Supplement to the "Queensland Agricultural Journal," October, 1933.

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The Hon. the Secretary for Agriculture

Edited by J. F. F. REID

JANUARY to JUNE, 1933

Supplement to the "Queensland Agricultural Journal," October, 1933.

QUEENSLAND AGRICULTURAL JOURNAL.

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QUEENSLAND AGRICULTURAL JOURNAL

VOL. XXXIX. 1 JANUARY, 1933. PART 1.

Event and Comment.

St. Lucia Farm School.

BROADCASTING from Radio Station 4QG in the course of the month, the Minister for Agriculture and Stock (Mr. Frank W. Bulcock) gave the following interesting account of activities to date in connection with the establishment of the St. Lucia Farm School:—

A contemplation of present conditions reveals that we are face to face with at least one condition that is inimical to the best interests of the State. This condition is described as unemployment, and parents are naturally anxious to find some suitable employment for their sons. With a lessened industrial demand and the capacity for greater and greater production, it is entirely unlikely that the industries of our State will be able to absorb that growing army of maturing boys. The stimulation of agricultural development must, however, reflect itself in a greater industrial demand, and under these circumstances we naturally turn to the land to provide ways and means to brighten the lot of our citizens. A reconstruction of thought is necessary to enable us to more clearly visualise the possibilities of land settlement. It is true that fortunes beyond the dreams of avarice do not lie within the soil, waiting to be charmed forth by the magic touch of a deft hand, but at least life on the land provides health, robustness, and a more fortunate vision than many city dwellers enjoy. Many representative bodies throughout the State recognise that we must turn to the land for the solution of our ''Unemployed Youth'' problem, and so have initiated movements having in view the employment of boys in rural pursuits. The churches are also co-operating in a State-wide scheme for the placing of youths on farms.

These schemes fall generally into two classes. The first provides for the absorption of lads *without previous training*. In the past, this method has been successful, but there has always been a steady demand for boys capable of milking, driving, and ploughing, and attending to the hundred and one duties associated with farm routine. A recognition of this demand has led to the establishment of the St. Lucia Farm School.

It will be remembered that Dr. Mayne and his sister, Miss Mayne, presented to the University a large block of land on the river opposite the South Brisbane Cemetery, and recently the Senate of the University made this land available for the purpose of the establishment of a farm school for boys. At present the holding is undergoing preparation for the new school which, it is confidently anticipated, will provide a sound elementary training for some of our boys at least.

Housing accommodation is being provided for twenty-five boys, and in all fifty boys will be in residence over a period of six months. Each boy will be required to do his turn as a resident student, and the usual surroundings of farm life will be maintained. There is no intention of making excursions into the higher flights of agricultural endeavour, but the rudiments of farm work will be thoroughly taught. A small herd of cows will be milked, the milk separated, and in the winter the processes of butter-making will be demonstrated. In addition, instruction in milk and cream testing will be provided. As dairying is such an important primary industry, special attention will be given to all its branches, and as an adjunct to our dairy a few choice pigs will be maintained. Poultry will be the third arm of animal husbandry. Boys will be taught to handle horses, and to engage in the production of crops and the conservation of fodder. No farm can be complete without these activities, and no farmer is properly equipped without a knowledge of these practices. It will be the aim of the Principal of the school to inculcate the sturdy maxim of "Do it yourself."

The whole of the operations of the farm will be open to the students, and the boys will be taught to cook in anticipation of that time which comes to each farmer sooner or later—that is, when he is thrown absolutely on his own resources. But all work and no play is a bad motto, so the Principal informs me that he intends to make each day one full of interest, and necessarily sport must play its part also. In addition, officers from my Department will visit the school frequently and deliver lectures on rudimentary agricultural subjects.

Each of these visiting lecturers will be a specialist, with vast stores of knowledge which he will be anxious to impart. So our Chief Dairy Expert, the Director of Agriculture, officers of the Animal Health Station, and the Chief Poultry Expert will arrange courses of lectures in accordance with the syllabus decided upon.

A comprehensive curriculum has been prepared, combining theory and practice. The elementary principles of the science and practice of agriculture will be demonstrated in a way that will be readily assimulated.

The possibilities of the farm are excellent. There is a surprisingly wide range of soil types, some of which are especially adapted for certain crops, and the grazing area is suitable for the purpose for which it is intended. The Principal who has been selected has been associated with agricultural education for a number of years, and the balance of the staff are all men specially qualified for the job.

St. Lucia is to be neither an institution within the accepted sense of the term, nor yet an agricultural college. It is to impart instruction in the A.B.C. of agriculture. After six months' instruction, it may be reasonably assumed that our students will have learned to be useful boys on farms. There can be no doubt about the capacity of the Department to train the boys, but side by side runs the great question of employment.

It is significant that various influential organisations, not only throughout the State, but throughout the Commonwealth, are interesting themselves in the vital questions associated with land settlement for youths, and there is a tremendous volume of feeling at the present time that in this direction lies social security. In order to find the necessary employment for the lads after they have completed their training at St. Lucia, the various organisations who have actively associated themselves with the question of employment of boys have been asked to co-operate with this Department.

A committee representative of all these interests has been appointed. Three sub-committees, known respectively as the Recruiting Committee, the Training Committee, and the Employment Committee are in existence.

The New Settlers' League, the Rotary Club, and the Legacy Club are intimately associating themselves with this work. In addition, it is proposed to utilise the various State officers situated in different parts of the State for the purpose of finding employers for the boys.

It is not our intention to place the boys on farms where no adequate supervision or training will be forthcoming. Our desire must necessarily be to place them with the practical progressive farmer. It is not maintained, of course, that a boy will be a completed agriculturist after six months' instruction at St. Lucia, but at least it is felt that the rudiments of agricultural practice will be satisfactorily absorbed.

From time to time we discuss the question of an agricultural bias and recognise the necessity, in present economic circumstances, of directing our thoughts and our attention to the land as one solution of our pressing problems.

In this direction, St. Lucia will be of very definite value. It frequently happens that boys, believing they have a bent along agricultural lines, seek farm employment, only to discover that their new surroundings are not conducive to their happiness or contentment. With St. Lucia we will be able to discover just where a boy stands in this regard, and those boys who show no aptitude or inclination for agriculture will be able to recognise this disability without heart-burning and unhappiness. Parents, too, will have their boys under their observation, and this should prove an attraction to them, for the boys will not be alienated from beneficial home influence.

Already the number of applicants exceeds the number of vacancies, and parents generally seem to be impressed with the possibilities of St. Lucia. In addition to ordinary agricultural training, that indefinable but necessary thing generally known as "bush craft" will be taught.

We have, owing once again to the generosity of Dr. Mayne and the Senate of the Queensland University, a considerable area of bush land at Moggill within easy reach of the St. Lucia farm. Here it is proposed to train squads of boys in timber-getting, clearing, and all the activities associated with bringing land under the plough. In conclusion, I would make an earnest appeal to the farming community to assist our city boys to a life of health, freedom, and comparative economic independence.

Rhodes Grass—Tested Seed for Sale.

IT is desired to call attention to the announcement in another section of the Journal that the Department of Agriculture and Stock has available for distribution tested Rhodes grass seed, at 1s. 11d. per lb., or 1s. 9d. per lb. for lots in excess of a hundredweight. Application, accompanied by remittance to cover cost, should be made to the Under Secretary. Exchange should, of course, be added to country cheques.

The Minister's New Year Message.

To the

FARMERS OF QUEENSLAND

Department of Agriculture and Stock,
Brisbane, 31st December, 1932.

THE dawning year will bring with it many difficulties, hardships and disappointments. These, however, can certainly be minimised by conscious united effort. We are people of a Commonwealth, with high ideals and lofty ambitions, to which all sections of the community subscribe.

Now is the testing time of nationhood. In the past we have contributed much to the advancement of national ideals, but much more remains to be done.

In the field of primary production, we are suffering from the effects of diminished purchasing power among the peoples of the old world, leading as it must to under consumption. Industry is efficiently organised but primary production is far less efficient in organisation.

Difficulties are overcome by that expression of conscious effort—"organisation"—and my sincere hope is that the new year will mark a definite advance along the road of primary production in our State.

We of the Department of Agriculture and Stock sincerely hope that happiness, health and prosperity will be the lot of our farming community during the year 1933.

Frank. W. Bulcock

Bureau of Sugar Experiment Stations.

CANE PEST COMBAT AND CONTROL.

THE GREYBACK CANE BEETLE.

By EDMUND JARVIS.

It is proposed to publish each month a short paper describing the movements of this insect, either above or below ground, according to the time of the year; together with descriptive details of a nature colculated to assist canegrowers in the study of this pest in every stage of its life cycle. Mr. Jarvis's entomological notes are always interesting, and this additional monthly contribution will be welcomed by our readers who are engaged in the sugar industry.—EDITOR.

1. Completion of the flighting and egg-laying periods of our principal cane beetle, *Lepidoderma albohirtum* Waterh.
2. Greyback grubs of the first instar (Stage 1) reach their maximum development.
3. Consult table below, giving correct date for commencing fumigation of grub-infested cane lands.

THE first two or three weeks in January offer special interest and attractions to lovers of Nature Study; the winged or aerial existence of our notorious cane beetle being now everywhere in evidence. In the day time, these grey uncanny-looking large cockchafers can often be seen clustering thickly on bushes by the roadside; while the branches of many big feeding-trees around the paddock or homestead are literally bending beneath the accumulated weight of tens of thousands of beetles clinging to twigs and leaves. Such abundant evidence of insect life, although admittedly more or less spectacular, too often foreshadows possible injury to cane crops in the near future, suggesting, perhaps, in some cases partial failure, or in others impending disaster.

Chief Food Plants of the Greyback Cockchafer.

The favourite feeding-trees of this insect are:—"Weeping Fig," mango, and "Moreton Bay Ash," but the foliage of several other trees and shrubs is also devoured by them with avidity.

Termination of the Egg-laying Period.

The commencement and mode of oviposition of the greyback was described last month in the "Queensland Agricultural Journal," and would naturally apply also to beetles chancing to emerge from the ground at the end of December, which would oviposit about the middle of January. During the present month, however, eggs of this pest are generally more plentiful than at any other time of year, and may now be found in the soil at depths of 12 to 15 in. or more in all stages of development, from ⅛ to nearly ¼ in. in diameter.

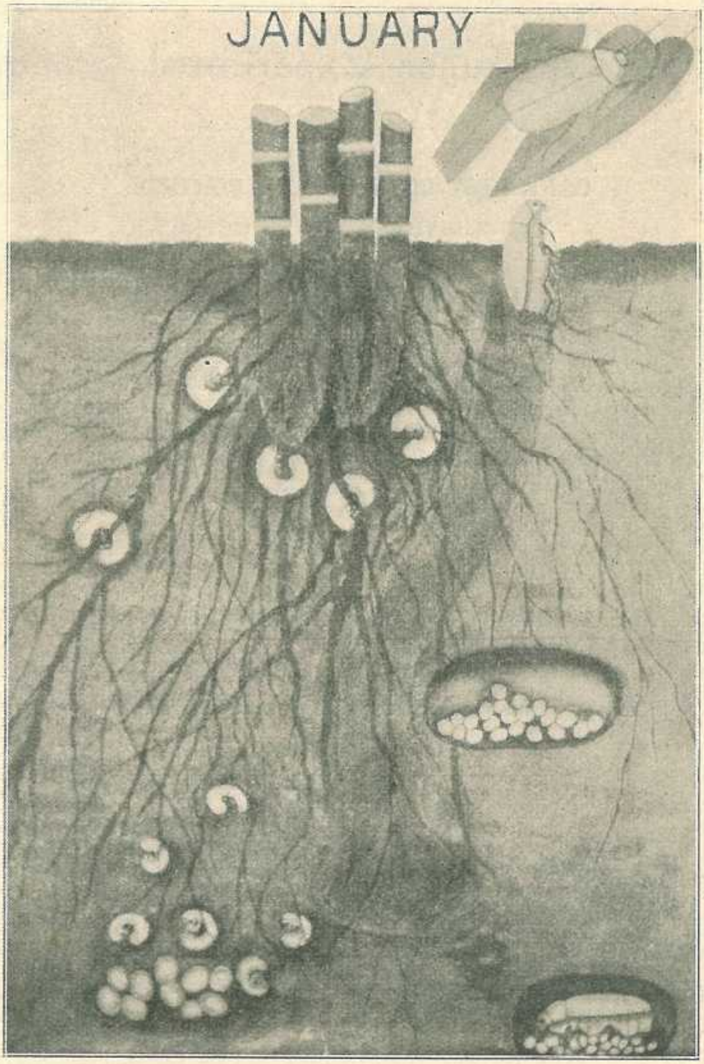


PLATE 1.

Habits of the "Greyback" Cockchafer Beetle and its young Grubs during the month of January.

A Single Emergence of Beetles Expected.

Owing to a spell of dry weather experienced throughout September to November, during which period only 115 points of rain fell at Meringa instead of 7.51 inches (which is the average for these three months), there has been no early appearance of greybacks this season. At present it looks as though a single primary emergence may take place about the second or third week in December; in which case, no additional brood should occur during January.

Greyback Cane Grubs Found During this Month.

In years when these cockchafers chance to appear on the wing in November, one can find larvæ in both first and second stages of growth during the month of January. In such seasons those of the first stage may occur in various sizes from ¼ to ¾ in. long; the head, however, invariably being ⅛ in. wide, and remaining so during the whole time occupied in development of the first instar.

Should the head be found to measure exactly a ¼ in. in width, one can be certain that such grubs have moulted (changed their skin) and commenced the second stage of growth, during which period of about thirty-eight days the body attains a length of 1½ in., although the head (let it be remembered) does not increase in size.

However, November has passed by without liberating the expectant host of greyback beetles confined in their subterranean pupal cells; so that growers in the Cairns district are not likely to encounter many second-stage grubs of this pest during January.

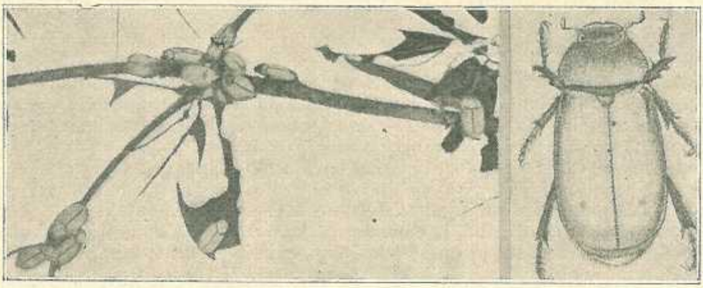


PLATE 2.
Fig leaves (*Ficus pilosa*) being eaten by the greybacks, together with a picture of the beetle slightly reduced.

The table given below should, nevertheless, be helpful to those intending to fumigate their grub-infested cane land, as in the event of an emergence of beetles taking place about the end of December or beginning of January, reference to this table will show the correct date on which to start fumigating the cane in February, together with the length of time available for making preparations for this important work:—

WHEN TO FUMIGATE GRUB-INFESTED CANE LAND.

Beetles emerge.		Time to Fumigate.		Beetles emerge.		Time to Fumigate.		Beetles emerge.		Time to Fumigate.	
December	5	February	13	December	14	February	22	December	23	March	3
,,	6	,,	14	,,	15	,,	23	,,	24	,,	4
,,	7	,,	15	,,	16	,,	24	,,	25	,,	5
,,	8	,,	16	,,	17		25	,,	26	,,	6
,,	9	,,	17	,,	18	,,	26	,,	27	,,	7
,,	10	,,	18	,,	19	,,	27	,,	28	,,	8
,,	11	,,	19	,,	20	,,	28	,,	29	,,	9
,,	12	,,	20	,,	21	March	1	,,	30	,,	10
,,	13	,,	21	,,	22	,,	2	,,	31	,,	11

Remember that the above dates refer to districts in which only one emergence has taken place. In those receiving sufficient rain to bring about a primary emergence of beetles during November, followed by a secondary brood a few weeks later, the period given in the table—from emergence of beetles to time to fumigate—should be extended in such cases to about 100 days, in order to make sure of killing the grubs from both emergences.

How to Destroy the Greyback Beetle, Its Eggs, and First Stage Grubs.

In seasons when grey-backs fail to appear until late December, the recommendations offered last month with regard to means of destroying them would apply also to January. Long continued dry weather will sometimes cause very heavy mortality among these beetles, and when operating over immense areas of forest land exercises an ideal natural remedy. Collecting the beetles is perhaps the best-known commonsense control method; having yielded beneficial results both in Australia and other countries. This is usually practised during seasons when the pest chances to be very plentiful; although it seems reasonable to assume that remedies of this kind might give us best results during years when such natural checks happen to have thinned the enemy's ranks, since any additional destruction of the survivors should tend to act as a kind of knockout blow, by prolonging the period which must necessarily elapse before the succeeding broods of this cockchafer could once more finally regain normal numerical force. In view of possible late emergence of these beetles, the following additional methods of fighting them should again be mentioned:—

1. Destruction of their food plants.
2. The use of soil deterrents against oviposition.
3. Poisoning the foliage of feeding-trees.
4. Rigorous protection of our insectivorous birds.

The economic value of numbers 2, 3, and 4 could with advantage be more fully investigated in the near future.

Destroying Eggs of the Greyback.

Experiments conducted by the present writer in November of 1921 secured conclusive proof that these eggs could be killed in a few hours of fumigating the soil above them with carbon bisulphide. Commonsense control measures against the eggs and newly-hatched grubs may also, to some extent, be affected by certain cultural operations. For instance, by keeping a strip of ground about 15 in. wide on each side of a cane row loosened up and free from weeds at commencement of the flighting season, and maintaining such state of friability about four to five weeks, one can take advantage of a habit common to many scarabæid beetles of ovipositing by preference in unbroken ground; the firm condition of which, by affording a suitable fulcrum, enables these insects to easily retain the correct position assumed when excavating their subterranean tunnels.

Such movement of the upper soil during a period of five to six weeks (commencing about a month after the first emergence of beetles) will often destroy a certain percentage of grubs of the first stage, which occur at times comparatively near the surface; by breaking up their feeding-tunnels, thus exposing them to attacks from various foraging ants.

Endeavour, if possible, to have the soil between cane rows well worked and free from weeds before greybacks appear on the wing, and throughout the flighting and egg-laying periods. A luxuriant growth of weeds, &c., amongst the stools is strongly attractive to egg-laden females of the greyback cane beetle.

At this time of the year when eggs and small grubs of the pest are much in evidence, it is advisable, so far as possible, to keep the surface soil in good "heart," as near to the stools as can be conveniently effected without risking material injury to the cane plants.

The plate for January somewhat resembles that published last month. Greyback beetles are still in the feeding-trees, or ovipositing in the ground, while eggs are hatching, and grubs of the first-stage feeding on cane roots near the surface are preparing to moult into the second stage of development.

THE RIGHT SPIRIT.

Fetlar is a small island in the Shetlands, with a population of only 200, but there were no fewer than 600 entries in all sections at its annual agricultural show. Some of the best cattle in the islands are reared in Fetlar. It has a high reputation also for sheep and ponies.

Factors Governing the Value of Different Forms of Lime.

By H. W. KERR and C. R. VON STIEGLITZ.

EARLY records show that the value of lime as a soil improver was known to agriculturists over 800 years ago, and its use has persisted as a standard practice through the intervening centuries. It is only quite recently, however, that its true functions have been clearly understood. Lime is, strictly speaking, an essential plantfood, and in its complete absence the soil is quite sterile. The relative needs of various plant species for this nutrient vary widely, however. Lucerne and many other legumes appear to thrive only in soils abundantly provided with this plantfood. Sugar-cane, on the other hand, is not a lime-loving plant, and the employment of lime on the cane soils of the State must be traced to its virtues in other important respects.

These may be listed briefly as follows:—

(1) Neutralisation of harmful soil acids;

(2) Provision of an environment more favourable to the helpful soil bacteria;

(3) Rendering plantfoods in the soil more readily available to the crop;

(4) Enabling fertilizers to exert their full influence on cane yields;

(5) By continued use on clays and clay loams, tending to improve their physical state and favouring the production and maintenance of good tilth.

Under our conditions, lime is employed primarily for its influence on soil acidity. In regions of high rainfall continued leaching results in the rapid removal of lime, and often induces an acid condition in the soil; in extreme cases the soil becomes so intensively acid that crop growth is completely suspended. Such lands actually exist in localised areas in North Queensland. It is the destruction of the poisonous acids by liming which promotes also increased activity among the soil microbes —those tiny inhabitants of the soil, which feed on the soil organic matter and yield valuable plantfoods as the by-product of their life processes. Certain of these little workers also, which normally effect the necessary conversion of fertilizer to a form in which it is absorbed by the crop roots, are unable to function under intensively acid conditions. Further, results are on record which show that sulphate of ammonia may actually reduce crop yields on soils of this nature. Following an application of lime, the same soils gave pronounced results from the use of this valuable fertilizer.

A confusion of terms appears to have arisen out of the use of the words "sour" and "acid" to describe the condition of certain soils. The farmer frequently applies lime to heavy, wet, ill-drained lands which he describes as "sour." The use of this material frequently facilitates the drying out and "sweetening" of the soil, as the farmer expresses it. It should be clearly understood, however, that the "acid" soils so far discussed comprise many of our best-drained lands such as the alluvial loams of the Innisfail and Babinda areas. The function of the lime on these lands is essentially to neutralise the soil acids; and though the heavier soils of this type are markedly improved in tilth following the use of lime, this is rather incidental.

KINDS OF LIME.

When a grower proposes purchasing lime, he is frequently perplexed by the range and variety of materials from which he may make his choice. A brief description of the important forms of lime may clarify the position, and indicate the several factors to be considered.

Lime occurs naturally in the form of deposits which vary considerably in their physical state. All have, however, the same chemical composition—*carbonate of lime,* or agricultural lime as it is popularly known in its marketed form. Marble, limestone, coral lime, and earth lime (or marl) all contain this compound as their active ingredient, though they may show a wide range of incidental inpurities in the form of clay or earthy matter which reduce their monetary value. Coral and marble are usually very pure forms of lime, while earth lime frequently contains as little as 40 per cent. of this constituent. On the other hand, certain earth lime deposits which are exploited in Queensland show as high as 95 per cent. of lime carbonate.

Another form of lime which is frequently employed is known as *burnt lime*. This form does not exist naturally, but as the name indicates it is manufactured from carbonate of lime by the process of burning. If we should burn 100 lb. of pure limestone or marble, we would obtain 56 lb. of burnt lime. The proportion which is lost (44 lb.) consists of carbonic acid gas or carbon dioxide, which passes into the atmosphere. Burning therefore results in a concentration of the active material, none of which is lost in the process. If a compact lump of burnt lime should be exposed to the air, it will be found that it slowly increases in size, and gradually crumbles to a very fine white powder. The action of the atmosphere in this respect is simply a reversion of the burning process, and the "air-slaking" as it is called results in the re-absorption of 44 lb. of atmospheric carbon dioxide by every 56 lb. of burnt lime, to give once again 100 lb. of carbonate of lime.

Now it is a well-known fact that the different forms of lime exhibit pronounced differences with respect to the speed with which they effect their beneficial influence on the soil. Burnt lime is consistently superior in this regard; and though the caustic action of the fresh material is often considered a serious objection, this effect may be largely minimised by air-slaking prior to spreading. It may appear somewhat difficult for the farmer to understand why the carbonate of lime which is again produced by slaking is so definitely superior to other forms of carbonate of lime. The explanation lies in the fact that the speed of action depends entirely on the fineness of the product. Lime does not readily dissolve in the soil moisture, as do soluble mineral fertilizers, and the rate at which it reacts with the solid acid substances in the soil depends on the degree of intimacy with which the lime and soil particles can be brought together. If the grower expects quick results from liming, the necessity for having the lime finely powdered will be readily appreciated. Air-slaking of burnt lime actually effects this desired condition most effectively, but the practical difficulties associated with the mechanical disintegration of limestone generally result in a marketed product which, though apparently well pulverised, still contains particles which are exceedingly coarse when compared with the particles of air-slaked lime.

EXPERIMENTAL.

This consideration is of the greatest importance in the evaluation of a sample of agricultural lime; and to provide a clearer picture of the influence of fineness of grinding on the speed of neutralisation of soil acids, an interesting series of tests was carried out in our laboratory.

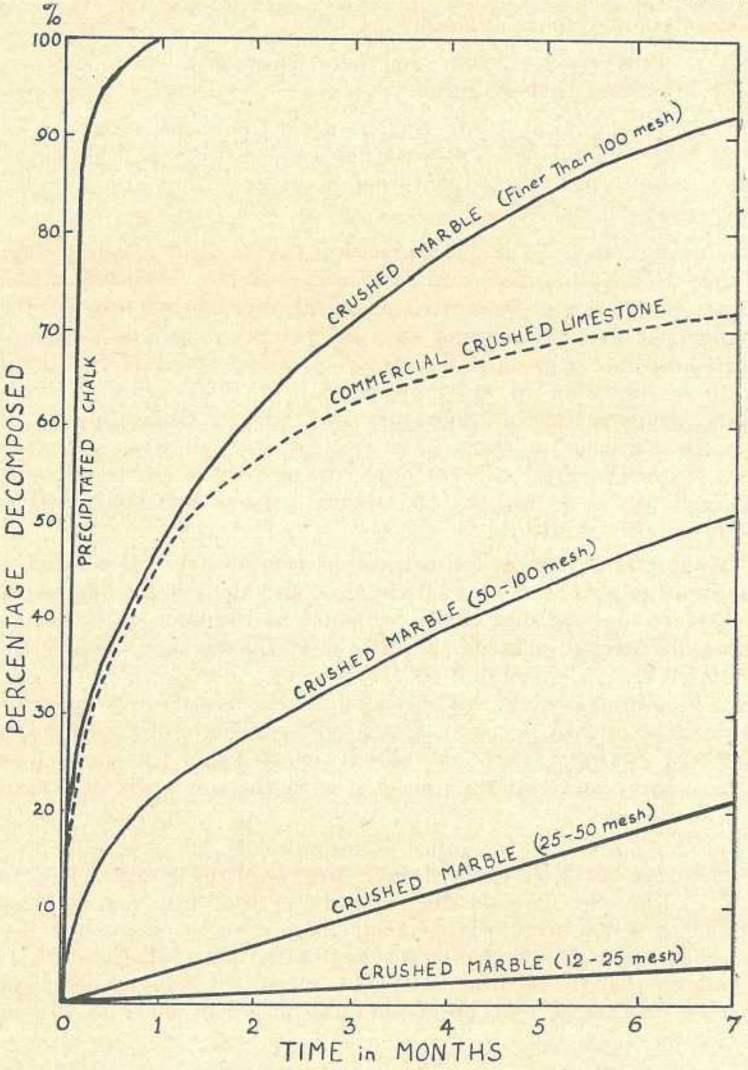


PLATE 3.—Fig. 1.

The graph shows that the finely-divided precipitated chalk had completed its work within a month of mixing. The high-grade commercial lime showed only about 70 per cent. decomposition after seven months, while the material of particle size 1/12-1/25 inch diameter was practically worthless.

A number of liming materials of varying particle size was selected as follows:—

(1) Precipitated chalk—an extremely finely divided form of carbonate of lime, comparable with air-slaked lime.

(2) Pulverised marble—particles fine enough to pass a sieve with 100 meshes to the inch.

(3) Pulverised marble—particles passing a 50-mesh sieve, but coarser than 100 mesh.

(4) Pulverised marble—particles passing a 25-mesh sieve, but coarser than 50 mesh.

(5) Pulverised marble—particles passing a 12-inch sieve, but coarser than 25 mesh.

(6) A sample of commercial crushed limestone, regarded as high grade; 90 per cent. was fine enough to pass a 50-mesh sieve, and the sample contained a large proportion of very fine particles.

As a suitable soil for the purpose a highly acid alluvial clay loam from our South Johnstone Station was selected. Six equal samples were weighed out and submitted to an application of lime at the rate of 6 tons per acre, employing each of the above grades of material.* The soil and lime were mixed thoroughly, and water added to bring the mass to a condition of optimum moisture. The samples were then covered, set aside in the laboratory and stirred from time to time to enable the material to react. Portions of the soil were withdrawn at regular intervals, and the amount of carbonate of lime remaining unchanged was determined. In all, the process was continued over a period of seven months.

The accompanying graph brings out very clearly the relative values of the lime, as governed by particle size; and the results demonstrate in no uncertain manner that if the influence of liming is to be felt within a reasonable period, a large proportion of the material used should be fine enough to pass through a 100-mesh sieve. The sample of high-grade crushed limestone which was included in the tests was found to react quite rapidly, and 50 per cent. of the material had done its work within a month of mixing. This undoubtedly constituted the finest particles, and the coarser material then reacted with the soil acids at a markedly reduced rate.

The fact that "coral sand"—undoubtedly a very pure form of lime—produces so frequently a very disappointing result when applied at, say, 2 tons per acre, is due entirely to the fact that it is usually marketed in a condition which is far too coarse to ensure a reasonable speed of action. In other words, the coarse material gives the farmer his money's worth in lime, but not in added cane yield; and the unchanged grains of lime may remain practically inert in the soil for many years.

CONCLUSION.

We may now summarise the conclusions to be drawn from the preceding remarks and experimental results. In choosing a suitable liming material, the following facts must be considered:—

(1) Burnt lime, even after air-slaking, will give most rapid results, due to the completeness with which it may be mixed with the soil particles.

* Though this may seem an excessive dressing, it was barely sufficient to neutralise all the acids in this particular soil.

(2) One ton of pure burnt lime is equal in lime value to 1¾ tons of pure agricultural lime; this is an important point, where freights and haulage charges constitute an appreciable proportion of the cost of lime *on the farm*.

(3) Other things being equal, the finer the condition of the agricultural lime, the quicker will favourable results be obtained. Particles coarser than one-twentieth of an inch in diameter are practically worthless, and in a country where lime costs are so high, the farmer should pay particular attention to this consideration.

In general, an initial application of burnt lime is to be recommended for highly acid soils. Where growers are able to obtain good quality agricultural lime at a reasonable price, the use of this material is recommended, as a subsequent practice, to maintain the soil in an acid-free condition. On many soils of the humid northern areas, it has been found that an application of 2 tons of agricultural lime may be employed profitably each time the land is replanted. Under these conditions, the lime should be spread broadcast following the final ploughing, and lightly harrowed into the land.

We would again point out that it is our pleasure to assist canegrowers in determining the need for lime, due to excessive acidity in their soils. Samples should be forwarded to the Director, Bureau of Sugar Experiment Stations, Brisbane; or where growers are situated in closer proximity to our South Johnstone Station, samples should be consigned to that address. A covering letter should express the desire for an opinion on the lime requirement of the particular soil.

CREAM FREIGHTS.

The Minister for Agriculture and Stock (Mr. F. W. Bulcock) has called attention to a certain amount of misapprehension on the part of cream suppliers in the application of the amendment of the Dairy Produce Act with regard to the payment of cream freights. He points out that it was not intended that the supplier must prepay the freight. He may send his cream to the factory in the usual way, and the amount due for freight would be deducted from the cream cheque at the end of the month and paid by the factory to the Railway Department.

The Minister states that the amendment was framed so that each supplier will be responsible for the amount of freight on his own particular supply of cream, and it will be necessary to indicate the cost of sending this cream to the factory on the statement he receives from that factory with his cheque. Mr. Bulcock also pointed out that it was necessary for the factory to show the individual debits made against suppliers when making payment to the railway for cream carried.

There is no restriction or prohibition on cream suppliers sending cream to any factory in Queensland, and they may continue to send cream to the factory they at present supply. The only factor taken into consideration, said the Minister, is the payment of the freight which must be borne by the individual supplier.

Intensive Cane Production.

By H. W. KERR and E. J. R. BARKE.

AS a means of reducing production costs of agricultural crops, the importance of intensive cultivation under our Queensland conditions has been repeatedly stressed. Before this can be effected, it is essential for the farmer to have a clear understanding of the chief factors influencing crop yields. For sugar-cane, the following are the more important:—

(1) A continuous supply of soil moisture in a well-drained soil;

(2) An adequate supply of available plant food;

(3) High temperatures combined with a humid atmosphere;

(4) Absence of harmful substances in the soil, such as intensive acidity;

(5) Freedom from the influence of diseases and pests.

In our several cane districts these various factors enter in greater or lesser degree to influence crop production. In the central and southern areas it is generally conceded that soil moisture deficiencies are the most serious causes of reduced yields, while in the humid north plant food deficiency is usually blamed for crop limitations. It is well to investigate these questions more closely, however, and learn by actual experiment the relative importance of these factors both individually and collectively.

During the past few years we have carried out extensive observations on the relationship between climatic factors and crop growth. Selected cane stalks growing in the field under observation are subjected to systematic periodical measurement, and from the records obtained it is possible to trace clearly the manner in which the crop has grown. Fig. 1 illustrates a growth rate curve constructed from data secured at our South Johnstone Station in 1929-1930. It will probably come as a surprise to most growers to find that even in this region of heavy rainfall the distribution is far from ideal; the cane does not make even growth, and the production rate is greatly influenced by the incidence of rainfall. The maximum growth rate is sustained for only a brief period following rain, and during rainless spells it falls to a small fraction of the maximum.

Repeated fertilizer experiments on this Station show very clearly that the soils of the heavy rainfall belt are highly leached, deficient in available plant foods, and often in need of liming to neutralise acidity. Heavy applications of lime or additions of appropriate mixed fertilizer up to one-half ton per acre result in very definite increases in crop yield, and these results prompt the question—What would be the maximum cane yield were we to remove all controllable factors limiting cane growth? Given an adequate supply of moisture and plant food at all times, how many tons of cane per acre could be produced under natural conditions of temperature and atmospheric humidity?

Experimental.

By the nature of the problem and the difficulties involved in fulfilling the prescribed requirements, the experiment had necessarily to be performed on a small scale. Actually a single row 25 feet in length was employed. The soil was excavated to give a trench 3 feet wide and 3 feet deep. Soil and subsoil were carefully separated. As the land was strongly acid the soil was limed liberally, and also treated to a heavy application of stable manure and mixed fertilizer before being replaced in the trench. The cane was planted in this excellent seed-bed in April, 1931. In order to ensure that the plant food and moisture supply to the crop should not limit cane production, the following treatments were made throughout the growing period of the crop:—

Fertilizer.—Every month the cane received a dressing at the following rate per acre:—

100 lb. sulphate of ammonia.
50 lb. superphosphate.
20 lb. muriate of potash.

Irrigation water was applied as follows:—

Winter—Two inches per acre per week.
Spring—Four inches per acre per week.
Summer—Six inches per acre per week.

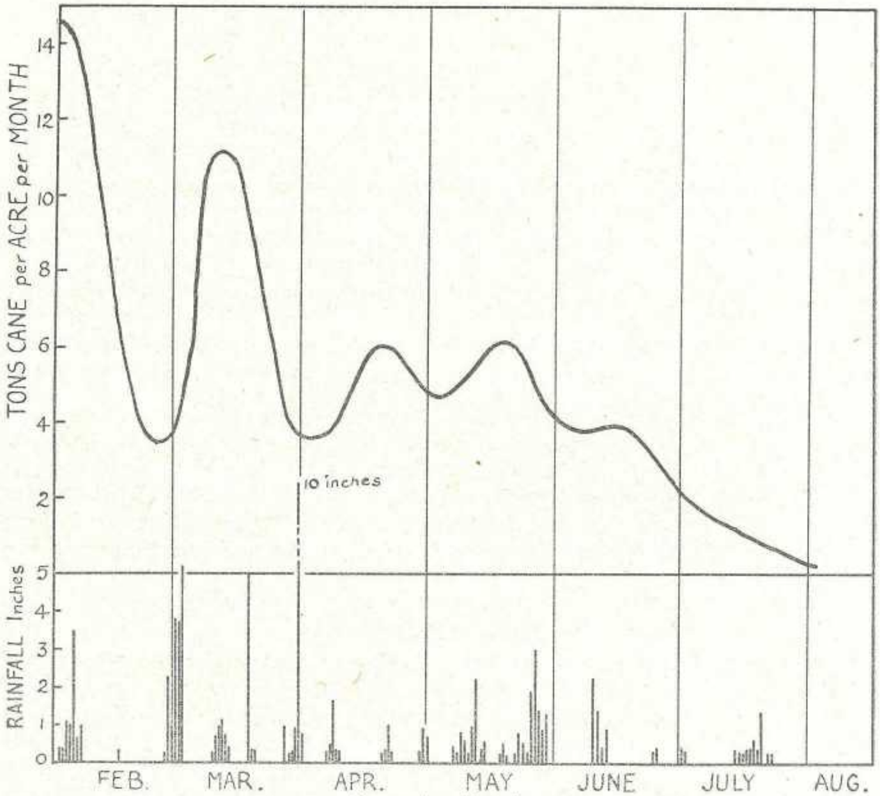


PLATE 4.—Fig. 1.

Showing the erratic nature of crop production under natural rainfall conditions at South Johnstone. The fluctuations in the growth curve lead to considerable reductions in crop yield.

Twenty-five secondary shoots were selected in July, and growth measurements on these were made at regular three-day intervals until the crop was harvested. It was thus possible to trace the course of crop production and, finally, to determine the relative proportions of the crop produced during individual growing months.

For purposes of comparison, a second trench was prepared in a manner entirely similar to the above, but the planting of this line was deferred until August, 1931. Under the conditions of the experiment it was thus possible to gauge the relative influence of time of planting on crop production.

In August, 1932, the crops were harvested. Each had made exceptionally good growth, particularly that planted in April; the stools were very heavy, and the average length of stick in the early plant Badila was over 11 feet. From the cane yields the following tonnages were calculated, assuming a field of similar cane with rows at 5-feet interspaces:—

Planted.	Harvested.	Age of Crop.	Tons of Cane per Acre.	C.C.S. %	Tons C.C.S. per Acre.
1931.	1932.	Months.			
April	August	16	**143·9**	**15·9**	**22·9**
August	August	12	**58·3**	**15·8**	**9·2**

Now it is not suggested for one moment that under field conditions the enormous crop of 144 tons of cane per acre could be produced; the above conditions were as nearly as possible ideal, and with the single row border effects were eliminated. Nor could a c.c.s. value of 15·9 per cent. be realised where under natural conditions such a crop would be a tangled mass of lodged cane with low sugar content. But there are valuable lessons to be learned by studying the various factors instrumental in the production of this heavy crop which could profitably be considered in conjunction with normal farm practice. It is proposed to study these influences and discuss their applicability.

As a basis for discussion the growth rate has been reproduced graphically in Fig. 2. The solid blocks represent by their area the tons of cane produced in each calendar month; the small numbers in the circle indicate the actual monthly tonnages. Curves representing variations in the relative periods of daylight and mean atmospheric temperatures are included also.

Time of Planting.

Under the conditions of our experiment we sought to remove the limiting factors—moisture and plant food supply—from the consideration. Any variations in crop growth rate should then be dependent chiefly on (1) air temperature and (2) hours of daylight. Fig. 2 shows very definitely that this is the case. The maximum growth rate was attained when the days were longest and the temperatures the highest—that is, in the month of December. This fact is one of very great importance in its relationship to normal farm practice. Where the cane was planted in April it utilised the cooler months of the winter in

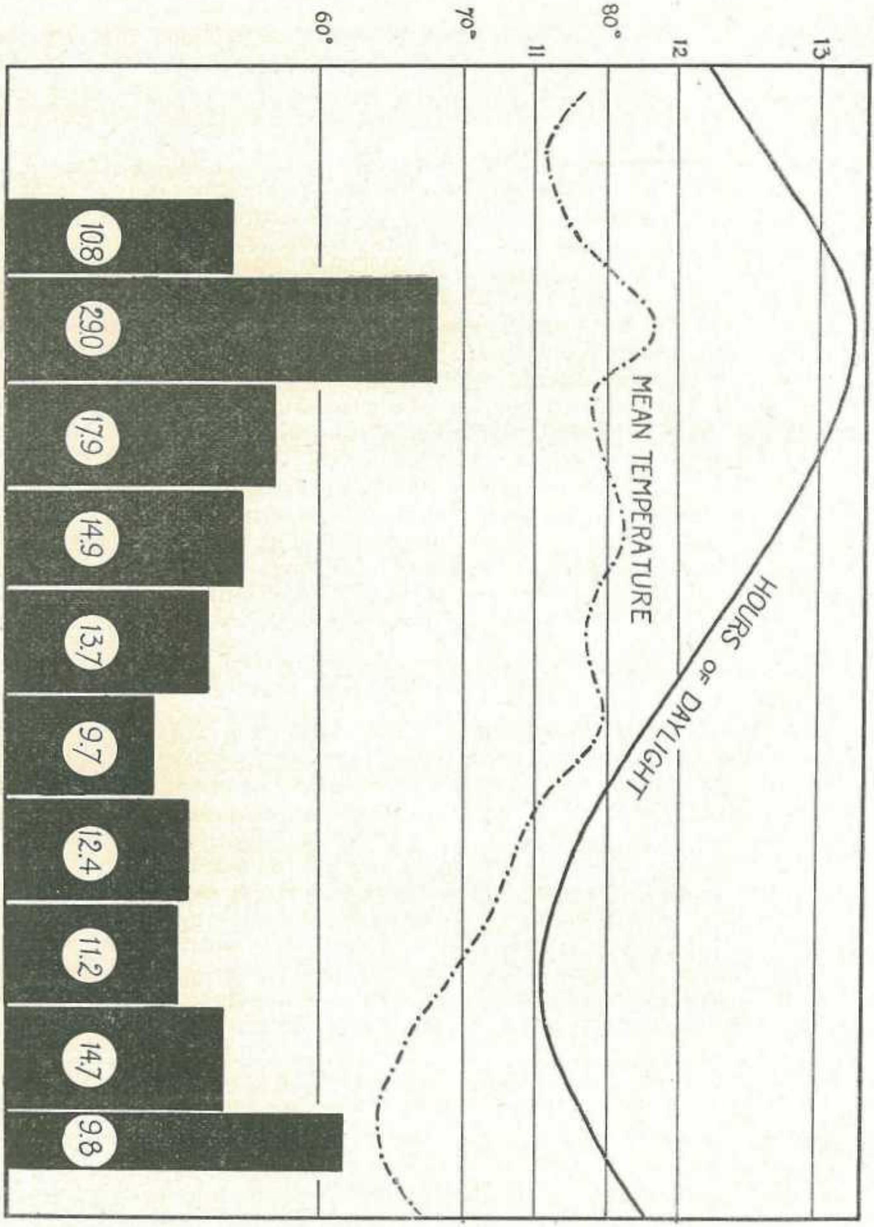


PLATE 5.—Fig. 2.

The solid blocks represent the tons of cane per acre produced under optimum conditions during each calendar month. The curves for hours of daylight and mean temperature fit very well with the growth rate, and show the particularly favourable growth conditions of December, provided that moisture and plant food are available.

becoming established and producing a heavy stool of vigorous shoots. Temperatures during this period were quite adequate for the purpose, and with the advent of the warmer spring months the growth rate speeded up, so that by early November millable cane was showing. During December this crop put on cane to the extent of 29 tons per acre, and from this maximum value the growth rate declined through the cooler and shorter days of late summer and autumn, but even in the coldest month (June) the rate was still about 10 tons per acre per month under the favourable growing conditions provided.

Contrast these figures with those from the spring planted crop. The highly favourable days for cane production of November and December were utilised in enabling the crop to become established, and millable cane was not in evidence until the latter part of January. This is a period when growing conditions, though still quite favourable, are on the decline. It should be pointed out that the discrepancy in crop yields between the autumn and spring planted cane was not entirely due directly to the time of planting. The spring planted cane was severely damaged by top-rot disease which seriously checked its growth and undoubtedly resulted in a marked reduction in crop yield. It is very significant that the autumn planted cane was quite free from the disease, though growing in close proximity to diseased cane. This provides a vivid example of the influence of planting time on the incidence of top-rot, and supports the recommendations of our pathologists that in areas subject to this disease early planting should be practised whenever possible. Assuming that the crop had been disease-free, and taking the growth rate of the autumn plant, the crop would still be inferior to the latter to the extent of 50 tons per acre.

Plant Food Supply.

Although no direct evidence was obtained from this experiment to indicate the influence of the added fertilizer on the growth of the crop, this was undoubtedly most important. During its growing period the early planted cane received about 2,700 lb. per acre of mixed fertilizer in the monthly applications, over and above that applied to the seed-bed. Excessive though this may appear, it was not capable of supplying the full plant food requirements of the 144-ton crop. It has been calculated that the plant food removed by 1 ton of cane is equal to that contained in 25 lb. of mixed fertilizer, and on this basis the above crop would require 3,600 lb. per acre. These facts emphasise the absolute necessity for the consistent application of heavy dressings of fertilizer if the farmer would harvest heavy tonnages of cane per acre while maintaining his soil in a highly productive state. This is particularly true of soils in the districts of heavy rainfall where the soil in its natural state has been robbed of its plant food reserves by the leaching action of the excessive rains over many centuries.

Irrigation.

Finally, we have to consider the influence of an adequate moisture supply in a well-aerated soil. The importance of this factor cannot be over-emphasised. The accompanying illustration (Fig. 2) shows that, even with low winter temperatures, cane can maintain an appreciable growth rate provided that moisture is available to it at all times. It is unfortunately true that September, October, and November are the driest months of the year, and at this time the crop often suffers severely from lack of soil moisture even in the humid North. The severe check which the crop receives at this time seriously retards its development and prevents it from taking full advantage of the favourable cane-producing conditions usually associated with the long, hot, and rainy days of December. The average wet season rains are also relatively poorly distributed, as is demonstrated by the growth rate curve of Fig. 1.

The obvious remedy for this defect is the exploitation of irrigation possibilities to their fullest extent. To growers in the central and southern areas this cannot be too strongly advocated; while growers in the far north, who are so frequently situated in close proximity to permanent streams of the highest quality water, could in many cases double their crop yields by judicious irrigation. It will be argued that irrigation adds to farming costs; the important question is, however, will it reduce the cost of production per ton of cane? If so, then it is in the grower's best interests to adopt the practice. It may also be suggested that the added tonnage will still further embarass an already depressed sugar market. This is, of course, entirely the grower's affair. The maximum area of land which he is permitted to bring under cultivation is limited by his assignment, but the lower limit is subject to his discretion. If he chooses to produce his present tonnage from one-half of the area now harvested, and in so doing he reduces his costs of production, then the principle is highly sound and economical.

At the present time the Burdekin district is the only one where irrigation is practised consistently. The results which are obtained there should afford strong evidence of its importance on crop growth. During recent years this area has made marked progress in the development of more efficient water application methods, and the better farmers of the district have repeatedly produced 50 and 60 ton crops. Certainly this area possesses some of the richest cane soils in Queensland, but there are others which are relatively difficult to work and in need of artificial manures. In other respects also conditions are not ideal. The land surface is practically level throughout the district, and the slight irregularities in the topography are just sufficient to make it more difficult to provide an even distribution of water. The favourable gentle slopes of other districts would make the process of irrigation simple by comparison. For a great proportion of the year, also, the area is subjected to the unfavourable influence of hot, drying winds, which rapidly remove soil moisture by evaporation and distress the crop. The latter does not flourish under these conditions, and much energy is expended in an attempt to sustain the unusually rapid evaporation loss from its leaves. These difficulties are cited to demonstrate the fact that other cane areas, both to the north and south, are much more favourably situated with respect to many conditions which would make for heavy crop yields, given an abundance of soil moisture. The Bundaberg district in particular is one which would again occupy a very prominent place in our sugar world, and it is pleasing to note that irrigation on an intensive scale is being practised at Bingera plantation this season. There can be no doubt as to the results which will follow. When it is remembered that the summer days are longer in the southern areas than in those districts lying nearer the equator, and air temperatures are equally favourable during this season, the production of a 50-ton crop requires but a few months of favourable growing conditions, and fertilizer and irrigation water will do the rest. The taller crops will be subjected to less damage from frosts in the winter, while a moist soil is characteristically a better conductor of heat than a dry one, so that the severity of frosts is again minimised by watering. The red volcanic soils of the Bundaberg area are probably the most suitable lands for irrigation that could be found, being almost identical with the better class irrigated areas of the Hawaiian Islands, which are famed for their productivity.

There is another aspect of irrigation which should appeal to growers in those areas where cane grubs are active. A continuous supply of soil moisture will provide conditions best suited to the rapid replacement of roots as they are chewed off by this pest, and though the severe check in growth will not be eliminated the crop will be saved. This suggestion is worthy of serious consideration by growers in the Gordonvale area, for example, where an abundant supply of water from the Mulgrave River could be diverted for the purpose.

This whole question is one which should not be turned aside lightly by any grower fortunately situated with respect to water supply. In times of economic stress it is easy for the primary producer to fall into unsound practices in an attempt to reduce costs. One most frequently employed is a reduction in the purchase of fertilizer—the material so essential to the maintenance of the plant food supply of soil and crop. Under this policy the assets of the farm are rapidly dissipated, and its effects are only too clearly illustrated by the unfortunate circumstances which surround certain of the older cane-producing areas. Their pioneering days came at a time when the value of artificial manures was not appreciated, so that to-day the land has been reduced to such a low level of fertility that in many instances cane production under natural climatic conditions is economically impossible. It should be evident to every grower that to farm a smaller area intensively, and give the remainder of the land a prolonged rest under grass, is the surest method of maintaining a fertile soil. This policy enables Nature to continue with her process of building up plant food reserves in the soil—a process which was rudely interrupted when the soil was devoted to continuous cane cultivation.

PEANUTS AND PIGS.

A Warning to Farmers.

Much trouble is being experienced by bacon factories through receiving pigs which produce soft, oily carcases which will not harden when chilled, and even when cured as bacon are so oily as to be practically useless to the trade. Even when used for smallgoods this soft meat is very unsuitable and difficult to handle.

The loss to the industry is very considerable and the bacon factories have already degraded soft pigs and paid for them at reduced rates, and as the supply still continues the factories are considering taking more drastic action, as they do not want these soft oily pigs. The Department of Agriculture and Stock, therefore, offers the following advice to pig-raisers:—

Although several foods may be responsible for the soft condition, all the evidence points to the fact that the chief cause of the present trouble is the feeding of peanuts to pigs which are being prepared for market. Maize and other pig foods are relatively scarce and as peanuts produce particularly fast growth in pigs, farmers are naturally tempted to use them just now. The position could be relieved if pig-raisers would concentrate their peanut feeding on the breeding stock and sucking pigs, which will make very good use of the peanuts, and then all the other available foods could be kept for the pigs from the weaning stage until they reach bacon weight. Separated milk, root crops, pumpkins, lucerne (either as green fodder, hay, or chaff), and small quantities of pollard, meat meal, and pasture can be used to make up good rations in the absence of maize.

Banana Leaf Spot.

PROGRESS REPORT.

By J. H. SIMMONDS, M.Sc., Plant Pathologist.

FOR the purpose of this report it has been found convenient to divide the matter into two main sections. The first deals with experiments directly applied to seeking methods of control, while the second considers the characteristics of the causal organism itself. Finally, two short sections are devoted to some other factors contributing to loss of foliage.

I. FIELD EXPERIMENTS.

(a) Dusting and Stripping—1928.

The first field work was made possible through the kind co-operation of Mr. Richardson, of Belli Park, who offered to carry out on his plantation experiments directed towards the control of leaf spot.

The work consisted in testing the efficiency of stripping with and without dusting. An acre block of twelve-months-old plants was used, a strip of 10 by 8 plants in this area receiving both dust and stripping —the rest being stripped only. An adjacent plantation served as a control. Stripping consisted in removing all spotted leaves present. Dusting operations were carried out in the early morning in the presence of dew, a copper sulphate-lime dust being used in the earlier applications and a copper carbonate-kaolin dust in the later applications.

The plants were stripped six times between 29th March and 16th August, 1928. Dust was applied on 23rd April, 1928, and on six subsequent occasions ending with 14th August. Unfortunately no appreciable control was evident as a result of these operations.

(b) Stripping—1928-29.

Somewhat later in the same year an experiment was initiated to determine whether a rigorous removal of all spots in their pre-fruiting stages during the early part of the leaf spot spreading period would sufficiently check the spread of the disease as to make the operation profitable. It might be pointed out that the first development of the disease in the new year is sufficiently light to render this operation not altogether unreasonable.

For this work we are indebted to Messrs. E. and L. Ball, of Eumundi, who offered their 2½-acre plantation for use in the experiment, and also supplied much of the labour necessary. Approximately two-thirds of the plantation, consisting of twelve rows, was thoroughly cleared of all affected leaves at the end of the 1928 winter. By keeping a careful watch on the development of the disease entire leaves or portions thereof on which spots appeared were removed in most cases before spores had formed. These removals took place on 28th November, 1928, 30th January, 1929, 3rd March, 6th, 11th, 17th April, and 1st May. Of the remaining one-third of the plantation two-thirds was left untreated as a control and one-third received the winter clean-up only.

Observations made on 10th July, 1929, showed that although the plants from which spots had been removed showed up to some slight advantage over the untreated, this advantage was not sufficient to justify the time and labour involved in the operation.

(c) Cover Cropping—1928-29.

An attempt was made to determine the effect of the presence of a cover crop during the later summer months when leaf spot commences to develop. In the above experiment at Messrs. Balls's plantation a portion of the area to be kept free of leaf spot continuously and of that stripped at end of winter only was planted to giant cowpea during the spring of 1928. Unfortunately, owing to a period of abnormal dry weather following, a good cover of the ground could not be obtained and no results were available.

With establishment of the Banana Experiment Station at Kin Kin all experimental work was transferred to this locality. The work attempted may be summarised as follows:—(1) Fungicidal treatment of suckers; (2) effect of spacing on leaf spot development; (3) effect of different methods of stripping; (4) control by application of fungicidal dusts.

(d) Fungicidal Treatment of Suckers—1928-29.

Suckers and "bits" of a fairly even type were prepared by the usual paring process and subjected to the following treatments immediately prior to planting in December, 1928:—

Row 1—Untreated (control).
Row 2—Mercuric chloride—1 in 500 for 1 hour.
Row 3—Mercuric chloride—1 in 500 for ½ hour.
Row 4—No treatment (control).
Row 5—Mercuric chloride—1 in 1,000 for 1 hour.
Row 6—Mercuric chloride—1 in 250 for 1 hour.
Row 7—No treatment (control).
Row 8—Mercuric chloride—1 in 250 for ½ hour.
Row 9—Mercuric chloride—1 in 250 for ¼ hour.
Row 10—Untreated (control).
Row 11—Copper sulphate (bluestone)—2 per cent. solution for ½ hour.
Row 12—Copper sulphate (bluestone)—4 per cent. solution for ½ hour.
Row 13—No treatment (control).
Row 14—Mercuric chloride—1 in 1,000 for 1 hour.
Row 15—Mercuric chloride—1 in 1,000 for 1 hour.
Row 16—No treatment (control).
Row 17—Formalin—1 per cent. commercial formaldehyde, ½ hour.
Row 18—Formalin—3 per cent. commercial formaldehyde ½ hour.
Row 19—No treatment (control).

The treatments were planted in the order mentioned, using 30 plants to the row. Rows 1 to 9 were repeated twice.

The obtaining of accurate results was rendered somewhat difficult owing to the steepness of the plantation, which made comparisons difficult, and to the fact that beetle borer caused the death of a number of plants.

None of the treatments appeared to have a detrimental effect on subsequent growth. However, as the young plants developed isolated spotting appeared more or less intermittently on the lower leaves, no particular treatment showing marked freedom. No distinguishing differences were noticeable as the plants approached maturity.

The origin of these early infections is uncertain and the possibility of their being due to air-borne spores cannot be overlooked. As the station area was being planted up for the first time it was itself free from sources of infection. However, a heavily infested neighbouring plantation was less than ¼-mile distant.

No significant differences could be detected in the root condition of the treated plants.

In conjunction with the steeping of banana suckers an analysis was made to determine the loss in strength of mercuric chloride during the dipping process. The results indicate that this loss is considerable and has to be allowed for if it is desired to maintain the solution at its orginal strength. The presence of exuded sap associated with freshly pared suckers may be largely responsible for this loss.

The figures for this analysis are as follows:—

	Mercuric Chloride.
Solution before immersion	1 in 1,030
Solution after immersion, 700 plants 1 hour	1 in 10,000
Solution after immersion, 800 plants 1 hour	1 in 20,000

(e) Spacing—1928-30.

A block approximately 10 chains deep was planted up in December, 1928, in the following order, running from east to west:—(1) Six rows 6 feet by 6 feet; (2) six rows 9 feet by 9 feet; (3) six rows 12 feet by 12 feet; (4) six rows 15 feet by 15 feet. Very little desuckering was practised throughout this block.

Observations made during the succeeding two years disclosed no significant difference as regards leaf spot development. Those plants in the 6 by 6 plot showed somewhat less Cercospora spotting. On the other hand speckle was present in this section to a considerable extent, owing to the crowded conditions, and a fair amount of leaf death could be attributed to this cause. Speckle was almost absent throughout the 12 by 12 and 15 by 15 plots. Definitely there could not be said to be any difference in the leaf spot incidence sufficient to justify disregarding the dictates of the best planting practice—the 6 by 6 and 15 by 15 both possessing disadvantages from the cultural point of view.

In connection with the spacing and steeping experiments we are indebted to Mr. H. J. Freeman, Acting Manager of the Station, who was responsible for carrying out the field work.

(f) Dusting—1930.

Two plots, each containing 140 stools spaced 10 by 10 feet, were taken within the confines of the plantation. An untreated area of equal size separated the two plots.

Plot No. 1 received a dust consisting of copper carbonate 7 per cent. CuO, sulphur 40 per cent., kaolin filler 53 per cent. Plot No. 2 received a copper carbonate dust containing copper carbonate 10 per cent. CuO and filler.

The first application was made on 21st January, 1930. Stools at this time were two years old and each contained 2-3 plants in various stages. From 2½ lb. to 4½ lb. of dust per plot per application were used, the increase being due to increased foliage development. The time occupied in treating each plot was from 3 to 4½ hours. In most cases an attempt was made to apply the dusts in the early morning before the dew had left the plants. As was to be expected from Queensland conditions rain interfered with the efficacy and proper spacing of the applications.

Dusting was carried out on the following dates:—

21st January (interrupted by wet weather).

3rd, 10th, 17th (interrupted by wet weather), 21st February.

5th, 18th, 25th March.

2nd April.

20th May.

6th, 14th, 18th June.

8th, 19th July.

4th August.

At no stage during the course of the applications or subsequently could any benefit be observed from the treatment, this notwithstanding the fact that the applications were made as efficiently as could be expected on a commercial scale. This failure to control the disease is in accordance with the results obtained previously from Mr. Richardson's work.

There are possibly three main causes for the failure:—(1) The banana leaf provides a large area to be covered and the shiny and waxy nature of the surface makes it practically impossible to obtain good adherence; (2) the heavy rains normally occurring in the main banana-growing districts during the summer and autumn months make it difficult to find suitable opportunities for dusting, and when these are obtained the chance of rain following shortly and removing the greater portion of the fungicide is always great; (3) the copper carbonate dusts used in the experiment, although the best available at the time, would no doubt be less efficient than a copper sulphate-lime preparation. However, the practical difficulties outlined in (1) and (2) above make it appear doubtful whether any of the known fungicidal dusts would be of sufficient advantage to justify their use against this disease. It might be pointed out here that the application of a wet spray is beset with many practical difficulties in the majority of Queensland plantations owing to the steepness of the slope on which they are situated and the lack of suitable water supply.

(g) Stripping—1929-30.

This experiment was based on observations which indicated that leaf spot attacked successively from the lower to the higher leaves of a plant, the source of infection apparently being to a large extent the lower leaves of the same or adjacent plants. It was thought that by removal of the infected leaves the rapid spread of the disease might be checked. Furthermore, by the removal of healthy leaves above those in a stage fit for infection a break to further advance would be formed. Each treatment was applied to three adjacent rows of 24 stools each. The spacing was 10 by 10 feet. The layout of the plots and the nature and date of the stripping were as follows:—

(C1) Control.—No treatment.

(1) 5th December, 1929.—All spotted leaves and the two lowest healthy green leaves removed.

(2) 5th December, 1929.—All spotted and the two lowest healthy green leaves removed.

21st February, 1930.—All spotted and the three lowest healthy green leaves removed.

(C2) Control.

(3) 5th December, 1929.—All spotted and the two lowest healthy green leaves removed.

30th January, 1930.—All spotted and the one lowest healthy green leaf removed.

21st February, 1930.—All spotted and the two lowest healthy green leaves removed.

25th March, 1930.—All spotted and the three lowest healthy green leaves removed.

(4) As (3), except that spotted leaves only were removed.

(C3) Control.

(5) 5th December, 1929.—All spotted and the two lowest healthy green leaves removed. Subsequently these plants were kept as free as possible of spots and spotted leaves by their removal at fairly frequent intervals until the last stripping on 26th September, 1930.

(6) As (1), 5th December.—All spotted and the two lowest healthy green leaves removed.

(C4) Control.

Insomuch as the amount of leaf spot present depends largely on the stage of development of the individual plants it was difficult to ascertain with certainty the relative incidence of leaf spot throughout the plots. In order to form some comparison a count was made on 26th March, 1930, of the number of unspotted leaves on all of those plants bearing a bunch which had reached the stage at which the floral organs turn black. The results are given in Table 1.

TABLE 1.

INFLUENCE OF STRIPPING ON THE LOSS OF LEAVES FROM LEAF SPOT.

Plot Number.	Number of Plants Available for Counting.	Average Number of Disease-free Leaves per Plant.
2	11	3·4
5	16	3·1
1	16	3·0
4	11	3·0
C2	13	2·7
C3	16	2·7
C1	12	2·5
6	12	2·3
C4	7	2·3
3	9	*2·1

* Stripping including three healthy leaves had been carried out on this plot one day before counting hence low average.

Owing to the small number of plants approximately of equal age available for counting no great significance can be attached to these figures.

By August very little difference could be noted between treated and control plants as regards leaf spot incidence except in the case of Plot 5, from which the disease was practically absent, but many plants had been defoliated during the process. The state of affairs at this time may have been largely due to the proximity of sources of infection to be found in the control rows and the adjacent portions of the plantation. That such was the case is also suggested by the fact that in the above counts the rows farthest from the control plants usually showed up better as regards healthy leaves present.

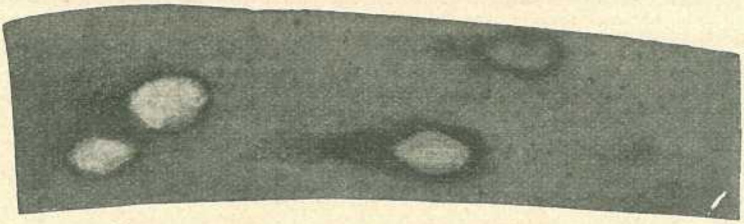
Although no definite conclusions can be derived from this experiment, a trial of a procedure such as that of Plot No. 2 over the whole of a fairly isolated area might yield better results. One likely to prove most useful without entailing too much labour would be somewhat as follows:—(1) A thorough clean up of the plantation after the new spring growth has commenced. All spotted and damaged leaves to be removed and destroyed. (2) The plants to be trashed again in January or early February before the wet season sets in. As well as spotted leaves, three or even four of the lower healthy leaves to be removed. An alternative might also be tried. (1) A clean up at the end of winter. (2) Trashing, including three healthy leaves, at the end of January. (3) Trashing, including three healthy leaves, at the end of February.

One point brought out by this experiment was that under the conditions obtaining at the time a banana plant will stand having a number of its healthy leaves removed without showing ill effects. The only plants showing definite evidence of harmful results arising out of the stripping necessary in the above experiment were those of Plot 5, when the continued removal of leaves or leaf portions showing spots led in many cases to complete defoliation. In this case the plants losing most of their leaves showed the lack of the usual shade and nourishment in the smallness of the bunch and stunted nature of the fruit.

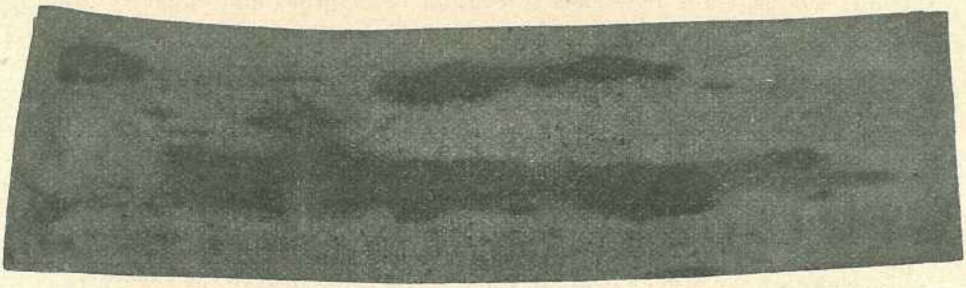
We have to thank Mr. Collard, Acting Manager of the Station, for superintending the field work associated with the dusting and stripping experiments, and also for many observations made in connection with them.

(h) Varietal Susceptibility.

The presence of a number of banana varieties in the one locality at the Kin Kin Station enabled some idea to be obtained of the varietal susceptibility to leaf spot. The Gros Michel and Cavendish appear to be outstanding in their susceptibility, the former being badly attacked in spite of its taller and more open habit of growth. The Lady Finger and Sugar varieties on the Station appeared to be less affected by the disease, but on other occasions the former has been known to be attacked with the same severity as the Cavendish. The Red Dacca showed up to best advantage and appeared definitely resistant. Unfortunately this is the only occasion in which observations have been made with this variety, which, moreover, is of little commercial use at present. The Mons Marie, a variety producing a bunch similar in type to the Cavendish, though on a taller stem and probably representing a sport from the latter, exhibits a susceptibility equal to that of the Cavendish itself.



A.



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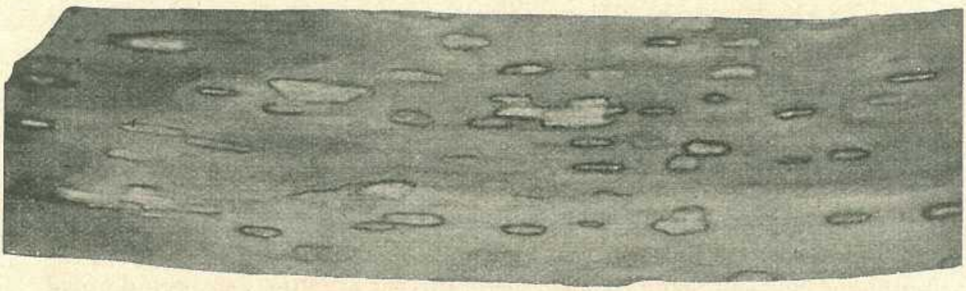

C.

PLATE 6.—BANANA LEAF SPOT.

A. The broad type of spot found on the first-formed leaves. B. Spots in the brown stage, surrounded in some cases by dying tissue. One example of the streak stage. C. The grey centre stage showing up conspicuously on dry leaf killed by the disease.

II. LABORATORY WORK.

(a) The Causal Organism.

A considerable amount of work on the etiology of banana leaf spot has been performed by J. G. C. Campbell (1, 2), Government Mycologist, Fiji, who visited Queensland in 1926 with a view to studying this banana disease and comparing it with a similar disease occurring in Fiji. He was able to show as a result of his investigations that the diseases in the two countries were identical symptomatically, and that the Cercospora associated with the lesions in Queensland is similar both morphologically and culturally with the one occurring in Fiji.

This organism from a consideration of morphological characters would appear to be similar to that originally described by Massee in 1914 from Fijian material as *C. musæ* Mass. Campbell further quotes a letter received from S. F. Ashby, Imperial Mycological Institute, who points out an error in Massee's original description and suggests that *C. musæ* Mass. is probably identical with *C. musæ* Zimm. described from Java in 1902. The latter name should therefore stand.

Our own measurements made from material collected in various districts of this State serve to confirm those dimensions given by Campbell for the Queensland species. Culturally our experience has also largely coincided with his so far as the work has been comparable. The canary yellow flourescence noted by him in certain cases has not been seen.

Support can also be given to Campbell's references to the occurrence of a similar disease in other countries of the Indo-Malayan region.

Cercospora musæ Zimm. has been recorded from Ceylon[3], though at the time of the writer's visit in February, 1932, the disease was not in evidence, and it is there regarded as of no great importance.

In the Federated Malay States a leaf spot similar to the Queensland one was observed in several districts. In one commercial area where the plants were suffering from poor cultural conditions the disease was present to an extent comparable with the situation here. Cultures obtained from material collected in this locality resemble those of the Queensland species. Spore measurements also support the view that the causal organism is the same. (Table 2.)

Cercospora musæ was described on *Musa sapientum* from Buitenzorg in Java by Zimmerman in 1902. As the disease is held to be unimportant, although common, little further attention has been devoted to it in this country.

The morphological characters in the original descriptions of *C. musæ* Massee and *C. musæ* Zimmerman, as well as those of Campbell and our own, are given in a summarised form in Table 2. When consideration is given to the variability in the morphological characters of *Cercospora* species it appears evident that we have in Queensland a disease of bananas common to other countries of the Indo-Malayan region and the Pacific. The causal organism of this disease is *Cercospora musæ* Zimm.

TABLE II.

SPORE MEASUREMENTS OF CERCOSPORA MUSÆ ZIMM. FROM VARIOUS SOURCES.

Author.	Origin of Material.	Number of Spores.	Length (Microns).			Breadth (Microns).			Number of Septa.		
			Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.
Zimmerman (4)* ..	Java ..	..	60	80	..	..	..	4	5	6	..
Massee (5)	Fiji ..	..	60	75	..	†4	†4·5	..	0	few	..
Campbell (2) ..	Fiji ..	100	23	66	43	2	5	3·5	0	4	2
Campbell (2) ..	Queensland	150	20	80	51	2	6	3·7	0	6	3
Original	Queensland	120	21	80	49	3	6	3·7	..	..	..
Original	Malaya ..	80	49	81	59	2·5	3·5	3	1	6	4

* Numerals in parentheses refer to literature cited.

† Ashby's correction. *Vide* Campbell (2).

Why leaf spot should have reached epidemic proportions in Fiji and Queensland and yet be regarded as of little importance in other countries is a point still to be determined. Campbell has suggested that its seriousness in the two localities mentioned may be due to close cultivation, general conditions of growth, and favourable environmental factors and, perhaps, to the variety of banana cultivated. This probably indicates the correct state of affairs, the importance of each factor being in the order mentioned. It is interesting to note that in Java a heavy leaf spot infection is usually held to be an indication of poor growing conditions or the presence of panama disease.

(b) Ascomycete Association.

Perithecia, pycnidia, and Colletotrichum acervuli may occasionally appear on old leaf spots. An attempt was made to locate a perfect stage of *C. musæ*, but without success. Amongst those most commonly occurring are two species of *Leptosphæria* with five and three septate spores respectively. The latter resembles in its morphological characters *L. musarum* Sacc. and Berl. In culture neither of these fungi resemble *C. musæ*, and their occurrence also on dead leaves apart from the Cercospora spots themselves suggests that they are present merely in a saprophytic capacity.

(c) Spermagonia.

Spermagonia may be formed in old leaf spot lesions after the leaf has died and dried out. They are to be found most commonly towards the end of the year on the dead trash hanging down round the pseudostem of the plant. Macroscopically these structures appear not unlike the black points formed by the pulvini of old conidial fructifications, the spermagonia, however, being, as a rule, of a more clearly defined dot-like appearance. They may be formed on both upper and lower surface, more commonly on the latter.

Microscopically the spermagonia appear as small, black, immersed, flask-shaped structures arising within the stromatic base of the old conidial fructifications or quite apart from these. The spermatia are very minute oblong hyaline cells, almost bacteria-like, which may be seen oozing from an ostiole at the apex of the spermagonium. The measurements are as follows:—Spermagonia 50-77 by 34-56 μ averaging 53 by 63 μ; spermatia 1 by 4 μ. The few attempts made to germinate the spermatia have had negative results.

(d) Fructification in Culture.

In an attempt to reproduce conidial, perithecial, or spermagonial stages in culture a number of media have been used. These were as follows:—

Potato dextrose agar
Plain agar
Prune agar plus 20 per cent. sucrose
Prune agar plus 40 per cent. sucrose
Meat extract agar
Malt extract agar
Oatmeal agar
Corn meal agar
Leonian's medium
Czapeck's medium
Rice
Cercospora-infected green and dry banana leaf agar
Papaw agar
Papaw petiole
Passion fruit rind
Mandarin stem
Banana fruit and skin
Banana leaf and midrib
Old agar culture of Cercospora sterilised
Mixed strains on potato dextrose agar.

Growth on these media may be of a compact mound-like type, grey at first, with or without a light pinkish overgrowth appearing later such as occurs on potato dextrose agar, or it may be of a more spreading grey velvety or irregularly tufted type, as for example when on banana fruit and midrib. A black substratum is, however, common to all media used with the exception of plain agar. Forming part of this there are in most strains dark pycnidia-like bodies. These structures are more or less distinct according to the strain or media used. In the more definite cases they consist of irregularly rounded bodies of varying size formed by a closely interwoven layer of hyphæ surrounding a central mass of loose hyaline cells. It is considered possible that these bodies represent immature spermagonial or perithecial structures. Further work along this line is in progress.

(e) Temperature Reactions.

The temperature reactions of *C. musæ* in culture are illustrated graphically by a growth-temperature curve in Graph 1. No great variation was noted in the six strains used in compiling this curve. The optimum appears to lie between 25 degrees and 26 degrees C., although fair growth may be expected between 20 degrees and 28 degrees C. Growth ceases at about 32 degrees C. in the upper range and 9 degrees C. in the lower.

Spore germination does not appear to be affected by temperature in quite the same manner as vegetative growth, as illustrated by the germination curve included in the same graph. The optimum is as high as 29 degrees C. While the upper range is greater the lower range is less than for vegetative growth. At the lower temperatures germination increases with time, and after forty-eight hours a fair percentage may be expected at as low as 15 degrees C.

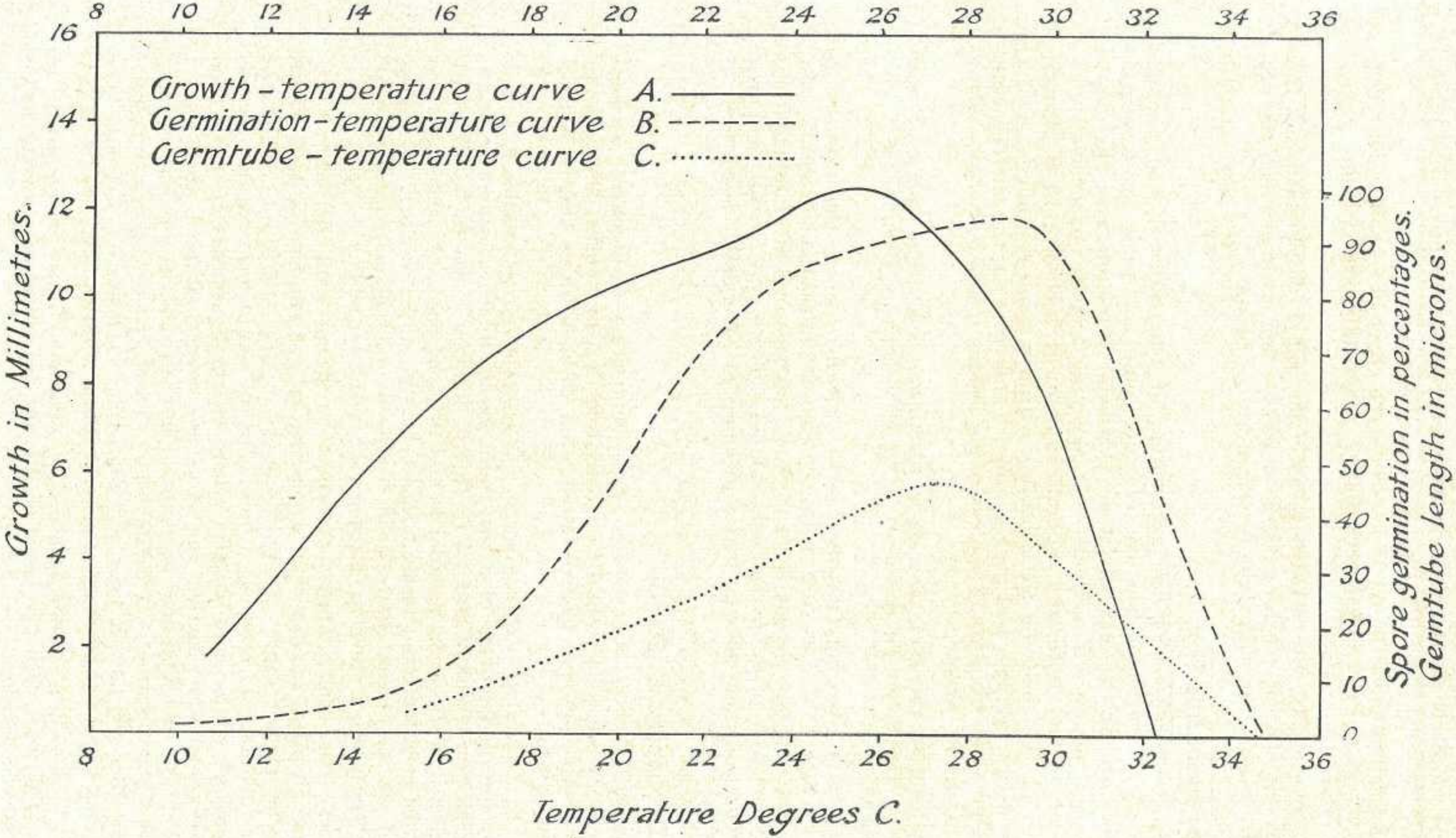

PLATE 7.

Graph I. Temperature reactions of *Cercospora musæ* Zimm. A. Growth-temperature curve averaged from six strains. Twenty-six and twenty-one days' growth in the case of four and two strains respectively on potato dextrose agar. B. Germination-temperature curve. Percentage germination after twenty-four hours in banana leaf infusion, average of two series. C. Germtube-temperature curve indicating germ tube development in microns after twenty-four hours in banana leaf infusion, average of two series.

As might be expected the germtube-temperature curve lies intermediate between those just discussed.

A preliminary attempt to ascertain the effect of humidity on spore germination indicated that germination practically ceased below 80 per cent. relative humidity.

These results are consistent with the rapid development of the disease during the early autumn months when average temperature conditions coincide with those favoured by the fungus.

(f) Artificial Infection.

In connection with the application of fungicides it was deemed necessary to determine whether infection could take place through both or one only of the leaf surfaces. Artificial infection was, therefore, attempted, using four methods—(1) spraying a spore suspension on to the leaf surface with and without subsequent inclosure in a glacene sleeve; (2) by enclosing the inoculum within a small cell affixed to the leaf; (3) by laying a leaf over a support and covering the surface with a bell jar; (4) by pinning spore-bearing lesions to the leaves of a plant left naturally exposed.

Owing to the fact that spore formation in culture had not been obtained the inoculum consisted of spore scrapings from natural leaf lesions.

Infection was only obtained in the instances where the application was by means of spraying with or without subsequent bagging. In these cases typical lesions formed about four months after inoculation. These occurred on the portions inoculated from the upper and the lower surfaces, both sides of the leaf appearing to be equally susceptible to invasion.

(g) Developmental Stages.

Another point of some interest in connection with control methods is the time taken for lesions to mature and develop spores. For sake of convenience leaf spot lesions can be said to show three stages in their development.

(1) The early or streak stage.—This is the earliest visible symptom of the spot and consists of a very light greenish-brown, somewhat indistinct, narrow streak of about 5 to 10 mm. long by 1 mm. or less in width running in a direction parallel to the veins of the leaf. These may at times be seen scattered in abundance over the upper surface. For some reason not at present understood it may be only a small proportion of these spots which develop further and reach maturity.

(2) The brown stage.—In this the lesion expands laterally to become elliptical in shape and turns first a light and then a dark brown to almost black colour. If conditions are suitable spores may be formed when this stage is reached. Under certain conditions, mainly towards the end of winter and usually when infection appears to have been specially abundant so that the spots are closely situated, the original narrow type of lesion does not expand laterally but merely darkens and forms a narrow line of fructification. This type of lesion often bears spores when the normal type is fruitless. It is, moreover, the only type on which spores may be expected to be found after the leaf has dried out.

(3) The grey centre stage.—The original elliptic lesion dries out to a light grey with the bases of the old fructification showing up as scattered black dots.

Only field observations are available for data in connection with the development of these stages. Individual lesions were ringed with indian ink and the subsequent development noted. It is apparent from these, however, that the development may be very erratic. Of the early stage lesions of one generation some may proceed to spore-bearing stage, while others remain without apparent alteration.

No data are available regarding the time elapsing from the incidence of factors stimulating spore germination until the development of early visible symptoms. In the laboratory spore germination takes from 12 to 18 hours or even longer at optimum temperature, and the fungus itself is relatively slow-growing, as evidenced by the fact that four to ten days elapse before colonies appear macroscopically visible in culture. Hence possibly several days are necessary for the period in question.

The following are the data to hand regarding subsequent development:—(1) Time taken from early stage to brown stage with, in some cases, the first signs of fruiting pulvini—3 to 30 days. (2) From early stage to spore formation—8 to 30 days. (3) From early stage to grey centre stage—10 to 30 days. The observations on which these records are based were necessarily limited, and it is probable that under different conditions these results would have to be revised. Mr. Collard, Manager of Kin Kin Experiment Station, has supplied a number of the figures used in this connection.

(h) Seasonal Occurrence.

With the help of Mr. Collard an attempt was made during the 1930 season to correlate outbreaks of leaf spot with meteorological conditions. In one series of stripping experiments all spotted leaves were removed from three adjacent rows of 24 plants, each at fairly frequent intervals throughout the season. In order to gain some idea of the extent of leaf spot development at different periods, Mr. Collard noted the number of leaves removed on these occasions. In Table 3 are given the figures so obtained from the plot as a whole.

TABLE 3.

SEASONAL DEVELOPMENT OF LEAF SPOT AS INDICATED BY REMOVAL OF INFECTED LEAVES.

Date of Stripping.	Number of Leaves Removed.	Average Daily Leaf Infection between Strippings.
8 January	30	0·9
30 January	7	0·3
7 February	15	2·1
21 February	313	22·4
1 March	381	47·6
12 March	322	29·3
20 March	138	17·3
25 March	19	3·8
2 April	120	15·0
15 April	120	9·2
17 May	113	3·5
10 June	213	8·9
17 June	169	24·0
24 June	180	26·0
1 August	130	18·5
30 August	89	3·0
26 September	220	8·5

These figures have been compared graphically with average relative humidity, average temperature, and rainfall for the first eight months of the year.

Very much closer attention to field developments would have been necessary in order to interpret these figures with entire satisfaction. Two points are, however, worthy of note. In the first place serious outbreaks of leaf spot are not necessarily dependent on cold weather association, as had been suggested previously. In the year under review the peak was reached between 21st February and 1st March after a period of average summer temperatures.

Secondly, it is to be noted that there are two main periods of leaf spot activity, one which had evidently reached its height at the date of the 1st March stripping, and the other at that of 24th June. Both these were preceded by an outstanding prolonged period of high relative humidity accompanied by rain extending in the first case from 20th January to 1st February, and in the second from 29th April to 12th May. Similar periods of high relative humidity are to be found subsequently to this latter, but the average temperature at the time lies well towards the lower limit for the normal growth rate of *C. musæ*, and active development could not be expected. A lower temperature average would also account for the delayed appearance of the second peak as compared with the first.

Assuming that these long periods of high relative humidity have some bearing on the subsequent development of leaf spot, two explanations are forthcoming. In this connection it must be remembered that the minimum period from the commencement of germination to spore formation in mature spots is possibly about ten days, and the maximum thirty days or more. The appearance of the clearly visible brown stage may also be delayed to thirty days. The possibilities are, therefore, as follows:—

Firstly, that a high germination taking place during the two periods of prolonged humidity produced infection which owing to delayed development only became clearly visible in time for the strippings taking place on dates near 1st March and 24th June respectively.

Secondly, that a period of rapid development allowed of a second or even third period of spore production and infection taking place between the first period of prolonged humidity and the peak outbreak—i.e., that the peak is the result of cumulative multiplication.

If the latter is the sole explanation, it is difficult to understand the cessation after the 1st March stripping, as conditions would appear to be as suitable for development to continue as just prior to this time. Possibly a combination of both explanations best meets the case. This will only be definitely decided, however, by the results of more detailed observations than have been possible up to the present.

In addition to those of 1930, further observations made along the same lines in 1929 would indicate that some increase in leaf spot may be expected after three consecutive days with a relative humidity above 80 accompanied by rain. It appears doubtful whether shorter periods of high humidity materially affect the leaf spot position.

Although leaf spot exhibits sporadic outbreaks throughout the winter, with the advent of spring-growing conditions the situation quickly changes. The weather is usually warm and comparatively dry. The plants develop rapidly, with the result that they quickly outgrow any slight advance that the disease may make, so that in a young plantation there is a period of from three to four months in which there is little evidence of the presence of the disease. In older plantations the plants which have thrown bunches and are no longer producing new foliage may retain the leaf spot on their upper leaves throughout the summer months, and these probably constitute a common means whereby the disease is carried over from one season to the next.

(i) Longevity of Spores.

Except for an experiment under way at the present time no attempt has been made to test the longevity of spores from any one batch of material.

Spore-bearing lesions were collected on different occasions and after drying retained in the laboratory. The spores were later tested for germination after various intervals had elapsed since collection.

The maximum germination obtained for a given period is contained in Table 4.

TABLE 4.

LONGEVITY OF THE SPORES OF C. MUSÆ ZIMM.

Date of Collection.	Date of Testing.	Time Retained.	Germination. Per Cent.
1930—	1931—		
26 March	7 March	12 months	0
16 July	7 March	8 months	0
4 September	7 March	6 months	0
1932—	1932—		
8 July	3 October	3 months	64
9 September	3 October	24 days	89
23 September	3 October	10 days	95

These results will need to be confirmed and elaborated by more extensive tests, but it would appear that under the conditions to which they were subjected the spores have not a long period of life.

III. ENVIRONMENTAL FACTORS CONTRIBUTING TO LOSS OF FOLIAGE.

Although there is no doubt that leaf spot alone is capable of causing serious loss, there are many cases in which the consecutive death of the lower leaves, resulting, in the case of bunch-bearing plants, in more or less complete defoliation simulating leaf spot injury, may arise from other causes. In these instances leaf spot is often blamed for destruction for which it is only partly responsible. Amongst these causes may be mentioned unfavourable cultural conditions, weevil borer and other fungus diseases.

In many of the hillside plantations the soil is of no great depth. The top 6 inches to a foot of light friable soil often merges into a stiff and somewhat clayey subsoil. The eroding action of a semi-tropical rainfall still further reduces the amount of suitable soil available. Associated with this condition it is found that after the heavy summer rains extensive root rot develops and the plants, especially the older ones, may be left almost devoid of sound roots. No doubt fungi and nematodes play an important part in this rotting, but the primary consideration appears to be the physical and possibly the chemical condition of the soil.

In certain situations where poor drainage is obviously a factor bananas have been seen growing in the absence of leaf spot, and yet exhibiting in the older plants the almost complete defoliation characteristic of this disease. No doubt the severity of the disease when present must often be augmented by the accompaniment of such unfavourable conditions.

A soil which is too porous and dries out quickly is found to be conducive to heavy leaf spot infection.

Magee and Fitzpatrick[6] have recently described a leaf fall of bananas in the Tweed district of New South Wales occurring on land which has been previously depleted by other crops. Excessive dying of the leaves occurs during the winter months until the bunch may be left practically bare, as in the case of severe leaf spot attack. This trouble can easily be rectified by the application of fertilizers.

Towards the end of winter plantations in cold situations often exhibit considerable yellowing and dying of the leaves as a result of exposure to abnormally low temperatures. In rare cases complete defoliation has been noted from this cause.

Weevil borer by acting in much the same way as root rot, that is by cutting down the supply of nourishment and so weakening the plant, is also able to aid leaf spot development. The association in individual plants of heavy leaf spot infection and extensive borer damage has often been noted.

IV. LEAF DISEASES OTHER THAN LEAF SPOT.

Two other foliage diseases to which the name speckle and yellow leaf spot have been applied are present in Queensland. Both these diseases act in a similar manner to leaf spot in that the lower leaves are first affected, resulting in a gradual loss of foliage from the base up. On occasions these diseases may be responsible for as much loss as leaf spot itself, and more than once they have been confused with the latter disease. These two diseases are briefly described here in order that they may be more readily recognised.

Leaf Speckle.

Speckle is found on the lower leaves of a plant usually in the more shaded or crowded situations. The symptoms can be seen at first on the under surface. Here there appear irregular light grey patches formed by a close speckling of the surface with greyish dots. The individual dots darken and coalesce as the disease advances, and the leaf surface comes to bear scattered or aggregated dark brown to black blotches of varying size and intensity. The presence of these areas of decay eventually leads to the complete destruction of that portion of the leaf on which they are situated. As in the case of leaf spot, if conditions are favourable speckle will gradually spread from the lower leaves upwards, leaving in its wake dead leaves draped round the pseudostem.

The loss from speckle is much more serious in a thickly growing plantation than in one which is kept well trashed and suckered. Under normal circumstances damp shady conditions appear to be necessary for any considerable development of this disease.

In a number of cases speckle on its own has been known to cause a reduction of the foliage quite comparable with that produced by leaf spot. It is very commonly present in association with the latter disease, and here again it must sometimes be regarded as being equally if not more responsible for the leaf damage occurring. Speckle assumes serious proportions earlier in the year than does leaf spot. The wet conditions of January and February may witness a fairly extensive development, and the disease then remains present to a varying extent throughout the year. A rapid epidemic outbreak such as occurs sometimes with leaf spot and yellow spot is not a feature of this disease.

Microscopic examination shows the presence of fungus in the affected tissue. Isolations have fairly consistently yielded the same organism. This produces on potato dextrose agar a mound-like and slowly spreading colony with a grey compact mycelium which may later develop pinkish areas. The cultural characters of certain strains of this organism resemble those of *C. musæ*. So far no definite fructification has been obtained in culture and the organism remains undetermined.

Speckle-infected areas on leaves which have been dead and dry for some time are often to be found thickly studded with pustules comprising small perithecia of the Mycosphærella type. So far no definite attempt has been made to establish the causal relationship of this organism.

A condition resembling speckle was collected by the writer from bananas in Ceylon. This appeared similar to specimens in the herbarium of the Department of Agriculture, Peradeniya, labelled *Leptosphæria musarum*. As has been mentioned previously a fungus resembling this species has been found in Queensland in association with old leaf spot lesions and elsewhere on the leaf, where it is considered to be present in a saprophytic capacity. In this State it is the *Mycosphærella* which is most consistently associated with speckle.

Yellow Leaf Spot.

This leaf spot has only been observed so far in two districts of North Queensland. The disease commences in the lower leaves of a plant as somewhat indefinite light yellow areas which gradually enlarge to an elongate elliptic or more characteristically a definite diamond shape. These turn deep yellow and then gradually darken in the centre and dry out to dark brown, leaving a narrow yellow margin. The mature spots may be 3 to 4 inches long by 1 to 1½ inches broad.

The effect of this disease on the plant is essentially the same as that of leaf spot. Commencing on the lower leaves dead areas are found round the spots, which if numerous soon involve the whole leaf. The death of the leaves then ensues from the lower ones up, with the result that a bunched plant may be left with few healthy leaves.

In general yellow leaf spot does not appear to be of such serious consequence as cercospora leaf spot, from which it differs somewhat in being capable of causing serious defoliations in young plantations. That the disease is capable under certain conditions of causing as much damage as leaf spot itself has been shown in one or two plantations where the two diseases occurred together.

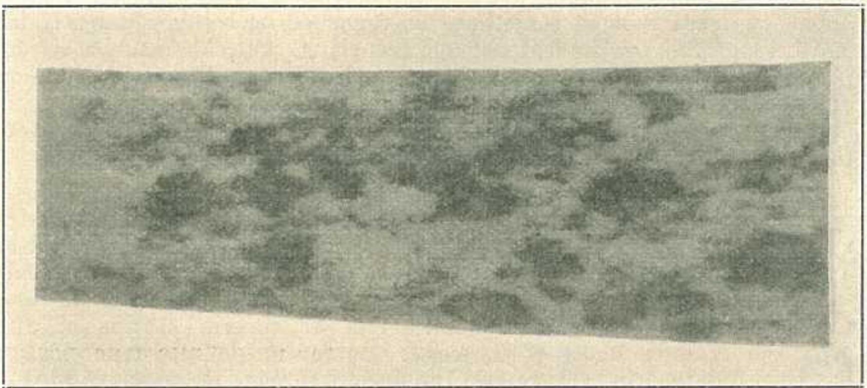

PLATE 8.—LEAF SPECKLE.

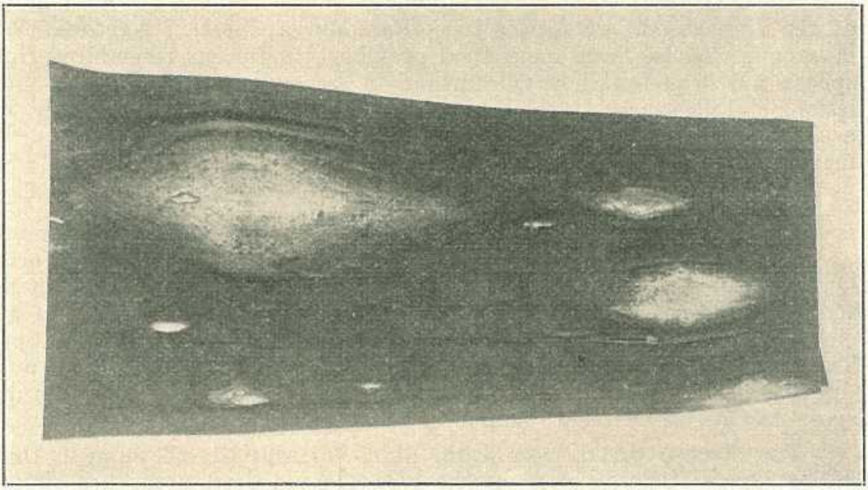

PLATE 9.—YELLOW LEAF SPOT.
Several Cercospora spots are included in the specimen, and form a comparison.
(Slightly reduced.)

In yellow leaf spot it appears we have again a disease which is common to the Indo-Malayan region. A leaf spot closely resembling the Queensland one was observed by the writer affecting bananas in Ceylon, Malaya, and Java.

Associated with these spots as well as those from this State is a species of *Scolecotrichum* closely resembling *S. musæ* Zimm. Specimens of a banana leaf spot of somewhat smaller dimensions received from Norfolk Island had a similar organism associated with it. What is apparently the same disease has also been obtained from *Musa Banksii* F.v.M., a species endemic to Queensland.

The fructifications of the *Scolecotrichum* form a greyish down covering the under surface of the spots. This is a characteristic feature of the disease.

The spore measurements of the *Scolecotrichum* obtained from various sources are outlined in Table 5, together with those given in the original description of *S. musæ* Zimm. It will be seen that with the exception of the Norfolk Island material there is little difference to be observed, although all fall somewhat short of the original length measurements. Variation in the conidiophores is somewhat greater, although this is perhaps to be expected.

It therefore appears probable that the species of *Scolecotrichum* associated with yellow leaf spot in Queensland is the same as occurs in similar situations throughout the Indo-Malayan region, and is to be regarded as *Scolecotrichum musæ* Zimm.

TABLE 5.

SPORE MEASUREMENTS OF SCOLECOTRICHUM SPP. FROM VARIOUS SOURCES. TWENTY MEASUREMENTS IN EACH CASE. ALSO ZIMMERMAN'S DIMENSIONS FOR S. MUSÆ.

Source.	Length (microns).			Breadth (microns).		
	Min.	Max.	Average.	Min.	Max.	Average.
Queensland	13	19	16·5	9	13	10·2
Queensland (*Musa Banksii*)	13	19	16·5	7	10	8·7
Java	15	20	16·5	9	15	10·4
Ceylon	15	19	16·6	9	12	9·9
Norfolk Island	19	27	23·3	14	16	15·2
Java [Zimmerman (7)] ..	..	..	20	8	10	..

We are not aware of any attempts having been made to prove the pathogenicity of *S. musæ* on the banana. This species is recorded as associated with a disease of *Musa paradisiaca* L. in Ceylon[3], and was originally described from the foliage of *Musa sapientum* L. in Java in 1902. The consistent association of this organism with the disease in such widely separated regions as now recorded would at least lead one to expect some causal relationship.

Conclusion.

Although it has not been possible to arrive at any definite measures for the control of leaf spot, the ground has been to a great extent cleared for future work.

It must be remembered that two important avenues for the control of plant diseases are largely closed owing to the nature of the banana plant itself. These are the use of a resistant variety—there being apparently no suitable one available; and the use of fungicides. As regards the latter, dusting has been shown to be of little value. Spraying is a practical impossibility in many plantations, but its use might be advisable on others should the exact dates on which applications were necessary be known. The vital point for attacking the disease has been shown to be most probably in the late summer months, and it is possible that some system of strict sanitation during the early part of the year might be found to yield definite benefit. A number of other factors have been shown to cause symptoms which simulate leaf spot damage, and these will have to be overcome in their turn before a satisfactory state of affairs is possible.

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QUEENSLAND SHOW DATES, 1933.

Royal National Bushmen's Carnival: 20th and 21st January
Stanthorpe: 1st to 3rd February.
Warwick: 14th to 16th February.
Clifton: 1st and 2nd March.
Allora: 8th and 9th March.
Pittsworth: 14th and 15th March.
Milmerran: 21st March.
Goombungee: 23rd March.
Killarney: 24th and 25th March.
Toowoomba: 27th to 30th March.
Beaudesert Camp Draft: 30th March to 1st April.
Oakey: 8th April.
Chinchilla: 11th and 12th April.
Boonah Camp Draft: 15th to 17th April.
Nanango: 20th and 21st April.
Kingaroy: 27th and 28th April.
Wondai: 4th and 5th May.
Murgon: 10th and 11th May.
Beaudesert: 10th and 11th May.
Ipswich: 16th to 19th May.
Goomeri: 18th and 19th May.
Kilkivan: 22nd and 23rd May.
Gympie: 24th and 25th May. Camp Draft: 27th.
Toogoolawah: 26th and 27th May.
Maryborough: 30th May to 1st June.
Marburg: 2nd and 3rd June.
Lowood: 9th and 10th June.
Rockhampton: 20th to 24th June.
Laidley: 28th and 29th June.
Caboolture: 13th and 14th July.
Esk: 21st and 22nd July.
Maleny: 26th and 27th July.
Royal National—Brisbane: 7th to 12th August.
Crow's Nest: 23rd and 24th August.
Nerang: 13th October.

Notes on the Onion Thrips.

By W. A. T. SUMMERVILLE, B.Sc., Assistant Entomologist.

ALTHOUGH there are more than seventy species of thrips native to Australia, practically the whole of the economic damage attributable to insects of this group is done by species which have been introduced from other parts of the world.

Of these destructive introduced species probably the commonest is the onion thrips, *Thrips tabaci* Lindeman.

The onion thrips is a minute, slender insect not more than $\frac{1}{25}$ inch in length, yellowish in colour, and for the most part very active in its movements about the plant on which it is found. The adult females are rather darker in colour than the males and the nymphs of both sexes, and possess two pairs of very fine wings. The main portion of the wing is very small even for the size of the insect, but on the hind margin of each wing there is a fringe of comparatively long, fine hairs. The immature stages, or nymphs and pupæ, and the adult males are wingless. The males are seldom found, and apparently the female is able to reproduce without having first mated.

Host Plants.

Mr. A. A. Girault has recorded *Thrips tabaci* from about twenty-five plants in this State. Most of these hosts are weeds and other plants growing apart from cultivation. The number could be considerably increased by the addition of plants of economic importance and plants such as garden flowering species as distinct from economic crops. Lists of the host plants recorded by Girault have already been published in this Journal and, apart from this, it is not considered that any useful purpose would be served by repeating the list here since it is probably by no means complete. In so far as weeds influence the control of the species it is considered advisable that onion growers treat all weeds as potential hosts of the pest and not differentiate between host and non-host amongst the many weeds of the State.

The following plants grown for crop purposes are known to be attacked:—Onion, tomato, bean, cabbage, cauliflower, cucumber, squash, melon, and beet. Practically all these plants suffer severe injury at times.

In so far as onions are concerned, it appears that with the exception of the white "Imperial" all varieties commonly grown in Queensland are subject to attack to about the same extent. Limited observations made recently suggest that, although the pest will attack the "Imperial," this variety is much less palatable to it than are the other common ones.

Injury to the Onion.

The thrips are to be found on the onion in two stages—the first stage young, or nymphs, and the adults. The nymphs are almost entirely confined to the bases of the youngest leaves, and are therefore hidden from view unless the leaves are held apart. On plants which are flowering or seeding the nymphs apparently habitually ascend the flower stalk in large numbers.

The adults may be found on any aerial part of the plant, but are mostly observed on the older leaves, and are therefore exposed to view. Although the nymphs are smaller than the adults, being grouped together in large numbers, and being of a very distinct yellow colour, they are, however, usually seen first—the more scattered distribution of the adult females and their more sober coloration making them rather difficult to detect. It is, however, essential that growers make themselves familiar with the adult insect if control measures are to be successfully carried out by them. The reason for this will be apparent later.

The main injury is done by the adult thrips. These attack the leaves, tearing away the surface tissue, and imbibing the plant juices. The tearing away of the tissues causes whitish blotches and streaks. This white marking is very characteristic of the damaged plants, and when the infestation is very heavy there may be very little continuous healthy green surface such as is normal to the onion plant.

The most heavily damaged leaves may wither at the tip, and the plant generally may take on an unthrifty appearance. The general appearance of a heavily attacked plant suggests that the bulb is commencing to ripen off, though, of course, the bulb may be less than half grown.

The effect on the bulb itself cannot be stated in definite terms at present. Observations have been limited to fields in which every plant of the one variety has been about equally and heavily attacked. Thus no comparison of attacked and unattacked plants grown under similar conditions has so far been possible.

It is too often found that farmers are apt to ignore the work of pests on their plants because they are not attacking directly the part of the plant in which the grower is most interested. Thus fruitgrowers often neglect a foliage feeder on their trees simply because unless it becomes very severe they do not realise that the whole of the rest of the tree must be somewhat affected. In the same way growers of onions in many cases do not appear to be concerned about onion thrips because the bulb itself is not directly attacked. This attitude is unsafe, and it is considered advisable that (though the effect on the bulb may not be apparent) onion growers should treat the thrips as a serious enemy. Experience in other countries, particularly North America, supports this view.

On certain types of soil in this State there is a tendency for some varieties of onions to produce a bulb which is really too large to command the best market price, and for this reason quite a number of growers appear to think that the thrips may do some good. It may do so, of course, but it is a very poor way of producing the desired size of bulb. For one thing, it is impossible to state that when the size of a bulb is reduced by making the plant somewhat unhealthy that this is the only effect on the bulb. It is almost certain that the characters of the bulb are changed in other ways as well as in size, and the characters of the bulb must include those points which come under the heading of quality. Even if it be allowed that a certain number of thrips do some good, there would certainly be a limit to the number of desirable thrips, and to keep the infestation of any insect at a stated limit is obviously impracticable. Therefore, onion growers would be better advised to treat thrips as nothing but a menace to their crop, and deal with it accordingly.

Life History and Habits.

Work in Queensland on the onion thrips has been confined, until the recent outbreak, to the collection, identification, and recording of host plants. No opportunity has so far occurred for the study of its life history under local conditions. In the United States of America the insect is of much importance both on onions and other crops, and some attention has accordingly been given to it.

It is found there that the eggs take from five to ten days to hatch, and that the nymphs require from fifteen to thirty days to reach the adult stage.

The eggs are laid on the plant, and the young on emerging remain more or less congregated in batches of up to forty or more, according to the infestation, at the base of the youngest leaves, as described above. Following this stage the insect moults, and the next two stages are passed in the soil. Whilst in the soil the insects apparently do not feed, and are capable of only a very limited amount of movement.

They return to the plant when the adult stage is reached, and again become active. The adults move particularly quickly, but the first-stage young, though capable of rapid movement, usually remain fairly still.

The habit of growth of the onion plant affords excellent protection to the nymphs congregated at the base of the youngest leaves. The youngest leaf during the early part of its growth fits closely into a concavity of the next oldest leaf, and the fitting is so close and the structure of the leaf surface of such a nature that it is scarcely possible to make a spray penetrate to the hiding place of the young between the two leaves. In fact, if the leaves be undisturbed and the plant held under water for several minutes, it is found that the base of these two leaves, where they are in contact, is not wetted. From this it will be seen that ordinary contact sprays are not likely to be of much use against the young owing to the efficiency of the protection which the plant affords the insects in this stage.

Thus direct measures against the pest have to be confined to attacking the adult, and it is for this reason that the life cycle is of importance. Under the circumstances it will, for the present, be necessary for growers to accept the American figures given above as a basis, and make their own observations as to the recurrence of large numbers of adults from time to time. Even if the life history were to be worked out for Queensland conditions it would still be necessary for growers to make some observations for themselves, as the length of the life cycle period would almost certainly vary from year to year as well as from month to month. The lack of knowledge referred to above is thus by no means as big a handicap as might at first appear.

Natural Enemies.

Two small hymenopterous wasps have been observed amongst the pests on the onion plant, and it is suspected that these are parasitic on the thrips. However, it has not so far been possible to prove this point. At the same time, though the onion thrips is an imported insect, it would appear that either some of its natural enemies have been introduced as well or that some Australian insect or other parasite has found the pest to its liking, otherwise *Thrips tabaci* would be even more important a pest than it is. Even so, there is no evidence to suggest that the parasites, if present, are so efficient that growers can afford to depend on them to control a heavy infestation at any particular time.

Control.

An opportunity occurred recently to test out a number of sprays against this pest. A very heavy outbreak of the insect was reported from the Rockhampton office, and arrangements were at once made to carry out experiments to test the relative efficiencies of some of the more promising contact insecticides.

From the habits of the pest as described above it will be at once apparent that the only stage which can be directly attacked in this manner is the adult. Killing the young by means of a spray is not so much a question of finding a material which would act satisfactorily as of finding a way of applying the material in such a manner that the innermost leaves could be thoroughly wetted. There appeared to be no hope of finding a solution for this difficult problem, and the time available was therefore devoted to the testing of sprays against the adults.

As the insects are found on the plant in the young form and as adults concurrently, it is apparent that to combat the pest successfully it was necessary to find an insecticide that would retain its potency over a fairly long period, or, alternatively, to obtain a material sufficiently cheap to allow of its application being repeated twice or oftener at certain times which would depend on the rate of breeding of the pest.

None of the available wet spray materials appeared to have any possibility of fulfilling the first alternative, but it was thought that a dust might be found. For this reason sulphur dust and nicotine dust were tested.

As a second alternative nicotine sulphate, Katakilla, and a local experimental proprietary spray were tried. Of these three wet sprays the lastmentioned insecticide was shown to be of little or no value for this particular purpose.

Sulphur dust was also found to be useless against the pest, whilst the nicotine dust gave no apparent kill. It might be here pointed out, however, that the test could not be considered as proof that nicotine dust was of no value, for the sample supplied was a very poor one, and could not be taken as typical in its action. Time did not permit of a second sample being obtained.

Nicotine sulphate used at 1 to 800 certainly killed a few of the insects, but the results obtained showed that too many applications would have to be made to make its use practicable.

At a strength of 1 to 400, however, the nicotine sulphate gave much better results, but the cost was so much higher than the more promising Katakilla that nothing beyond the preliminary tests was done with it. At the same time there is little doubt that at this strength the nicotine sulphate would have proved effective against the adult stage of the pest.

By far the best result, considered with cost, was obtained in the preliminary tests with Katakilla. This material made to the strength recommended by the manufacturers gave such promising preliminary results that it was decided to concentrate on it in further tests.

Accordingly four beds, each containing three rows of plants, were sprayed with the Katakilla. The plants were examined twenty-four hours later and counts made of the adult thrips on approximately 1,000 leaves. It was found that the average number of adult thrips per leaf on the sprayed plants was 1·9. The number of the insects on each leaf was moreover remarkably constant. The leaves were counted in groups of forty, and the figures obtained show that the number of thrips on the groups was always between sixty-nine and seventy-seven, thus adding to the significance which may be placed on the data.

Counts made at the same time on nearby untreated plants gave the average per leaf as 8·7. It may be necessary to point out that before the spraying was done the plants were examined to see that the infestations on all were about the same.

On these figures it appears that approximately 80 per cent. of the adult insects had been removed by the spraying. Under the circumstances in which the work was done it was impossible to find and count the dead thrips, and the above method, though admittedly open to error, was the only satisfactory one which could be devised.

It is considered that of the factors which would tend to make the obtained figures incorrect those which would make the apparent kill less than the actual were likely to act most strongly.

Of these factors the most important would be migration of adults from plant to plant or from row to row. This would be expected to operate in two ways. In the first place, whilst the actual spraying was being carried out some of the insects might move from one row to the next or from the sprayed beds to unsprayed ones. This would then perhaps tend to increase the number of insects on the unsprayed plants at the expense of the sprayed ones. To partly offset this the ground round the plants was wetted with the spray as it was applied to the plants, and further, in counting the insects, the row next to the sprayed ones was not used. It might also be mentioned that the counts of the plants in the two middle of the four sprayed beds did not differ materially from those of the other two.

In the second place there is the possibility of migration of the adults from the untreated to the treated plants, or vice versa, after the spraying had been finished. If the spray killed any of the pests this must favour an increase in the number of insects to be found on the sprayed plants and a decrease on the unsprayed ones. It is considered that this migration would be the more important of the two, particularly as there was no evidence to suggest that the spray left any residue which might be deterrent to the pest.

It is therefore considered that the stated 80 per cent. is, if anything, an underestimate of the effect of the spray. That this effect was not wholly derived by driving out the pest was shown by the fact that a number of dead were found on several plants.

Recommendations.

Since portion of the life cycle of the insect is spent under the ground attention to cultural work cannot fail to be of benefit against the pest. Further, the best offset against the depredations of any pest such as this is to keep the attacked plant in the best possible state of health and vigour. One of the best ways of doing this is by the adoption of good cultural practice.

In some districts onions are grown under irrigation conditions, and, particularly where the water is cheap, there is sometimes a tendency to make irrigation a substitute for cultivation. Growers would do well to remember that this is bad policy.

Apart from its place in pure cultural practice, the cultivation should be kept as free from weeds as possible on account of the fact that the onion thrips feeds on so many common weeds. Further, it is advisable for the same reason to keep the weeds on the headlands back as far as practicable from the cultivation.

Spraying is effective only against the adults, and after the pest has become well established will have to be carried out twice or oftener to be of any lasting value. If the thrips occur early in the growth of the plant, *i.e.*, up to about a month old, it may be possible to wet all leaf surfaces with a spray, and thus young may be killed. Even so, however, it is more than likely that a further infestation will take place from outside sources.

With respect to the actual application of the spray, as has been indicated, growers should not waste time and material trying to penetrate the plant to the hiding place of the young. The whole of the exposed portions of the plant should be wetted thoroughly, and the ground round about the plants should also be lightly sprayed.

The interval which should elapse between sprayings will be dictated by the rate of development of the pest, and as this will no doubt vary it is not possible to make any definite statement. Growers will need to make the necessary observations for themselves.

After the first spraying the insects will appear as adults, probably gradually, in greater and greater numbers. They may, of course, appear in heavy numbers rather suddenly, but this is less probable. At all events the time of the next spraying will be determined by the appearance of large numbers of thrips in the adult form. The presence of the young must be ignored in this connection, no matter what their numbers.

It will probably be found that three sprayings will be necessary when the outbreak assumes plague proportions, or when it is neglected in the early stages. From the figures given above it would appear that the three sprayings applied at intervals of a week between each will be followed by the best results. The third spraying is suggested mainly because there is almost certain to be some overlapping of succeeding generations.

TO SUBSCRIBERS—IMPORTANT.

Several subscriptions have been received recently under cover of unsigned letters. Obviously, in the circumstances, it is impossible to send the journal to the subscribers concerned.

It is most important that every subscriber's name and address should be written plainly, preferably in block letters, in order to avoid mistakes in addresses and delay in despatch.

TRANSPORTING DAIRY CATTLE BY AIR.

THE athletic prowess of the cow in the nursery rhyme, through which our infantile interest in high-jumping quadrupeds was first aroused, seems almost within the realms of the possibility visioned by us with the credulity of extreme youth, as we record as an actual fact the transport of Queensland dairy stock by air to the New Guinea goldfields. The cow in this case, however, had no ambition to eclipse the mythical lunar record; it merely flew with its mate over the high mountains between Salamaua and Wau in the territory of New Guinea.

Some little time ago Mr. Arthur Thompson, of Bulolo, who includes dairying among his enterprises, bought some young stock from Messrs. Hickey and Sons, of the Glendalough Stud, Wilston, near Brisbane. Delivery after their arrival by steamer at Salamaua presented serious difficulty, for travelling the stock in the ordinary way by road was out of the question. Lofty and almost inaccessible ranges had to be crossed, and the difficulties of transport otherwise were insurmountable; so the only way to solve the problem was to carry the cattle over the mountains by aeroplane. The animals were duly landed at the headquarters of the Guinea Airways at Lae, and were transported subsequently in one load by the Guinea Airways triple-engine junker plane to Wau without mishap.

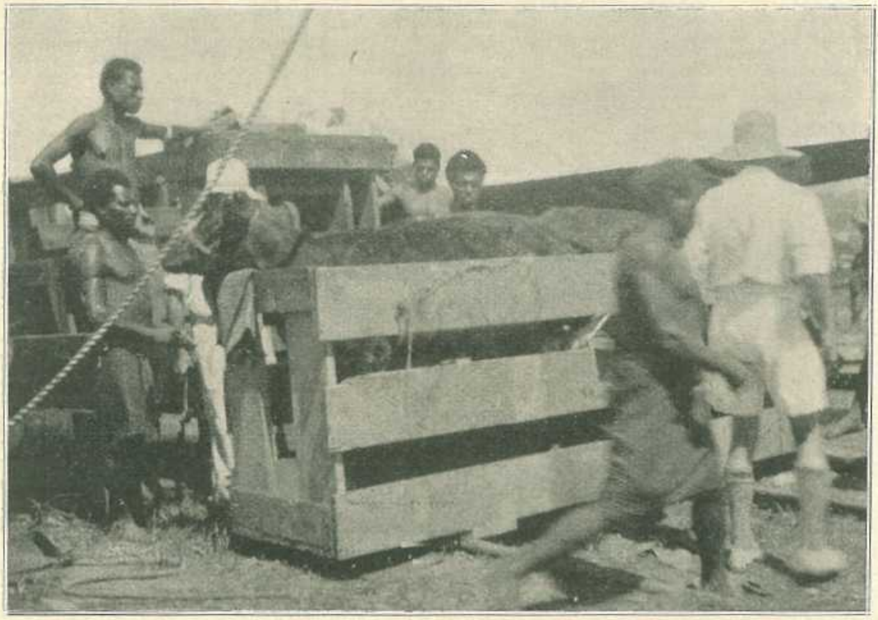

PLATE 10.—YOUNG DAIRY STOCK CRATED FOR AEROPLANE TRANSPORT.

A consignment of A.I.S. cattle from Messrs. Hickey and Sons' Glendalough Stud, Wilston, near Brisbane, to Wau, Territory of New Guinea, to the order of Mr. Arthur Thompson, of Bulolo. Lae, the headquarters of Guinea Airways, was the port of lading.

The undertaking was the first of its kind, and should therefore be of considerable interest to cattlemen and commercial air transporters. So far as we are aware, it is also the first time that an aeroplane has been used for the transport of dairy cattle. The accompanying illustrations tell the story of how it was done.

The cattle consigned to Mr. Thompson were an A.I.S. heifer, "Glendalough Scarlet," by "Don of Springdale," from "Scarlet of Pine View"; and a young bull, "Glendalough Commodore," by "Young Commodore of Springdale," from "Redwing IV. of Upton."

The consignment was the second from the Glendalough stud to Wau. The first was disastrous. After landing at Salamaua the stock were started on the road, the droving outfit consisting of twenty native boys with provisions for six weeks. The country traversed was most difficult, and long and weary detours through trackless mountain ranges were necessary. The cattle died on the road.

The second consignment was carried by 'plane and delivered at its destination without loss in forty minutes. The freightage was at the rate of 6d. per lb. Further consignments are in view, and the aeroplane will again be employed by Mr. Thompson as the quickest, cheapest, and safest means of transport in that part of New Guinea.

We are indebted to Mr. C. J. Hickey for the use of the photographic prints from which our illustrations were made.

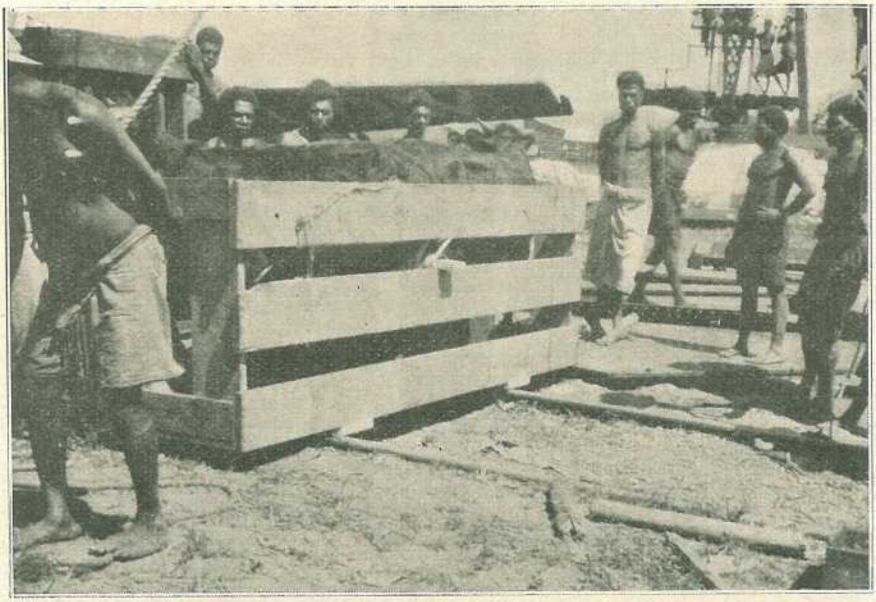

PLATE 11.—READY FOR THE LIFT AT THE LAE AERODROME.

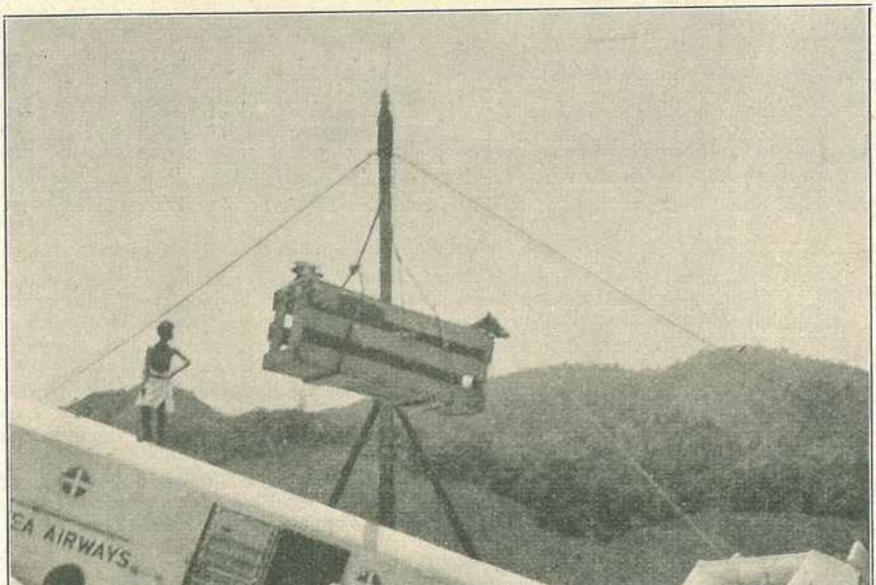

PLATE 12.—IN THE AIR FOR THE FIRST TIME.

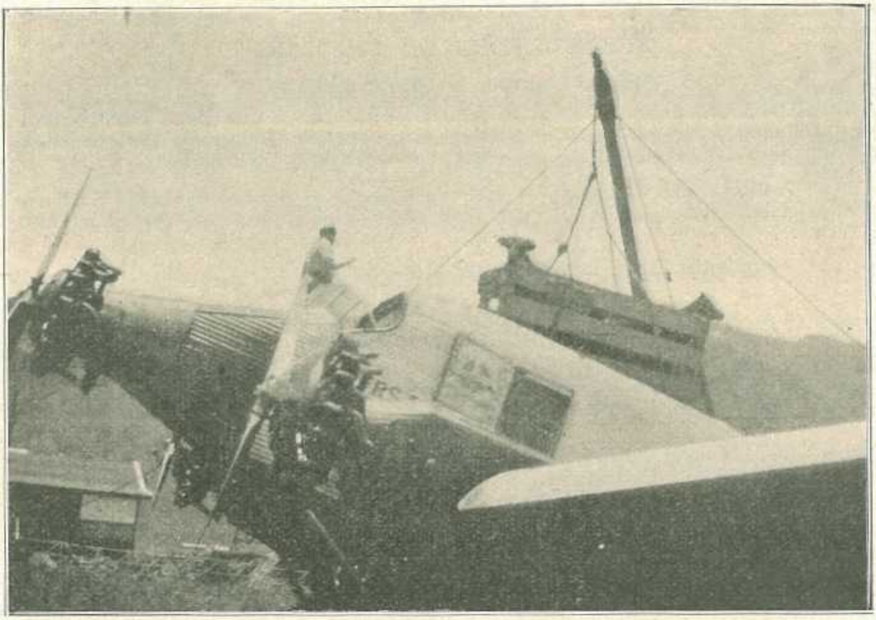

PLATE 13.—THE JUNKER PLANE BECOMES A CATTLE TRANSPORT.

The load was carried on the roof of the plane, and surely no cow has had a more exciting ride, nor a finer view of future mountain pastures.

PLATE 14.—CATTLE ARRIVE AT WAU AFTER A FORTY-MINUTE FLIGHT FROM THE COAST.

A previous consignment of cattle from Brisbane was sent to Wau from Salamaua by road with a droving outfit of twenty natives, provisioned for six weeks. The cattle did not survive the rough journey. The aeroplane is now regarded as the quickest, safest, and cheapest means of transport in that part of New Guinea.

AGRICULTURE ON THE AIR.

Radio Lectures on Rural Subjects.

ARRANGEMENTS have been completed with the Australian Broadcasting Commission for the regular delivery of further radio lectures from Station 4QG, Brisbane, by officers of the Department of Agriculture and Stock.

On Tuesdays and Thursdays of each week, as from the 3rd January, a fifteen minutes' talk, commencing at 7.30 p.m., will be given on subjects of especial interest to farmers.

Following is the list of lectures arranged:—

SCHEDULE OF LECTURES.

BY OFFICERS OF THE DEPARTMENT OF AGRICULTURE AND STOCK.
RADIO STATION 4QG, BRISBANE (AUSTRALIAN BROADCASTING COMMISSION).

Tuesday, 3rd January, 1933—"Diseases of the Passion Vine." J. H. Simmonds, M.Sc., Plant Pathologist.

Thursday, 5th January, 1933—"The St. Lucia Farm School." Hon. F. W. Bulcock, M.L.A., Secretary for Agriculture and Stock.

Tuesday, 10th January, 1933—"Poultry Culling," J. J. McLachlan, Poultry Inspector.

Thursday, 12th January, 1933—"The Cultivation of Pineapples." H. J. Barnes, Instructor in Fruit Culture.

Tuesday, 17th January, 1933—"Some Lessons from Denmark." J. F. F. Reid, Editor of Publications, Department of Agriculture.

Thursday, 19th January, 1933—"Some Fodder Crops of Central Queensland." W. R. Straughan, Instructor in Agriculture, Rockhampton.

Tuesday, 24th January, 1933—"Potato Cultivation in Central Queensland." C. S. Clydesdale, Senior Instructor in Agriculture, Rockhampton.

Thursday, 26th January, 1933—"Egg Marketing.' P. Rumball, Poultry Expert.

Tuesday, 31st January, 1933—"The Story of Milk," Part I. F. J. Watson, Instructor in Dairying.

Thursday, 2nd February, 1933—"The Story of Milk," Part II. F. J. Watson, Instructor in Dairying.

Tuesday, 7th February, 1933—"Agricultural Correspondence Schools." E. J. Shelton, H.D.A., Senior Instructor in Pig Raising.

Thursday, 9th February, 1933—"School Pig Clubs." L. A. Downey, H.D.A., Instructor in Pig Raising.

Tuesday, 14th February, 1933—"The Cultivation of Tomatoes." H. J. Barnes, Instructor in Fruit Culture.

Tuesday, 16th February, 1933—"Production Recording of Dairy Herds and Its Value to the State." L. Anderson, Senior Herd Tester.

Tuesday, 21st February, 1933—"The Story of the Balance Sheet," Part I. G. B. Gallwey, A.F.I.A., Inspector of Accounts

Thursday, 23rd February, 1933—"The Story of the Balance Sheet," Part II. G. B. Gallwey, A.F.I.A., Inspector of Accounts.

Tuesday, 28th February, 1933—"Butter and Cheese Quality" (Farmer's Share). O. St. John Kent, B.Sc., Analyst.

Thursday, 2nd March, 1933—"Butter and Cheese Quality" (Factory's Share). O. St. John Kent, B.Sc., Analyst.

Tuesday, 7th March, 1933—"The Dairying Industry in Relation to the State's Progress." C. F. McGrath, Supervisor of Dairying.

Thursday, 9th March, 1933—"The Cultivation of Passion Fruit." H. J. Barnes, Instructor in Fruit Culture.

Tuesday, 14th March, 1933—"Sheep Station Management." J. L. Hodge, Instructor in Sheep and Wool.

The Home and the Garden.

OUR BABIES.

Under this heading a series of short articles by the Medical and Nursing Staff of the Queensland Baby Clinics, dealing with the welfare and care of babies, has been planned in the hope of maintaining their health, increasing their happiness, and decreasing the number of avoidable cases of infant mortality.

BETTY'S TANGLED TROUBLES.

BETTY is a healthy little girl, six years old who should be happy, but is not. The trouble is that she wants to be happy in her own way, which is not a possible way to happiness, yet she persists in it. The most prominent symptom in her behaviour is the trouble she makes about eating. Rarely is she eager for food and almost always she dawdles over her meals. When she eats she keeps a few bolts of food in her cheek and appears agonised at the necessity of swallowing. The worst meal is breakfast, at which Betty can hardly be forced to eat anything. For a long time she has resorted to vomiting, and has had a number of food fads. If she was forced to eat, she would vomit.

What are her reasons for behaving in this way? She has kind and affectionate parents, who are fond of each other, and is an only child. She resents their affection for each other. When the father caresses her mother she protests, saying, "Kiss me, too," or "I want a hug, too." They are poor, and the mother has to go out to work. She resents this, also. She wants her mother always with her, and tries to dominate her, and so to prove her own superiority. She likes being cross to her mother. As her mother attaches much importance to her eating, she uses this to enforce her superiority, for she has found out that by the trick of vomiting she can get the better of her. Both parents are high-strung, and outbursts of nerves have occurred from time to time. This does not help matters. The father's mother has been over-anxious about Betty's food, and constantly discusses it in the child's hearing. Grandmothers with the best intentions sometimes make things worse.

An Aggravating Child.

When Betty was first sent to school she revolted violently, crying agonisingly, refusing to eat, and vomiting. This she kept up for three months. Then she suddenly announced that she would go to school without crying. Since then, strange to say, she has become quite a favourite there, for she knows how to ingratiate herself with other children and with her teachers. But she is no better at home, and, indeed by contrast seems worse. Lately, though, she usually sleeps well, she has several times awoke screaming, saying that lions and tigers were coming up the stairs. Thus she has found a new way to irritate and occupy her parents at night. She has also invented a new way to frighten her playmates by saying, "If you don't do such and such I'll send you the influenza to get you to-night. I'll send it through the open window, and you'll die." Finally she has succeeded in frightening herself, and insists on the windows being shut.

It must be admitted that Betty is a very aggravating child. But she is far from stupid; she has formed for herself a pattern of behaviour, which she has carried out with much intelligence and much force of will. She has deep affections, a strong character, and knows how to adapt herself to circumstances. Were her mother to treat her more wisely, to appeal frankly to her intelligence, and to suppress her own emotion, Betty is open to improvement and should grow up a strong woman. After all, she has, like all of us, been searching for happiness, but searching along a wrong road. There is yet hope for Betty, which is fortunate, for there are many Bettys in Queensland.

Orchard Notes for February.

THE COASTAL DISTRICTS.

FEBRUARY in coastal Queensland is frequently a wet month, and, as the air is often heavy with moisture and very oppressive, plant growth of all kinds is rampant, and orchards and plantations are apt to get somewhat out of hand, as it is not always possible to keep weed growth in check by means of cultivation. At the same time, the excessive growth provides a large quantity of organic matter which, when it rots, tends to keep up the supply of humus in the soil, so that, although the property looks unkempt, the fruit-producing trees and plants are not suffering, and the land is eventually benefited. When the weed growth is excessive and there is a danger of the weeds seeding, it is a good plan to cut down the growth with a fern hook or brush scythe and allow it to remain on the ground and rot, as it will thereby prevent the soil from washing, and when the land is worked by horse power or chipped by hand it will be turned into the soil. This is about the most satisfactory way of dealing with excessive weed growth, especially in banana plantations, many of which are worked entirely by hand.

The main crop of smooth-leaf pineapples will be ready for canning, and great care must be taken to see that the fruit is sent from the plantation to the cannery with the least possible delay and in the best possible condition. The only way in which the canners can build up a reputation for Queensland canned pineapples is for them to turn out nothing but a high-class article. To do this they must have good fruit, fresh, and in the best of condition.

The fruit should be about half-coloured, the flesh yellowish, not white, of good flavour, and the juice high in sugar content. Over-ripe fruit and under-ripe fruit are unfit for canning, as the former has lost its flavour and has become "winey," while the latter is deficient in colour, flavour, and sugar content.

For the 30 or 32 oz. can, fruit of not less than 5 in. in diameter is required, in order that the slices will fit the can; but smaller fruit, that must not be less than 4 in. or, better still, 4½ in. in diameter, and cylindrical, not tapering, can be used for the 20-22 oz. can.

Bananas for shipment to the Southern States should on no account be allowed to become over-ripe before the bunches are cut; at the same time, the individual fruit should be well filled and not partly developed. If the fruit is over-ripe it will not carry well, and is apt to reach its destination in an unsaleable condition.

Citrus orchards require careful attention, as there is frequently a heavy growth of water shoots, especially in trees that have recently been thinned out, and these must be removed. Where there are facilities for cyaniding, this is a good time to carry out the work, as fruit treated now will keep clean and free from scales till it is ready to market. Citrus trees can be planted now where the land has been properly prepared, and it is also a good time to plant most kinds of tropical fruit trees, as they transplant well at this period of the year.

A few late grapes and mangoes will ripen during the month, and, in respect to the latter, it is very important to see that no fly-infested fruit is allowed to lie on the ground but that it is gathered regularly and destroyed. Unless this is done, there is every probability of the early citrus fruits being attacked by flies bred out from the infested mangoes.

Strawberries may be planted towards the end of the month, and, if early ripening fruit is desired, care must be taken to select the first runners from the parent plants, as these will fruit quicker than those formed later. The land for strawberries should be brought into a state of thorough tilth by being well and deeply worked. If available, a good dressing of well-rotted farmyard manure should be given, as well as a complete commercial fertilizer, as strawberries require plenty of food and pay well for extra care and attention.

THE GRANITE BELT, SOUTHERN AND CENTRAL TABLELANDS.

THE marketing of later varieties of peaches and plums and of mid-season varieties of apples and pears, as well as of table grapes, will fully occupy the attention of fruitgrowers in the Granite Belt, and the advice given in these notes for the two previous months with regard to handling, grading, packing, and marketing is again emphasised, as it is very bad policy to go to all the trouble of growing fruit and then, when it is ready to market, not to put it up in a way that will attract buyers.

Extra trouble taken with fruit pays every time. Good fruit, evenly graded and honestly packed, will sell when ungraded, and badly packed fruit is a drug on the market. Expenses connected with the marketing of fruit are now so high, owing to the increased cost of cases, freight, and selling charges, that it is folly to attempt to market rubbish.

During the early part of the month it will be necessary to keep a careful watch on the crop of late apples in order to see that they are not attacked by codlin moths. If there is the slightest indication of danger, a further spraying with arsenate of lead will be necessary, as the fruit that has previously escaped injury is usually that which suffers the most.

Fruit fly must also be systematically fought wherever and whenever found, and no infested fruit must be allowed to lie about on the ground.

Grapes will be ready for market, and in the case of this fruit the greatest care in handling and packing is necessary. The fruit should never be packed wet, and, if possible, it is an excellent plan to let the stems wilt for a day at least before packing. This tends to tighten the hold of the individual berries on the stem and thus prevent their falling off.

In the western districts winemaking will be in progress. Here again care is necessary, as the better the condition in which the fruit can be brought to the press the better the prospect of producing a high-class wine.

Where necessary and possible citrus trees should be given a good irrigation, as this will carry on the fruit till maturity, provided it is followed up by systematic cultivation so as to retain a sufficient supply of moisture in the soil.

Farm Notes for February.

REFERENCE was made in last month's Notes to the necessity for early preparation of the soil for winter cereals, and to the adoption of a system of thorough cultivation in order to retain moisture in the subsoil for the use of crops intended to be raised during the season. The importance of the subject, and its bearing in relation to prospective crop yields, is made the excuse for this reiteration.

Special attention should be given to increasing the area under lucerne (broadleaf Hunter River) wherever this valuable crop will grow. Its permanent nature warrants the preparation of a thorough tilth and seed bed, and the cleansing of the land, prior to sowing the seed, of all foreign growths likely to interfere with the establishment and progress of the crop. Late in March or early in April is a seasonable period to make the first sowing providing all things are favourable to a good germination of seed.

Dairymen would be well advised to practise the raising of a continuity of fodder crops to meet the natural periods of grass shortage, and to keep up supplies of succulent fodder to maintain their milch cows in a state of production.

Many summer and autumn growing crops can still be planted for fodder and ensilage purposes. February also marks an important period as far as winter fodder crops are concerned, as the first sowings of both skinless and cape barley may be made at the latter end of the month in cool districts. Quick-growing crops of the former description, suitable for coastal districts and localities where early frosts are not expected, are Soudan grass, Japanese and French millet, white panicum, liberty millet, and similar kinds belonging to the Setaria family. Catch crops of Japanese and liberty millet may also be sown early in the month in cooler parts of the State, but the risk of early frosts has to be taken.

Maize and sorghums can still be planted as fodder and ensilage crops in coastal districts. In both coastal and inland areas, where dependence is placed largely on a bulky crop for cutting and feeding to milch cows in May and June, attention should be given to Planters' Friend (so-called Imphee) and to Orange cane. These crops require well-worked and manured land; the practice of broadcasting seed for sowing at this particular season encourages not only a fine stalk but a density of growth which in itself is sufficient to counteract to some extent the effect of frost.

In most agricultural districts where two distinct planting seasons prevail, the present month is an excellent time for putting in potatoes. This crop responds to good treatment, and best results are obtainable on soils which have been previously well prepared. The selection of good ''seed'' and its treatment against the possible presence of spores of fungoid diseases is imperative. For this purpose a solution of 1 pint of formalin (40 per cent. strength) to 24 gallons of water should be made up, and the potatoes immersed for one hour immediately prior to planting the tubers. Bags and containers of all kinds should also be treated, as an additional precaution. ''Irish Blight'' has wrought havoc at times in some districts, and can only be checked by adopting preventive measures and spraying the crops soon after the plants appear above the ground. Full particulars on the preparation of suitable mixtures for this purpose are obtainable on application to the Department of Agriculture, Brisbane.

Weeds of all kinds, which started into life under the recent favourable growing conditions, should be kept in check amongst growing crops; otherwise yields are likely to be seriously discounted. The younger the weeds the easier they are to destroy. Maize and other ''hoed'' crops will benefit by systematic cultivation. Where they are advanced, and the root system well developed, the cultivation should be as shallow as possible consistent with the work of weed destruction.

First sowings may now be made of swede and other field turnips. Drilling is preferable to broadcasting, so as to admit of horse-hoe cultivation between the drills, and the thinning out of the plants to suitable distances to allow for unrestricted development. Turnips respond to the application of superphosphate; 2 cwt. per acre is a fair average quantity to use when applied direct to the drills.

Where pig-raising is practised, land should be well manured and put into good tilth in anticipation of sowing rape, swedes, mangels, field cabbage, and field peas during March, April, and May.

TO NEW SUBSCRIBERS.

New subscribers to the Journal are asked to write their names legibly on their order forms. The best way is to print your surname and full christian names in block letters, so that there shall be no possibility of mistake.

When names are not written plainly it involves much tedious labour and loss of valuable time in checking electoral rolls, directories, and other references. This should be quite unnecessary.

Some new subscribers write their surname only, and this lack of thought leads often to confusion, especially when there are other subscribers of the same surname in the same district.

Everything possible is done to ensure delivery of the Journal, and new subscribers would help us greatly by observing the simple rule suggested, and thus reduce the risk of error in names and postal addresses to a minimum.

CLIMATOLOGICAL TABLE—NOVEMBER, 1932.

COMPILED FROM TELEGRAPHIC REPORTS.

Districts and Stations.	Atmospheric Pressure Mean at 9 a.m.	Shade Temperature. Means. Max.	Means. Min.	Extremes. Max.	Date.	Min.	Date.	Rainfall. Total.	Wet Days.
Coastal.	In.	Deg.	Deg.	Deg.		Deg.		Points.	
Cooktown	29·93	89	76	90	5, 25–27	73	12, 13, 21, 25, 26	93	5
Herberton	..	83	61	90	20, 21	56	12	7	1
Rockhampton	30·00	88	68	93	5, 17, 19, 21, 22	61	20	431	5
Brisbane	30·07	80	64	87	21	59	11	284	9
Darling Downs.									
Dalby	30·02	84	61	93	22	54	7	376	9
Stanthorpe	..	77	54	89	17	46	28, 29	310	10
Toowoomba	..	78	57	87	21, 22	50	2	509	9
Mid-interior.									
Georgetown	29·86	94	74	102	24	66	12	50	1
Longreach	29·90	96	69	104	21, 22	63	2, 8	209	6
Mitchell	29·97	87	62	101	17	49	2	381	12
Western.									
Burketown	29·88	94	77	99	22, 25	71	10	9	1
Boulia	29·89	98	67	109	21	55	2	47	3
Thargomindah	29·94	92	65	103	21	53	1	70	4

RAINFALL IN THE AGRICULTURAL DISTRICTS.

TABLE SHOWING THE AVERAGE RAINFALL FOR THE MONTH OF NOVEMBER, IN THE AGRICULTURAL DISTRICTS, TOGETHER WITH TOTAL RAINFALL DURING NOVEMBER, 1932, AND 1931 FOR COMPARISON.

Divisions and Stations.	Average Rainfall. Nov.	No. of Years' Records.	Total Rainfall. Nov. 1932.	Nov. 1931.
North Coast.	In.		In.	In.
Atherton	2·25	31	0·27	6·73
Cairns	3·80	50	1·68	4·06
Cardwell	4·04	60	1·75	7·06
Cooktown	2·59	56	0·93	3·58
Herberton	2·54	46	0·07	3·46
Ingham	3·62	40	5·16	4·47
Innisfail	6·14	51	1·56	14·64
Mossman Mill ..	4·19	19	1·73	7·23
Townsville	1·82	61	1·98	5·48
Central Coast.				
Ayr	1·63	45	1·48	1·73
Bowen	1·27	61	0·13	1·56
Charters Towers ..	1·45	50	1·32	1·50
Mackay	3·01	61	1·39	9·08
Proserpine	2·71	29	0·99	2·28
St. Lawrence ..	2·29	61	0·85	6·76
South Coast.				
Biggenden	2·77	33	1·16	4·85
Bundaberg	2·48	49	0·56	3·49
Brisbane	3·73	81	2·84	8·51
Caboolture	3·41	45	2·44	9·40
Childers	2·68	37	1·60	3·23
Crohamhurst ..	4·33	39	4·64	8·77
Esk	3·18	45	3·75	4·24
Gayndah	2·86	61	5·31	5·88
Gympie	3·16	62	1·74	5·14
Kilkivan	2·56	53	1·77	3·08
Maryborough ..	3·13	60	1·80	4·49

Divisions and Stations.	Average Rainfall. Nov.	No. of Years' Records.	Total Rainfall. Nov. 1932.	Nov. 1931
South Coast—continued—	In.		In.	In.
Nambour	3·79	36	2·67	7·09
Nanango	2·62	50	3·12	3·65
Rockhampton ..	2·23	45	4·31	5·40
Woodford	3 21	45	1·41	6·25
Darling Downs.				
Dalby	2·69	62	3·76	4·84
Emu Vale	2·66	36	3·53	4·76
Jimbour	2·40	44	3·67	3·55
Miles	2·48	47	3·21	6·13
Stanthorpe ..	2·71	59	3·10	4·06
Toowoomba ..	3·26	60	5·09	7·24
Warwick	2·58	67	5·82	4·67
Maranoa.				
Roma	2·07	58	4·34	3·65
State Farms, &c.				
Bungeworgorai ..	2·02	18	4·14	3·84
Gatton College ..	2·73	33	4·81	4·34
Gindie	1·97	33	3·84	1·83
Hermitage ..	2·59	26	4·39	4·43
Kairi	2·27	18	..	5·13
Mackay Sugar Experiment Station	2·66	35	2·02	5·67

GEORGE E. BOND, Divisional Meteorologist.

ASTRONOMICAL DATA FOR QUEENSLAND.

TIMES COMPUTED BY D. EGLINTON, F.R.A.S., AND A. C. EGLINTON.

TIMES OF SUNRISE, SUNSET, AND MOONRISE.

AT WARWICK.

	January, 1933.		February, 1933.		MOONRISE. Jan., 1933.	MOONRISE. Feb., 1933.
	Rises.	Sets.	Rises.	Sets.	Rises.	Rises.
					a.m.	a.m.
1	5·3	6·47	5·28	6·42	9·37	11·15
2	5·4	6·47	5·29	6·42	10·33	11·56
						p.m.
3	5·4	6·47	5·29	6·41	11·27	12·57
					p.m.	
4	5·5	6·48	5·30	6·41	12·21	1·50
5	5·6	6·48	5·31	6·40	1·15	2·44
6	5·6	6·48	5·31	6·40	2·9	3·27
7	5·7	6·48	5·32	6·39	3·5	4·28
8	5·8	6·49	5·33	6·39	4·0	5·17
9	5·9	6·49	5·33	6·38	4·54	6·0
10	5·10	6·49	5·34	6·37	5·47	6·37
11	5·10	6·49	5·35	6·36	6·37	7·11
12	5·11	6·49	5·36	6·36	7·23	7·42
13	5·12	6·49	5·36	6·35	8·3	8·13
14	5·13	6·49	5·37	6·34	8·40	8·46
15	5·14	6·49	5·38	6·33	9·9	9·22
16	5·15	6·49	5·39	6·33	9·40	10·1
17	5·16	6·48	5·39	6·32	10·11	10·45
18	5·17	6·48	5·40	6·31	10·42	11·40
19	5·18	6·48	5·41	6·31	11·18	..
20	5·18	6·48	5·42	6·30	12·0	12·40
					a.m.	a.m.
21	5·19	6·47	5·42	6·29	..	1·44
22	5·20	6·47	5·43	6·29	12·49	2·50
23	5·21	6·47	5·44	6·28	1·48	3·56
24	5·21	6·47	5·45	6·27	2·52	5·1
25	5·22	6·46	5·45	6·25	3·59	6·2
26	5·23	6·46	5·46	6·24	5·8	7·1
27	5·24	6·46	5·47	6·23	6·15	7·57
28	5·24	6·45	5·48	6·22	7·18	8·53
29	5·25	6·45	..	..	8·19	..
30	5·25	6·44	..	..	9·14	..
31	5·26	6·44	..	..	10·9	..

Phases of the Moon, Occultations, &c.

4 Jan.	☾ First Quarter	2 24 p.m.
12 ,,	○ Full Moon	6 36 p.m.
19 ,,	☽ Last Quarter	4 15 p.m.
26 ,,	● New Moon	9 20 a.m.

Apogee, 7th January, 11.36 a.m.
Perigee, 23rd January, 12.48 p.m.

January 3rd, Earth in perihelion. The velocity of the Earth will be somewhat greater than its average of 18 and a fraction, which amounts to nearly one-half mile a second.

This will be occasioned by its nearness to the Sun, being 94,330,000 miles instead of 94,450,000, as it was on July 4th.

On the 8th Jupiter will reach a stationary position on the border line of Leo and Virgo, after being, apparently, amongst the stars of Leo for 9 months.

On the 16th at midnight the moon will be passing from west to east of Mars, which will be 5 degrees northward of it. Four hours later the Moon will be passing Jupiter, which will be 3 degrees to the north.

On the 16th at 3 a.m. telescopic observers will find Neptune 1 degree northward of the Moon.

On the 22nd Mars will be stationary near the border line between Leo and Virgo, having been amongst the stars of Leo since October 12th.

On the 27th Saturn will reach that far part of its orbit which brings it in a line with the Sun and the Earth. It will then be nearly 900 million miles distant, which would reduce it to its smallest apparent dimensions, if observable. Saturn is now on the border line between Sagittarius and Capricornus. Since June, 1928, the apparent width of the Ring has been decreasing and, although fairly well observable during 1932, was not quite half as good as in 1928. The apparent width will continue to decrease till June, 1936.

Mercury rises at 3.36 a.m. at Warwick on the 1st and at 3.55 a.m. on the 15th.

Venus rises at 3.11 a.m. on the 1st and at 3.28 a.m. on the 15th.

Mars rises at 10.48 p.m. on the 1st and at 10.0 p.m. on the 15th.

Jupiter rises at 10.57 p.m. on the 1st and at 10.2 p.m. on the 15th.

Saturn sets at 8.31 p.m. on the 1st and at 7.33 p.m. on the 15th.

Venus will be in Orphincus from the 1st to the 9th and in Sagittarius from the 10th to the 31st.

2 Feb.	☾ First Quarter	11 16 p.m.
10 ,,	○ Full Moon	11 0 p.m.
18 ,,	☽ Last Quarter	12 8 a.m.
24 ,,	● New Moon	10 44 p.m.

Apogee, 4th February, at 7.12 a.m.
Perigee, 18th February, at 8.42 p.m.

For places west of Warwick and nearly in the same latitude, 28 degrees 23 minutes S. add 4 minutes for each degree of longitude. For example, at Inglewood, add 4 minutes to the times given above for Warwick; at Goondiwindi, add 8 minutes; at St. George, 14 minutes; at Cunnamulla, 25 minutes; at Thargomindah, 33 minutes; and at Oontoo, 43 minutes.

The moonlight nights for each month can best be ascertained by noticing the dates when the moon will be in the first quarter and when full. In the latter case the moon will rise somewhat about the time the sun sets, and the moonlight then extends all through the night; when at the first quarter the moon rises somewhat about six hours before the sun sets, and it is moonlight only till about midnight. After full moon it will be later each evening before it rises, and when in the last quarter it will not generally rise till after midnight.

It must be remembered that the times referred to are only roughly approximate, as the relative positions of the sun and moon vary considerably.