system of growing limes; that is, to run a drain between each row of limes. If such drains are properly constructed, most of the fruit on falling would roll into them, and pickers, if supplied with a small wooden rake, could easily draw into them such as did not. Under such conditions, practically all the trampling would be done in the drain, and compaction of the soil on the beds would not take place to any extent. It is the constant trampling of the soil by labourers in undrained fields which renders forking necessary. The soil itself, subject as it is to the ameliorating conditions of the weather, will remain in good condition in orchard cultivation for long periods, if well drained and manured.

The defect of this system is the possible loss of great quantities of limes by their being swept away during torrential rains. That loss goes on to a considerable degree in undrained fields with little chance of prevention, but in drained areas, it should not be beyond the wit of the planter to prevent this. It is clear that the small barriers which are sometimes erected across drains in fields with this view are of little use. A better plan would be to take advantage of the position in the main drains in which the water falls suddenly, a matter of 2 or 3 feet or more, thus forming a cascade—a not infrequent condition in a hilly country, and to spread wire netting or other suitable material secured on small posts and cross pieces in front of the cascade, so that the water would drop through the netting, and the limes would be shot forward, and remain on the farther portion of the platform.

It would appear that efficient means of securing limes carried away by water must be constructed horizontally, and not, as attempted at present, by perpendicular obstructions.

## Details of Administration.

### EXPENDITURE, RECEIPTS, ETC.

#### EXPENDITURE.

The votes for the Agricultural Department for the year were as follows.—

	£	s.	d.
Salaries, Curator, Assistant Curator and Foreman	657	0	0
Travelling expenses	50	0	0
Maintenance, Botanic Gardens	280	0	0
Cultivation of saleable products	260	0	0
Fumigation of imported plants	5	0	0
Maintenance, public gardens	15	0	0
Purchase of special manures	50	0	0
Printing reports, etc.	40	0	0
Cacao Prize Holdings Competition	25	0	0
Experiment Station	250	0	0
Purchase of vegetable seeds	25	0	6
Trial shipments of fruit	20	0	0
Field experiments	20	0	0
Chemicals and apparatus	25	0	0
Lime mill for Experiment Station	200	0	0
Purchase of horse	10	0	0
Contingencies	10	0	0
Telephone	8	0	0
Agricultural instruction	199	0	0
	<b>£2,149</b>	<b>0</b>	<b>0</b>

The actual expenditure during the year under the above heads was £1,698 9s.

#### RECEIPTS.

The receipts under the various heads were as follows:—

	£	s.	d.
Lime	£25	6	7
Cacao	395	14	2
Nutmegs	15	12	10
Kola nuts	12	8	1
Plants	113	7	2
Fruit	13	16	9
Vegetable seeds	13	16	9
Cassia pods	10	7	11
Miscellaneous	7	13	6
<b>Total</b>	<b>£1,220</b>	<b>19</b>	<b>8</b>

The total cost of the Agricultural Department during 1919-20 was therefore £447 9s. 5d.

#### STAFF CHANGES.

Mr. C. A. Gomez, Acting Assistant Curator since November 1918, left the Department on September 31, 1919, to take up the duties of Acting Curator at the Experiment Station, Tortola.

## CORRESPONDENCE, ETC.

Mr. Alfred Keys, of the Royal Botanic Gardens, Kew, arrived in the island on October 1, and filled the vacant post of Assistant Curator.

In connexion with agricultural instruction, J. Hutton, senior agricultural pupil, was selected as overseer in place of J. LeBlanc.

## ADDITIONS AND REPAIRS TO BUILDINGS, NURSERIES, ETC.

The roof of the garden pavilion was renewed, and the building painted. Other alterations, effected under the direction of the Public Works Department, were the strengthening of the cacao drying house in the Gardens, and certain minor improvements in the quarters occupied by the Assistant Curator at Morne Bruce.

## CORRESPONDENCE AND DISTRIBUTION OF INFORMATION ON AGRICULTURAL MATTERS.

During the year, communications were dispatched from the office of the Department, and 104 minute papers were dealt with. Ninety-eight copies of the various issues of the *West Indian Bulletin*, and 164 of the Annual Report on the Agricultural Department for 1918-19, were distributed free of charge to leading planters, officials, and others in the island.

As in previous years, the Department was visited by a large number of planters and others desiring information on agricultural matters.

No new books were added to the Library during the year, but the publications of a number of Tropical Agricultural Departments were duly received and bound. The opportunity is again taken to thank those Departments who kindly forward their publications.

## PLANT AND SEED EXCHANGES, FOREIGN AND LOCAL.

Contributions of seeds and plants were received from the following:—

The Imperial Commissioner of Agriculture; Royal Botanic Gardens, Kew; Botanic Gardens, Buitenzorg, Java; Ministry of Agriculture, Cairo, Egypt; Botanic Gardens, Ceylon; the Agricultural Departments of Trinidad, Jamaica, Antigua, Montserrat, St. Lucia, and Grenada.

Seeds and plants were sent to the Imperial Commissioner of Agriculture, Royal Botanic Gardens, Kew; the University of Toronto; Experiment Station, Porto Rico; Botanic Gardens, Buitenzorg, Java; Chamber of Commerce, Martinique; Ganeshkhiud Gardens, Poona, India; Botanic Gardens, Ceylon; Les Tropiques, Nice, France; Experiment Station, Guadeloupe; the Agricultural Departments of British Guiana, Trinidad, Barbados, Grenada, St. Vincent, St. Lucia, Antigua, Montserrat, St. Kitts, and Tortola.

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**METEOROLOGICAL RETURNS**


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**VISITS BY OFFICIALS OF THE DEPARTMENT.**

His Excellency the Governor, Sir Edward Marsh Merewether, K.C.M.G., on the occasion of his stay in Dominica during May, visited the Botanic Gardens and Experiment Station.

Sir Francis Watts, K.C.M.G., Imperial Commissioner of Agriculture for the West Indies, paid a visit to the Botanic Gardens and Experiment Station on March 5, on his way to the Northern Islands, and again on March 17, on his return voyage to Barbados.

Mr. H. A. Ballou, Entomologist on the staff of the Imperial Department of Agriculture for the West Indies, arrived in the island on January 7, and visited estates in the Soufrière district to investigate an outbreak of scale insects. He departed for Antigua on January 11, and on his return voyage to Barbados, on March 17, paid another visit to the Gardens.

Other visitors during the year were: Mr. Frank Keefer, Canadian Parliamentary Under Secretary of State for External Affairs; Mr. J. E. Bovell, I.S.O., Director of Agriculture, Barbados; Mr. W. Robson, Curator, Botanic Station, Montserrat; Dr. A. S. Hitchcock, Agrostologist, United States Department of Agriculture; and Mr. T. Jackson, Agricultural Superintendent, St. Vincent.

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**METEOROLOGICAL RETURNS.**
**RAINFALL.**

The rainfall at the Botanic Gardens for 1919 amounted to 68.03 inches, or 3.21 inches less than the previous year, and 9.67 less than the average annual precipitation for the last twenty-seven years, which is 77.70.

The following table shows the mean monthly and annual rainfall at the Botanic Station from 1893 to 1919, a period of twenty-seven years, and the accompanying chart shows at a glance the fluctuation from year to year.

RAINFALL AT THE BOTANIC STATION, DOMINICA, 1898-1919.

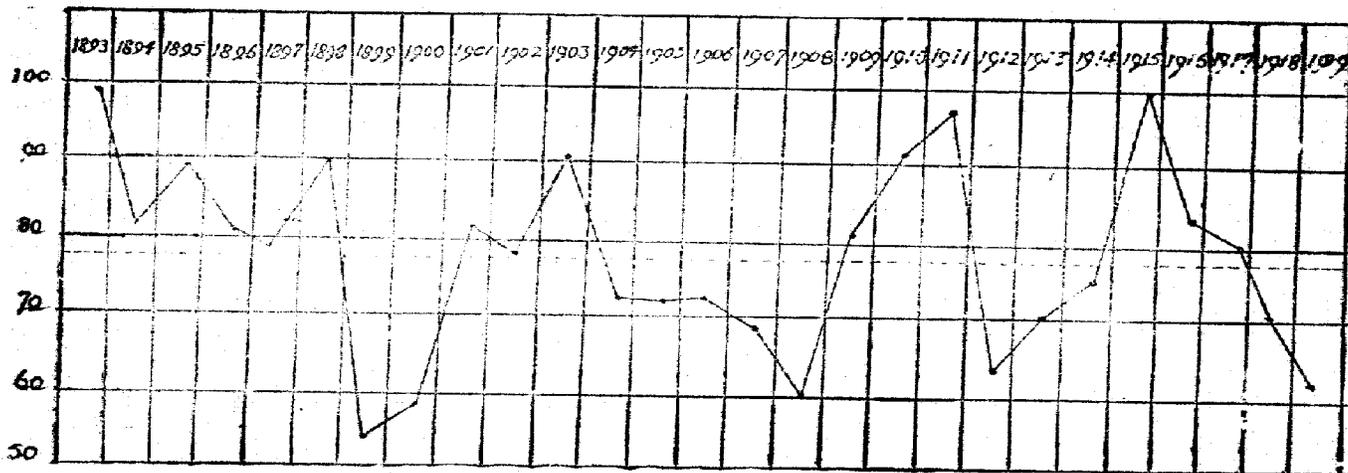
Month.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.	1908.	1909.	1910.	1911.	1912.	1913.	1914.	1915.	1916.	1917.	1918.	1919.	Monthly Total
January	3.62	10.20	4.08	5.52	2.60	3.00	6.78	2.25	4.52	2.01	3.10	7.92	3.86	3.74	4.48	1.56	2.30	5.20	11.46	8.21	7.48	3.22	1.76	10.79	5.00	6.02	2.42	4.92
Feb. ...	7.65	4.99	1.09	1.23	3.21	2.11	3.00	1.15	0.88	0.43	5.01	5.58	2.56	2.04	3.82	1.16	5.02	11.42	4.00	1.82	2.32	5.56	1.04	1.90	4.10	8.73	1.52	3.43
March	2.97	4.39	5.35	2.73	3.36	1.53	1.32	3.36	3.27	2.69	2.44	2.16	4.38	0.90	1.96	3.68	2.08	1.16	3.11	4.61	7.29	2.23	0.84	4.52	6.74	3.32	0.69	3.08
April ...	4.71	2.33	2.92	1.27	1.39	0.75	0.60	1.29	0.25	2.80	0.57	1.64	1.90	3.18	2.66	3.08	8.12	2.86	5.00	3.38	1.57	6.45	15.75	1.22	0.47	1.86	2.36	2.97
May ...	5.45	3.09	10.08	6.12	12.75	1.16	1.76	7.62	2.05	6.86	2.44	1.53	4.32	3.78	1.64	2.24	1.93	7.30	11.16	1.56	3.46	2.58	3.65	2.05	2.94	5.90	4.60	4.44
June ...	16.12	8.2	3.10	8.23	6.50	11.78	7.23	5.59	12.16	12.89	9.02	6.00	5.54	9.46	5.54	6.16	9.00	14.26	6.54	5.44	3.49	7.27	9.17	4.82	15.34	6.04	3.88	8.10
July ...	13.67	8.62	7.13	14.88	8.80	14.75	10.08	10.30	22.96	9.74	8.91	10.38	6.10	10.10	8.00	9.22	9.86	12.60	8.08	5.83	7.57	11.83	14.84	8.23	13.70	11.28	12.64	10.75
August	11.86	5.84	9.07	7.07	8.87	16.35	6.32	7.34	13.53	7.41	18.41	7.69	14.18	7.30	7.40	9.41	13.12	10.22	11.43	4.88	10.93	3.98	14.74	16.58	8.58	8.46	9.64	10.04
Sept. ...	11.15	3.22	17.72	9.47	4.51	7.89	7.04	5.28	5.86	8.62	9.69	11.32	8.92	10.88	11.60	7.52	6.44	8.90	15.34	3.32	8.39	7.71	11.36	6.20	15.02	4.14	7.06	8.75
October	8.94	14.41	11.32	3.93	8.42	7.97	1.31	6.60	4.81	5.75	12.73	10.21	9.10	8.12	7.80	5.12	13.10	3.82	7.06	7.26	10.40	5.13	8.41	10.06	2.46	6.67	7.50	7.73
Nov. ...	3.18	6.14	11.21	16.81	7.81	6.55	5.02	3.49	6.43	11.20	4.17	3.13	5.48	9.58	5.98	1.96	4.36	5.40	6.94	11.20	4.28	9.44	10.05	14.28	1.92	3.36	9.02	6.97
Dec. ...	10.61	4.89	5.66	6.60	10.55	5.86	2.19	3.68	4.32	7.16	14.23	4.84	5.72	2.94	8.42	7.80	5.82	7.50	7.14	6.66	2.72	9.70	8.40	3.77	4.58	5.86	6.70	6.46
Total	90.93	81.44	80.12	80.86	78.77	79.73	53.15	58.85	81.09	77.56	90.72	72.45	72.06	72.02	69.30	58.51	81.14	90.64	97.26	63.72	69.90	75.10	100.01	84.42	80.80	71.46	68.03	176.7

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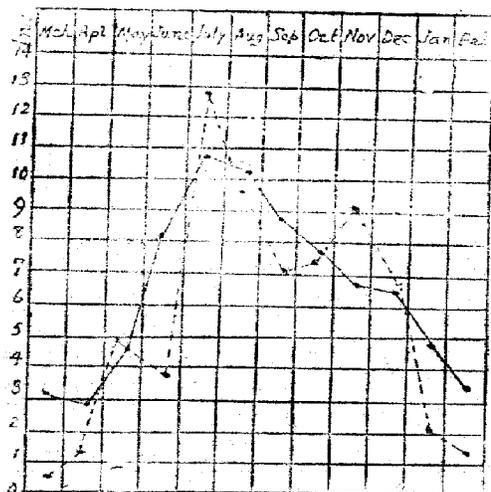
METEOROLOGICAL RETURNS.

DIAGRAM SHOWING ANNUAL RAINFALL IN THE BOTANIC GARDENS, DOMINICA, 1893-1919. THE AVERAGE FOR THIS PERIOD—77.70 INCHES—IS SHOWN BY THE DOTTED LINE.



Another dotted chart shows the mean monthly rainfall over the same period. From this it will be observed that the months of February, March and April are the dry months, with a mean rainfall of about 3 inches, and that of July and August are the wettest months, with a precipitation of over 10 inches.

DIAGRAM SHOWING MEAN MONTHLY RAINFALL, BOTANIC GARDENS, DOMINICA, FOR TWENTY-SEVEN YEARS 1893-1919. THE MONTHLY RAINFALL FOR THE YEAR UNDER REPORT IS SHOWN BY THE DOTTED LINE.



Following the above will be seen the monthly rainfall at the twenty-seven recording stations located in different parts of the island. The thanks of the Department are due to those planters who furnish the information from year to year.



## Manurial Experiments with Cacao.

The customary review of the results obtained in the manurial experiments with cacao conducted by the Agricultural Department in Dominica is now given.\*

A change in the method of presenting the report was made in 1916-17, and the method then adopted is again used. Nine of the eleven plots have been running for a sufficient length of time to draw definite conclusions therefrom, and these only are discussed in the present report. The remaining two, started in 1913-14, have met with vicissitudes in regard to the manurial treatment owing to the shortage and difficulty in obtaining certain kinds of concentrated manures. Although it was not possible to obtain Nitrolim, the nitrogen was applied in another form, and the records have been carefully kept to date. The results may be published in a later report.

The first seven plots are situated on level ground, and occupy approximately 2 acres. The soil is moderately even in character, especially that of plots 1, 2, 3, 6 and 7. Plots 4 and 5, on a lower level, are rather heavier, plot 4 being distinctly so.

Plots 8 and 9 are situated on a steep hillside, a situation typical of many acres in cultivation in Dominica.

A question that will probably be asked in connexion with the manuring of the experiment plots during recent years is 'How has a supply of sulphate of potash been obtained?' The answer is simple. During 1915, before the price of this manure rose in value, the Department obtained a sufficient quantity to carry on the experiments to the present year.

The physical and chemical nature of the soils of the plot has been ascertained at the Government Laboratory, Antigua, and may be seen on reference to the *West Indian Bulletin* (Vol. 14, pp. 81-119).

It is here necessary to make a correction in the published figures of the last few years. In a paper recently published† on the significance of the results obtained in these experiments, the writer, Mr. W. R. Dunlop, makes the following statement:—

'In previous statements of the results of these experiments however, one important point has not been taken into account. It will be observed that the yield of the control plot began some 300 lb. of cured cacao per acre below the plots which were to receive treatment: . . . allowance should have been made for this constant difference.'

On referring to previous reports of this Department, it will be ascertained that in the year 1900-1, the Hon. (now Sir) Francis Watts laid out a certain scheme of manurial treatment, which after slight modification was adopted in that year. The manures were applied in May-June of the same year for the first time, and the same manures have been used annually without a break since that date.

In the following year (Annual Report, 1901-2, p. 5), the following report on these plots appeared:—

The cacao manurial plots failed to show any improvement over the control plot during the year. This is attributable to two very dry years, the rainfall in which was 33.31 inches and 23.95 inches, respectively, below the average. During the present period the rainfall has been normal, but badly distributed, nearly 50

\* Owing to certain difficulties during recent times it has not been possible to present the results since 1916-17. In the present report the plot returns for the past three years are included, a course which brings the experiments up to date.

† *West Indian Bulletin*, Vol. XVI, pp. 121-26.

## CACAO EXPERIMENTS.

inches falling in June, July and August. The experiment will be continued, and the result of the application of special manures, if any, noted under normal climatic conditions.

'What strikes one most in dealing with fields made up of various strains, is that certain kinds of cacao usually bear well while, other trees exist that year after year bear little or nothing. This shows the importance of selecting pods for seed from prolific strains only. This has been done largely in Dominica for the past nine years. All the plants and pods distributed are carefully selected, and in quality and bearing powers Dominica cacao should show a great improvement in the future.'

For the first two years the yields of the plots were not actually weighed, as it was then thought possible to estimate the results sufficiently accurately by the appearance of the trees and the crops thereon. After two years of manuring the plots failed to show any visible improvement over the control plot.

During 1902-3, after the third application of manures, it was decided to weigh the yields from each plot separately, and the figures were published.

The conclusion of the writer referred to above, as to the natural yield of the control plot being lower, cannot be accepted as definite. The increase of some 300 lb. of cured cacao per acre shown by all the plots over the control plot in 1902-3, may quite easily have been due to the two applications of manure they had received, and not to the supposed smaller 'natural yield' of the control plot. As reference to these reports show, the control plot was in no way inferior to the other plots at the outset of the experiment.

It is regretted that these facts were omitted from previous recent reports; the omission has led to a certain amount of confusion.

The first five plots were thus started in the year 1900-1, and the crops were first weighed in 1902-3. Similar treatment has been accorded to each plot in every succeeding year, so that at the present time the condition of each represents the accumulated results of twenty years' continuous treatment on the same lines. The remaining four plots were started seven years later, and each plot has thus obtained identical treatment for thirteen years.

## CACAO EXPERIMENTS.

TABLE I.

## AREA OF PLOTS UNDER EXPERIMENT, 1919-20.

The following table shows the number of trees per plot and per acre at the present time, the area of each plot, the manurial treatment received, and the year of the first application of the manure :—

Number.	Letter on station plan.	No. of trees per plot, 1920.		Area of plots, in acres.	Manurial treatment.	Year of first application.
		Bearing.	Non-bearing.			
1	C	51	20	0.28	No manure. Basic slag, 4 cwt per acre. Sulphate of potash, 1½ cwt. per acre.	1900-1
2	A	58	13	0.29	Dried blood, 4 cwt. per acre.	"
3	B	58	10	0.36	Basic slag, 4 cwt. per acre. Dried blood, 4 cwt. per acre. Sulphate of potash, 1½ cwt. per acre.	"
4	E	53	3	0.29	Mulched with grass and leaves, 5 tons per acre.	"
5	D	50	6	0.37	Mulched with grass and leaves, 4 tons per acre.	"
6	F	50	2	0.25	Cotton-seed meal, 600 lb. per acre.	1907
7	G	49	3	0.25	No manure.	"
8	H	103	11	0.414	Mulched with grass and leaves, 5 tons per acre.	"
9	I	88	5	0.373		"

Some years ago the plan was adopted of planting on each plot a sufficient number of trees to cover the ground, and the figure given represents the number of bearing trees in each plot at the present time. The continued fluctuation in the number of trees rendered the figures for the yield per tree very uncertain, and this has in consequence been omitted from the results for the season now under review.

The plots have received the same manurial dressings as in previous years. The method of application consists of raking away the leafage in a circle round each tree, applying the manure in the space thus uncovered, and then raking back the leaves over the manure. In those plots receiving both basic phosphate and dried blood, an interval of several weeks is allowed between the application of the two manures. The mulch after being carefully weighed is scattered evenly over the surface of the plot. The material of which the mulch is composed is of two types, varying widely in their chemical composition. To the mulched plots 5 and 6, varying quantities of mulch composed largely of fallen leaves and pods of the Saman tree (*Pithecolobium Saman*) are used; for plots 9 and 10 no Saman tree material is utilized, but in this case the fallen leaves of the West Indian mahogany tree (*Swietenia Mahagoni*) supply the mulching material. The manures and the mulch are applied once a year. These are the sources of coarse organic matter which are available in an experiment station of this nature. Similar results would in all probability be obtained by the use of many other forms of organic matter. As an appendix to the Annual Report for 1915-16, there was given the analysis of a large number of materials which could be utilized equally well. Several of these are under experiment in this Station, and reliable information as to the quantity which can be produced, and cost of production will, we hope, be soon available. The value of several of these manures, such as pen manure, sheep manure, etc., is well known and appreciated by planters.

No forking has been performed in any of the plots since the inception of the experiments, the only cultural operations undertaken beyond the application of the manures being the usual ones connected with the pruning of trees, and sanitation of the orchard.



## CACAO EXPERIMENTS.

TABLE II.

## MAIN SERIES.

Yield for twenty years, 1900-20.

Year.	Plot 1.		Plot 2.		Plot 3.		Plot 4.		Plot 5.	
	No manure.		Phosphate and potash.		Dried blood.		Dried blood, phosphate and potash.		Mulched with grass and leaves.	
	Per plot.	Per acre.	Per plot.	Per acre.	Per plot.	Per acre.	Per plot.	Per acre.	Per plot.	Per acre.
1900-2.	No	records	were	kept.						
1902-3.										
Wet cacao ...	759	2,711	1,063	3,666	1,281	3,588	1,104	3,807	1,145	3,095
Cured cacao ...	...	1,138	...	1,540	...	1,494	...	1,599	...	1,300
1903-4.										
Wet cacao ...	548	1,956	808	2,786	970	2,694	738	2,545	962	2,600
Cured cacao ...	...	822	...	1,170	...	1,131	...	1,069	...	1,092
1904-5.										
Wet cacao ...	673	2,403	814	2,801	970	2,694	979	3,376	1,279	3,457
Cured cacao ...	...	1,009	...	1,179	...	1,131	...	1,418	...	1,450
1905-6.										
Wet cacao ...	748	2,672	763	2,331	1,056	2,933	1,040	3,586	1,519	4,105
Cured cacao ...	...	1,122	...	1,105	...	1,232	...	1,596	...	1,724
1906-7.										
Wet cacao ...	730	2,607	887	3,059	972	2,700	1,009	3,479	1,536	4,151
Cured cacao ...	...	1,095	...	1,285	...	1,134	...	1,461	...	1,743
1907-8.										
Wet cacao ...	903	3,225	1,160	4,000	1,381	3,836	1,180	4,069	1,773	4,792
Cured cacao ...	...	1,354	...	1,680	...	1,611	...	1,709	...	2,012
1908-9.										
Wet cacao ...	978	3,492	1,205	4,155	1,377	3,825	1,344	4,634	1,777	4,803
Cured cacao ...	...	1,467	...	1,745	...	1,607	...	1,946	...	2,017
1909-10.										
Wet cacao ...	848	3,029	963	3,921	1,167	3,241	1,267	4,369	1,822	4,924
Cured cacao ...	...	1,272	...	1,395	...	1,361	...	1,835	...	2,068
1910-11.										
Wet cacao ...	859	3,067	1,097	3,783	1,289	3,581	1,297	4,473	1,890	5,107
Cured cacao ...	...	1,288	...	1,589	...	1,504	...	1,879	...	2,145
1911-12.										
Wet cacao ...	804	2,871	1,012	3,490	1,272	3,533	1,272	4,387	1,721	4,651
Cured cacao ...	...	1,206	...	1,466	...	1,484	...	1,842	...	1,953
1912-13.										
Wet cacao ...	892	3,186	1,089	3,752	1,512	4,200	1,314	4,531	2,001	5,408
Cured cacao ...	...	1,338	...	1,576	...	1,764	...	1,903	...	2,271
1913-14.										
Wet cacao ...	678	2,422	885	3,050	1,133	3,147	1,104	3,807	1,509	4,078
Cured cacao ...	...	1,017	...	1,281	...	1,322	...	1,599	...	1,713
1914-15.										
Wet cacao ...	779	2,782	1,049	3,617	1,366	3,794	1,133	3,907	1,715	4,635
Cured cacao ...	...	1,168	...	1,519	...	1,593	...	1,641	...	1,947
1915-16.										
Wet cacao ...	715	2,554	1,110	3,827	1,298	3,607	1,069	3,686	1,474	3,984
Cured cacao ...	...	1,073	...	1,607	...	1,514	...	1,548	...	1,673
1916-17.										
Wet cacao ...	941	3,361	1,285	4,431	1,497	4,158	1,486	5,124	1,772	4,789
Cured cacao ...	...	1,412	...	1,861	...	1,746	...	2,152	...	2,011
1917-18.										
Wet cacao ...	543	1,939	788	2,717	887	2,463	805	2,776	1,277	3,451
Cured cacao ...	...	814	...	1,141	...	1,035	...	1,166	...	1,449
1918-19.										
Wet cacao ...	603	2,153	955	3,293	1,114	3,094	1,191	4,107	1,417	3,829
Cured cacao ...	...	905	...	1,383	...	1,299	...	1,725	...	1,909
1919-20.										
Wet cacao ...	694	2,478	845	2,914	1,006	2,791	963	3,320	1,379	3,727
Cured cacao ...	...	1,041	...	1,224	...	1,173	...	1,394	...	1,505

## CACAO EXPERIMENTS.

TABLE III.

## ADDITIONAL SERIES.

Yield for thirteen years, 1907-20.

Year.	Plot 6.		Plot 7.		Plot 8.		Plot 9.	
	Mulched with grass and leaves.		Cotton-seed meal.		No manure.		Mulched with grass and leaves.	
	Per plot.	Per acre.	Per plot.	Per acre.	Per plot.	Plot acre.	Per plot.	Per acre.
1907-8.								
Wet cacao ...	881	3,524	1,019	4,076	882	2,130	1,053	2,823
Cured cacao ...	...	1,480	...	1,712	...	895	...	1,186
1908-9.								
Wet cacao ...	1,119	4,476	1,060	4,240	957	2,311	1,214	3,255
Cured cacao ...	...	1,880	...	1,781	...	971	...	1,367
1909-10.								
Wet cacao ...	1,242	4,969	1,039	4,156	965	2,331	1,352	3,625
Cured cacao ...	...	2,687	...	1,746	...	979	...	1,523
1910-11.								
Wet cacao ...	1,225	4,900	1,006	4,024	977	2,860	1,897	5,086
Cured cacao ...	...	2,058	...	1,690	...	991	...	2,136
1911-12.								
Wet cacao ...	1,070	4,280	923	3,692	924	2,232	1,669	4,476
Cured cacao ...	...	1,798	...	1,549	...	937	...	1,879
1912-13.								
Wet cacao ...	1,377	5,508	1,207	4,828	845	2,041	1,674	4,487
Cured cacao ...	...	2,313	...	2,028	...	857	...	1,885
1913-14.								
Wet cacao ...	1,300	5,200	924	3,696	767	1,853	1,548	4,150
Cured cacao ...	...	2,184	...	1,552	...	778	...	1,743
1914-15.								
Wet cacao ...	1,529	6,116	1,229	4,918	947	2,287	1,750	4,692
Cured cacao ...	...	2,569	...	2,035	...	960	...	1,971
1915-16.								
Wet cacao ...	1,380	5,520	977	3,908	814	1,966	1,432	3,839
Cured cacao ...	...	2,318	...	1,641	...	825	...	1,612
1916-17.								
Wet cacao ...	1,380	5,520	1,118	4,472	1,124	2,715	1,563	4,190
Cured cacao ...	...	2,318	...	1,878	...	1,140	...	1,760
1917-18.								
Wet cacao ...	1,045	4,180	646	2,584	547	1,321	819	2,196
Cured cacao ...	...	1,756	...	1,085	...	555	...	922
1918-19.								
Wet cacao ...	1,185	4,740	890	3,560	669	1,616	929	2,490
Cured cacao ...	...	1,991	...	1,495	...	678	...	1,046
1919-20.								
Wet cacao ...	1,206	4,824	756	3,024	653	1,577	1,093	2,930
Cured cacao ...	...	2,026	...	1,270	...	662	...	1,231

## CACAO EXPERIMENTS.

TABLE IV.

## AVERAGE ANNUAL RETURN FOR EIGHTEEN YEARS.

The following supplementary table gives the average annual return of wet and dried cacao in pounds for eighteen years in the case of the first five plots, and for thirteen years in the case of plots 6 to 9. The last column shows the percentage increase of each plot over the no-manure plot:—

No.	Manurial treatment.	Wet cacao,		Cured cacao,	Increase over No-manure plot, per cent.
		per plot.	per acre.	per acre.	
Average for 18 years.					
1	No manure ... ..	761	2,717	1,141	...
2	Phosphate and potash ...	987	3,405	1,430	25.3
3	Dried blood ... ..	1,197	3,325	1,396	22.3
4	Dried blood, phosphate and potash ... ..	1,127	3,886	1,633	43.1
5	Mulched with grass and leaves	1,553	4,198	1,763	54.5
Average for 13 years.					
6	Mulched with grass and leaves	1,226	4,905	2,060	138.5
7	Cotton-seed meal ... ..	984	3,936	1,653	91.4
8	No manure ... ..	851	2,055	803	—
9	Mulched with grass and leaves	1,383	3,709	1,558	80.4

In former reports the pecuniary aspect of the experiments was shown in one table for the year under review, and in another for the whole period of the experiments, but in these times of high rates for manures, prohibitive in some instances, and fluctuating prices for cacao, such tabulations convey little in the way of reliable information. To those planters who are interested, the above table showing percentage increases over no-manure plots, will afford facts for consideration and future guidance.

## GENERAL REMARKS.

A study of the figures in Tables II and III shows that the crop returns of all the plots were very high during 1916-17, and that the following year a great falling off occurred. This was due to the hurricane of 1916. During this occurrence plots No. 4 and 5, which are more exposed than the others, were considerably damaged, and the trees in all the plots were severely shaken. The effect of this was not an immediate falling off of crop; on the contrary, a considerable increase resulted as shown by the figures for the following season. The injury to the trees was such that the heavy fruiting which followed was probably of the nature of a dying effort. After this period much drying up of branches took place, and the crop during the year following was the smallest one recorded during the whole series of the experiments. Up to the present date, and four years after the disastrous occurrence of 1916, the plots have not regained the standard of productivity which marked the pre-hurricane period. This is a striking example of the greatest set-back which orchard cultivation receives in those countries which experience occasionally the full force of tropical cyclones.

## CACAO EXPERIMENTS.

The main series of experiments which consists of five plots has been under the same treatment for twenty years. The results have been recorded with care for eighteen years. They are situated on level land, and are not subject to wash by heavy rains. In the additional series which consists of four plots, two are situated on level land, and two, one being the control, on a steep undrained hillside. It will be observed that the percentage increase over the no-manure plot is much higher in the second series than in the main series of experiments. This difference can only be due to the effect of surface wash which occurs on steep hillsides. The control plot situated on level land in the main series slowly yields up its supplies of plant food and is subject only to the drain of the trees growing upon it. In the case of the control plot on the hillside, there is a second cause of loss; that is, the periodic sweeping away of the surface soil during heavy rains. This is a point that deserves consideration by those who are ever ready to affirm that hillsides under cultivation, whether the slopes be steep or easy in character, do not require a drainage system.

Another point brought out by the hillside plots is the exceedingly good effect, under ordinary conditions, of a surface mulch in preventing loss by wash on undrained sloping land. The application of mulches to slopes which have been properly drained should result in a fertility and productivity nearly equal to the best level lands under similar treatment.

The effect of the various manures on cacao is clearly brought out in the tables of records, and particularly so in that showing the percentage increases. As far as orchard cultivation is concerned, the results show the great advantages which follow the use of a complete fertilizer.

Keenly interested cultivators are not likely to be content with anything less than the best results, and it is clear that such can only be attained by the application of a complete concentrated manure, or by suitable quantities of pen manure or mulches. And the planter who applies complete manures, coupled with the carrying on of good cultural measures, gets in return much more than is shown in tabulated statements. By such means he increases the fertility of the soil, and adds to the capital value of his estate. Suitable complete manures give healthy trees, good crops, and tend, under normal conditions, to reduce insect attacks and fungoid diseases to a minimum. Further, there cannot be much doubt that by following Nature's system of fertilizing, that is, mulching the surface of the ground, yields the best results. In Dominica where a bird's-eye view of the plots can be obtained from close range, the leaves of the trees in the mulched plots possess a distinct hue or tint which evidently represents a perfect state of health and vigour, which is absent from the trees in all other plots.

It can only be regarded as unfortunate, in view of the excellent results obtained by mulching, that in a country like Dominica, where there is an abundance of this material, so little use is made of it. However near these supplies may exist to fields greatly in need of manure, planters usually hold that the material is too far away, and that it is too expensive to cut and apply to the land. Even in places where a supply is not easily available, there are always odd corners, such as banks of rivers and streams and steep hillsides, where grasses and leguminous plants could be easily grown for this purpose at a cost per acre below that needed to purchase a complete concentrated manure. In the meantime owing to the small amount of imported fertilizers used, to their irregular application—probably once in four or five years, instead of every year—and to the fact that larger areas are not manured, it may be stated truly that 90 per cent. of the cultivated lands in this island are being allowed to decline in fertility, while in the majority of cases there lies close at hand an abundance of material provided by Nature for soil renovation. But the will to use it is absent, and thousands of lime and cacao trees continue to starve for want of a supply of humus.

As it is unlikely that any further information will be obtained from the plots in their present form, also, as it is clear that complete manures are a necessity in orchard cultivations, it would appear desirable to bring the present treatment to an end, with a view of starting, as soon as manures are obtainable freely, a new series in which the plots now receiving complete manure would be continued, and in which the control, as well as other plots now receiving incomplete manures, would receive a complete fertilizer. The experiments having shown the need of complete manures, it is now desirable to test the effects of nitrogen, phosphates, and potash in varying forms, and the plots might be so arranged as to give effect to this. The starting and carrying out of such a system of experiments appears to be the natural sequence of the work done during the past twenty years.

See page 6  
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