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QUEENSLAND AGRICULTURAL JOURNAL

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Event and Comment

Agricultural Standards.

"IN the final analysis, we can only hold our export markets if our standards of production are at least equal in all respects to the standards of our competitors," declared the Minister for Agriculture and Stock, Hon. Frank W. Bulcock, in the course of a recent address.

"The problems of farming," he added, "fall under three headings: (1) That which the farmer himself appreciates and solves; these are largely cultural problems associated with the varying phases of routine farming practice. (2) That set of problems needing for their solution the co-operation of the producer and the Department—the Department to instruct and the farmer to apply; and (3) that set of intricate questions that are by their very nature entirely within the province of the research officer. Agricultural research is at the root of all progress. Stability, advancement, and, indeed, preservation, all demand a vigorous research policy, and to-day the research division, in close association with the various other branches of the service, are engaged on work in connection with cotton, maize, wheat, peanuts, tobacco, fruit, grasses, fertilizers, soil research—chemical and bacteriological—and indeed in all branches of production.

"One of the happiest indications for the future is the degree of co-operation we are able to obtain from the farmer. The day of the centralised experiment farm is past, and the best work being done is on the farm plot situated on the holding of an approved farmer. It is clear that such co-operation is essential, if a successful programme of work is to be carried out."

Agriculture in Queensland.

IN his annual report to the Minister, the Under Secretary and Director of Marketing, Mr. E. Graham, makes a general appraisal of the agricultural and live stock situation in Queensland. It is clear, he remarks, that farmers as a body appreciate the value of technical advice, and that they are eager to make full use of the instructional services of the Department. They are realising the importance of soil conservation —the prevention of erosion by wind and water. A wider appreciation of the fact that correct fertilization means something more than the mere application of crop stimulants is evident. The storage of plant foods in the soil as sound practice is recognised to a greater extent. Rotational cropping and grazing in our farming system is becoming more general. The belief that success in agriculture can only be achieved by planned methods is well established. The necessity of making provision against fodder shortage has been demonstrated to a greater degree than at any other time in the history of the industry. Protection and improvement of native grasses have been bracketed with the establishment of sown pastures of proved stock-feeding value. Swards of introduced grasses are extending widely, especially in areas where climatic and other conditions are conducive to their rapid growth. The necessity of correct pasture management and the evils over grazing are kept continuously before stockowners.

A systematic campaign for livestock improvement and the raising of standards of animal husbandry has been entered upon. The control and eradication of stock diseases have been continued with vigour.

Soil erosion, as one of the greatest menaces to rural industry, is receiving the earnest attention of the department, and for the purpose of devising practical schemes of prevention the Soil Erosion Committee was brought into being.

The Government, fully cognisant of the importance of agriculture in the economy of the State, once again came to the assistance of farmers, who through the stress of seasonal adversity were forced to look beyond their own boundaries for fodder, either to maintain dairy herds in production or minimise stock losses in districts where the drought was most severe. An effective organisation was established in co-operation with butter factory directorates. Molasses and other food materials were supplied at bare cost at reduced transport rates. This prompt action in a time of emergency helped materially to tide the dairy industry over a period of very great difficulty.

Once again it is very pleasing to be able to record an excellent spirit of co-operation between the department and every section of primary producers. A continuance of this spirit of mutual help is obviously essential to the progress of the State. It is felt, however, that the Department should not be regarded as of use only in time of need, and that it should be realised more widely that the work of the Department has been planned with the object of ensuring better conditions for the whole countryside. It is, therefore, to the advantage of the entire body of producers to make full use of the facilities provided for them.

Agriculture the world over is confronted with special and extremely intricate problems, of which the marketing and distribution of primary products remain among the most perplexing. To be reasonably profitable, primary industry must have prices for its products which are higher than its fixed charges and production costs. This is plainly impossible when supplies greatly exceed effective demand. In this connection, it is interesting to observe the world-wide growth of economic regulation, not only in trade but in production. In an entirely altered world economic system, a purely competitive and wholly unregulated agriculture can no longer survive. The necessity of readjustment of agriculture to permanently changed conditions has to be accepted. A truism worth repetition with emphasis is that, if economic equilibrium between market prices and production costs is to be attained, a concentration on production costs is a necessity; but not, of course, at the expense of the quality of the product.

Farmers have become impressed more deeply with the importance of the business side of the land industries. The necessity of economic foresight and insight has been forced upon them.

The days of extensive farming are rapidly passing. Intensive farming is taking its place. With the passing of the years competition for markets is becoming keener, and only products of the highest quality can maintain their hold.

In the further development of agriculture and related industries in Queensland, due appraisal must be made of all the factors influencing production, manufacture, marketing, and distribution. There is nothing static about the policy of the Department. Reorientation to constantly shifting situations is often essential. New problems arise and have to be faced. An elasticity in policy must, therefore, be conceded, for pace must be kept with changing conditions and requirements. Agriculture, consequently, is subject to continuous economic investigation and adjustment to altering circumstances.

Animal Health.

THE work at the Animal Health Station, Yeerongpilly, progressed steadily during the year. This applies particularly to the tick-fever inoculation work in respect of the number of stud animals inoculated, bleeders, and doses of blood supplied.

Investigational work in connection with the recent outbreak of "three-days' sickness" is being carried out with the co-operation of the entomological and veterinary staffs of the Queensland University and the Council for Scientific and Industrial Research. In co-operation with the Health Department, experiments are in progress for the purpose of investigating the aetiology and pathology of "Q" fever. In conjunction with the Agricultural Chemist, work also is proceeding in connection with cattle losses due to the saw-fly larvæ.

A wide variety of diseases affecting the domestic animals and birds were encountered in addition to those mentioned, and the following are among the most important:—

Arsenical poisoning in cattle and sheep; ergot poisoning in cattle; plant poisoning in cattle and sheep; contagious pneumonia in pigs; hæmorrhagic septicæmia of pigs; posterior paralysis of pigs; filariosis of dogs; bacillary white diarrhœa of chicks; coccidiosis of poultry; and blackhead in poultry.

The Use of Acetylene to Induce Flowering in Pineapple Plants.

H. K. LEWCOCK.

IT has long been known that pineapple plants may be induced to flower prematurely by exposing them to smoke fumes for periods ranging from twelve to twenty-four hours. For many years pineapple growers in the Azores have taken advantage of this knowledge to control the blossoming period of their crops by using smudge pots in their glasshouses. From time to time, growers in Queensland have reported premature flowering in pineapple plants which have been exposed to smoke from neighbouring bush fires. In several instances this has occurred in suckers even prior to planting. It was not until comparatively recently, however, that the action of smoke in stimulating flowering was investigated. One of the constituents of wood smoke is a gas known as ethylene and it has been found that it is this gas which provides the stimulus which causes flowering when pineapple plants are exposed to smoke. Researches conducted in Hawaii have shown that acetylene gas is equally as effective as ethylene in inducing flowering in pineapples and that it is both cheaper and more convenient to use under field conditions, since it can be dissolved in water and applied in that form. This is the method of application which has been adopted in Hawaii and which is now recommended for use in Queensland. Applied in this manner, the acetylene treatment has not been found to exert any adverse effect either on the plant itself, its sucker growth, or on the quality of the fruit it produces. (Plate 216.)

Advantages of the Acetylene Treatment.

In Hawaii the acetylene treatment has found general application, firstly, as a means of spreading the harvest peak over a much longer period than it normally occupies and, secondly, as a means of forcing would-be "holdover" plant crop and ratoon plants into flower.

Under Queensland conditions, the acetylene treatment possesses obvious possibilities not only as a means of supplying market requirements for fresh pineapples at times when supplies are normally inadequate, but also as a means of reducing cannery losses from black heart and brown speck by advancing the ripening period of a large proportion of the winter crop from July and August to April and May.

Experiments have shown that, by the use of the acetylene treatment, it is possible to force plants into flower during October and November which normally would not blossom until the following February and March. Plants which flower during the latter months produce fruits which ripen during July and August and these, because of the short day periods, low temperatures and other unfavourable climatic conditions during ripening, are of poorer quality than those harvested at any other time of the year. Moreover, largely because of their low sugar content, fruit which mature during these months are particularly subject to black heart and other internal diseases. By forcing the plants which bear this fruit to flower some three or four months earlier, they would mature their crop during March, April and May, at which time climatic conditions are favourable for the production of yellow-fleshed fruit of high sugar content. Advancing the flowering period

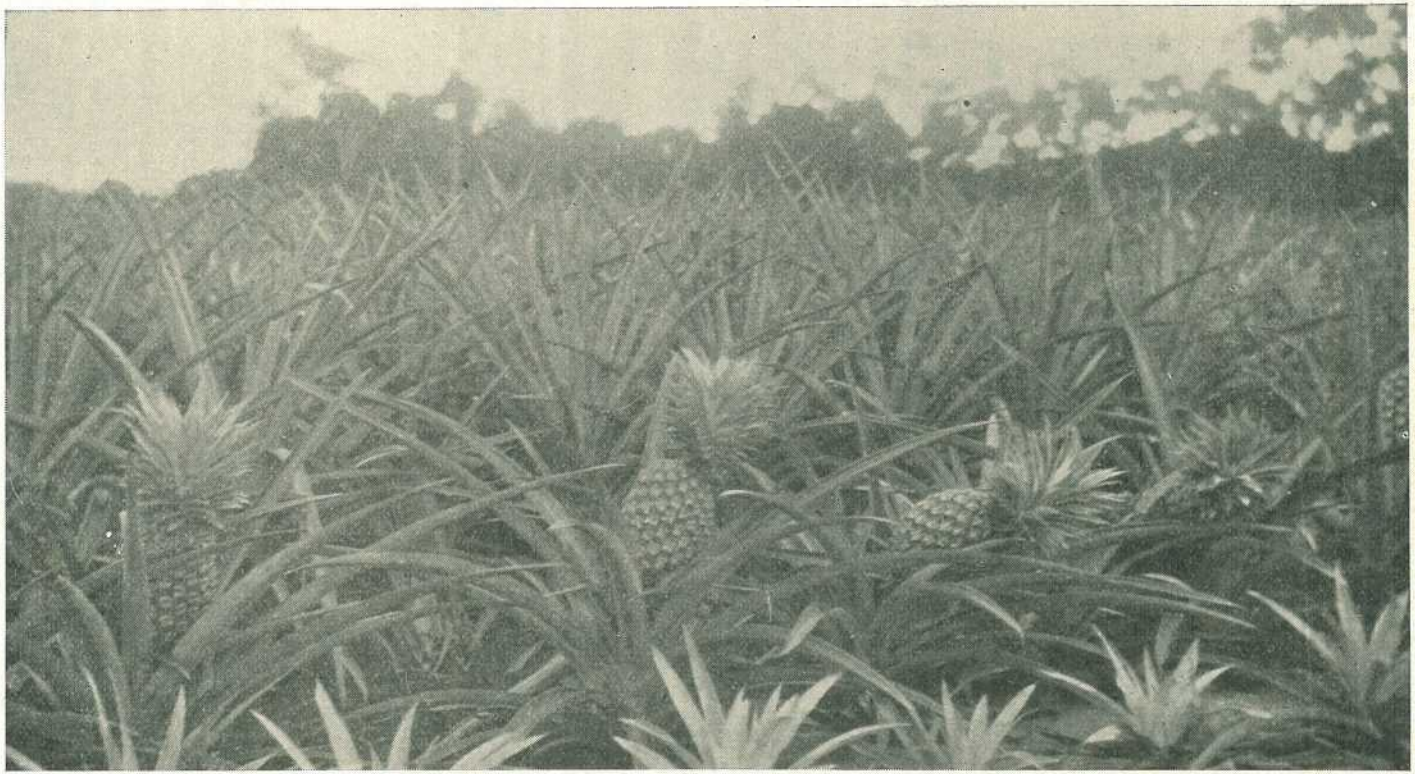


Plate 216.

Acceleration in time of fruiting of pineapples resulting from treatment with acetylene. The fruiting (acetylene-treated) plants in the foreground were planted at the same time as the untreated plants at the rear.

of such plants may therefore be expected to result in a marked improvement in the quality of their fruit and, at the same time, greatly reduce losses from black heart and other winter diseases. For reasons of quality alone, however, it seems highly desirable that the bulk of the pineapples intended for canning should be harvested during the months of February to May, and the fact should not be lost sight of that the production of high quality fruit results in a higher net return to the grower, since a higher canning quality is synonymous with an increase in weight per unit volume of fruit. In Hawaii, approximately 95 per cent. of the crop is harvested during the summer and autumn months, not because of climatic and other chance factors, but because production methods have all been designed to achieve this very desirable objective. Moreover, plants which fruit at this time of the year customarily produce many more slips than those which fruit during the winter months and slips are generally recognised as the preferred type of planting material.

Precautions to be observed in using the Acetylene Treatment.

Because acetylene gas can be dissolved in water, it has been possible to devise a very simple, cheap and efficient method of using it on pineapple plants. Approximately one-eighth of a pint of a saturated or nearly saturated solution of the gas is introduced into the heart of each plant or sucker, where it is retained in contact with the growing point by means of the "cup" formed by the upper whorls of leaves. Provided no rain falls within twenty-four hours, only a single application of the solution is necessary to induce flowering to take place. Should rain fall during this period, however, the treatment must be repeated. Since dew collecting in the cupped heart leaves dilutes the acetylene solution in the same way as a shower of rain, it is usually undesirable to apply the solution during the forenoon.

One cubic foot of water will dissolve approximately the same volume of acetylene gas, but even this relatively small degree of solubility is not readily obtained unless the gas is confined in an enclosed space under pressure. Since undue pressure will cause acetylene gas to explode spontaneously, it is necessary to observe certain precautions in preparing the solution. If the instructions which follow are strictly adhered to in every detail no risk whatever is entailed in using the acetylene treatment. However, unauthorised or haphazard methods of preparing the solution may result in serious accident and therefore should be avoided.

Procedure used in conducting Experimental Trials.

In the experiments and trials which were conducted during last spring and autumn, a method of preparing the solution was employed which involved introducing a weighed quantity of carbide into a petrol drum partly filled with water and, after replacing the bung, agitating the drum until a saturated solution of the gas was obtained.

Publicity was not given to the details of this method because it involves careful calculation of the quantity of carbide required, since this varies with the cubic capacity of the drum employed and the extent to which it is filled with water. A slight excess of carbide results in a rapid increase in pressure within the drum and if this should exceed 30 lb. per square inch the gas will explode spontaneously. While of value for experimental purposes, this method is obviously unsuitable for general use.

Procedure Recommended for Preparing the Acetylene Solution.

After the effectiveness of the acetylene treatment under Queensland conditions had been demonstrated by experimental trials, attention was given to devising a safe, simple and efficient method of using it under the limitations imposed by local farming practices. The method about to be described has been found to meet all these requirements. It has been worked out with the co-operation and assistance of the Queensland Oxygen Pty. Ltd., whose engineers have thoroughly familiarised themselves with the field aspects involved.

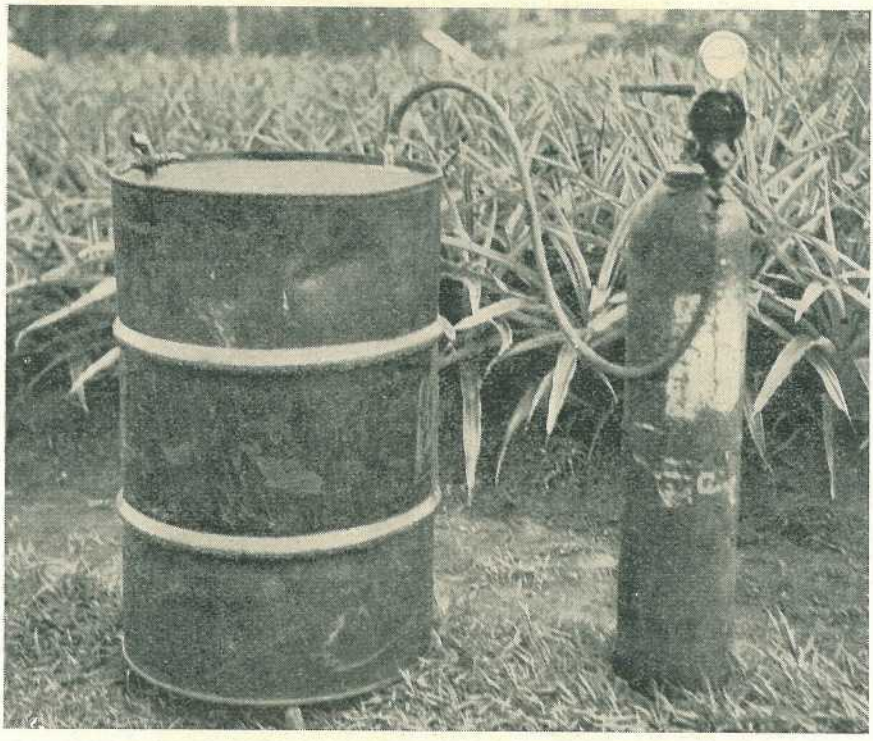


Plate 217.
Equipment set up for preparing acetylene solution.

In this method, which is the only one recommended at present, compressed acetylene gas contained in a special type of steel cylinder is conveyed into a petrol or oil drum filled with water until a saturated solution of the gas is obtained. This is accomplished in the manner depicted in the accompanying diagram (Plate 218). The steel cylinder (A) is connected to the petrol or oil drum (B) by means of rubber tubing (C). As the gas leaves the acetylene cylinder it passes through a regulator and pressure gauge (D) which controls the flow at a fixed pressure, namely, 9 lb. to the square inch. As a special safety precaution, this regulator is so arranged that when the pressure exceeds 15 lb. per square inch the gas automatically blows off to atmosphere by means of a safety valve. It is particularly important

that the adjustments on this regulator should not be tampered with in any way, since they have been set to give the maximum degree of efficiency and safety.

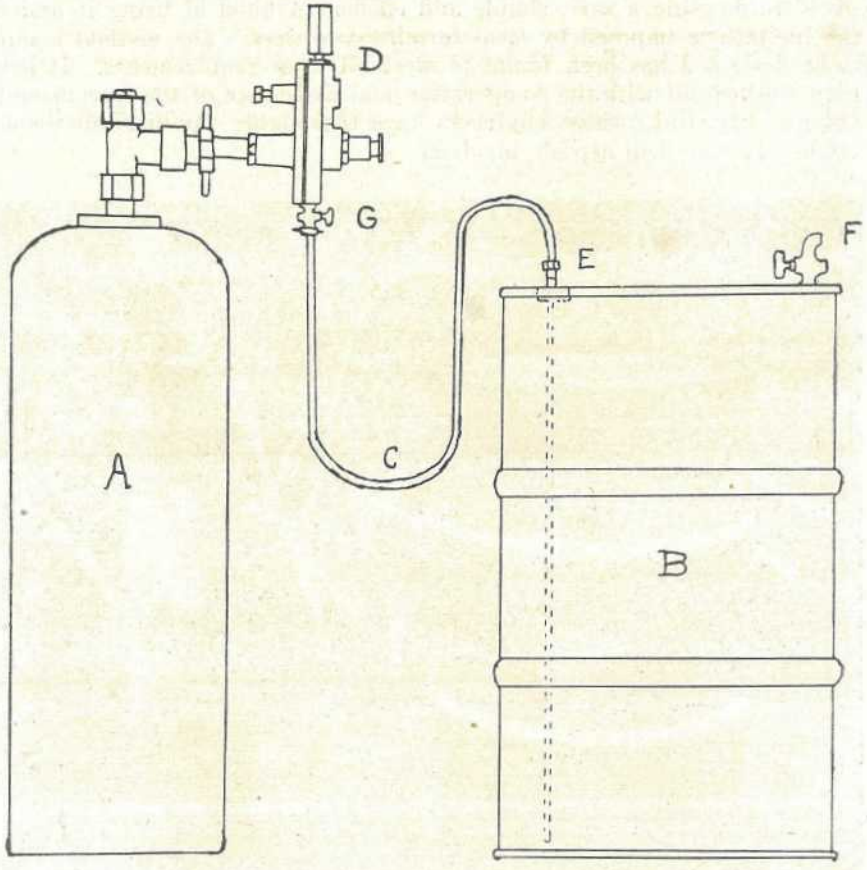


Plate 218.
Diagram of equipment for preparing acetylene solution.

Method of Preparing and Applying the Acetylene Solution.

In operation, the rubber tubing which proceeds from the regulator is connected to a fitting (E), which in turn screws into the large bunghole of a 44-gallon petrol drum filled with water to within about 4 inches of the top (approximately 40 gallons). If the drum used is of the type in which the large bunghole is on the side instead of on one end, the copper tubing attached to the fitting (E) must be shortened accordingly. Before using a new drum, it is important that all dregs of petrol should be thoroughly washed from the drum by filling it to overflowing with water.

After the equipment has been connected up in the manner indicated and the cock (G) on the bottom of the regulator has been turned to the "on" position, the valve on the gas cylinder is opened carefully by means of the cylinder key which is provided. This key should not be given more than one full turn; a half turn or less will usually provide

an adequate flow of gas. As soon as the gas is turned on, the water in the drum is agitated by rocking the drum from side to side until the needle on the pressure gauge registers a pressure of 9 lb. per square inch. The gas flow should then be turned off at the cylinder valve by means of the cylinder key and the drum should be further agitated until the needle on the gauge falls to zero. This operation is repeated until the needle on the pressure gauge no longer drops when the drum is agitated, but remains stationary at from 7 lb. to 9 lb. pressure. At this stage, which should be reached in from five to ten minutes, the water in the drum is fully saturated with acetylene and the solution is ready for use. Before it can be drawn from the drum, however, the cylinder valve must be turned off tightly, the cock on the regulator shut, and, with the drum standing on its end, the water tap (F) opened to allow any free gas contained in the drum to escape. When this has been done, the rubber tubing leading from the drum should be disconnected from the regulator and the water tap (F) closed, after which the drum may be laid on its side to permit of easy withdrawal of the solution.

From the drum, the solution is run off through the tap (F) into the containers from which it is to be applied to the plants. An ordinary knapsack or pneumatic sprayer may be readily adapted for this purpose by replacing the normal nozzle with a 3/16-inch jet fitted with a trigger release (Plates 219 and 220). The tanks supplied with certain types of flamethrowers are even better suited for applying acetylene solution, since they are designed to hold a relatively high pressure with only intermittent pumping. Consequently, when using the latter type of equipment, one hand is free to move away obstructing leaves, and the application of the solution is thereby greatly facilitated. (Plate 221.) If neither of these containers is available, however, the solution may be applied from a bucket by means of a long-spouted coffee-pot or similar utensil.

Irrespective of the type of equipment which is employed for applying the solution, care should be exercised to introduce it squarely into the hearts of the plants which it is desired to force into flower. Each plant should receive sufficient solution to fill completely the receptacle formed by the cupped heart leaves. In practice, it will be found that one gallon is ample for sixty applications.

It is more satisfactory to prepare the acetylene solution at or near the tank or well from which the drum is filled, rather than in the plantation itself. A convenient method of arranging this is to mount the drum on a truck or slide so that it can be easily and quickly transported to and from the field. Such an arrangement has an additional advantage in that the clearance provided between the bottom of the drum and the ground facilitates the filling of the containers employed for applying the solution to the plants, particularly when the solution in the drum is nearing exhaustion. Agitation of the drum while the solution is being prepared is likewise facilitated by standing or laying it on a short piece of round wood about the thickness of a broom handle.

Cost of the Acetylene Treatment.

Approximately 2,400 plants can be treated with each drum full of solution, viz., 40 gallons. Since slightly less than 8 cubic feet of gas are required to saturate this quantity of water, a cylinder containing

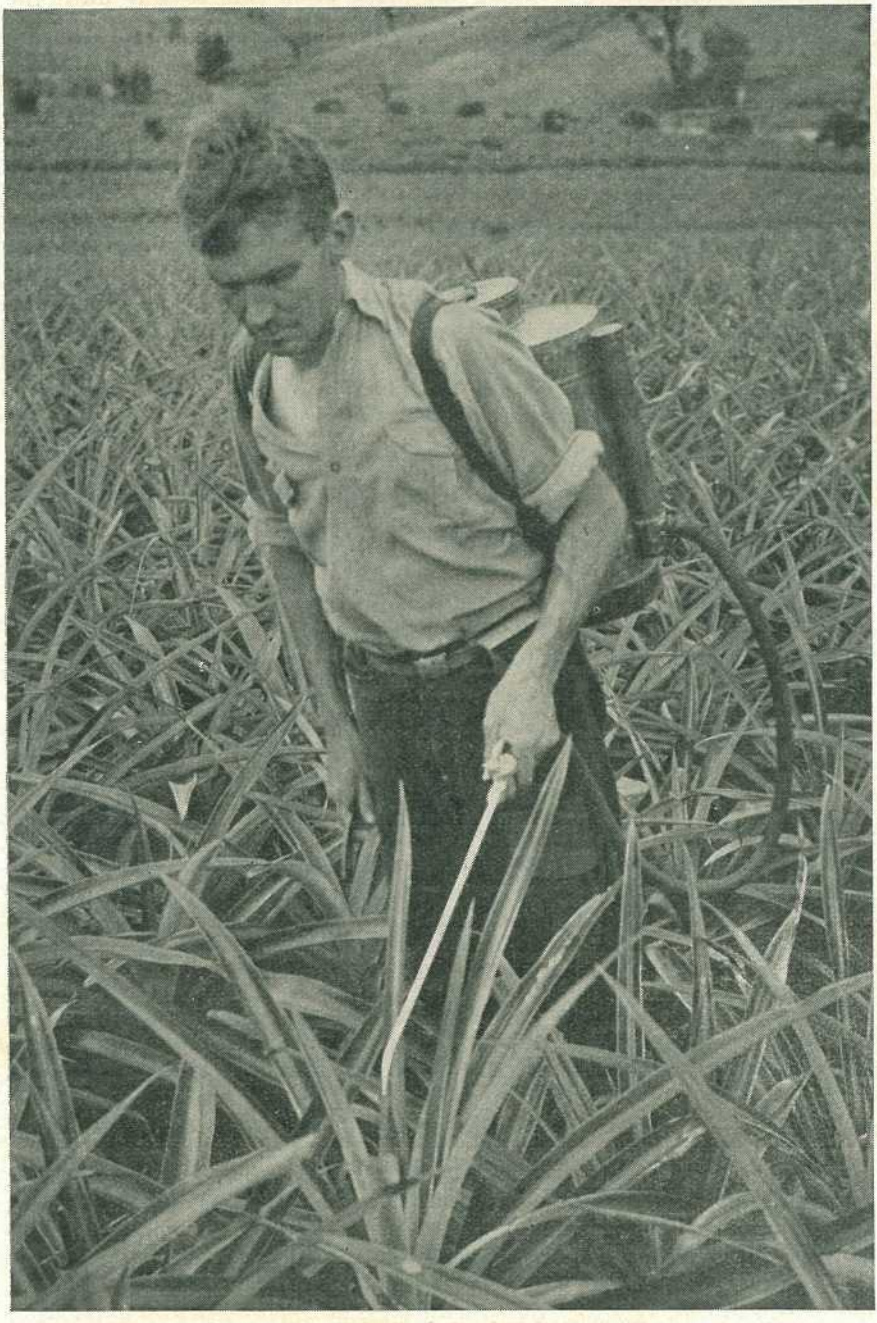


Plate 219.

Applying acetylene solution by means of a knapsack sprayer. Note that one hand is continually engaged in operating the pump.

100 cubic feet of compressed gas should provide sufficient acetylene to treat at least 30,000 plants. At current prices, this would entail an expenditure for materials of approximately 8d. per 1,000 plants.

Plate 220.

Trigger release and jet recommended for the application of acetylene solution from a knapsack sprayer or flamethrower.

Age at which the Acetylene Treatment may be applied.

By means of the acetylene treatment, pineapple plants can be forced into flower at any stage of their growth provided climatic conditions are favourable at the time the treatment is applied. However, the size of the fruit which will develop is determined by the size and vigour of the plant or ratoon receiving the treatment. Even under

the most favourable growth conditions plants are rarely large enough for treatment before they are ten or twelve months old. (Plate 222.) When treated at this age, well-grown plants should yield fruit corresponding in size and weight to those which are normally obtained from untreated plants. Plantings made in the late spring or early summer

Plate 221.

Applying acetylene solution by means of a flamethrower. Note that the type of pump employed permits the operator to use one hand for moving away obstructing leaves.

Plate 222.
Application of acetylene solution in a replanted field at Woombye (planted December, 1936). Young plants should not be treated before they have attained a stage of development similar to that depicted above.

Plate 223.
Partially-developed fruits on acetylene-treated plants in the Dayboro' district. Treatment applied 29th October, 1936; photographed 4th April, 1937.

of one year will usually be sufficiently advanced for treating at about the same time in the following year. Suckers in ratoon fields should be similarly well developed before the acetylene treatment is applied.

The production and development of suckers and slips is not affected in any way by the acetylene treatment, provided discrimination is exercised in regard to the size and vigour of the plants to which the treatment is applied. The extent to which these vegetative organs are produced depends almost entirely on inheritance factors and on the vigour of the parent plant.

Time of Application.

Field experiments indicate that, under the climatic conditions existing in Southern Queensland, response to the acetylene treatment is likely to be uncertain if it is applied before the middle of September or after the middle of March. Applications made between these months should induce flowering in from six to eight weeks. Following earlier or later applications, however, the interval between treatment and flowering is considerably lengthened, and may run to twelve or fourteen weeks. Moreover, while late spring and summer applications may be expected to prove between 80 and 100 per cent. effective, those made during the colder months are likely to prove most unreliable and sometimes wholly ineffective.

Despite these limitations the acetylene treatment will probably be found to meet all normal requirements. Plants treated early in November should mature their fruit during May (Plate 223), a time when supplies are frequently inadequate for the needs of the fresh fruit markets; while it appears likely that the usual November-December shortage can be met by treating holdover plants or suckers during February. Applications made during the first half of March are almost equally effective as those made earlier in the summer, but the fruits which develop from these late applications may not mature until the following Christmas or New Year and, in addition, they are likely to be "prickly-eyed."

It will be noted that there is a wide variation in the interval which elapses between the application of the treatment and the ripening of the fruit, according to the seasonal conditions which obtain during this period. It appears that the rate of development of acetylene-forced fruit is influenced by seasonal conditions to the same extent as that produced on untreated plants.

"Don'ts" to be observed in Using the Acetylene Treatment.

Don't treat plants or suckers until they are large enough to bear profitable fruits.

Don't expect satisfactory results from applications made during the autumn or winter months.

Don't treat plants for at least twenty-four hours after rain has fallen, nor when rain is threatening.

Don't smoke or strike matches while preparing the solution—acetylene gas is highly inflammable.

Don't employ any but the recommended method for preparing the solution—acetylene gas explodes spontaneously above 30 lb. pressure.

Don't fail to read the instructions *carefully*.

Diseases of the Papaw.

J. H. SIMMONDS, M.Sc., Senior Research Officer.

UNTIL recent years there has been but little attention focussed on papaw diseases in Queensland, with the result that although the cause of most of them is now known control measures have not yet been worked out in all cases. As would be expected from the soft nature of the fruit, transport rots are a source of considerable loss. The development of disease is aided in Southern Queensland by winter conditions, which are often too severe and variable for a tropical plant such as the one under discussion.

BLACK SPOT.

Black spot is widely distributed throughout Queensland, where it is probably the most serious disease to which papaws are subject. All the aboveground parts of the plant, with the exception of the leaves, may be affected.

On the fleshy white flowers and very young fruit there develop brown areas of decay which later turn to conspicuous, dark, shrunken spots (Plate 224). The infection often extends back until the stalk is invaded, when the flower or fruit will gradually shrivel up. Fruit older but still green may exhibit a black, circular spot limited in extent to an inch or an inch and a-half in diameter. This type of infection usually occurs where two fruit touch or where a leaf has been lying. In mature fruit the rot takes the form of one or more circular brown spots, distinct or coalescing, which appear on the exposed side of the fruit (Plate 226). This form of injury will be discussed more fully under the heading of ripe rots.

A serious loss arises from the invasion of the main stem. This is usually the result of the disease working in through a decaying flower or fruit stalk, or through the point of attachment of a dead leaf (Plate 224). The dying leaf stalks often act as a source of infection in this way, especially if death has been premature due to winter injury. A somewhat shrunken, brown or black area of decay is set up, and this may extend for some distance and completely cincture the stem so that the upper part of the tree dies.

Studding the surface of the dark, decayed areas are often minute pimples or pustules from each of which a white gelatinous tendril issues in moist weather. The pustules are the flask-shaped fruiting bodies of a fungus (*Ascochyta caricæ*), and the white exuded substance consists of a mass of minute two-celled spores. By inoculating pure cultures of this organism into healthy plants it has been shown to be the cause of the disease.

Black spot is serious during the winter and spring months. In May and June some decay of young flowers and fruit may occur. Later the black spot on green fruit may be in evidence and the ripe rot cause loss in fruit colouring on the tree and during transport. As the weather warms up in the spring and growing conditions improve the disease lessens gradually, and towards the end of the year losses are less serious.

Exposure and cold appear to favour the development of the disease. The papaw is a tropical plant, and if grown in cold, exposed situations, will lose most of its older leaves during the winter months.

The dying leaf stalks afford an opportunity for the fungus to gain entrance to the stem. Also, owing to lack of protection the fruit is exposed to cold winds and the heat of the sun, thus predisposing it to infection. In this connection, it is important to note that maintaining a vigorous growth by the application of suitable cultural methods will reduce the extent of winter leaf injury.

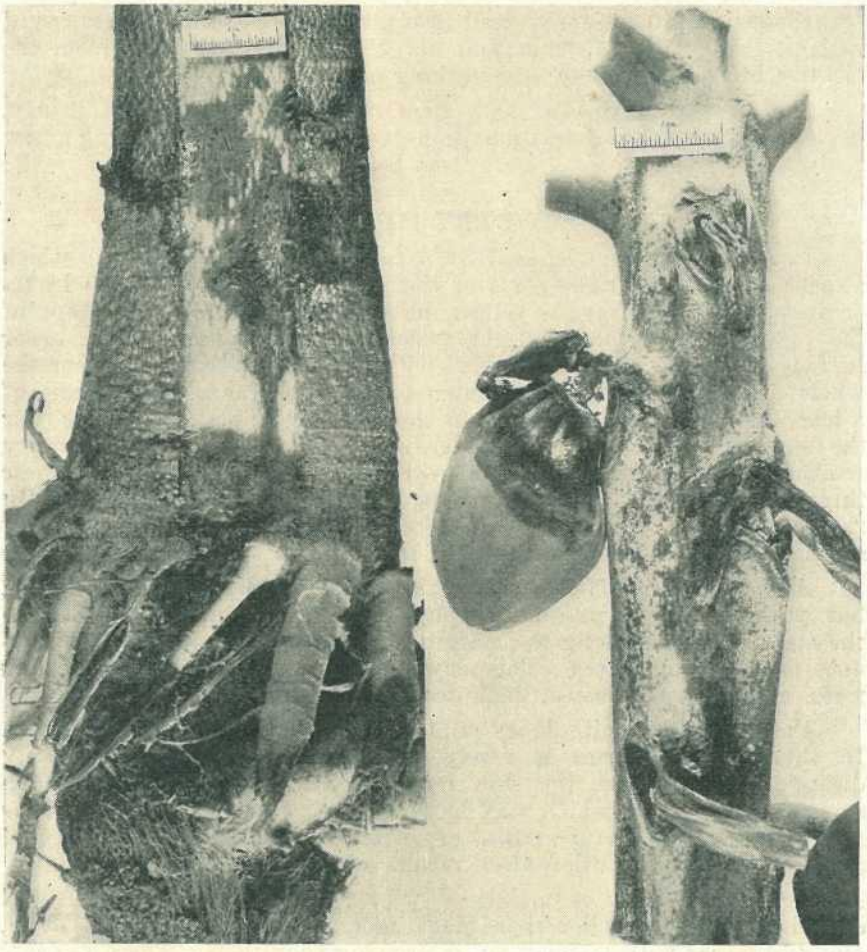


Plate 224.

Left—Papaw affected with foot rot; a strip of bark removed to show the rot below.

Right—Black spot attacking a young fruit and entering the stem through dead leaf stalks. (Note the decay commencing at the point of insertion of the two lower leaf stalks).

Control.

A satisfactory spraying programme for the control of black spot has not yet been worked out. A Bordeaux spray has to be avoided, as it may cause a scorching of the young crown leaves. Only where powdery mildew is also serious can spraying be definitely recommended. It is then suggested that a wet spray of either lime-sulphur, 1 in 35,

or colloidal sulphur be applied at approximately monthly intervals, commencing in April and ending in September. A suitable spreader should be added to the spray.

Choose a warm, sheltered situation for papaw growing. Fertilize well in order to obtain a vigorous growth resistant to winter injury. The fertilizer should contain an adequate supply of potash when the plants are in fruit.

Collect and burn any dead leaf stalks which may be removed without injury to the fruit, and also remove spotted fruit from the vicinity of the plantation and packing shed.

Cut off plants affected with stem rot below the point of injury, if possible at one of the stem partitions, with the object of forming a new fruiting stem by a lateral shoot from below.

POWDERY MILDEW.

Powdery mildew is caused by a fungus (*Sphærotheca sp.*) which attacks only the younger parts of the plant. The young crown leaves of an affected tree have a yellow, blotched appearance as a result of the presence of numerous light yellowish-green patches. The lower surface of these is usually speckled with small water-soaked dots, or the whole may have a distinctly water-soaked appearance. By means of a lens, delicate cobweb-like fungous threads may be seen spreading over the surface, usually on the under side. During moist or showery weather short chains of delicate oval spores are given off from these threads, which, in a mass, form conspicuous white floury patches. On rare occasions a second type of spore body appears as scattered grey specks along the main veins and leaf stalk.

Affected leaves often outgrow the disease if the infection is light, but, with the fungus present in abundance, dead areas appear between the main veins and along the margin, giving a brown, scorched appearance to the young leaves. This may result in a severe setback to young trees, and may even cause their death.

Patches of the white floury mildew develop on the young fruit also. In this case, the fruit is rarely killed and the fungus gradually disappears. However, the skin reacts to its presence to produce a superficial grey scar which may be of large size and seriously mar the appearance of the mature fruit. Growth is restricted over the affected area, so that malformation often results as well (Plate 225).

Powdery mildew is mainly a winter trouble. It becomes well established rather earlier than black spot, usually in May and June, and disappears with warm summer growing conditions. There appears to be a definite variation in the susceptibility of individual plants to this disease.

Control.

The fungus causing powdery mildew lives mainly on the outside of its host and, consequently, can be controlled with comparative ease by a sulphur spray or dust. If black spot is present also, the wet spray is preferable. Lime-sulphur 1 in 35 or colloidal sulphur may be used. The addition of a spreader is advisable, since without one it is difficult to cover the young growth. For powdery mildew alone, dusting is to be preferred on account of the ease and speed of the operation. A simple dust containing about 50 per cent. sulphur with lime as a filler is suitable.

It is necessary to concentrate on the young crown leaves and fruit, covering the under surface of the leaves thoroughly. Applications should commence about May, or as soon as the disease makes an appearance. The wet spray will need to be repeated once a month or every six weeks until the end of August. The dust must be applied more often, especially if rain storms are frequent or if the disease appears to be on the increase.

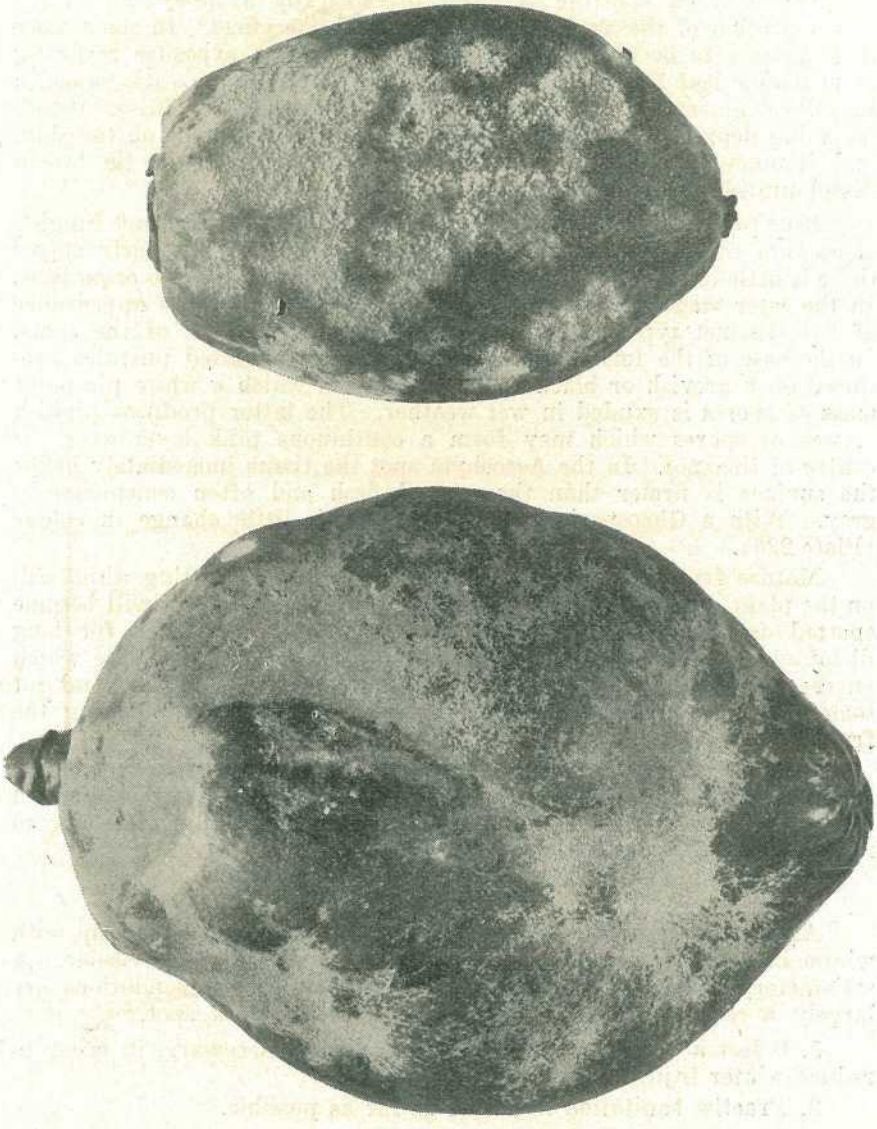


Plate 225.

Powdery mildew of the papaw, showing the fungus growing on a young fruit and the scarring and malformation which develops later.

RIPE ROTS.

The spring and early summer crop may suffer severely from one or more types of ripe rot. Circular brown spots develop in varying numbers on the skin of the mature fruit. These range in size from small, shallowly-depressed spots to large, saucer-shaped depressions an inch or more in diameter. In some cases there may be an exudation of latex into the hollows of the depressions, giving a scabby appearance to the fruit.

This distinct spotting is often preceded by a superficial brown discolouration of the skin, producing a scald-like effect. In some cases this appears to be a true scald brought about by exposure resulting from winter leaf fall, but in other cases it represents an early stage in the development of the ripe rot spots themselves. These, before becoming depressed, appear as small, circular, brown stains on the skin, and, if numerous, may spread and become confluent to form the brown discolouration described above.

Ripe rot of the papaw may be caused by at least two distinct fungi—*Ascochyta caricæ* and a species of *Glœosporium*. In the early stages there is little difference in the spotting produced by these two organisms. In the later stages they are usually distinguishable by the appearance of two distinct types of fruiting body over the surface of the spots. In the case of the former these consist of minute, raised pustules produced on a greyish or black background from which a white pin-point mass of spores is exuded in wet weather. The latter produces pinkish masses of spores which may form a continuous pink layer over the centre of the spot. In the Ascochyta spot the tissue immediately below the surface is firmer than the normal flesh and often conspicuously grey. With a Glœosporium infection there is little change in colour (Plate 226).

Mature fruit may develop the brown scald and spotting while still on the plant, or, as is often the case, apparently sound fruit will become spotted on reaching the market, especially when consigned for long distances. In either case the spots develop typically on the side which on the tree is the exposed outer surface of the fruit. A stem-end rot sometimes follows infection through the wound left by breaking the fruit from the stalk.

Both the abovementioned organisms live and produce spores on dead and dying leaf stalks, and it is probable that much of the infection is derived from this source. Unfortunately, it is usually impossible to remove the leaf stalks without injury to the fruit.

Control.

As the development of the ripe rots appears to be bound up with winter injury, any practice calculated to minimise this is advisable. A satisfactory spray has not yet been found, and recommendations are largely a recapitulation of those suggested for black spot.

1. Select a warm locality and fertilize when necessary, in order to reduce winter injury.

2. Practise sanitation measures as far as possible.

3. Apply a sulphur spray during the winter and spring months if powdery mildew is also present and needing control.

4. Attend to correct picking maturity, as the delayed ripening of immature fruit increases the incidence of ripe rot.

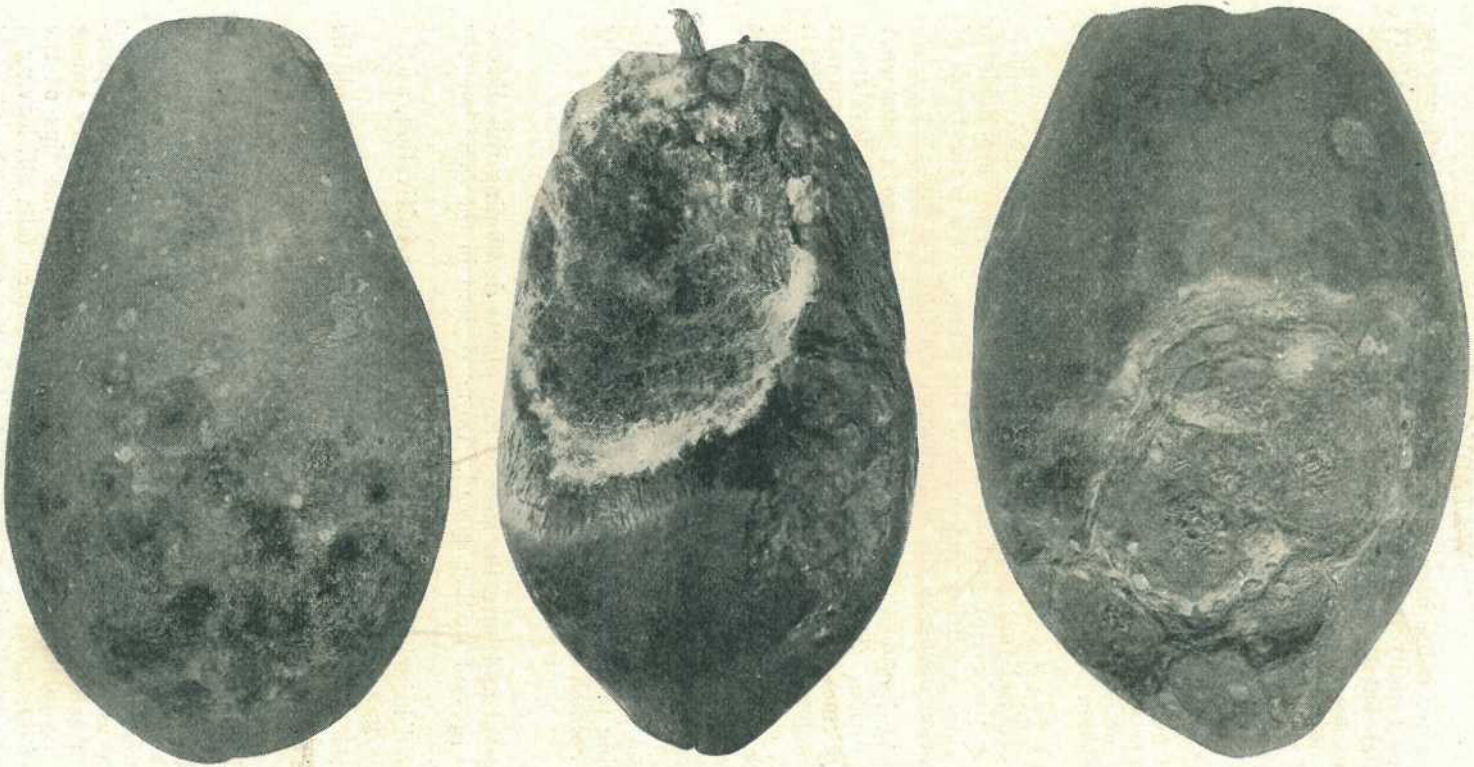


Plate 226.

PAPAW FRUIT DISEASES.

A. The type of papaw ripe rot produced by *Glœosporium sp.* B. Watery rot, showing an abundant development of the fungus *Rhizopus nigricans* on the soft area. C. A well-developed black spot lesion on mature fruit.

WATERY ROT.

Fruit, after it has been picked, occasionally develops a soft, watery decay which rapidly involves a large proportion of the flesh. Apart from a water-soaked appearance, no discolouration is present. The rot is commonly associated with some form of injury, and often with old black spot lesions. It is caused by a common mould fungus (*Rhizopus nigricans*) which may produce wefts of long, grey, fungous threads over the surface of the soft area. In advanced stages these threads may bind fruit and packing material together into a "nest" (Plate 226).

No special control measures are necessary. Fruit should be handled carefully so as to avoid injury, and any damaged or spotted fruit should be omitted from long-distance consignment. Sanitary precautions such as the destruction of rotting fruit in the plantation and packing shed should be taken.

FOOT ROT.

It is essential that papaws be grown on well-drained land; otherwise, during periods of prolonged wet weather, the roots are liable to decay and cause a wilting and death of the plant. This is the result of loss of aeration owing to the waterlogged state of the soil.

There is, however, a definite disease giving rise to a somewhat similar condition. The base of the stem near ground-level develops a soft, spongy rot which may involve the main roots and extend upwards in brown tongues of decay within the pith and woody parts (Plate 224). Externally, except for a dark and somewhat water-soaked appearance of the bark, there is often little to attract attention. The final effect is a wilting or gradual decline of the plant.

This rot is caused by a fungus (*Pythium ultimum*) which can sometimes be seen forming a white, mould-like growth on the bark covering the rotting region, and also masses of fine fungous threads in the adjoining pith cavities. Both young and old plants are affected by the disease, which usually appears only in fairly isolated cases.

Control.

1. Dig out and burn the stem of any plants developing this disease in order to prevent further spread. Do no replant in the same hole for some time.

2. Avoid injuring the base of the plant during cultivation, as the fungus may gain entrance through the wounds.

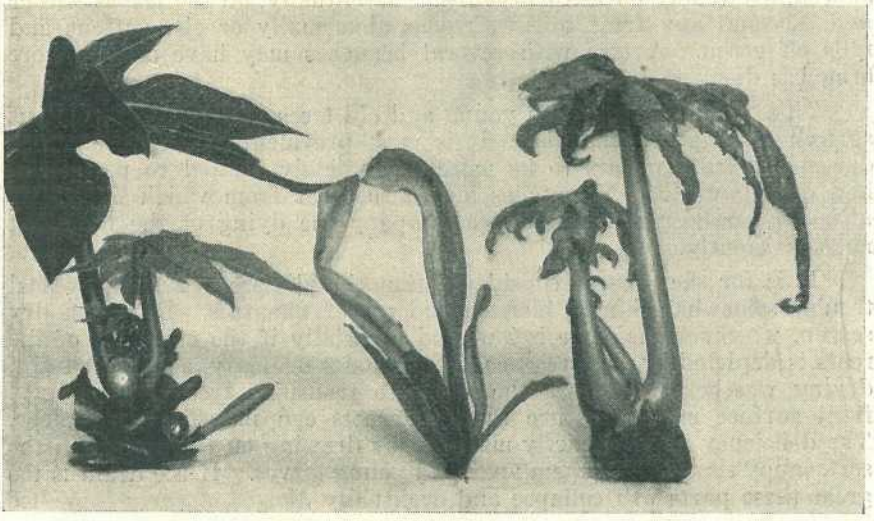
3. If the land is flat and liable to flooding, young plants should be set out on hills.

YELLOW CRINKLE.

In a plant affected with yellow crinkle the older leaves exhibit a yellow colour and the petioles take up a characteristic drooping habit. The young leaves develop thin, translucent areas along the margin and between the main veins and, as they expand, these weak chlorotic portions break away, leaving holes in the leaf and a ragged margin. These leaves as they mature have a somewhat hard and crinkled appearance, and usually remain a lighter yellowish green. The very young leaves are characterised by a talon-like incurving of the tips of the segments (Plate 227). Gradually the older foliage falls off, leaving a bare stem crowned with a few stunted leaves conspicuous by their

puckered appearance and indented margin. The floral parts, if present, may develop into abnormal foliage-like structures. Although the plant often remains in this condition for some time, fruit formation rarely occurs.

Yellow crinkle usually makes its appearance during the late summer. The disease is commonly restricted to scattered individuals, but as high as a 25 per cent. infection has been recorded. It is apparently more serious following a period of drought.



A. B. C.

Plate 227.

YELLOW CRINKLE OF THE PAPAW.—A. Portion of the crown of a healthy plant for comparison. B. Abnormal development of a flower. C. Yellow crinkle symptoms in the crown leaves of a diseased plant. Note the broken margin and incurved end of the segments.

The exact cause of yellow crinkle has not been proved definitely, but its characteristics suggest that it may be due to an infectious virus, as is the case with bunchy top of the banana. This type of disease is usually spread by transferring sap, in which the virus is present, from a diseased to a healthy individual. In the present case it does not appear possible to effect a mechanical inoculation by means of the hands or implements, and it is likely that certain sucking insects are implicated in the spread of the disease. Normally, very few insects of any description are to be found on the papaw, which may account for the fact that yellow crinkle is sporadic in its appearance.

Control.

From the point of view of control it would be wise to assume, as the evidence suggests, that this disease is of a virus nature. If this be so, it is useless to expect a cure, and it becomes necessary to eliminate the source of the virus by digging out any affected plant as soon as it is noticed. The crown of the plant should be sprayed before removal with kerosene or strong nicotine sulphate solution to kill any infective insects present. Although it is not uncommon for one crown of a branched tree to be affected first, it is unwise to destroy only this one, as the disease usually appears later in the remainder.

DIEBACK.

A papaw tree affected with dieback exhibits a general yellowing of the leaves accompanied by the death of a few of the younger ones, either completely or in segments only. The dark shrivelled areas on these centre leaves may continue down the petiole to a dark brown rather dry area of decay at the tip of the stem. This dead area on the stem does not usually extend for more than a few square inches and, unlike the lesion caused by black spot, is fairly shallow and apparently unoccupied by any parasitic organism. Eventually, all the leaves wither and die, and any fruit present ripens abnormally or else softens and falls off green. A tree with several branches may have one or more branches die.

This trouble affects both young and old trees and those in vigorous as well as in poor condition. It is most prevalent during protracted dry spells, and appears to be more immediately related to periods of hot, drying winds. Nematodes and a root rot from which *Phythium ultimum* has been isolated may accompany the dying of the tops, but not consistently.

It is for the present considered that this disease is a physiological trouble somewhat akin to blossom end rot of tomatoes. During a dry season, when soil moisture is low, and especially if the efficiency of the roots is depleted by the presence of nematodes or decay, a period of hot, drying weather will cause the plant to transpire from its leaf and fruit surface more moisture than the roots can immediately replace. The deficiency may be partly made up by drawing on the supply in the soft, sappy tissue of the stem apex and young leaves. If the drain is too great these parts will collapse and eventually die.

A partial root rot, following excessive rain, by producing artificial drought conditions, has also given rise to similar symptoms.

Control.

Where possible, careful irrigation so that the soil does not become too wet or too dry should minimise loss from this trouble.

In many cases an affected plant will send out healthy lateral shoots from farther down the stem. If, therefore, the dead top is cut off at one of the stem partitions, a new fruiting stem will often be formed to replace it as soon as growing conditions improve.

FOWL MANURE.

Poultry are usually fed a ration rich in protein, and consequently their excrement is rich in nitrogen. The arrangement by which intestinal and kidney waste products are voided together makes the nitrogenous products of fowl manure largely soluble.

It follows that care must be taken in storing fowl manure to see that no loss by leaching occurs. This may be done by storing it under cover in peaked heaps, or by mixing it with sand or friable earth which will absorb the soluble plant food.

Its high nitrogen content makes fowl manure a forcing fertilizer—usually termed "strong"—so that while its use for rapidly growing vegetables and strawberries is advocated, admixture with superphosphate and potash is advisable for most other crops.

Insect and Allied Pests of the Papaw.

J. HAROLD SMITH, M.Sc., N.D.A.

THE papaw is subject to a fairly wide range of pests, all parts of the plant being attacked. Some, such as the red spider, can be expected in most districts every year; others, such as the fruit-spotting bug, are only troublesome occasionally. Only the more important pests are discussed here.

THE RED SPIDER.

The red spider* is a mite known to attack a variety of hosts. The name is rather misleading, for the colour is seldom red, greyish green being dominant, although the actual shade varies greatly even within a single colony.

The leaves of affected plants show symptoms comparable with dry weather effects; the margins curl, the colour is bleached, particularly near the main veins, and reddish brown blotches may appear in the final stages of an attack. Normally, infestation commences in the older leaves, and then spreads to the younger growth. These symptoms are the result of mass feeding by very large numbers of mites on the under surface of the leaves. The fruits may also be infested, but this type of injury is of slight importance compared with the impoverishment associated with extensive leaf injury.

When infested leaves are closely examined, all stages of the mite from the microscopic egg to the very minute adult can be observed on the under surface. Silken threads are spun by the adult, and illustrate a characteristic habit of this and some related species, from which they have acquired the name "spinning mites."

Growth is very rapid, particularly in summer, when the period between egg and adult is approximately only a fortnight. Because of its high reproductive rate, an attack may develop very quickly. Red spider outbreaks are, however, usually sporadic, acute one month and negligible the next, but a whole season's growth may nevertheless be disturbed by a single attack. These marked fluctuations in the red spider populations are usually attributed to the mite's sensitivity to climatic changes, warm dry weather being favourable for a rapid increase, while cold temperatures with or without heavy rain retard development. In coastal Queensland, red spider infestation is frequently worst in spring when the weather is relatively dry with comparatively warm days.

Although predators are frequently active on red spider infested plants, they cannot be relied upon to keep the pest in check, and control measures are often necessary. Fortunately, the red spider is by no means difficult to control, and either a lime sulphur spray or a sulphur dust can be used. Lime sulphur is, perhaps, the more effective, and as the spray gives good control of powdery mildew this treatment is frequently preferred. Although a lime sulphur spray can be used at a concentration of 1 in 35 during winter and early spring, weaker solutions will be necessary in warmer weather if injury to the plant is to be avoided. For large-scale work, particularly in hilly country, the sulphur dust is more easily applied, and where mite control is the main objective reasonably good results are achieved. No matter which treatment be adopted, thoroughness in application is essential, and particular attention should

* *Tetranychus telarius* L.

be paid to the under surface of the leaves, where the pest is most numerous. If the mites are plentiful, some may survive a single spray or dust application. More than one treatment may then be necessary to give adequate control.

PAPAW BUGS.

A number of bugs are partial to the papaw, the two chief being the fruit-spotting bug* and the green vegetable bug.† The former is the more spectacular in its effects; the latter is more commonly encountered.

The fruit-spotting bug (the common name describes typical injury in banana fruits) is most troublesome in the Central district, where it achieved notoriety some years ago as a pest of bananas. The injury to papaws is seldom acute elsewhere. The actual damage caused by a comparatively small fruit-spotting bug population is sometimes considerable. The young growing point is attacked and cracks appear in both the leaf stalks and the main stem; fruit may develop black sunken spots where they have been pierced, and there is frequently a characteristic after-effect in which the young growth is stunted and crinkled. The check to the plant may be serious, particularly if growing conditions do not favour a rapid recovery.

The green vegetable bug attacks numerous hosts other than the papaw, for which it shows no special preference. The pest is frequently abundant in summer, and papaws may suffer, both the young growth and the fruits being attacked. In the latter case, a lesion appears where the fruit has been pierced, and produces a "marbled" appearance, which is reflected in the uneven texture of the edible flesh. As in the case of the fruit-spotting bug, an attack on the terminal growth produces distinct though noticeably less serious abnormalities.

Control of these pests by insecticides has not, as yet, proved practicable, and the grower must, when necessary, resort to handpicking.

THE YELLOW PEACH MOTH.

Growers are more familiar with the damage caused by the yellow peach moth‡ than with the insect itself. Papaws frequently suffer at least some dieback due to larval infestation at the growing point. Not all dieback is attributable to the pest, but when conditions are otherwise favourable for the plant and dieback still occurs, this pest can be suspected. The larvæ may also infest the fruit, penetrating the flesh particularly where adjacent fruits are in contact with each other. A similar type of injury to peach and citrus fruits is not uncommon in some districts.

The adult moths possess a wing span of approximately one inch, and the wings are yellow or orange with numerous black spots. Eggs are laid singly, and the larvæ when hatched soon commence to burrow into the fruit or growing point, as the case may be. When full fed, the larvæ pupate in a loose webbing among dry fragmented leaves or similar organic matter.

The habits of the insect are such that no control measures can be relied on to ease the position in the papaw grove. In the event of dieback from yellow peach moth, the grower has no option but to foster one

* *Amblypelta lutescens* Dist.

† *Nezara viridula* L.

‡ *Dichocrocis punctiferalis* Gn.

or more of the lateral shoots which develop, treating these as the bearing arms of the plant. In practice, it is advisable to cut off the damaged head from the plant and place a suitably sized tin over the cut surface to protect the stump from excessive decay.

NEMATODES.

The papaw is particularly susceptible to eelworm or nematode* attacks. The symptoms correspond with those in other hosts (Plate 228; figs. 2 and 3), and typically consist of malformed swollen roots—hence the colloquial term "knotty root." Although heavily infested the roots may still function to some extent, but the cumulative effect of an attack extending over many months, or even years, is such that the plant is starved for essential nutrients. Above ground the effect is apparent in the sluggish development of new spring growth, a lack of colour in the leaves, and undersized slowly maturing fruit. Ultimately the plant ceases to be profitable to the farmer.

Nematodes appear to thrive in the lighter types of soil, and as many papaw groves are located on precisely this kind of soil, nematode-free plants are the exception rather than the rule.

Nematodes are very minute eelworms which attack a large range of cultivated plants. The reproduction rate of this pest is very high. When the young hatch from the eggs (Plate 228; fig. 5) they move through the soil until they find the roots of a suitable host plant, which are then entered through incisions made by the needle-shaped mouth parts. Growth occurs within the the plant tissues, and "knots" or galls develop in the roots. When these galls are cut the small glassy pear-shaped female (Plate 228; fig. 7) can sometimes be seen embedded in the tissue. Several generations are possible in a year, and the build-up in the nematode population in soil carrying a suitable host is very rapid.

Control presents serious difficulties, and reasonable protection is the most that can be expected in practice. Natural movement of the eelworm through the soil is comparatively slow, and when high populations occur in relatively new land it is reasonable to suppose that the pest has been introduced with nursery stock or by dirty implements used previously in infested soil. It is therefore sound practice to clean the soil from implements which are being transferred to the papaw grove from infested truck crop areas. For the same reason, it is preferable to grow the seedlings in the grove rather than in an infested nursery from which they must later be transplanted. Alternatively, seedlings may be grown in ground which has not previously grown plants susceptible to nematode attack.

Although most crops are attacked, there are a few immune, or at least resistant, crops, which include many grasses, some cereals—e.g., wheat, barley, maize—and several varieties of cowpea. The use of such crops in conjunction with fallowing is very helpful in conditioning nematode infested land for papaws. A year or two's preparation in this way is by no means a waste of money; the crops themselves are of some value, and, most important of all, the papaws, when planted, get a good start, and may then crop profitably for a reasonable period in spite of nematodes.

For the same reason, papaws should never follow other nematode-susceptible crops, such as tomatoes and potatoes, in the rotation. If soil-conditioning is not practicable, the grove should be established on new ground or, failing this, the least infested ground on the property.

* *Heterodera marioni* Goodey.

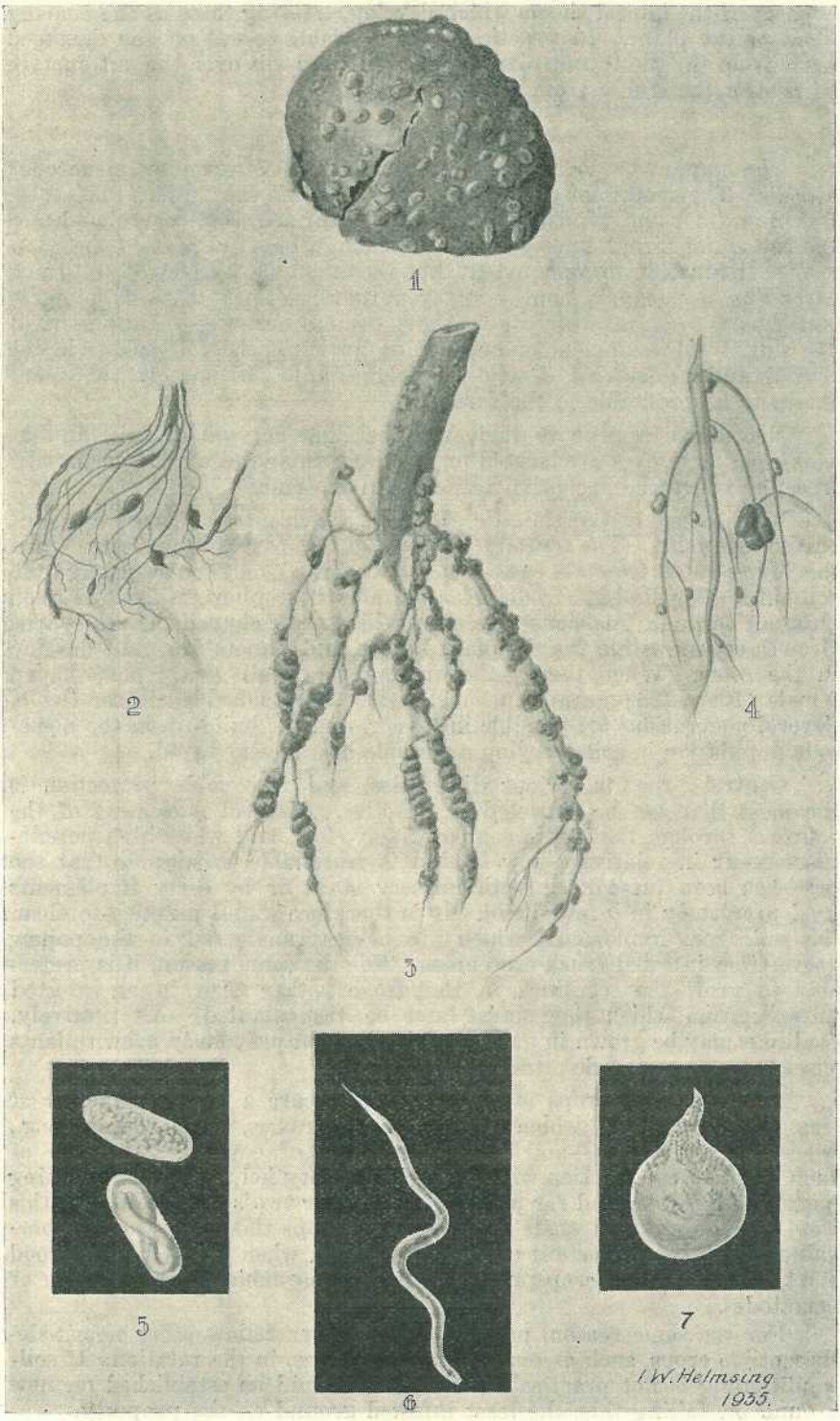


Plate 228.

Papaw failure due to nematodes is primarily a sequel to direct starvation following root injury, the vigour of the plant being proportional to its feeding capabilities. Liberal cultural and manurial treatment increase the efficiency of existing roots, while the plant tends, under such treatment, to throw out further lateral roots above the already injured tissues. The bearing life of the plant may be prolonged for a year or so in this way.

Careful attention to the isolation of the grove from outside contamination, conditioning the land with immune or resistant crops before planting, the selection of new ground when practicable, and adequate cultural and manurial treatment should therefore ensure a reasonably long bearing period.

OTHER PESTS.

Other pests of the papaw which may attract the grower's notice are fruit flies, fruit-sucking moths, and jassids.

Although authentic cases of papaw infestation by the Queensland fruit fly* are known, there is frequently some confusion in the grower's mind between this pest and scavenging species associated with fungal rots on the fruit. When the papaw is attacked by fruit fly, the injury is much the same as that in other commercial fruits, the edible flesh being destroyed by larvæ developing from eggs laid by the female in the fruit. Control measures are rarely necessary, but presumably the standard recommendations for this pest requiring the destruction of infested fruit and systematic luring with a vanilla-ammonia solution would diminish the losses.

Fruit-sucking moths† are primarily seasonal, and attack a variety of maturing fruits during summer and autumn. A number of species are usually associated with any one outbreak, and the fruit losses are sometimes considerable. Control recommendations in other countries require the use of poison baits, but these have so far proved valueless here. Reasonable protection can be obtained by inspecting the plants at night by means of a torch. The moths are then feeding, and can be easily caught by hand and destroyed. Systematic attention may be necessary for some weeks, but the work is well worth while when a maturing crop is at stake.

Jassids‡ are small agile hoppers which occasionally attack papaws in some parts of the State. When numerous they seriously affect the vitality of the plant, for partial or complete leaf failure may reduce the capacity of the plant to bear and mature good fruit. Adequate control measures are not available. Nicotine dusts certainly kill some of the immature stages, but the necessary expenditure is seldom justified in practice.

* *Chætodacus tryoni* Frogg.

† *Othreis fullonica* L. and *Eumænas salaminia* F. principally.

‡ Jassidæ.

DESCRIPTION OF PLATE 228.

Root Knot Nematode.—Fig. 1—Nematode-infested potato tuber. Fig. 2—Nematode galls on strawberry roots. Fig. 3—Nematode galls on tomato roots. Fig. 4—Bacterial nodules on lupin roots. Fig. 5—Nematode eggs x 150. Fig. 6—Larval nematode x 150. Fig. 7—Adult female nematode x 30. Figs. 1 to 4 half natural size.

Tobacco Seedling Production in North Queensland.

R. C. CANNON B.Sc.Agr., Instructor in Agriculture.

IT is generally recognised that the production of healthy, vigorous seedlings is of paramount importance to the tobacco grower. Given satisfactory growing conditions, such seedlings will make good growth and result in an even stand of uniformly maturing tobacco in the field. Such plants are also better fitted than weakly seedlings to withstand adverse weather conditions and the ravages of the numerous pests and diseases to which the crop is subject.

Selection of Site.

The land selected for the seedbeds should be well drained and protected as much as possible from strong winds, which dry out the soil and are prone to damage the protective coverings of the beds. The seedbeds should not be located, however, in low-lying, cold, or shady situations conducive to disease development. Loamy soils are admirably suited to seedling production, though in most cases the grower is forced to make use of a more sandy type of soil. The texture of the soil may be improved by ploughing under green manures or by the addition of suitable organic matter from other sources. All other considerations apart, it is most desirable that the seedbed area should be located conveniently with respect to the water supply. The regular attention required also demands that it be situated as close as practicable to the dwelling. It is inadvisable to attempt to grow seedlings continuously on the one area of land on account of the possible accumulation of spores of disease organisms. For preference, a system of seedbed rotation should be evolved to overcome this difficulty.

Area Required.

The extent of the seedbeds required will be governed by the area it is proposed to plant in the field; it is usual to regard 100 square feet as adequate to plant out 1 acre. Old seedlings cannot be expected to make the same growth in the field as young ones, and in order to obtain a good stand in the field it is essential that the seedlings be young and vigorous. As it is impossible to accurately forecast weather conditions, it will be obvious that the objective can only be attained by laying down a series of beds at regular intervals to provide suitable seedlings for planting when appropriate weather conditions are experienced. This means a larger seedbed area, with slightly increased costs, but the added security provided would to a large extent offset the additional costs.

Preparation of Beds.

With such minute seed as that of tobacco, it is essential to have a bed of very fine tilth, and the need for thorough cultivation cannot be stressed too much. The land should receive several cultivations before being made up into beds.

The next operation is the sterilization of the soil, which serves a dual purpose—namely, the destruction of harmful organisms in the soil as well as weed and grass seeds. The cheapest and most general sterilizing agent is heat; for this purpose brushwood or the organic material from certain antbeds may be used. Very good results have been obtained with

the latter, which is easy to collect and handle, and produces a steady, even heat. The whole area of the seedbeds, inclusive of pathways, should be covered; in the case of wood, a layer about 9 inches deep should be used, or where antbed is employed a layer 3 to 4 inches thick should be sufficient. Following the burn, all unburnt fragments should be carefully raked off before the whole bed is dug over to thoroughly incorporate the residual ash. At this stage it will be found convenient to erect the framework, the design of which will be determined by the methods to be adopted as a protection against diseases and pests.

Framework.

In the hot, dry climate of the tobacco-growing areas of North Queensland, unprotected seedbeds rapidly dry out, and the young seedlings are liable to be scorched by the direct rays of the sun. Therefore, it is necessary to make provision for the shading of the young seedlings during the day, and also to protect them from the inroads of insects. A suitable framework will not only maintain the beds in good shape, but will also provide a base for the erection of covers. For this purpose the most satisfactory material is sawn timber, which is easy to erect and gives a neat finish which assists in making the beds moth-proof. Many attempts have been made to utilise cheaper materials, but none are quite as effective as sawn timber, which will last well if treated with care. Boards 6 inches wide are well suited for the sides of the seedbeds.

The maximum length of the seedbed for ease of manipulation is about 50 feet, while the width will be determined by that of the covering material to be used, the usual width of beds being from 3 to 4 feet. The most convenient framework has three straining posts at each end to carry the wires which support the covers. The centre post should be high enough to hold a central wire about 15 inches above the ground. The side posts need not be so long, and are placed a few inches in from the edges to carry wires about 9 inches above the level of the bed.

Final Preparation and Fertilization.

As a rule, tobacco seedbeds are of necessity situated on poor, sandy soils deficient in organic matter If possible, the humus content of these soils should be increased by the application of horse or goat manure or some other suitable organic matter used in moderation. This should be previously sterilized by boiling to destroy any harmful organisms which may be present, as well as the weed seeds, which are inevitable. Where such organic matter is added, the application should be made at least two weeks prior to the sowing of the seed. A dressing of such organic manures will improve the texture of the soil, as well as its capacity for retaining moisture and plant foods. Plants grown in good textured soils are enabled to produce well-developed root systems, which materially assist in their establishment in the field.

The general practice is to apply a dressing of an ordinary fertilizer mixture, such as 4 : 12 : 6, before sowing the seed. An alternative procedure is to apply superphosphate at the rate of 1 oz. per square yard and nitrate of soda at the rate of ½ oz. per square yard. It is not considered necessary to include potash in this mixture, since sufficient potash is added to the soil in wood ashes when the beds are sterilised by burning. The superphosphate and nitrate of soda may be applied separately or else thoroughly mixed just before application. In all cases the fertilizers should be thoroughly incorporated in the soil at least one week prior to sowing. While the beds are still in the rough, it may

be of advantage to apply sufficient water to ensure a good moisture content in the soil. It is most important that the soil be well dug and raked over to break down any coarse soil particles before proceeding to sow the seed.

If desired, as an added precaution against damping-off, the beds may be watered over with Cheshunt mixture a day or so before planting. The preparation and method of application of Cheshunt mixture is described at the end of this article.

Sowing the Seed.

The seed should not be sown too thickly, otherwise soft, spindly plants are likely to result. It has been found that a rate of two-thirds of a teaspoonful of seed per 100 square feet of bed is ample for the purpose. The usual method adopted for sowing tobacco seed is to mix it with fine sand or ashes, and then distribute the mixture as evenly as possible over the surface of the bed by hand or by means of a home-made shaker. This should be done at a time when there is no wind, otherwise the distribution will not be even. Another method is to apply the seed in water through an ordinary watering-can—a method which has the advantage of being more or less unaffected by windy conditions. A can is half-filled with water, and the requisite quantity of seed added and well stirred before the rest of the water is added to nearly fill the can. The seed will remain in suspension for some time, but the can should not be allowed to stand for any length of time without being again stirred before sowing. Some growers favour the addition of a fine layer of loamy soil to cover the seed, but it must be remembered that the seed should not be deeply covered. As soon as convenient, the soil should be tamped down with a flat board to establish contact between the seed and the soil particles. In many districts it has been found necessary to apply a light mulch of medium grade river sand $\frac{1}{8}$ inch in thickness to protect the seed from the ravages of seed-harvesting ants. In any case, this mulch possesses the added advantage of appreciably reducing the evaporation of moisture, and is to be recommeded irrespective of the prevalence of ants. Should leaf-cutting ants make their appearance, they can be dealt with by broadcasting fine maizemeal over the seedbeds when the seed is germinating.

Covering of Beds.

As protection against the sun and insects, a number of materials have been used—e.g., hessian, stockinette, cheese-cloth, Rhodesian cloth, duck, and calico. When using hessian care must be taken to ensure that the plants receive sufficient sun, otherwise soft seedlings are apt to result. A very effective cover may be made from Rhodesian cloth, which is a specially reinforced cheese-cloth. It has the advantage of permitting the entry of abundant light and air, both of which are so necessary to the growth of good, hardy seedlings. Covers of Rhodesian cloth can be kept in position from 5 p.m. to 10 a.m. without adversely affecting the seedlings, and if retained in position during these hours they will prevent the moths of the stem borer and leaf miner, which do not fly by day, from gaining access to the seedlings for egg-laying purposes. Recently the use of benzol vapour against blue mould has come into prominence, and this calls for materials of better quality, which must be more or less gastight. When suitable calico or duck covers are used in conjunction with benzol vapour, they must be removed early in the day, so that the plants may receive the benefit of the early morning sun. Even so, leaf miner and stem borer infestation may be somewhat reduced by the

presence of these covers. Whatever covering material is chosen, it still remains necessary to harden off the seedlings a week or so before planting out.

As mentioned previously, it is usual to have three wires running the length of the beds to support the covers. Quite a number of methods are employed to attach the covers so as to facilitate removal for watering, spraying, and sunning, but space will not permit of detailed descriptions.

Care of the Beds.

The vital stage in seedling production occurs during the early period of growth, when the plants are small and possess a poorly developed root system. At this stage the beds should never be allowed to dry out, and abundant, though not excessive, water should be supplied. The amount required and the frequency of waterings will depend on weather conditions; under dry conditions it may be necessary to water as often as three times a day during the first few weeks. As the plants grow, and the root system extends, watering may be reduced to once daily. From the time of germination onwards it is necessary to protect the young seedlings with the covers at least during the hot periods of the day.

Seedlings should always maintain a vigorous growth, and should there appear to be any serious retardation of growth at any time, the application of a solution of nitrate of soda in water at the rate of ½ to 1 oz. per 4 gallons of water will in most instances sufficiently accelerate growth. On the other hand, it is inadvisable to apply nitrogenous manures too liberally, or there is likely to be a tendency towards soft seedlings, which will be difficult to harden off.

Hardening off should be a gradual, rather than a sudden, process, and the plants should be allowed an increasing amount of sunlight in the mornings and afternoons until they can stand the full sun during the whole day without serious wilting. The tendency of some growers to overdo this and seriously retard growth is to be deplored. It is much preferable to have another series of beds in case planting is delayed. Vigorous, hardened seedlings are able to make a rapid recovery from the shock of transplantation and to make quick growth in the field.

Protection Against Diseases.

One of the most serious diseases encountered in tobacco seedbeds is blue mould, in the development of which, over-watering of beds is often a predisposing factor. In the past good results have been obtained in North Queensland with a colloidal copper spray. Gas treatment has proved most effective during the past two seasons, though the costs are much higher. Colloidal copper also offers protection against frog-eye leafspot, whereas benzol apparently does not, and if the latter is used it is strongly recommended that the seedlings be sprayed at least once a week with the colloidal copper spray in addition. This spray will also afford some measure of protection against infestation by the leaf miner and stem borer.

Satisfactory results may usually be obtained by regular spraying with colloidal copper twice a week. The object is to maintain a thin protective film on the under-surface of the leaves, and where the plants are making very rapid growth, or where there is a likelihood of the spray having been washed off by rain, it may be necessary to increase the frequency of treatment. It is most essential that the under-surface of

the leaves be well covered, otherwise the spray will be ineffective. When the plants are very small a fine spray over the whole area will be adequate, but as soon as they are large enough to stand greater force a flat spray should be used. The beds should be sprayed from both sides with the rod held nearly horizontal so as to turn back the leaves and ensure complete covering. Very satisfactory results have been obtained with a bucket-pump and spray.

Home-made colloidal copper spray may be prepared as follows:— Dissolve 1 lb. of bluestone fines in 2 quarts of water in a non-metallic vessel, then stir in 1 pint of molasses, and make the solution slightly alkaline by the addition of caustic soda solution. For this purpose 5 oz. of caustic soda are dissolved in 1 quart of water, and gradually added to the bluestone and molasses mixture with constant stirring. Sufficient of this solution must be added so that litmus paper will not be affected— i.e., red paper does not turn blue nor blue paper red. Usually the mixture will thicken just before this point is reached. For spraying, this stock solution is diluted as follows:—

(i.) Stock solution, 1 quart in 7 gallons of water; to this add
(ii.) Potash soft soap, 6 oz. dissolved in ½ gallon of water.

These quantities will make up about 8 gallons of spray. It will be found convenient to make up as large a quantity of the stock solution as can be stored, since it will not deteriorate with storage, but rather improve. On the other hand, it is inadvisable to keep the stock solution over from one season to the next.

Gas treatment with benzol has proved more effective in controlling blue mould in seedbeds than colloidal copper, and was used on a commercial scale during the past season. The initial experiments carried out in the Southern States indicated a higher concentration of vapour than has been found necessary in North Queensland, where an evaporating surface of 1 square inch per square foot of seedbed has been found to be ample. The first essential is to have the beds as nearly gastight as possible, a condition which is fulfilled by good quality calico or duck without any further treatment. It is advisable, however, to protect the material from the growth of moulds, which darken it and reduce its effective life. For this purpose alum-lead acetate has proved satisfactory, and its preparation and use is outlined hereunder:—

Dissolve 1 lb. of alum in 1 gallon of boiling water with stirring, then add this to 4 gallons of cold water. Soak the cloth in this solution for twenty-four hours, and make sure that it is thoroughly wetted throughout. Then wring lightly before transferring to a solution prepared by dissolving ½ lb. of lead acetate in 1 gallon of boiling water with stirring, to which is subsequently added 4 gallons of cold water. Soak the material in this solution for five or six hours, and then wring out and allow to dry.

A proprietary product kown as Shirlan AG also has been found satisfactory for this purpose, and has the advantage of being easily prepared. A suspension is made up by stirring ½ lb. in 5 gallons of water, and the cloth is immersed in it, and kneaded well, for half an hour.

To prevent leakage of vapour from the beds the edges should have a neat, smooth finish, and ends should be made of timber. It has been found quite convenient to use the usual tent-shaped beds for benzol treatment. The benzol is exposed in shallow tins about 4 inches square

and about 1¼ inches deep. These tins should not rest on the ground, but can be placed on suitable short stands made of wood or wire. There should be sufficient of these to provide 1 square inch of evaporating surface to every square foot of bed, and they should be evenly spaced along the length of the bed. The benzol is exposed in these tins during the night from, say, 5 p.m. or 6 p.m. to 7 a.m. Experiments carried out in the Dimbulah district during the past season showed the consumption of benzol to be about 2 fluid oz. per 100 square feet per hour—that is, a little over 1¼ pint per 100 square feet per night. Any benzol remaining in the tins when the beds are opened in the morning should be collected and stored for future use. The beds should be opened to allow free passage of air, which will remove any vapour and so prevent damage to the seedlings when the sun is hot.

As previously mentioned, it is advisable to spray in addition such seedlings at least once a week as a protection against frog-eye leafspot as well as leaf miner and stem borer.

Should damping-off develop at any time, prompt application of Cheshunt mixture will usually check its spread. To prepare this mixture grind up some copper sulphate (bluestone) and some ammonium carbonate (rock ammonia) separately, and then thoroughly mix them in the proportions of two parts of copper sulphate to eleven of ammonium carbonate, and store in a well-stoppered bottle at least twenty-four hours before using. The powder is dissolved in water at the rate of 1 oz. per 2 gallons of water, and the solution is then applied with a watering can, which should be well rinsed after use to prevent corrosion.

At all times the beds should be carefully observed in order that remedial measures may be instituted immediately any disease symptoms are apparent. Strict attention to seedbed sanitation will have the effect of greatly reducing the liability to losses from diseases and pests. Should webworms or leaf-eating caterpillars become numerous in the seedbeds in spite of the adoption of the measures recommended in the preceeding paragraphs, it will be necessary to dust the seedlings twice weekly with a 50 to 75 per cent. arsenate of lead dust to obtain control.

DESTRUCTION OF OLD TOBACCO PLANTS.

The practicability of checking the ravages of various pests and diseases will determine in a very large measure the degree of success achieved in growing tobacco. The leaf miner and stem borer constitute a very serious menace to the crop, and it is essential that the populations of these two insects carrying over from the old crop to the new one should be reduced to a minimum.

Much can be accomplished by the elimination of breeding grounds during the months intervening between successive crops of tobacco, because in some of the more important tobacco districts practically nothing but tobacco is grown. Hence, if tobacco plants are uprooted and destroyed by fire as soon as possible after the completion of the harvesting of the leaf, and if volunteer plants are similarly dealt with, the new crop should get a good start free from any serious infestation. The position will be improved still further if the destruction of these tobacco plants is accompanied by the elimination of several leaf miner weed host plants, which occur in the main tobacco districts, and are closely allied botanically to tobacco. Again, from the point of view of insect control, the production of two tobacco crops in twelve months is fraught with great danger, at least in so far as the incidence of leaf miner and stem borer is concerned, and should be avoided on that account.

The procedure just recommended, of course, will help materially to reduce the carry-over of tobacco diseases. Growers are advised not to burn old tobacco stalks on the site of a new seed-bed.

Inconspicuous Organisms which Aid the Growth of Plants.

H. E. YOUNG, M.Sc.Agr., Assistant Research Officer.

OF recent years the importance of various fungi which are found in association with the roots of plants has been realised, and a considerable amount of research into the nature of the relationship carried out. Different species of fungi are found with many different groups of plants. The first plants to receive attention were the orchids. In these it has been found that the seeds will not germinate naturally without the presence of a particular fungus.

In the case of the orchids, the fungus after germination enters the roots of the seedling and lives there in the root tissue, sending out fine threads to the exterior, where they come into contact with the bark or leaf mould, &c., on which the plant is growing. The fungus is able to break down the insoluble organic matter in the dead bark and leaves into compounds which are available to the plant. The plant then absorbs the greater proportion of its ration of these substances through the roots, and some probably finds its way along the threads into the plant cells where the plant, under normal circumstances, is continually digesting the fungus structure after it reaches certain stages of development. By these means the hitherto unavailable but essential foods in the raw organic matter are rendered usable for the orchid plant.

Of course, if the seed lodges where one of these fungi is not present, in the first place it will not germinate, and in the second place if it did certain forms of organic matter would be unavailable to the growing plant. The germination effect is brought about by the fungus causing a rise in the concentration of sugars and also adjusting the acidity of the substratum. Germination can now be caused in test tubes by artificially supplying these conditions without the presence of a fungus.

After the discovery of the importance of fungi to orchids other plants were examined for similar effects and it was found that nearly all plants growing on peat soils, such as the heaths, had these fungus associations. Following this, similar structures were found on the roots of many forest trees, particularly conifers, and the list of plants with these associations is growing rapidly.

The failure to grow pine trees successfully in many nurseries was then found to be due to the absence of the particular fungi which are normally associated with the pines, and vigorous growth was produced by inoculating the nursery soils with these fungi. This is easily done by getting a small quantity of soil from beneath a vigorously-growing tree and placing it, with its contained fungi, in the nursery beds. The trees then, instead of being small, yellow and stunted and gradually dying out, become green and grow vigorously. This was found to be the case in several nurseries in Queensland and has been found in numerous cases overseas and in other States. The Queensland native hoop pine could not be successfully reared in Nyassaland until the nursery soil was inoculated with material from beneath a vigorous hoop pine tree.

In the case of trees, the fungus is found on the roots in various types of structures (Plate 229) know as mycorhiza, the type appearing to depend on the soil conditions, the species of tree, and the species of

fungus. In soils which have a low content of raw organic matter the fungi come to act as parasites, when the structures are called pseudo-mycorhiza. This is in direct contrast to the assistance they render when the supply is adequate.

Plate 229.
Mycorhiza and fungus fruiting body on roots of a pine tree.

In the normal beneficent type, the fungus threads branch out from the mycorhiza, which are situated on the feeding roots in the surface layers of the soil, and penetrate the soil in all directions and appear to represent a very much extended root hair system. They spread much

further and come into contact with many more soil particles than do root hairs, which disappear from fungus-infected roots. These fungi in the soil act in the same manner as do those in association with orchids. They make available the products of raw organic matter in the soil which the plant is unable to use before the fungus action, and without which poor growth is usually produced. The fungi probably have a second role in the soil by carrying mineral salts in a dissolved state along the fungal threads to the roots.

Poor growth in a soil does not necessarily mean that the fungus is absent, but may indicate that a sufficient supply of raw organic matter is not present and should be supplied for the fungus to work on. In fact, one worker in England has shown that with forest trees one can tell the state of the organic supply of the soil by microscopic examination of the mycorhiza on the root of the plant growing in it when once the normal structure for that species has been found for comparison. There have been cases reported also of harmful fungi forming pseudo-mycorhiza with roots and causing poor growth in plants.

Mycorhiza have been reported as being present on citrus and have been observed on the few trees examined in Queensland. Members of the Pasteur Institute have carried out researches on citrus mycorhiza in California, and from their work, and that of others, it would appear likely that poor or contradictory results obtained after the application of fertilizers to citrus trees may be explained by taking mycorhiza into consideration. Ample supplies of all the essential mineral salts are, probably, in the case of mycorhizal trees, of little value without the presence of sufficient raw organic matter for the mycorhizal fungi to work on; consequently, mulching might be of value in these cases.

In the case of a disease in pecan trees known as pecan rosette, it has been found that the treatment of affected trees with zinc alleviates the trouble. One investigator of this problem considers that the presence of zinc is essential in the pecan tree in order that it may maintain a correct balance with its mycorhizal fungus. The fungus, according to this theory, apparently becomes antagonistic towards the tree when there is an insufficient supply of available zinc. It has also been suggested that mottle leaf of citrus may be due to the same cause.

Mycorhiza have been reported from strawberries and many species of fruit trees and grasses. Australia's eucalypts, even, possess mycorhiza. Work is being carried out in France on the mycorhiza of the potato, and from reports it appears likely that the results will be of considerable economic value. Research on mycorhizal problems is really only beginning, and exacting work will have to be done with the various plants before the complete picture of the fungus-plant association is made clear. Experiments in the study of the physiology and nutrition of the fungus will have to be done, and research concerning the effect of different fungus species on the nutrition of particular plants will have to be carried out. So far, the study of the mycorhiza of forest trees is, in general, in advance of that of other crop plants, but if the results at present being obtained experimentally with species of pine, particularly in England, are any criterion of what may happen with other plants, some important results are likely to be obtained from a closer study of this little-known problem.

Sown Pastures and Their Management.

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(PART V.)

[*Continued from p. 429, Part 4, Vol. XLVIII.—October,* 1937.]

SELF-REGENERATING SUMMER PASTURE LEGUMES.

Lespedeza (*Lespedeza striata* Hook. et Arn.).

Origin and Distribution.—The common lespedeza is a native of the Orient which has been cultivated for many years in the Southern United States of America for hay, pasturage and soil improvement purposes. It was introduced to Queensland over thirty years ago and has spread to some extent in the coastal strip south of Gympie. No systematic use of the legume has yet been made in Queensland, but there would appear to be a future for it if properly utilised.

Description.—Lespedeza is a somewhat bushy plant reaching a height of about 18 inches when growing under favourable conditions. The branches in the lower portion of the plant are almost horizontal and individual plants may be as much as 3 feet in diameter. Small leaves are borne in profusion along the stems and are distinctly veined. The small rose-coloured flowers occur singly in the axils of the leaves in all parts of the plant.

Climatic Requirements.—Common lespedeza is a summer-growing annual which makes its development between October and March and goes to seed prior to dying off in April. Because of its long growing season it is of more use in the sub-tropics than in temperate areas, and for the same reason might be expected to have a limited sphere of usefulness in areas in which the wet season commences late in the summer. The plant is moderately susceptible to frost injury and late frosts may kill early-planted lots and destroy late sowings before seed is set.

Soils.—An important feature of lespedeza is its ability to thrive on soils too acid to permit of the development of the common clovers (white, red, &c.) and lucerne. Since most of our coastal dairying and grazing country is somewhat acid in nature this is an important characteristic. On the most sour soils liming would be necessary. The range of soil types on which lespedeza can be grown is large, and one of its main uses is for the improvement of poor, worn soils.

Planting.—Lespedeza is used both for pasture and for hay, and seeding practices vary accordingly. For pasture purposes, the legume can be sown alone, in admixture with other pasture seeds or on already established pastures. When sown alone on well-prepared land about 15 lb. of seed per acre should produce a good stand. Sown with paspalum or Rhodes grass seed, 4 lb. per acre would suffice to start the legume. Broadcasting 4 lb. per acre on ploughed or disced native pasture or paspalum pasture would ensure a good foundation for the spread of the plant. Quite commonly in the United States, lespedeza is broadcasted in the early spring on top of crops of wheat, oats or other cereals and slightly covered by harrowing. Spring or early summer sowing is desirable.

Management.—Since lespedeza is an annual which regenerates itself each year from self-sown seed that germinates in the spring, the early summer grazing of pastures containing this legume must not be heavy,

otherwise the seedlings might be destroyed. Once the plants have become established, the pastures may be grazed heavily at intervals, but towards the end of the season the legume must be permitted to ripen seed, if it is to carry itself on and spread. The use of superphosphate may prove beneficial to the plant.

Conservation.—Lespedeza is said to make a good class of hay, but, so far as is known, it is not yet used for this purpose in Australia. The common form is not of tall enough growth to make a good hay plant, but the selection known as Tennessee 76 is used for hay in United States of America.

Feeding Value.—The plant is palatable and of high nutritive value if eaten before it becomes too stemmy. All classes of stock are fond of the green plant and of its hay.

Seed Production.—The usual method employed in Queensland is to pull the maturing plants up, allow them to dry out on a floor, and shake or beat the seed out. In the United States, where seed production is of some importance, harvesting is carried out by a mower with a seed pan attached to the back of the cutter bar, or else the crop is cut and raked while the dew is on it, and run through a grain thresher when dry.

Special Uses.—Lespedeza is used fairly extensively in the South-eastern United States for soil improvement purposes, either in crop rotations or on worn-out cultivation areas, and may prove useful for this purpose in Queensland.

Korean Lespedeza (*Lespedeza stipulacea* Maxim.).

Origin and Distribution.—Like the common lespedeza, Korean lespedeza is a native of the Orient and is cultivated most commonly in the United States, particularly in the warm temperate States, north of the sub-tropical Gulf States. The legume has been tried in Australia, but in Queensland at least appears to be of less general promise than the common lespedeza.

Description.—Korean lespedeza is annual in habit and is a summer grower. The leaves are broader than those of common lespedeza and the plant is generally larger and coarser. The seeds are borne in the axils of the leaves on the ends of the branches.

Climate Requirements.—In the United States, Korean lespedeza can be used in areas experiencing a fairly protracted winter, because the seed germinates at a moderately low temperature, and the plant matures early and so sets seed before the onset of frosts.

Soils.—Practically any type of soil is said to suit this legume.

Planting.—Korean lespedeza is utilised similarly to the common lespedeza and should be planted as indicated for *Lespedeza striata.*

Management, Conservation and Feeding Value.—The remarks made under these headings in the section dealing with common lespedeza apply also to Korean lespedeza.

Townsville Lucerne (*Stylosanthes sundaica* Taub.).

Origin and Distribution.—Townsville lucerne is a native of Brazil and other tropical American countries and now has a wide natural distribution as a weed in warm countries. It has been naturalised in

Queensland for many years and within the past 20 years has been spread both naturally and by artificial means over a lengthy strip of coastal country in North Queensland.

Description.—Of annual habit, Townsville lucerne (Plate 230) is a shrubby plant with numerous branches each up to 3 feet or so in length and clothed in a greyish down. The branches are often prostrate, but erect branches up to 2 feet high are produced. The leaflets occur in threes on short stalks. The flowers are small and occur in dense rounded heads at the ends of the stems. The "seed" is small, angular and grooved across the middle and has a stiff hooked bristle at one end.

Plate 230.
Townsville lucerne.

Climatic Requirements.—Townsville lucerne is a summer-growing legume which germinates following spring or early summer rains and matures prior to the following winter. Since the plant depends for its regeneration on self-sown seed, it is only in areas with a long summer that Townsville lucerne is of permanent value. Though it will survive fairly long, dry periods, it will only develop properly under fairly high rainfall conditions. Little success has been attained south of Rockhampton or outside tropical areas with an annual average rainfall of about 40 inches or more.

Soils.—Provided moisture conditions are satisfactory, Townsville lucerne will thrive on a variety of soil types, from cultivated scrub soils to poor forest soils. Apparently it can tolerate a high degree of soil acidity, but a well-drained soil is desirable.

Planting.—The plant is propagated by means of seed, which is fairly plentifully produced in the main growing areas. What is commonly considered as the seed is really a hard pod containing the seed. Unless their surface is scratched to permit of easier uptake of moisture by the seed, the pods are likely to lie in the ground for some time before germination occurs.

The chief use of Townsville lucerne is as a constituent of permanent pastures, either native or artificial, and it is commonly sown down on established pastures. Where practicable, it is desirable that a form of seed-bed be provided by discing or peg-harrowing of the pasture, followed by a brush-harrowing to cover the seed. The best time to plant is with the advent of the summer wet season, though earlier planting is advisable if spring rains occur. In order to get the legume started on a property, scattered small areas might be sown at the rate of 1-2 lb. of seed per acre. These areas would serve as distribution centres, since the seed is readily spread in manure, on the hair of animals, &c.

Management.—Townsville lucerne is less likely to bloat ruminants than are lucerne and the common clovers, but where the plant is plentiful, bloating must be guarded against. Intermittent grazing should be practised and seeding must be permitted.

Conservation.—Neither hay nor silage are as yet made from Townsville lucerne.

Feeding Value.—The rank growth produced by the plant at the height of the rainy season is apparently not relished by stock, but as the plant commences to dry out from March onwards, stock readily eat it. Since the plant is late in maturing, the dry autumn encourages self-haying and the dry material, even when it has shattered, is greedily eaten. This autumn feed is particularly valuable. The nutritive value of Townsville lucerne is high, though the dry, stemmy material is much poorer than lucerne.

Special Uses.—Whilst at present Townsville lucerne is used mainly for pasturage, it is possible that it might have some value for soil renovation purposes, since it can be grown on fairly poor soils.

Undesirable Features.—In some countries the plant has a tendency to spread on to cultivated land and to behave there as a weed. To date there is no indication that the plant will become a pest of any consequence in Queensland.

ANNUAL SUMMER-GROWING PASTURE GRASSES AND FODDER CROPS.

* Sudan Grass (*Sorghum sudanense* Stapf).

Origin and Distribution.—Sudan grass is a native of tropical North Africa, now extensively used in most subtropical and tropical agricultural areas as a summer pasture plant. In Queensland it is perhaps the most commonly used annual summer pasture.

Description.—Normally, Sudan grass is annual in habit, though it may last for two or three years on occasions. It is a tufted plant which stools freely, the stems reaching a height of up to 10 feet. The thickness of the stems is very variable, but is seldom greater than ⅛ inch. The

* A special leaflet dealing with Sudan grass is available on application to the Department of Agriculture and Stock.

length of the leaves also varies greatly, the length being up to 2 feet and the width ½ to ¾ inch. The erect leafy stems eventually produce spreading flower heads. The root system is fibrous and there is no development of underground rootstocks such as characterise Johnson grass.

Climatic Requirements.—Sudan grass is a summer-growing annual, which is capable of developing on a lower rainfall than most other summer annuals. In Queensland it is grown without irrigation in the driest agricultural districts as well as in fairly wet districts. Early seedlings are easily killed by frost.

Soils.—Whilst it prefers rich loams, Sudan grass will produce a crop on a large number of soil types.

Planting.—A thoroughly prepared seedbed is as necessary for Sudan grass as for similar crops. Sowing should be carried out in spring or in early summer, a seeding rate of 5—15 lb. per acre being used. The quantity of seed used depends on the method of sowing and the district, lower rates being employed in dry districts and when the seed is drilled in. Occasionally Sudan grass is planted in rows about 3 feet apart, but more usually it is drilled close together or broadcast. Sudan grass seed is often contaminated with seeds of the noxious Johnson grass, and seed should always be purchased from a reliable source.

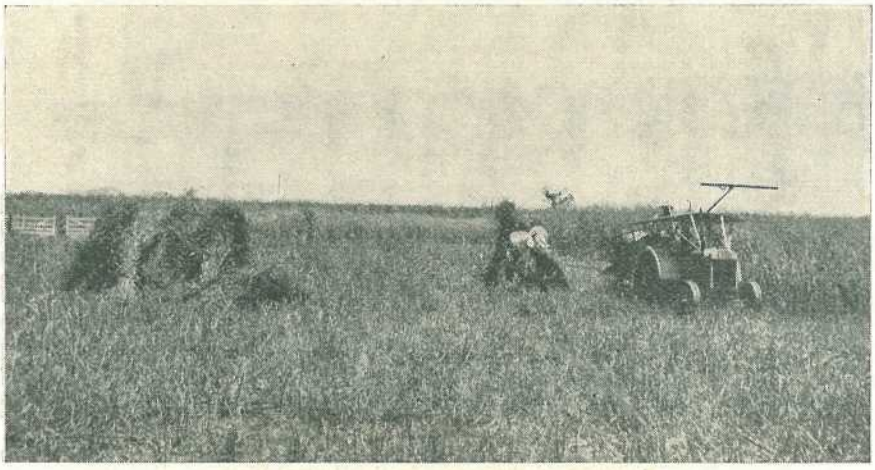


Plate 231.
Harvesting a crop of Sudan grass in Central Queensland.

Mixtures.—Because of its erect growth and good hay qualities Sudan grass is occasionally sown with cowpeas and the mixture ultimately used for hay or silage.

Management.—Sudan grass is used chiefly for hay and for grazing. If used for grazing in the immature stages, careful management must be practised to prevent losses of stock due to prussic-acid poisoning. Whilst the grass is commonly grazed at all stages of growth, frequent heavy losses are experienced. Once the plant has reached the flowering stage all danger of poisoning is passed. The plant may safely be fed after cutting and wilting, but wilted young growth prior to cutting is extremely dangerous.

The grass makes rapid recovery after grazing and several grazings are obtainable during the growing period.

Conservation.—For hay purposes, Sudan grass is a very suitable plant, since it is a heavy yielder in a short time, cures readily and makes a good class of hay. The earlier cuttings should be made when the crop is commencing to flower and the last cut when the grass is in full bloom. Three or four cuttings may be expected during a season.

Sudan grass is an excellent silage crop, either stacked or chaffed.

Feeding Value.—Stock readily eat Sudan grass in all stages of growth and as hay or silage. It is advisable to chaff stemmy growth before feeding. The feeding value of the grass is excellent, though it falls considerably as the plant matures.

* Sorghums (*Sorghum vulgare* Pers.).

Origin and Distribution.—The cultivated sorghums originated in northern Africa and the warm Asiatic countries and are now very extensively grown in all warm countries for green feed, silage and grain.

Plate 232. [*Photo. W. C. Miller.*
A young sorghum crop in the Central-West.

Description.—There are two main classes of sorghum grown in Queensland, namely the saccharine or sweet sorghums, grown for fodder purposes, and the grain sorghums, grown for their grain. There is a wide variety of types, but all are tufted, erect, stooling plants with fairly thick stems and long, broad leaves.

Climatic Requirements.—Sorghums can be grown without irrigation in all the agricultural districts of Queensland and they are the most suitable fodder and grain crop for dry districts.

Soils.—Whilst fertile soils produce the heaviest crops, good results are obtained with the sorghums on many soil types.

* Special pamphlets dealing with sorghums are obtainable from the Department of Agriculture and Stock.

Planting.—Sorghums should be sown only on well-prepared land, and planting should be carried out during the spring or early summer. Since the crop is being grown for harvesting, it is advisable to sow in well-spaced drills, about 5 lb. of seed per acre being used.

Management.—Owing to the great danger of poisoning, saccharine sorghums should not be grazed by stock, but should be harvested before feeding. For fodder purposes, the best time to cut is when the grain is formed but still soft, but the nutritive value is retained in a large measure well after this stage is passed. The crop is usually cut in small sections with a cane knife, but is most readily harvested by a maize binder.

Conservation.—The saccharine sorghums make good silage and are commonly ensiled.

The grain sorghums are heavy yielders in most districts.

Feeding Value.—Saccharine sorghums are very palatable and nutritive if fed when chaffed and before too mature.

* Maize (*Zea mdis* L.).

Origin and Distribution.—Maize is a native of subtropical America and is extensively grown in most warm countries, chiefly for grain, but also for green fodder and silage.

Climatic Requirements.—Maize is a summer-growing annual, which requires a moderate to fairly high rainfall, together with a fairly long growing season. It is somewhat drought resistant, but has not the same power of recovery from dry spells as has sorghum. It frosts fairly easily.

Soils.—Most good quality soils, provided they are well-drained, are satisfactory for maize.

Planting.—The seed should be planted only on well-prepared land. The time of planting depends on the district and the variety and extends from August to January. Sowing in drills is desirable, a seeding rate of about 10 lb. per acre being employed.

Management.—The green crop has its highest feeding value when in cob and the grain glazed, but is often cut before coming into ear in order to supply feed which is urgently required. The crop may be cut by hand with a cane-knife or harvested with a sledge-cutter (Plate 233), or the maize harvester.

Conservation.—For silage purposes maize should be cut when fairly green and succulent. The best time is when some of the ears are dented or glazed, a portion of the husks are dry and the upper leaves are still green. Older growth which has failed to mature its grain may be conserved as stover, the cut material being cured in the field. The grain is, of course, readily conserved, either in the crib or in tanks.

Feeding Value.—The feeding value of green maize, maize silage, maize stover and maize grain is fairly good, but maize and its products must be balanced with some protein concentrate to provide a production ration.

* A special pamphlet on Maize Cultivation is available from the Department of Agriculture and Stock.

Plate 233.
A sledge cutter at work in an immature maize crop.

*"Millets" and "Panicums".

Description.—There is a good deal of confusion regarding the identity of the various types of quick-maturing fodder plants embraced in the terms "millets" and panicums." The following classification is adopted in this discussion:—

White Panicum (*Echinochloa crus-galli* var.). (Plate 234.)

Japanese Millet (*Echinochloa crus-galli* var. *edulis*). (Plate 234.)

French Millet (*Panicum mileaceum*).

Giant Setaria (*Setaria italica*). (Plate 235.)

Dwarf Setaria (*Setaria italica*).

Climatic Requirements.—The various plants listed above are all summer-growing annuals which are readily killed by frosts. They exhibit drought resistance in varying degrees, but all are able to survive short periods of dry weather and to develop on a fairly low rainfall. Even in our driest agricultural districts they can be relied upon to produce feed in most years.

Soils.—Whilst they do well on a variety of soil types, fertile clay loams or sandy loams are favoured.

Planting.—The millets, &c., are all propagated by seed and from 10 to 15 lb. per acre of seed are necessary to produce a good stand. The quality of the seed is usually high and a minimum germination percentage of 75 for commercial seed is prescribed by the Pure Seeds Acts. The seed may be broadcast or drilled and should, of course, be sown on well-prepared land. Sowings may be made at any time during spring or summer and often the crop is used as a catch crop, to take the place of an agricultural crop which has failed for one reason or another. Good grazing will be provided in five to six weeks if weather conditions are favourable.

Management.—The crop should be permitted to establish properly before being grazed off. Usually 8 to 9 inches of top-growth should be allowed to develop. After the initial grazing, if this is not made too late, the crop will respond fairly well and produce a second grazing or cutting.

Conservation.—The millets, panicums, &c., make a good class of hay, if cut when the grain is forming. Owing to their succulent nature, they take some time to cure. The plants are also very suitable for silage.

Feeding Value.—All classes of stock find these crops very palatable and their nutritive value is high.

Undesirable Features.—Owing to their free-seeding habit the danger of volunteer growth of millets to succeeding crops is high and care should be taken to prevent the ripening of seed if subsequent extra working of the land is to be avoided.

* A special pamphlet dealing with millets, &c., is available on request to the Department of Agriculture and Stock.

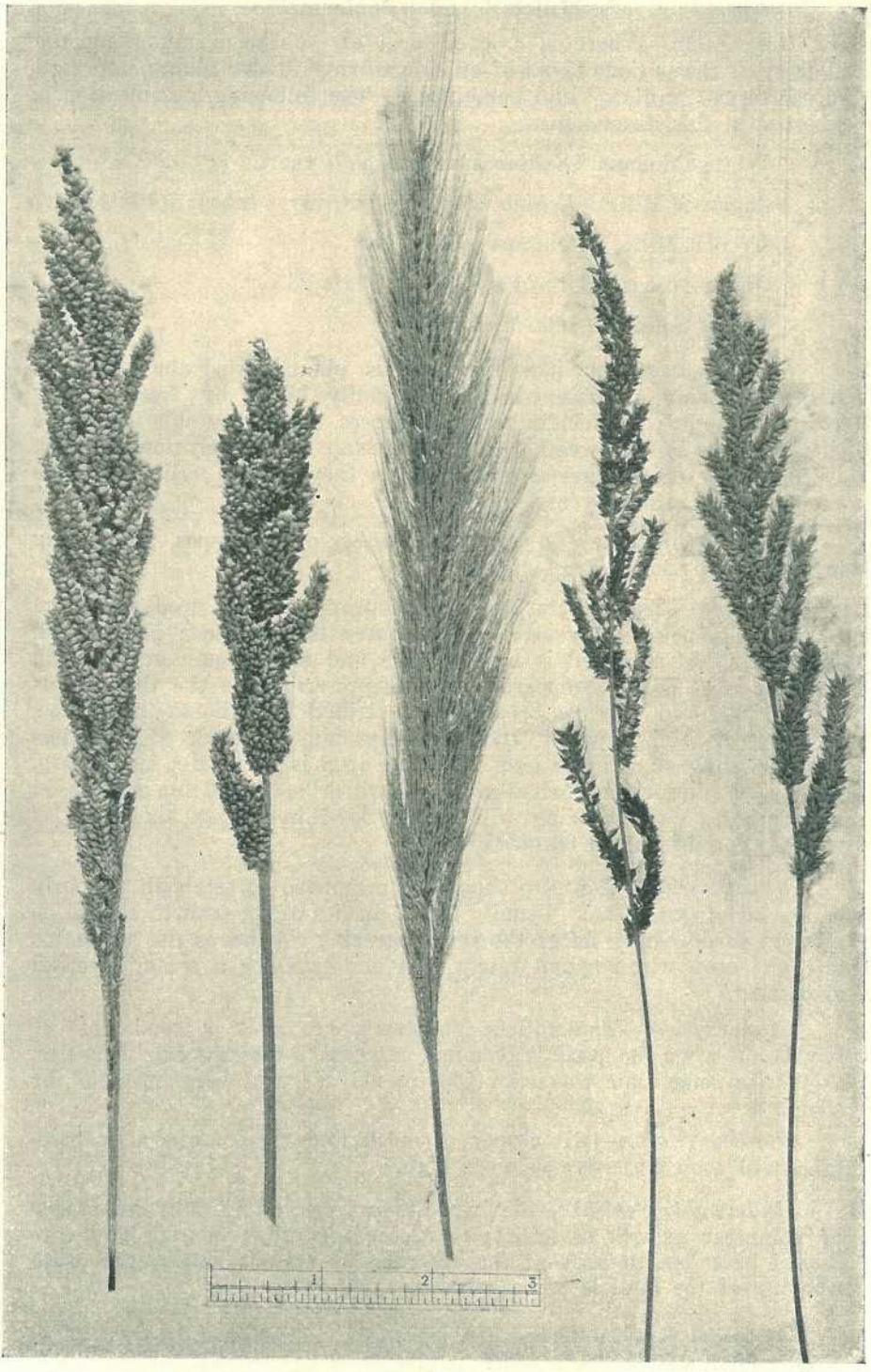


Plate 234.

Seedheads of various millets. From the left—white panicum, Japanese millet, and three forms of wild millets.

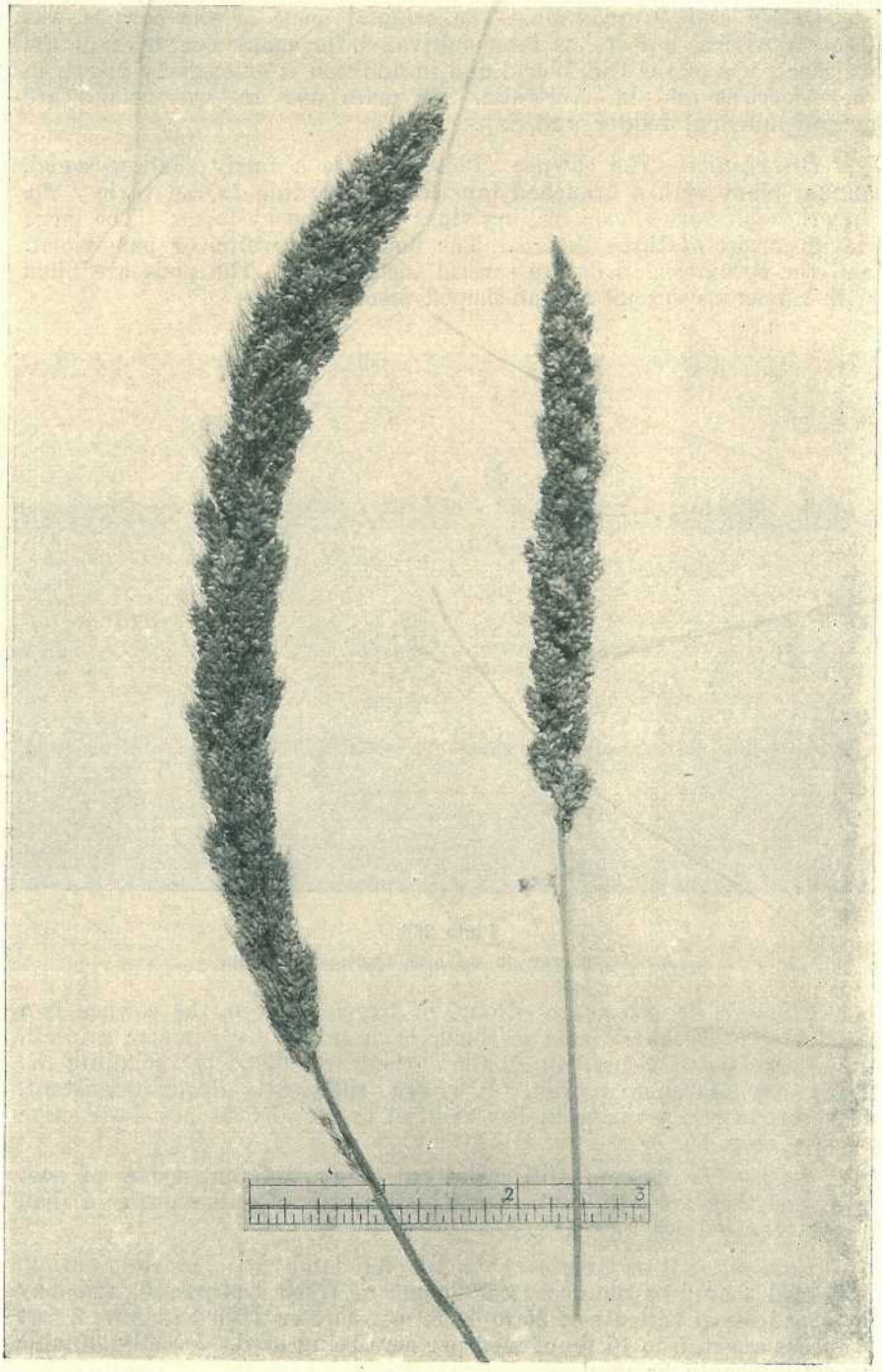


Plate 235.
Seedheads of two forms of Setaria.

* Cowpea (*Vigna unguiculata* (L.) Wallp.).

Origin and Distribution.—The original home of the cowpea was Central Africa, but it has been cultivated for many centuries in the warmer parts of the Old World and in addition is extensively grown in the Americas and in Australia. Its main uses in Queensland are green-manuring, fodder and hay.

Description.—The cowpea (Plate 236) is a fairly shallow-rooted, annual plant with a branched tap-root. According to the variety the growth habit varies from trailing vines to tall, bushy forms. The large leaves consist of three leaflets. The flowers are white, or pale violet, and the cylindrical pods are several inches long. The pods are filled with numerous speckled, bean-shaped seeds.

Plate 236.
A cowpea crop on a North Queensland farm.

Climatic Requirements.—Being of tropical origin, the cowpea is a summer-grower, but is able to thrive on a fairly low summer rainfall. In Queensland it is used in all the agricultural districts, including the fairly dry Maranoa district. It is not sufficiently drought-resistant, however, to really thrive in low rainfall areas. Frosts are destructive of the crop.

Soils.—The cowpea will grow on many different types of soil, provided they are well-drained, and will thrive on soils more acid than those required by lucerne.

Planting.—It is necessary to till the land well before planting. The seed should be planted after danger of frosts has passed, and may be broadcast at the rate of 25 to 40 lb. per acre or drilled in rows 2 feet 6 inches apart, 5 to 15 lb. of seed per acre being used. Locally suitable varieties should be used.

* A special pamphlet is available from the Department of Agriculture and Stock.

Management.—The crop can be grazed by stock during its growing period. For hay purposes, it is best cut when a fair proportion of the flowers have formed pods. The crop is somewhat difficult to cure properly.

Feeding Value.—The feeding value of cowpea, both green and cured, is excellent. Dairy stock do not readily take to the green material at first, but later acquire a taste for it.

* Velvet Bean (*Mucuna* spp.)

(including Mauritius Bean (*Mucuna aterrima* Holl.) and Florida Velvet Bean (*Mucuna deeringiana* (Bort.) Holl.).

Origin and Distribution.—The various types of velvet bean are natives of tropical countries and are employed in a number of tropical and subtropical areas chiefly for green manure purposes. It is for green manure that the crop is mainly used in Queensland, but it is utilised also for grazing, though only to a small extent.

Plate 237.
Velvet beans growing amongst maize.

Description.—Velvet bean (Plate 237) is an annual plant, varying in habit from bush types to vine types. The plants have fleshy surface roots and stems and the vine types often spread over a large area. The leaves are large and occur in groups of three leaflets. The large flowers are borne singly or in small groups and are variously coloured from white to purple. The pods are from 2 to 6 inches long and in some varieties are hairy. The seeds are large, but vary in shape from globular to oblong and are white, mottled, brown or black in appearance.

* A special pamphlet is obtainable from the Department of Agriculture and Stock.

Climatic Requirements.—The velvet bean is a summer grower and requires a fairly heavy summer rainfall and a long growing season. Best results are obtained in the tropical north coast: elsewhere cowpeas usually are employed as an alternative to velvet bean.

Soils.—A well-drained fertile soil is desirable, and a wide range of soil types is suitable for the crop. It will grow on soils too acid for lucerne or clovers.

Planting.—Sowing should not be commenced until danger of frosts is passed, but early sowing is desirable, especially of the late-maturing varieties. The land should be well cultivated. The method of planting varies according to the purpose of sowing. When sown in a pure stand for hay, grazing or green manure, the crop is planted in drills 4 or 5 feet apart, with 12 to 18 inches between the seeds. Between 10 and 20 lb. will seed an acre.

Sometimes velvet bean is sown with maize or sorghum to provide a mixed grazing or silage crop. The bean seed may be sown either at the same time as, or later than, the maize or sorghum seed.

Management.—In the early stages of growth of the velvet bean, weeds should be kept down by cultivation. When the plants are well established, grazing may be commenced, but should be intermittent in character.

Conservation.—For hay purposes, velvet beans are best harvested by hand-cutting, when the crop is in early flower. The wilted plants are cocked for a few days before stacking. When grown in a mixed stand, a useful silage may be made from velvet beans.

Feeding Value.—The vines are extremely palatable to stock and possess a high feeding value. The mature beans also provide good feed.

* Peanut (*Arachis hypogea* L.).

Origin and Distribution.—A native of Brazil, the peanut is grown in a number of tropical and subtropical countries for the edible "nut" which it produces. In Queensland a fairly large area in the Burnett, and in more tropical districts, is sown annually to the crop.

Description.—The peanut is a thick-stemmed annual plant of either bushy or creeping habit and possessing a thick tap-root. There are four large leaflets in each leaf, and the stemless, yellow flowers occur at the bases of the leaves. When the flower is fertilized, it develops a long stalk, which carries the flower (minus its petals) into the ground, where the fruit is matured.

Climatic Requirements.—A long, warm-growing period, with moderate rainfall, is necessary if fruit is to be matured.

Soils.—Loose-textured soils are essential to permit of the flower being buried and to facilitate harvesting, and light, sandy loams, not too acid and with a good humus content, are recommended.

Planting.—A well-tilled seed-bed should be provided and the seed sown in spring or early summer in drills.

Management.—Whilst the usual practice is to market the nuts and to cure the tops for feeding to stock, on occasions the standing green crop is grazed, especially by pigs, which are able to use also the underground nuts.

*A special pamphlet dealing with peanut cultivation is available.

Conservation.—Peanut tops make a very rich hay and should be cured in the manner recommended in the special pamphlet, which is available from the Department of Agriculture and Stock.

PERMANENT WINTER-GROWING GRASSES.

Toowoomba Canary Grass (*Phalaris tuberosa* L.).

Origin and Distribution.—Though it might appear from the common name of this grass that it is a native of Queensland, the plant originated in the Mediterranean region. It was introduced to Australia for trial purposes over 50 years ago, being first sown in this country at the Toowoomba Botanic Gardens in 1884. Small quantities of seed were distributed from Toowoomba to various States, but it was not until twenty years after its introduction that it came to the notice of agriculturists in Southern Australia as possessing the valuable properties of drought-resistance, permanency, high productivity and adaptability to varying soil types. It was slowly brought into more extensive use, and during recent years the demand for seed has been heavy.

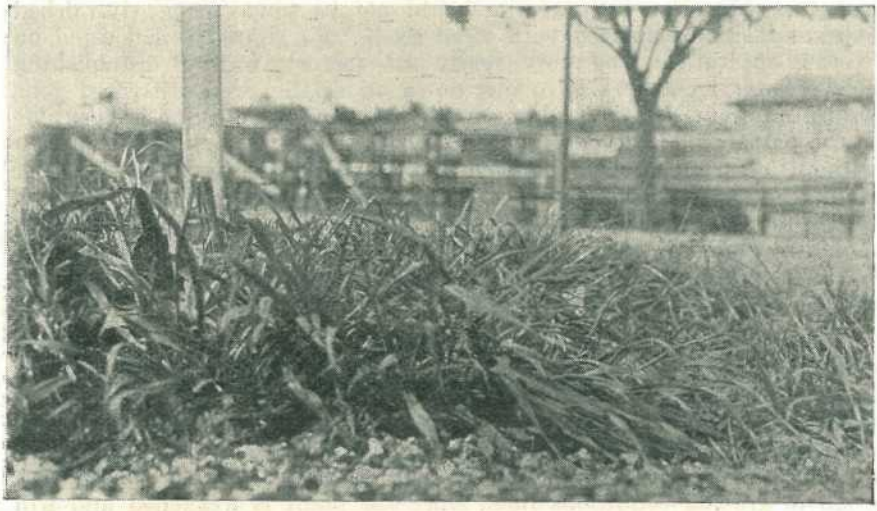


Plate 238.
Phalaris tuberosa.

Description.—*Phalaris tuberosa* is a deep-rooted perennial plant, which increases in size by means of short, underground runners. The tufts produce, during the winter and spring months, a large quantity of palatable and nutritious leafage. The production of seed stalks is limited under grazing conditions.

Climatic Requirements.—For maximum production during its autumn-spring growing period, Phalaris requires a moderate to heavy winter rainfall, and is best suited to areas experiencing such conditions. It is, however, fairly productive during short, dry periods, although dormant under drought conditions. Severe frosts do not injure the grass.

Soils.—So far as soil conditions are concerned, Phalaris prefers a rich, well-drained soil, but will do well on a wide range of soil types possessing these characteristics. The nitrogen requirements of such a high-producing grass as *Phalaris tuberosa* are high, and soils rich in organic matter or other form of nitrogen should be selected.

Planting.—The sowing of Phalaris pastures should be performed during the autumn months. The seed is of light weight, and as only a small bulk per acre is required, the seed should be mixed with some filler, such as superphosphate or sand, to facilitate distribution, whether by drilling or by broadcasting. *Phalaris tuberosa* seed is somewhat erratic in its behaviour, as far as germination is concerned. Some lots germinate well over 80 per cent., other lots fail to reach the 55 per cent. minimum, which operates in most States. It is advisable to purchase Government Certified seed, which, in addition to being approved with regard to origin, also carries a seed-tester's certificate, showing the percentage germination at the time of testing. By purchasing Government Certified seed the buyer can be certain of securing seed from pastures of a truly perennial type, and does not run the risk of purchasing seed contaminated with seeds of short-lived types of Phalaris.

Phalaris is a grass which takes some time to establish its root system, and is sensitive to severe competition during its early stages. Consequently, care should be taken that the grass is sown only under conditions in which it will not be subject to heavy competition for soil moisture, &c. For instance, it should not be sown on poorly-worked cultivations contaminated with weed seeds; nor simply broadcasted on existing pastures. The only really satisfactory way of establishing good Phalaris pastures is to sow down on fertile, well-cultivated soils with a minimum of other plants in the mixture. A legume is desirable in the pasture and lucerne, red clover or white clover could be included without affecting the establishment of the Phalaris. Sometimes a light seeding of quick-growing grasses, such as rye grasses, is made to provide feed while the Phalaris is establishing, but in most instances, the Phalaris should be given the least possible opposition. The rate of sowing should be about 4 lb. per acre of Phalaris seed, together with 2 lb. of seed of one of the legumes.

Management.—A pasture of Phalaris should be permitted to establish itself before being grazed, and during the first year only light intermittent grazings should be made. In subsequent years the pasture will stand up to heavy stocking at intervals, provided sufficient time for recovery is allowed between grazings. Whilst Phalaris will make some growth during the summer months, it is inadvisable to subject the grass to grazing conditions then, since the plant is weakened and will not produce heavily during the following growing season.

Like paspalum, Phalaris is likely to become sod-bound after a few seasons of grazing, but the pasture can be kept in good condition by periodical renovation, commencing during its second season of growth. Renovation is best effected by means of a drastic harrowing with a rigid tine implement of deep penetration. The operation should be carried out in spring, so that the storms which may be expected at that time will help the torn plants to recover.

Conservation.—Phalaris makes a very fine type of hay and a useful silage.

Feeding Value.—All classes of stock relish the succulent feed produced by Phalaris, and the grass is extremely valuable for fattening and for cream production.

Seed Production.—It is probable that the growing of Phalaris for seed would prove satisfactory at one or two centres on the Darling Downs, but under general grazing farm conditions seed production is very unreliable.

Perennial Ryegrass (*Lolium perenne* L.).

Origin and Distribution.—A native of Europe, perennial ryegrass now enjoys considerable favour in many temperate and cold temperate climates. It is of considerable importance in New Zealand, South Australia, Victoria, Tasmania, and New South Wales, but in Queensland has a very limited distribution.

Description.—Perennial ryegrass is a long-lived tufted grass with characteristic soft, green leaves. It tillers well and forms a close sward. The leaves may reach a length of 18 inches, under favourable conditions.

Climatic Requirements.—The climates in which perennial ryegrass thrives are those of New Zealand, England, and like climates, and the climate of Queensland is for the most part unsuited to the grass. The main causes of the failure of the grass in most parts of Queensland are dry winter conditions (i.e., during the normal growing season of the grass) and high summer temperatures. When one or both of these conditions are not severe some success has been attained, e.g., on the southern highlands and on moist soils on the south coast.

Soils.—Perennial ryegrass will thrive only on well-drained fertile soils. It is definitely not a suitable grass for sowing under any but good conditions of soil and climate.

Planting.—Sowing of perennial ryegrass should be carried out in the autumn following adequate preparation of the soil. Commercial seed is usually of good quality, and a minimum germination percentage of 60 per cent. is prescribed by the Pure Seeds Acts. The question of the variability of perennial ryegrass, according to its place of origin, has been studied in some detail, and as a result seeds carrying a Government guarantee of conformity to a desirable pasture type are on the market. Such seed should be purchased in preference to uncertified seeds, which may or may not be from desirable pastures. The field germination of perennial ryegrass is very reliable.

In those restricted areas, to which perennial ryegrass is suited, permanent winter pasture mixtures should have this grass as their basis. The other plants in the mixture should include a clover and one of the annual ryegrasses to provide some quick feed while the perennial plants are becoming established.

Management.—Pastures of perennial ryegrass will withstand fairly heavy grazing, but intermittent grazing is desirable. The pasture should be spelled during the summer months.

Conservation.—Perennial ryegrass may be conserved as hay or as silage. For silage purposes the grass should not be harvested whilst in a very young condition.

Feeding Value.—In most instances perennial ryegrass is very palatable to all classes of stock. Its feeding value is of a high order and the grass is particularly valuable for dairy stock.

Cocksfoot (*Dactylis glomerata* L.).

Origin and Distribution.—Cocksfoot is a native of Europe but is now cultivated for grazing in Africa, Asia, America, New Zealand, Australia and other countries. In Queensland it is grown to only a small extent, chiefly on elevated coastal country in the south-east.

Description.—Cocksfoot is a perennial grass of tufted habit, with dark green leaves. It is an extremely leafy grass, producing very few flower stalks. In the best types leafy shoots are produced in profusion from the whole of the crown; in inferior types the shoots are mostly marginal.

Climatic Requirements.—Cool, moist conditions rather than the hot and oftentimes dry climate of the Queensland grazing areas are most favourable to cocksfoot: hence the grass is really successful only in the Springbrook, Tamborine, Maleny and Granite Belt areas. Elsewhere it is not likely to become more than a minor pasture grass.

Soils.—An important feature of cocksfoot is its adaptability to a wide range of soil types. Under suitable climatic conditions it will thrive in almost any type of agricultural soil except sands. Moist clay loams suit it best.

Planting.—Sowings of cocksfoot should be made in the autumn months, as the seedlings require cool conditions during establishment. The germinating capacity of commercial cocksfoot seed is seldom very high, a sample germinating 75 per cent. being considered quite good. The Pure Seeds Acts prescribe 50 per cent. as the minimum and occasional samples are below standard. The productive period of cocksfoot is during spring and summer, though it is able during the cooler months to provide some feed. As a component of permanent winter pasture mixtures it is valuable in extending the grazing season into the warmer months. Because of its cool weather production it is useful also in paspalum pastures. If sown alone cocksfoot should be sown at the rate of 15 to 20 lb. per acre in order to encourage a thick sward. If a good initial stand is not obtained the pasture is inclined to become tussocky.

Management.—Intermittent grazing should be practised and regular light harrowings given.

Conservation.—No cocksfoot hay is conserved in Queensland, though the grass is cultivated for hay purposes in some temperate countries.

Feeding Value.—The palatability of cocksfoot is fairly good and its feeding value is of a high order.

Seed Production.—Under Queensland conditions little seed is produced by the grass and collection is not economic.

SELF-GENERATING ANNUAL WINTER-GROWING GRASSES.

Wimmera Ryegrass (*Lolium* (*?*) *subulatum* Vis.).

Origin and Distribution.—Believed to have been brought from Europe to Victoria in 1887, Wimmera ryegrass is now a widely used grass in fairly dry areas in various Australian States. It has been used spasmodically in Southern Queensland for many years but it is only recently that any extensive area has been sown.

Description.—Wimmera ryegrass (Plate 239) is a tufted annual plant, very soft in nature but producing many stems, which reach a height of about 18 inches. These stems are produced in abundance in the early spring and seed is set early, after which the plant dies off.

Climatic Requirements.—Since it is a winter growing grass, Wimmera ryegrass requires winter rains for its growth. It adapts itself to

a range of winter rainfall conditions but the minimum rainfall below which it is unproductive is often not reached away from the south coastal area. In years of reasonable rainfall, however, Wimmera ryegrass does quite well in the southern parts of the State as far west as the Maranoa district. Being an annual, Wimmera ryegrass hastens to produce seed in the spring and the length of the grazing period varies considerably according to the seasonal conditions experienced.

Soils.—When grown under low rainfall conditions, Wimmera ryegrass requires to be sown on fertile soil types. In higher rainfall districts it should be reserved for the poorer classes of cultivated land and Italian ryegrass sown on the richer soils for annual winter grazing.

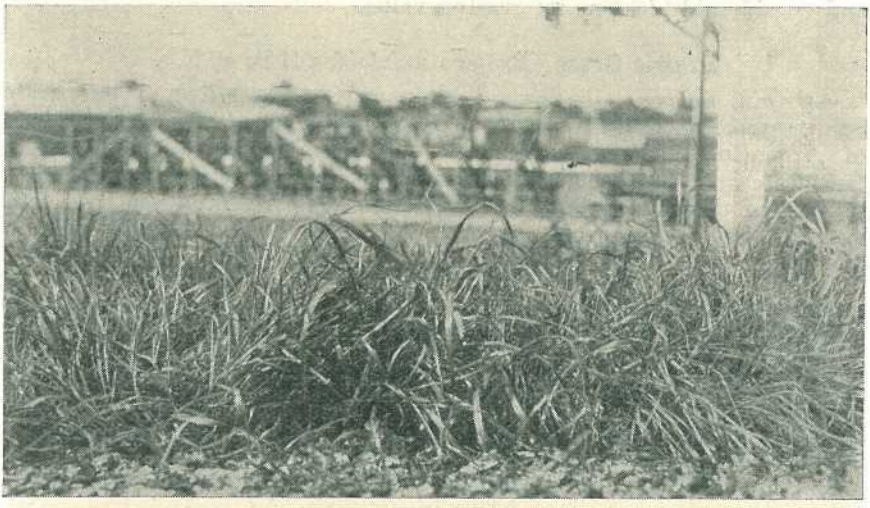


Plate 239.
Wimmera ryegrass.

Planting.—Wimmera ryegrass should be sown down in early autumn on cultivated land. The seed is usually of good germinating power and the grass establishes quite readily in the field. On the South Coast, as much as 8 to 10 lb. per acre may be sown; 4 to 6 lb. per acre, together with 2 lb. of lucerne, should suffice in drier areas.

Because of its easy establishment and quick growth, Wimmera ryegrass is useful for some special purposes. It is often included, in small amounts, in permanent winter pasture mixtures, to provide some grazing while the slower-growing perennials are becoming established. Sometimes it is sown on old lucerne stands to provide better grazing than the weedy grasses which would otherwise invade the area. Quite often it is sown down between the rows of a maize crop at the time of final scuffling to provide grazing when the crop is harvested.

Management.—Intermittent grazing should be practised with Wimmera ryegrass, as with other pastures. In addition, the pasture must be spelled when seed is being set in order to assist the grass to re-establish itself from self-sown seed. After the seed is shed, the dry plants can again be grazed by stock. If the grass is to be cut for hay, grazing should be discontinued sufficiently early to allow of a good hay crop being formed by the spring.

Conservation.—A fairly good hay can be made from Wimmera ryegrass cut before maturity.

Feeding Value.—The palatability of the grass in the green state is good and stock will also eat the mature plants. The feeding value, which is excellent in the younger stages, declines rapidly after maturity.

Seed Production.—Several growers of Wimmera ryegrass in Southern Queensland have collected seed from their paddocks. The grass seeds very profusely and the seed does not shatter easily. The practice adopted has been to mow the grass and thresh it with the ordinary grain thresher.

Pests and Diseases.—Rust occasionally affects Wimmera ryegrass and considerably lessens its grazing value.

Prairie Grass (*Bromus unioloides* H.B. et K.).

Origin and Distribution.—Prairie grass is a native of temperate South America, where it forms an important part of the grazing lands of Argentina, Paraguay, &c., and has now a wide distribution in temperate and warm temperate countries. In Queensland it is common in most of the eastern areas as a weed in sheltered situations, but it is only in the southern districts that it is used extensively for pasture purposes.

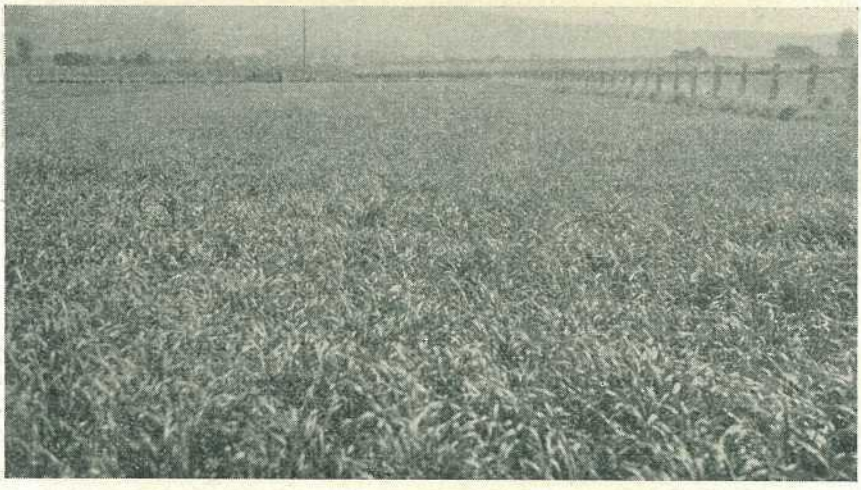


Plate 240.
A prairie grass pasture.

Description.—In habit prairie grass is usually annual or biennial, though long-lived types have been obtained and are on the market. The grass forms somewhat small tufts, but tillers quite freely, and the erect stems produce abundant leaf. The very large "seeds" occur in narrow panicles on the seed stalks. The perennial form of prairie grass, which until recently was believed to be entirely different from the common prairie grass, was discovered in New South Wales a few years ago, and has been sown on a small scale in Queensland and New South Wales. Its main point of difference from the annual prairie grass is its long-lived habit. Instead of dying after running to seed

before the summer, perennial prairie grass continues to live and to produce feed. Its summer production of leaf is not very large and if the pasture is grazed heavily the crown of the plant is exposed to the heat of summer, and damage results. In Queensland, there is a fairly high mortality among established plants each year, but self-sown seed helps to keep the pasture thick.

Climatic Requirements.—Prairie grass is a winter-growing plant and consequently requires early autumn rains for its germination and follow-on rains to keep it productive until the late spring, when normally it goes to seed and dies off. Only in the southern parts of the State is the autumn-spring rainfall sufficient to produce good prairie grass pastures.

Plate 241.
Prairie grass in seed.

Soils.—Rich loams are the most suitable soil types for prairie grass. On heavy clay soils it is of lesser value, whilst on sandy soils it is of little use.

Planting.—Seed of prairie grass should be sown in the autumn, preferably on well-prepared land. Although the parts of the seed head which are sold for sowing are quite large, the actual seeds within these parts are not very big and only a light covering of the seed should be made. Commercial seed of prairie grass is extremely variable in quality. Some lots will germinate as high as 96 per cent., while occasional lines are quite valueless. The Queensland Pure Seeds Acts

prescribe 50 per cent. as the minimum germination permitted. The main causes of low quality seed are harvesting when immature and smut infection. Farmers growing prairie grass for seed purposes require before sowing their seed areas to treat the seed with a disinfectant, such as a mercury dust (e.g. Abavit B or Ceresan at the rate of 3 oz. for every 20 lb. of seed) or a solution of formalin (1 pint of 40 per cent. formalin to 30 gallons of water—sprinkle over the seed at the rate of 1 gallon per bushel the day before sowing).

Management.—The chief use of prairie grass is for winter grazing, either in admixture with summer-growing plants or as a pure stand. It is difficult to maintain prairie grass in association with good grazing types, because of its tendency to be eaten out by stock. The grass forms a crown above the surface of the soil and heavy grazing soon destroys the plants. In order that grazing may be rigidly controlled to prevent the grass being eaten out, prairie grass is best sown apart from other winter grasses. It is commonly sown, however, in Rhodes grass pastures to provide grazing during the dormant period of the Rhodes grass. When sown alone, up to one bushel of seed per acre is recommended. In mixtures, 4 to 5 lb. should suffice. If permitted to seed at the end of its growing season, prairie grass will re-establish itself each year.

Conservation.—Prairie grass is seldom utilised for other than pasture purposes, though it makes a very good hay.

Feeding Value.—Wherever it is grown prairie grass is recognised as one of the sweetest and most nutritious grasses. It is relished by all classes of livestock, has a high feeding value, and is a good cream producer.

Pests and Diseases.—Prairie grass is subject to attack by the smut fungus, which prevents seed formation, and should be protected by seed disinfection. A special pamphlet dealing with the process is available from the Department of Agriculture and Stock, Brisbane.

PERMANENT WINTER-GROWING PASTURE LEGUMES.

White Clover (*Trifolium repens* L.).

Origin and Distribution.—A native of Europe, white clover is the most commonly used leguminous constituent of permanent pastures in practically all temperate countries, including western European States, the United States of America, New Zealand and Southern Australia. Its range extends into subtropical areas, and in Australia white clover is a common naturalised clover in the coastal paspalum-growing areas of New South Wales and Queensland.

Description.—White clover is a perennial legume, with prostrate running stems. There are a large number of commercial types of the clover, which show extensive variation as regards runner development, density of growth, size of leaf, &c. The general habit of the clover is to spread by means of the creeping stems, which root at the joints. Leaf stalks and flowering stems arise from the joints. Each leaf stalk attains a height of 3 to 18 inches, depending on soil and climatic conditions, and bears three leaflets. The flowering stems grow upright and each terminates in a white globular head of flowers.

Climatic Requirements.—The late winter and spring months cover the usual period of growth of white clover in Queensland. What are recognised as good clover years occur on an average once in four or

five years, and are characterised by a higher winter rainfall than usual and moist and cool early spring months. Growth is retarded by very warm weather and ceases early in the summer. August to November is the main growing period, and a rainfall of about 12 inches in the May-October period is considered essential for good clover development.

Soils.—Provided sufficient moisture is available, white clover can be grown on a wide range of fertile soil types, but prefers loamy types to sandy or excessively clayey soils. The acidity of the soil must not, however, be high, though white clover is less exacting in its requirements than is lucerne. It is essential that the soil be rich in available plant foods.

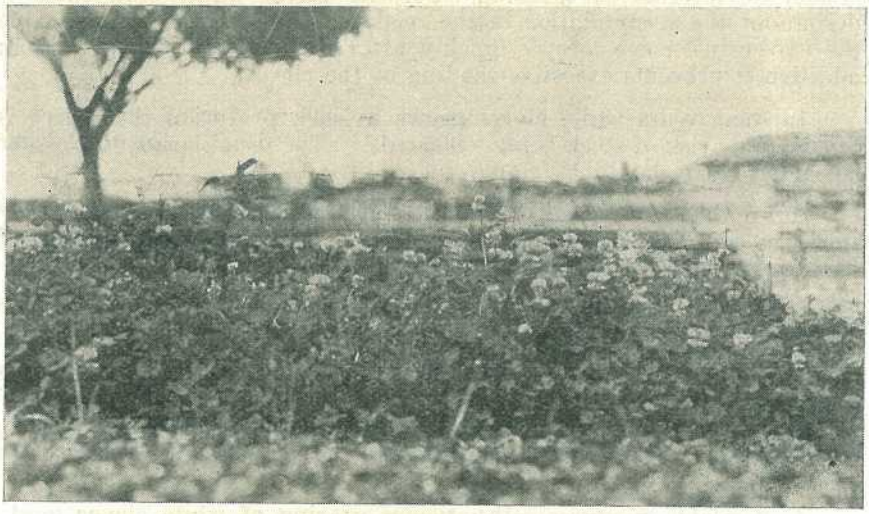


Plate 242.
White clover.

Planting.—The sowing of white clover is best carried out during the early autumn months. Spring sowing is less successful, since the young plants resulting from early germination are unable to become established sufficiently well to withstand the rigors of the hot summer. However, a proportion of the seed will lie dormant until the following autumn. Seed of white clover is readily obtainable from seedsmen and is usually of good germinating capacity. A minimum germination percentage of 70 is considered desirable.

The main use made of white clover is in permanent pasture mixtures, and it is either sown down when the pasture is being sown or else it is incorporated in existing permanent pastures. White clover is of particular value in conjunction with paspalum and with Kikuyu grass and is readily established by sowing down on renovated grass areas in the early autumn. In order to encourage the early development of the clover superphosphate should be sown with the seed. Two pounds of white clover seed sown on an acre of renovated grass pasture should form the nucleus for a fairly extensive spread of clover over the area. After the seed is sown, it should be given a light covering by running harrows over the land.

When permanent winter pastures are being sown in suitable districts 2 lb. of white clover seed should be included in the mixture.

The naturalised form of white clover, which is fairly common in some paspalum pastures, has been developed from European types, particularly the white Dutch clover, and tests which have been carried out have shown New Zealand selected types to be superior to the naturalised and European types, consequently New Zealand Government Certified White Clover Seed or the cheaper New Zealand Superfine White Clover Seed should be used, the former for preference.

Management.—The type of management imposed on white clover depends usually on the type of pasture of which it is a component. The system of intermittent grazing suits the clover quite well, since it permits of the accumulation in the roots of food reserves which enable the clover to "come away" quickly after its dormant period, and in addition it prevents excessive shading of the clover.

In some years white clover grows in such profusion that there is considerable risk of stock being "bloated." The usual means to prevent hoven or bloat should be employed.

Since the flower heads of white clover usually are not eaten by stock, no special precautions to ensure the ripening and shedding of seed appear to be necessary.

Conservation.—White clover is primarily a pasture species and is not particularly suitable for use as hay or silage.

Feeding Value.—The palatability and feeding value of the clover when growing in pasture mixtures are good, though a diet of clover alone is unbalanced. The high percentage of leaf among the material available to stock is responsible in a large measure for the high feeding value of the plant.

Undesirable Features.—Injudicious grazing of white clover might result in "bloating" of ruminants.

Red Clover (*Trifolium pratense* L.).

Origin and Distribution.—Red clover, or cow-grass, is a native of Europe and is extensively grown for pasture and hay purposes in temperate countries, including England, United States of America, New Zealand and Southern Australia. In Australia it is used also for winter grazing on the north coast of New South Wales and in south-eastern Queensland.

Description.—In habit, red clover is an upright plant with hairy stems and large hairy leaves. The flowers are borne in fairly large globular heads and are reddish-purple in colour. In temperate areas with a well-distributed rainfall, some strains of red clover are long-lived perennials, persisting for four or five years. Under Queensland conditions two or three years is the maximum life of the plant.

Climatic Requirements.—Though commonly regarded as a winter-growing clover, red clover makes its main growth from August onwards and produces feed right through mild summers. Hot, dry conditions persisting for some time destroy the plants, hence the tropical coast and the drier areas of the State are unsatisfactory for red clover. Only the south-eastern portion of the State appears to be climatically suitable for it.

Soils.—The soils favoured by red clover are clays and clay loams not subject to waterlogging and of alkaline or slightly to moderately acid nature. Medium and strongly acid soils are unsuitable.

Planting.—Owing to the danger of bloating, red clover is seldom sown in a pure stand for grazing purposes. Its main uses are for sowing down in admixture with annual or semi-permanent winter and spring growing pasture mixtures and for sowing down on renovated paspalum pasture. In all mixtures the amount of seed sown per acre should not exceed three pounds. Seed is readily obtainable from seedsmen and is usually very reliable. Seed lots germinating less than 75 per cent. should not be accepted.

Management.—In common with other pasture plants red clover should be grazed intermittently and not continuously. Close grazing is likely to damage the crown of the plant. Where red clover is plentiful in pastures, precautions against bloating of stock must be taken. There is little point in spelling the clover to permit of seed production, for, whilst it does mature a certain amount of seed if rested, red clover is not very efficient in sowing itself down.

Conservation.—In suitable districts a good quality hay may be made from red clover, and when ensiled in admixture with grasses, the clover adds to the value of the resultant silage.

Feeding Value.—The palatability of red clover is somewhat variable, its hairiness apparently sometimes making it unattractive to stock. However, young growth mixed with grass is eaten readily. The nutritive value of the clover is high before the plants become stemmy in nature.

Seed Production.—The amount of viable seed produced under Queensland conditions is small and the growing of the clover for seed production purposes is unlikely to be a successful commercial proposition.

Special Uses.—Red clover is occasionally sown in New South Wales as a rotation crop with maize and may have some value for this purpose on alluvial flats on the coast in Queensland.

Undesirable Features.—The succulent character of red clover renders "bloating" a danger if proper precautions are not taken.

Alsike Clover (*Trifolium hybridum* L.).

Origin and Distribution.—Alsike clover is a native of northern Europe and is cultivated there and in other cool temperate countries. It is very little used in Australia, where red clover and white clover can be grown with greater satisfaction.

Description.—Though in suitable countries Alsike clover has a life period of 4 to 6 years, in Queensland it is very short-lived and may be regarded as an annual. It is an upright, leafy plant with branching stems and a thick taproot. The leaflets occur in groups of three and the white or pink flower heads are borne on long stems. The small pods each have 2 to 4 seeds.

Climatic Requirements.—Alsike clover is a winter and spring grower, which requires a fairly moist growing season. In Queensland it usually dies in early summer owing to the heat.

Soils.—Most moderately fertile soils are suitable for Alsike clover and it will thrive on fairly moist soils.

Planting.—Alsike clover is not likely to be used to any extent in Queensland, and if its use is increased it will probably be in winter pasture mixtures, when one pound of seed per acre should suffice.

Conservation.—A good quality hay is made from Alsike clover.

Feeding Value.—The feeding value of the clover is quite good, but "bloating" must be guarded against.

Strawberry Clover (*Trifolium fragiferum* L.).

Origin and Distribution.—Strawberry clover is a native of the Mediterranean regions of Europe, Asia and Africa and is cultivated to a small extent in various warm temperate areas. In Australia it is utilised in the Southern States for growing in damp areas, but Queensland experience with the clover is too limited to generalise regarding its potential usefulness in this State.

Description.—Resembling white clover in habit, strawberry clover is a perennial plant with creeping and rooting stems and erect leaf stalks and flowering stems. Each leaf stem carries three leaflets and the globular flower head, when mature, has the appearance of a strawberry fruit.

Climatic Requirements.—Strawberry clover makes most of its growth during the warmer months of the year and requires a well-distributed annual rainfall if not grown in damp places. It will not do too well in hot, dry weather unless supplied with abundant soil moisture.

Soils.—Provided soil conditions are not extremely acid, strawberry clover will grow on all fairly fertile moist soils.

Planting.—If runners are not readily available the clover should be started by sowing seed, but planting of runners is much more reliable.

Management.—The clover is well adapted to grazing and will survive heavy stocking if given time to recover between grazings.

Feeding Value.—Its palatability and feeding value are good.

SELF-GENERATING ANNUAL WINTER-GROWING LEGUMES.

Burr Medic (*Medicago denticulata* Willd.).

Origin and Distribution.—The native home of burr medic, which is also known as burr clover, burr trefoil, trefoil or clover, is Europe, but the plant now has a wide distribution in many other temperate countries, including Argentina, United States of America, and Australia. It is naturalised in some parts of Queensland, particularly on the Darling Downs and in the Maranoa and in addition is sown to a small extent.

Description.—Burr medic is an annual plant with prostrate or weakly ascending stems. The leaflets are borne in groups of three at the end of a long leafstalk and have serrated edges. The flowers are small and yellow and occur in groups of 2 to 8 on short stalks. The pods are disc-shaped and are made up of two or three coils. They are about $\frac{1}{4}$ inch in diameter and are covered with hooked spines.

Climatic Requirements.—Whilst burr medic makes its early growth during the winter months, it prefers mild winter growing conditions to very cold conditions and its most rapid development is made during the warm months of early spring. As hot weather commences the plant dies off. The seeds germinate in autumn and fairly regular winter rains are required to keep the plants growing. Nevertheless, the legume can survive moderately long, dry winter periods and is one of the hardiest of the fodder legumes.

Soils.—The soils most favoured by burr medic are the heavier types of alluvials or basalt soils, and these must be well supplied with lime. The very acid soils of the coast are unsuitable, as are also sandy soils.

Planting.—Most of the burr medic grazed in Queensland is of voluntary growth and little is sown. Seed is, however, available at a cheap rate and areas of native pasture in which the legume does not occur might, in suitable districts, be sown with seed of the legume. Sowing must be carried out in the autumn and 2 lb. of seed per acre should suffice in most southern districts.

Management.—Prevention of bloating is the chief point to observe in the grazing of burr medic. It is necessary also that the plant be permitted to seed itself down in early summer and this means protection or light stocking while the pods are maturing. The plants produce abundant pods, each with 3 to 6 seeds, and these lie in the ground until the seeds germinate with autumn rains.

Conservation.—In certain districts burr medic grows in sufficient quantities to merit its conservation as silage.

Feeding Value.—The young green plants do not appear to be as palatable to stock as semi-mature growth or green material cut and wilted. The protein and mineral contents are high in both young and fairly old plants and the legume is a very useful fodder. The seeds after being shed are readily eaten by stock and provide a good deal of nutritious feed.

Undesirable Features.—In wool-growing districts, burr medic causes some trouble, because of the tendency of the hard, spiny pods to cling to the fleece.

Black Medic (*Medicago lupulina* L.).

Origin and Distribution.—Black medic, which also is known as English trefoil or yellow trefoil, is a native of Europe, and is used to a slight extent in various other temperate areas. Though it has been naturalised in Australia for many years, it has not spread naturally to any great extent and is found chiefly in cool districts. On the New England Tableland of New South Wales the legume is fairly widely used in pasture mixtures, but its present use in Queensland is very limited.

Description.—The legume is a mixture of perennial and annual types, but under Queensland conditions appears to behave for the most part as an annual. The plant has small leaves and prostrate stems. The flowers are small and yellow and are borne in globular heads on the end of fairly long-flowering stems. The pods are free of spines but are twisted.

Climatic Requirements.—Black medic is a winter and spring grower and prefers a cool, moist growing season. It provides earlier feed than most other legumes, but also matures fairly early. It has a moderate degree of drought resistance, being intermediate in this respect between white clover and lucerne.

Soils.—Black medic evinces a preference for heavy soils and is of little value on sandy soils. Acid soils are apparently unsuitable and soils lacking in phosphates require the application of a phosphoric manure to encourage the legume.

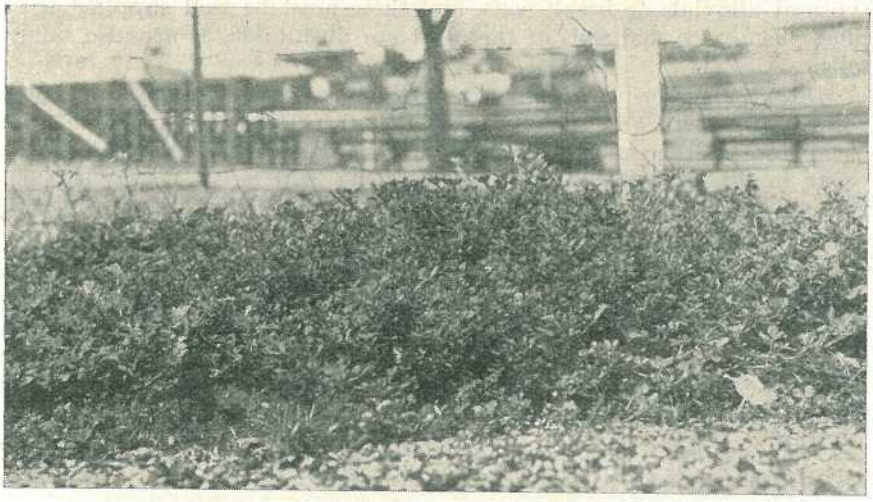


Plate 243.
Burr Medic.

Planting.—Pure stands of black medic do not form a suitable type of pasture and the main use of the legume is in pasture mixtures. Two or three pounds per acre in winter pasture mixtures are recommended and similar quantities may be sown on renovated Rhodes grass or native grass pastures. Autumn sowing is desirable.

Feeding Value.—Both the palatability and the feeding value of black medic are good.

Clustered Clover (*Trifolium glomeratum* L.).

Origin and Distribution.—A native of the Mediterranean region and western Europe, clustered or ball clover is a hardy annual naturalised in all States of Australia and sown to a slight extent for pasture improvement. In Queensland it is common on fairly dry soils along the coast and in the drier agricultural districts.

Description.—The plant is an annual with spreading prostrate stems along which leaves are produced on fairly short stems. Globular heads of pink flowers are formed at the base of the leaf stalks and themselves have no stalk. Small pods are produced, each of which contains one or two small seeds.

Climatic Requirements.—Clustered clover germinates in the autumn but makes little growth until the warm months of early spring. In

late spring it goes to seed and dies off when the summer commences. The clover is fairly drought resistant and will develop on a low winter rainfall, though not much feed is produced if the June-August rains are light.

Soils.—On all well-drained soils of fertile character clustered clover can be relied upon to produce some growth in most seasons, but some encouragement in the shape of fertilizer may be necessary to produce worthwhile grazing.

Planting.—Clustered clover merits sowing in native pastures on fertile soils not moist enough to support the better winter and spring growing clovers. Such pastures, after discing or other harrowing, should be improved by the broadcasting of 2 to 3 lb. of clustered clover seed per acre.

Management.—The clover depends for its persistency on self-sowing and though it will set seed under fairly close grazing conditions, it is advisable to encourage seeding by spelling the pasture at the appropriate time.

Feeding Value.—All classes of stock find clustered clover palatable and it makes a nutritious feed.

Subterranean Clover (*Trifolium subterraneum* L.).

Origin and Distribution.—Subterranean clover is a native of Mediterranean regions and western Europe, where it is a weed rather than a significant pasture plant. It was introduced by accident to Australia and its systematic cultivation was first undertaken in South Australia about 30 years ago. It is now extensively used for pasture and soil renovation purposes in Southern Australia and in New Zealand.

Description.—The plant is a hairy annual which produces prostrate stems and erect leaf stalks. Whitish flowers are produced in heads at the ends of short stalks and as the flowers mature many of the heads turn downwards into the ground and bury their seed pods.

Climatic Requirements.—Subterranean clover is a winter-growing plant and requires a fairly heavy late autumn and winter rainfall for its full development. The weather must also be moist and not too hot when the seeds are being formed, otherwise the flowers abort and the plant fails to seed itself down. A precipitation of 12 to 15 inches during the period May-October is required in most instances, and this is seldom realised in Queensland. In addition seasonal conditions in Queensland during August and September usually are unfavourable to seed development.

Soils.—Heavy soils are not favoured by subterranean clover. It prefers light soils of high fertility. In addition to its use for pasture purposes on good soils, subterranean clover is employed as a renovator of worn-out soils or as a pioneer pasture on naturally infertile soils.

Planting.—Seeds of various strains of subterranean clover are available on the market and farmers and graziers desirous of testing the clover under their local conditions are advised to experiment with early, mid-season and late-maturing strains. The seeds can be sown down on well-prepared land, either alone or in admixture with other pasture seeds, or they can be sown on renovated native or sown pastures.

A maximum seeding rate of 5 lb. per acre may be employed. It is essential to employ superphosphate with the seed if it is being sown on phosphate-deficient soils, and seed inoculation may be necessary.

Management.—The young plants should be permitted to develop some lateral branches before being grazed and stock should be removed at the time of seeding. There is some danger of hoven if grazing is not carefully controlled.

Conservation.—A hay of good quality is made from subterranean clover in the Southern States, the crop being cut when commencing to mature.

Feeding Value.—The clover provides, when green, a very luscious and nutritious feed for all classes of livestock and if allowed to cure naturally in the paddock retains much of its palatability and feeding value.

Pests.—The lucerne flea is very destructive of subterranean clover stands in some States, but does not occur in Queensland.

[TO BE CONTINUED.]

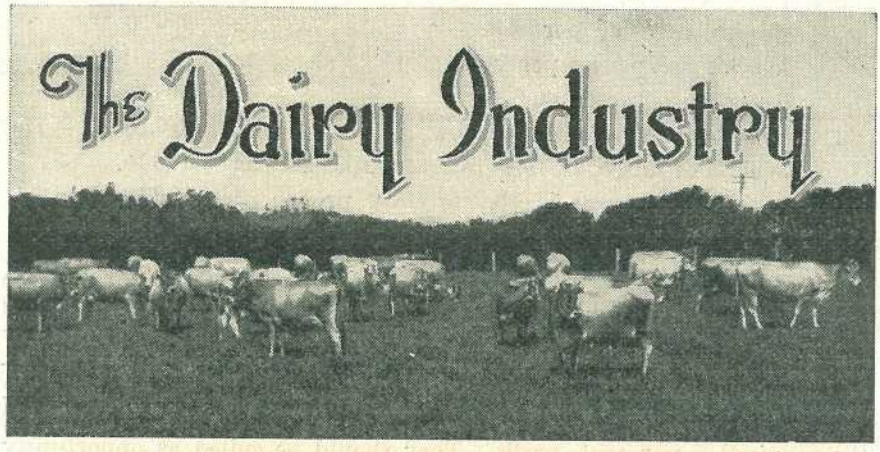
PLANTING OF GRASS CUTTINGS.

Grasses which are propagated commonly by means of stem cuttings, plantlets, or crown divisions, include Kikuyu grass, Para grass, couch grass, elephant grass, and Guinea grass. In special circumstances, the planting of vegetative material of the grasses mentioned may be carried out on rough country and on timbered land with some prospects of successful establishment; but, wherever possible, well-worked land should be provided.

Where stem cuttings are used, these should be cut with a knife, shears, or chaff-cutter into lengths, each containing at least two nodes or joints. If abundant material is available, it is advisable to allow several nodes to each cutting. The cuttings may be laid flat in shallow furrows and covered or placed vertically so that one or more nodes are buried and the remainder are above the surface. The soil should be well firmed about the cuttings. The cuttings shoot and root at the buried nodes and also form shoots at the other joints.

If plantlets or crown pieces are being planted, the best method is to set them out in holes in lines across the paddock. The holes are made with a hoe, the tool being used with its head at right angles to the line. When planting, the planter works along the line, places the plant against the hard far edge of the hole, fills up the hole, and compacts the soil with all his weight on his right foot, while putting in the next plant. To avoid setting the plants too deeply, the tuft should be held from above, but close to the crown, so that the knuckles of the hand are on top of the ground when the plant is being set.

—*C. W. Winders.*



To Cull or Not to Cull.

L. A. BURGESS, A.A.C.I., Dairy Research Laboratory.

TO cull or not to cull, that is the question which faces a dairy farmer after receiving the production records of his herd from the official herd tester. Against culling it has been argued that "the cows are only eating grass which costs the farmer nothing," and that other costs are equally inconsequential. Grass, however, is just as much an agricultural crop as wheat, maize, and sugar-cane. It is the crop on which the dairy farmer depends for his livelihood, and the cultivation of grass requires as much attention from him as other farmers give to cultivated crops. The cost of producing the grass crop is by no means small; it includes interest on the capital invested in land, stock, and equipment. The annual cost of pasture management must be added—including renovation of old pastures, fodder conservation, destruction of weeds and pests, the purchase of fertilizers to maintain the fertility of the pastures, cutivation of special fodder crops, and water conservation. Rates and other charges also add their quota to the cost of producing grass in sufficient quantity for the dairy herd.

The cost of milking includes interest on the capital invested in buildings and equipment. The cost of living of all persons engaged in milking must be added, no matter whether they are members of the farmer's family or not. If labour is employed, wages also must be taken into account.

The small amount of fat produced by some unprofitable cows in a herd certainly adds to the farmer's income, but unless the cream returns from them covers the working expenses involved such cows reduce the farmer's net income. As a profit of 5 per cent. is only a reasonable return from any investment, each cow should be required to give at least that rate of profit on her share of the capital invested. As an example of this reasoning the following hypothetical case is submitted:—

Total capital invested in the farm, stock, buildings, and equipment is £2,100; number of cows, 30; total working expenses for the year, £210.

	£	s.	d.
Capital invested per cow .. .. =	70	0	0
Working expenses per cow .. .. =	7	0	0
5 per cent. profit on £70 .. .. =	3	10	0
Total return required per cow .. .. =	10	10	0
Weight of fat (at 1s. lb.) to cover expenses =	140 lb.		
Weight of fat (at 1s. lb.) to cover profit =	70 lb.		
Minimum fat required from each cow =	210 lb.		

Cows producing less than 140 lb. of fat a year would not even be paying for their upkeep. As they would thus be responsible for a definite financial loss, they should be culled immediately and replaced either by young stock bred from the higher producing cows or by good cows purchased from a reliable source. Cows producing between 140 and 210 lb. of fat would be paying for their upkeep, but would not be returning the required 5 per cent. profit. They should be culled as opportunity offers of replacing them with better stock. The extra fat produced by the better stock would very soon compensate for any expenditure involved in the replacements, and thereafter would greatly increase the profit.

There is only one answer to the question at the head of this note, and that is: *Cull.*

QUALITY OF DAIRY PRODUCE.

The dairyman should always bear in mind the fact that butter and cheese can be only as good as the milk from which they are manufactured. If milk of an inferior quality is produced, the butter or cheese factory cannot be expected to manufacture a first-class article.

Milk is the normal secretion obtained from the udder of a healthy cow, properly fed and cared for. Milk obtained during fifteen days immediately prior to, and ten days immediately following, calving, should be excluded from the bulk supplies. Milk should contain not less than 3.3 per cent. of milk fat, and must be free from any added water, separated milk, or preservatives.

Milk from cows suffering from mastitis, or any other disease of the udder, should not be used.

Cows should not be allowed to wade in or have access to stagnant water. The flanks should be brushed with a cloth, when the animals come into the bails. Clean water and clean cloths should be used for the purpose of washing the udders and teats prior to milking, and the hands of the milkers should be washed before, and again after, milking each cow.

The first few drops of milk are usually contaminated and, therefore, should be milked into a tin and thrown away after milking. They should not be milked on to the ground, or thrown about the bails where they are liable to attract flies.

Musty feed must not be fed to cows. The animals should not be allowed to graze in paddocks known to contain weeds which will impart a detrimental flavour to milk, nor should they be fed highly flavoured foods immediately before or at the time of milking.

Dairy utensils should be thoroughly cleansed and scalded, then aired and dried in the sun in an inverted position.

Disinfectants, under normal conditions, should not be used in the dairy house or bails.

—*D. A. Logan.*

Hot Weather Ailments in Pigs.

E. J. SHELTON, H.D.A., Senior Instructor in Pig Raising.

AS is well known, pigs can stand ordinary extremes of temperature if they are in health; but there are times and occasions when hot weather beats them, especially if they are forced against their will to travel.

Sunstroke and heat apoplexy are ailments which are aggravated by the exposure of the animal to the actual rays of the sun, by over-exertion, and by thirst.

Pigs running in paddocks, and kept ordinarily under open air conditions, are rarely overcome by the effects of heat so long as they are provided with reasonably cool shade; but they cannot stand up to exposure in bare yards where there is no protection and no relief from the heat.

Breeding stock, both boars and sows, of mature age, usually can be relied on to look after themselves and keep out of the sun when it becomes very hot; but young pigs sometimes lie too long in the sun and, as a consequence, suffer severely from sunburn and scald.

These skin ailments are caused by the effects of the sun on the tender, somewhat unprotected skin of the pig.

Treatment for sunscald or sunburn must be preventive as well as curative. The pigs should be housed in clean, comfortable, well-protected sties, or in a well-shaded grassy yard or paddock. If the animals show soreness and are in need of treatment, they should be treated so as to cleanse and heal the skin, and should thereafter be kept under better conditions. The old-time remedy, kerosene and fat, although crude and sometimes effective, is not a reliable skin ointment. Spraying with crude oil or sump oil is usually preferred.

During and after treatment, the pigs should be given sound, nourishing foods, plenty of greenstuff, clean drinking water and essential minerals. Shade trees—such as weeping willow, pepperina, native figs, and phytolaccas—or upright growing shrubs like Buddleia—are recommended. Where skin trouble in pigs is aggravated by the presence of parasites like lice, sandflies, mosquitoes, fleas, or flies, the hair will also become affected. There may be a scurfiness of the skin indicating an unhealthy condition and a deep subcutaneous penetration of the burn or scald. In very severe cases, partial paralysis and a rickety condition may become evident. The animal suffers great pain, and may even lose the use of its hindquarters, particularly in the case of young pigs weakened by improper care and unbalanced rations.

Any animal showing signs of illness during hot weather should be immediately isolated and given proper treatment. In addition to skin treatment, affected animals should be fed on very light nourishing foods. Occasional doses of epsom salts will also be beneficial, and may be administered in the food.

Sunscald, sunstroke, heat-stroke and heat apoplexy are similar in their effect on the animals; sunstroke is due to exposure to the direct rays of the sun; heat-stroke is due to intense heat, even though the animal may be protected from the direct sun rays; heat apoplexy follows exposure and exhaustion during hot weather.

In each case very fat animals suffer most, especially if they are exercised too freely or are compelled to travel during the heat of the day, or are forced along too rapidly during muggy weather. Exposure to heat, even without exercise, is dangerous. Many valuable pigs have been lost through being shut up in hot, dry yards without any shade, water, or protection from the heat.

It is unwise to overfatten pigs in hot climates—it also is uneconomical, especially as no payable demand exists for fat pork or bacon. It is equally disastrous to keep breeding and growing pigs in an overfat condition. Pigs in sties may suffer very greatly from heat, because of bad ventilation, or unsuitable accommodation.

Many pigs die of heat apoplexy en route to market or factory. In some cases the animals are overheated before being trucked, and this, together with consequent excitement and fatigue and the absence of cool drinking water, leads to fatal results. To pen pigs in comparatively cool, shady pens, and then suddenly expose them to heat and severe exercise during a journey is to invite trouble. An overheated pig will lie down and lose control of its movements. The first indication is usually an unsteady gait and dullness. The pig may show no other indication of illness, but may just fall over and become unconscious.

In these cases, the animal's breathing is usually much more laboured than normal, even though it may appear very faint. The ears are invariably hot and droop loosely. The eyes are dull and the nose is hot and dry. The animal appears to lose control of its movements; the head hangs limply and the body sways to and fro. As the trouble advances, trembling of the muscles, followed by convulsions, may also be observed. The bodily temperature increases and the animal gasps for breath. The course of this disease may be very short and the animal may die in a few minutes after the illness first manifests itself.

In other cases—as when animals are loaded into pig wagons in an overheated condition—the pigs may live for several hours.

A good clean water bath in some convenient shady place is an excellent thing for pigs in hot weather. If provision can be made to enable the pigs to cool off for an hour or two before trucking, and for a good water supply, many valuable animals may be saved. A properly constructed concrete wallow or bath is preferable to a mud bath.

One sometimes notices a farmer carting his pigs on a hot day in a small cart or wagon quite unprotected except for a few green bushes over a wire netting frame work. The provision of a suitable cover for pigs, such as would allow for a current of cool air and protection from the sun, would soon repay its cost, and add considerably to the comfort and satisfactory transit of the pigs. If trucking must be done in very hot weather, the pigs should be delivered to the station early in the morning, and should be allowed time to cool off. They should, of course, have ample drinking water before starting on the road.

If treatment is necessary the animal should be placed in the shade and cold water or a cold water pack (wet bagging) be applied to the snout, face, and then the head. The treatment must be persisted in for several hours in severe cases, after which the animal should be compelled to take light exercise.

A change to a very light nourishing diet is advised when once the animal has been placed in a suitable pen or yard with plenty of shade and protection, as it will take affected animals several weeks to get back to normal again. No attempt should be made to send them to the factory until they have quite recovered from the attack.

BRANDING OF PIGS.

Under the Queensland Pig Industry Act, the identification of all pigs sold, offered for sale, barter, or exchange, is compulsory. This is essential to satisfactory marketing of this class of stock, and where marking is carried out as a regular routine job, presents little difficulty. Identification facilitates investigation into disease, whether epidemic or otherwise.

The Act provides particularly for the marking of all pigs consigned to factories, and there has been widespread appreciation of its value. There may be differences of opinion in regard to the advantages of various systems of identification; but from a factory point of view it is a very great advantage to have the carcases plainly identified.

Exporters prefer the body tattoo as a means of identification, and bacon-curers almost without exception are more than satisfied if the carcases are tattooed efficiently. The use of the firebrand is being superseded generally by the more efficient method of tattooing, in which a body-tattooing instrument and marking paste or ink are used.

The marking of sucker, weaner, and store pigs presents greater difficulty, because neither the body tatoo nor the firebrand are sufficiently permanent where the pigs are to be retained on the farm for periods varying from two to five months. In the case of these young pigs, two systems are especially adaptable viz., earmarking and ear-tattooing, the latter being suitable only in the case of white or red coloured pigs.

The departmental pamphlet, "Identification of Pigs," is available free on application to the Department of Agriculture and Stock, Brisbane.

Possible Substitutes for Lead Arsenate in the Control of Codling Moth.

HUBERT JARVIS, Research Officer.

FOR a considerable time lead arsenate has been the most widely used insecticide for the control of the codling moth in deciduous orchards. Although reasonably effective, a spray schedule based on lead arsenate has some disadvantages; residues greater than the tolerance limits permitted may accumulate on the fruit, and the vigour of the trees may be affected adversely. A considerable amount of attention has therefore been given to the study of non-arsenical substitutes during recent years.

Experiments at Stanthorpe during the 1935-36 season indicated that a number of possible substitutes, including potash soft soap, colloidal sulphur—potash soft soap, nicotine sulphate—white oil and colloidal sulphur—nicotine sulphate may be just as effective as lead arsenate for the control of codling moth. With the exception of potash soft soap, spraying costs are much higher, and it is improbable that these sprays will, in practice, replace lead arsenate for specifically codling moth control purposes. Potash soft soap, however, compared favourably with lead arsenate in both efficiency and costs, and some comments on this insecticide are therefore necessary.

Potash soft soap is readily prepared, and at the experimental strength of 10 lb. to 80 gallons of water has no harmful effects on the trees. Colloidal sulphur can be added when necessary to form a combined spray which should control not only the codling moth, but also powdery mildew which is frequently troublesome. Experimental trees were free from "scorch," which so often appears in orchards treated with lead arsenate—particularly during the harvesting period.

Potash soft soap may therefore be of some value, but a great deal more work is necessary before the grower can regard it as a reliable

substitute for lead arsenate. Experimental results always require confirmation on a large scale before any existing practices can be safely modified. The current year's experiments at Stanthorpe are accordingly designed to check the accuracy of the results already available, as well as to investigate the insecticidal properties of potash soft soap in detail. The practicability of timing spray applications more accurately by observations on moth activity will also be studied. Alterations of standard practices may or may not then be advocated.

In the meantime, orchardists may wish to use a little potash soft soap on their own trees during the coming year for personal observations. Under these conditions, a small group of trees may be given the complete potash soft soap schedule, adding colloidal sulphur when necessary for the control of powdery mildew, the balance of the orchard receiving the customary treatment. If the moths are very numerous, growers should adhere strictly to the ordinary spray programme on the orchard, rather than risk losses by using an alternative spray, such as potash soft soap, the value of which requires further investigation.

THE PLANTING OF BANANAS.

The best aspect for banana-growing is one varying from easterly to northerly, and even north-westerly, provided that the plantation is well sheltered from strong winds. As southerly slopes are usually cold, banana plants, if grown on them, develop slowly, and the fruit is generally inferior—hence land with a southerly aspect is not worth considering if other land is available.

Logging and hoeing operations should, if possible, be followed by a thorough grubbing. Grubbing is particularly advisable if the plantation is being established in forest soil. It is necessary for the aeration and drainage of the soil, and the maintenance of a supply of moisture for the plants. Many growers look askance at forest soils for bananas, but plantations on such soils, if worked thoroughly and desuckered carefully, can produce fruit of first-class size and quality.

As a result of the recent rains, it is now possible to plant bananas in many localities in which, hitherto, the protracted dry weather had been against a successful setting. If bits or butts are being utilised, careful attention must be paid to baiting for the banana weevil borer to ensure the planting of clean material. Growers in need of advice on the selection and preparation of planting material should get in touch with the nearest fruit inspector or banana agent.

Holes for planting should be, roughly, about 15 inches square by 15 inches deep. The surface soil from the top side should be raked back into the hole and the sucker placed in the loose soil and tramped firmly all round. The top of the sucker need only be covered lightly with loose earth, and the hole should not be refilled completely.

An application of about ¼ lb. of fertilizer when planting will hasten and strengthen the growth of the young plants. The actual time of planting will depend on the conditions in the different districts. On a slow-growing aspect, October planting is best, while on warmer slopes November and December may be more suitable.

Where grubbing has not been done previously a circle around each plant with a radius of approximately 3 feet should be grubbed. This gives the plant both sufficient sunlight and freedom from smothering weeds. Planting 10 feet by 10 feet is a good average distance, but 12 feet by 12 feet is preferred by many growers.

The best method of spacing followers is that known as "one bunch one follower." This enables the grower to regulate and handle his fruit cutting and packing with convenience, as it is more or less confined to the winter months. For about the first twelve months after planting, all but one or two followers should be kept back, and thus all energy is directed into one plant and its bunch. The folly of allowing as many suckers as may appear to develop cannot be condemned too strongly.

—*J. Freeman.*

The Fruit Market.

JAS. H. GREGORY, Instructor in Fruit Packing.

NEW season's cherries, apricots, and China Flat peaches are on sale, heralding the early approach of all types of stone fruits.

The following were the prevailing prices at the end of October:—

TROPICAL FRUITS.

Bananas.

Brisbane.—Nines, 18s. to 19s. 6d. per case; eights, 13s. to 18s. 6d.; sevens, 11s. to 18s.; sixes, 9s. to 15s.; smalls, 6s. to 14s.; Lady Fingers, 4½d. to 11d. per dozen.

Sydney.—Eights and nines, 22s. to 25s. per case; sevens, 18s. to 22s.; sixes, 15s. to 18s.

Melbourne.—Nines, to 22s. per case; eights, to 20s.; sevens, 18s. to 20s.; sixes, 16s. to 17s.

Adelaide.—23s. to 24s. per case.

Pineapples.

Brisbane.—Smooths, 6s. to 8s. 6d. per case; 2s. to 8s. per dozen. Ripleys, 9s. to 11s. per case; 1s. 6d. to 7s. per dozen.

Sydney.—Smooths, 9s. to 12s. per case.

Melbourne.—Smooths, 8s. to 12s., with some specials up to 14s., per case.

Adelaide.—16s. to 17s.

Papaws.

Brisbane.—Yarwun, 7s. to 10s. a tropical case; Local, 4s. to 5s. a bushel case; Gunalda, 5s. to 6s. a bushel case; inferior lines lower.

Sydney.—9s. to 12s. a tropical case.

Some lines are arriving specky, and it would be to their advantage for a better selection of firm types to be used.

Melbourne.—10s. to 14s. a tropical case.

Mangoes.

Brisbane.—Well-packed lines, 7s. to 8s. per bushel case; bruised lines lower and hard of sale.

Sydney and Melbourne.—Only good types of mangoes should be sent to these markets.

Passion Fruit.

Brisbane.—First grade, 10s. to 13s. per half-bushel; second, 6s. to 9s.

Sydney.—7s. to 10s. per half-bushel.

Melbourne.—9s. to 18s. half-bushel.

Strawberries.

The present crop is now practically finished. Few first-grade berries are now to be seen. The advent of new season's stone fruits will decrease the demand for strawberries; so only first-grade fruit should now be marketed.

CITRUS FRUITS.

Oranges.

Brisbane.—6s. to 8s. per case; specials, 9s. to 10s. 6d. per case; second crop, 3s. to 5s.

Second-crop fruit is extremely hard of sale, only well-coloured lines being saleable.

Sydney.—Valencias, 5s. to 8s. per bushel.

Melbourne.—Navels, 4s. to 9s. per bushel; Valencias, 4s. to 9s.

Grape Fruit.

Brisbane.—4s. to 9s. per bushel.

Sydney.—4s. to 10s. per bushel.

Melbourne.—7s. to 16s. per bushel.

Lemons.

Brisbane.—Gayndah, 6s. to 12s. per bushel; Benyenda, 14s. to 15s.; locals, 3s. to 8s.

Sydney.—2s. to 5s. per bushel.

Melbourne.—4s. to 8s. per bushel.

OTHER FRUITS.

Apples.

Brisbane.—Jonathan, 6s. to 10s. per case; Granny Smith, 5s. to 9s.; Sturmer, 4s. to 7s.; Crabs, 6s. to 7s.; Delicious, 9s. to 10s. 6d.; Democrat, 5s. to 8s.; Crofton, 7s. to 10s.; Yates, 5s. to 9s.

With the exception of Yates variety, all others are giving a lot of trouble in becoming specky. Only selected fruit should now be sent to Brisbane.

Pears.

Brisbane:—Coles, 10s. to 13s.; specials to 16s.; Winter Nelis, 9s. to 15s.; Josephine, 10s. to 15.

Some lines specky and hard of sale.

Cherries.

Brisbane.—7s. to 10s. a 12-lb. box; specials higher.

China Flat Peaches.

Brisbane.—2s. to 4s. per tray.

Cape Gooseberries.

Brisbane.—6d. to 6½d. per lb.

Tomatoes.

Brisbane.—Ripe, 1s. to 3s. half-bushel; green, 2s. to 3s.; coloured, 3s. to 4s. 6d.; specials higher.

Sydney.—Queensland tomatoes, 2s. to 5s. per half-bushel.

Melbourne.—Adelaide hothouse, to 18s.; Western Australian, 6s. to 14s.

VEGETABLES.

Beans.

Brisbane.—5s. to 6s. sugar-bag.

Melbourne.—To 16s. per 50-lb. bag.

Peas.

Brisbane.—5s. to 6s. bag.

Lettuce.

Brisbane.—1s. to 2s. per doz.

Cucumbers.

Brisbane.—3s. to 5s. a bushel.

Sydney.—6s. 6d. to 10s. a bushel.

Melbourne.—5s. to 7s. a bushel.

PUBLICATIONS.

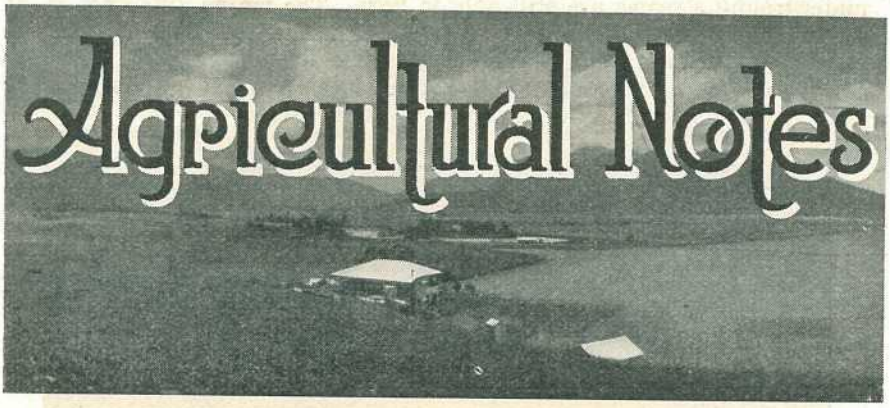
"Strawberry Packing," "Passion Fruit Marketing," and "Peach Packing" are now available for distribution. "Tomato Packing" is now in the hands of the printer, and should be available for distribution later in the month.

SOWING TOBACCO SEED.

Owing to its minute size, special care has to be taken in the sowing of tobacco seed. The method followed most generally is to mix it with some solid distributing medium, such as wood-ashes, and to apply the mixture to the prepared seed-bed.

Another method, which has much to commend it, is to apply a suspension of tobacco seed and water to the bed by means of a watering can. Advantages claimed for this method are that the process of mixing the seed with the distributing medium is quicker and less troublesome than the other method, and furthermore it can be used in windy weather quite satisfactorily. The momentum of the falling drops furthermore tends to partly embed the seed in the soil.

The procedure for watering-in is as follows:—Half fill a watering can with water, measure out the requisite quantity of seed, and mix thoroughly with the water, then pour in the rest of the water to nearly fill the can, and again stir. It will be seen that the seed remains in suspension, evenly distributed throughout the volume of water. The water then should be quickly and evenly distributed over the surface of the bed. This is easier if the surface crust of the bed is dry, when the ground covered can be the more readily distinguished.



First Steps in Irrigation Practice.

H. W. KERR.*

INTRODUCTION.

IT is pleasing to record the sustained interest in the value of irrigation practice, as an aid to reduced production costs; this is evident in most cane areas of Queensland, with the exception of the humid belt from Tully to Babinda. Doubtless, irrigation is also the greatest single force capable of conferring stability and certainty in those areas where rainfall deficiency and distribution are the major factors in limiting acreage yields. The best example of what may be achieved by wide-scale irrigation is the Lower Burdekin area. During recent years great strides have been made in the more economical application of water and the judicious use of appropriate manures; the result has been to raise the average sugar yield per acre, over the three mill areas, to almost 5 tons of sugar per acre.

In response to numerous requests, the following notes have been prepared to serve as a guide to those farmers who, with limited funds, are desirous of searching for and developing water resources chiefly through their personal efforts, so as to minimise costs of investigations and installation. It is hoped that the relevant data provided may prove useful, though it should be stressed that these notes are necessarily general in character, and specific advice should be requested where any special features are involved.

WATER SUPPLY.

The first consideration is, of course, the availability of adequate, good-quality water. This may be obtained from either open streams or subterranean sources. In point of fact, there is essentially no difference between these seemingly widely separated sources. In each case a stream of water is involved; whereas the former is flowing in an existing "natural" water course, the subterranean stream actually follows a pre-existing course which has since become overlaid by sediments or other deposits so that its existence is no longer obvious, but along which

* In the "Cane Growers' Quarterly Bulletin" (Bureau of Sugar Experiment Stations, Queensland) for October, 1937.

underground streams are still able to flow. The major difference is, of course, that careful search is required to locate the latter; but it is rather significant that Queensland practice demonstrates a generally greater degree of reliability and permanence than can be claimed for open streams, notably in the drier areas of the State.

Plate 244.
Delivery of water from flume to main ditch.

The location of underground water is a subject for controversy which revolves around the claims advanced in support of some occult power, alleged to be possessed by certain individuals, in detecting the existence of subterranean water—so-called "divining." The writer has no desire to become involved in any discussion on this topic, and doubtless nothing that might be advanced for or against would influence farmers in their attitude towards the diviner and his work. Suffice it to say that the location of probable sites at which water-bearing strata will be encountered is largely a matter of "hit and miss" methods. Where any extensive borings have been made in an area, it is possible to formulate general principles which will indicate whether the site selected offers prospects of success. The only sure method of testing any probable site is by boring. In soft strata, the use of a posthole digger, and later, the sand pump, may enable a bore to be driven in a fairly simple and rapid manner. But where compact rock strata are encountered, the use of a boring outfit is necessary. Naturally the cost of boring will be governed by the nature of the strata and the depth at which water is encountered.

QUALITY OF WATER.

One of the first considerations, when a water supply is located, is to determine the quality of the water. It is always desirable to have a test made by a competent analyst, whether the water be drawn from an open stream or an underground supply. For this purpose, a representative sample of about a pint should be transferred to a clean bottle, and despatched to the nearest Sugar Experiment Station, or the Head Office of the Bureau, where an analysis will be made and an opinion given free of charge to all canegrowers. With subterranean supplies,

the sample should be taken after pumping for a time to assure that the sample is truly typical of the supply and is not the result of surface seepage.

Many natural waters are too salty for irrigation purposes, while others contain harmful amounts of substances such as carbonate of soda, which act as "poisons" to crops. This simple precaution of chemical test is always worthwhile, and might save much worthless expenditure on plant and installation. The limiting concentrations of undesirable salts cannot be formulated without reference to the soil type on which the water will be used, and to the presence or absence of other compounds in the water, which may act as correctives.

TESTING CAPACITY OF SUPPLY.

It is next important to determine the capacity of the available supply. Where an open stream is to be drawn on, this is a relatively simple matter. For large streams, records are generally available, from gaugings, and these will indicate the capacity of the river or creek with the necessary degree of accuracy. It is well recognised that open streams vary in flow, being usually at a minimum in the spring and early summer months. As it is at this season of the year that the greatest demands are made by the cane crops, the farmer should assure himself that the flow (or flow plus possible storage) is capable of supplying the full demands of the plant which he proposes to install. This is especially important with creeks of limited capacity. For such streams it may be necessary to arrange for a measuring weir to be installed, and careful and systematic flow records kept. To provide some idea of the flow required to supply the needs of centrifugal pumps of varying size, the following table is presented as a useful guide:—

Diameter of Pump. Inches.	Capacity per hour. Gallons.
3	9,000
4	16,000
5	24,000
6	33,000
7	45,000

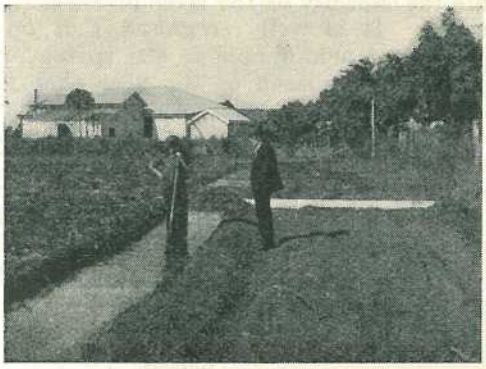
Where the minimum flow does not permit of the desired pump size, the possibilities of damming the stream to provide night storage for daylight pumping, should be carefully investigated. It should be noted that, before a farmer is permitted to draw on open streams for irrigation purposes, application must first be made to the Department of Irrigation and Water Supply, which will advise him of the formalities to be complied with.

As a guide to the number of acres which might be watered satisfactorily with a given supply, it is safe to assume that this will be equal to the number of thousands of gallons which the pump will deliver per hour. Thus, for a 7 inch pump delivering 45,000 gallons per hour, an area of 45 acres may be watered adequately, when the pump is operated for ten hours per day, approximately 100 days per year.

The testing of underground supplies is not so simple. Some indication may be gained by a pumping test on a bore which has been driven into the water-bearing stratum. When boring, it is customary to operate the auger, sand pump, etc., inside a steel casing somewhat

larger in cross sectional area than the tool which is employed. By applying weights or force to the casing, it is driven downwards as the soil or sand is removed from within. Successive lengths of casing are attached to enable it to extend to the water-bearing stratum; for preference, the casing should be lowered to the *bottom* of this layer. For the pumping test, a "spear" attached to a suitable suction pipe is then lowered within the casing, and attached to a pump. The spear consists of a cylinder of gauze which serves to admit the water while excluding the sand. Modern spears are now manufactured as variations of the earlier type, but they perform essentially the same task with greater or less efficiency.

The nature of the test pumping unit is a matter for consideration. A centrifugal or other form of suction pump cannot be operated unless located at not more than 25 feet above the water level; the level will, of course, also be lowered during the progress of the trial.



Main or feeder ditch.

Furrow irrigation from main ditch.

Plate 245.

Naturally, the capacity of a single bore may not provide a true reflex of the full capacity of the water beds. A number of factors enter to complicate the problem. If the water-bearing stratum, or "drift" as it is called, is of very coarse sand or gravel, it will offer little resistance to the free passage of water, and it may be possible to draw a large supply from a single bore. On the other hand, a fine sand drift may yield water at a relatively slow rate, yet with a series of spears, each suitably located, and jointed to one central suction pipe, it may supply over 100,000 gallons of water per hour. These questions require

careful study and test in order that the true capabilities of the site may be gauged. Of course, expert advice is very helpful and necessary in reaching a reliable conclusion in these matters.

SELECTION AND INSTALLATION OF PUMPING UNIT.

Having established the existence of an ample and accessible water supply, the next considerations are what it will cost to deliver water to the field, and what will be the most economical unit to install for pumping; the latter question involves (*a*) cost of installation, and (*b*) operating and maintenance cost.

The cost of pumping will be directly related to the height to which the water must be raised. Thus it will require four times the power to raise a given quantity of water 100 feet, as it will to raise it 25 feet. To determine the total "head," as it is called, one must determine the difference in height between the water in the drift, *when the pump is operating,* and the point of emergence of the water from the delivery pipe. In addition, it is necessary to make allowance for the friction loss due to the passage of water through the spears and pipe line. It is customary to provide a suction and delivery pipe about 1 inch greater in diameter than the intake and outlet of the pump respectively, to avoid any serious loss from the lastnamed cause. However, if water must be raised a considerable height through heavy gauge piping, the increased diameter may add appreciably to the installation cost. The friction loss at the spear will be governed by the type of drift.

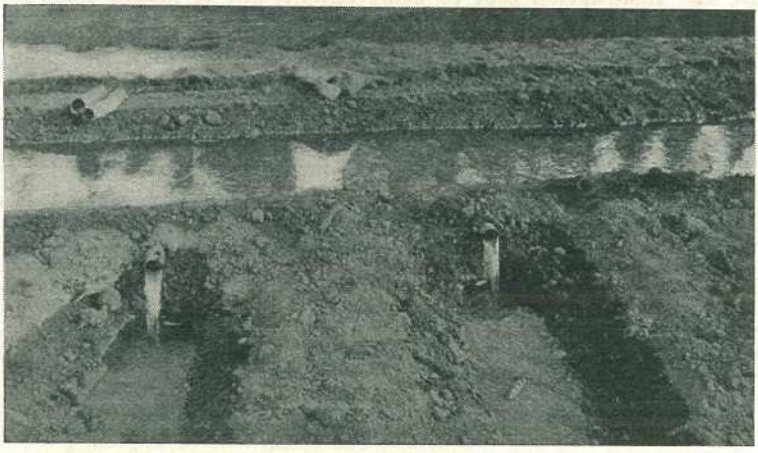


Plate 246.

Illustrating tube method of delivery of water from feeder ditch to furrows. The flow of water may be controlled by adjusting the level of the galvanised iron tubes.

When the total head against which the pump must operate is known, it is possible to calculate the approximate engine power necessary to take care of the desired volume of water. This figure will naturally be governed by the efficiency of the pump. Though the modern centrifugal pump has been developed to a high state of efficiency, it is most important that the speed at which it is operated be carefully checked to ensure the maximum pumping efficiency. That is to say, there is definite speed at which the pump will deliver water at a

minimum cost per gallon; for speeds above or below this figure, the *actual* water delivery will be raised or lowered, but at the same time the cost per gallon will be invariably increased. The best speed will also depend upon the pumping head, and the guidance of a reputable irrigation supply firm should be sought in the selection of the most suitable unit for a given job.

Wherever practicable, it is desirable to install a horizontal centrifugal pump, operated by belt drive from the engine. As was indicated earlier, the pump must not be more than 25 feet above the level of the water, or it will not draw its supply. For preference, the pump should be placed as close as possible to the water bed. Where the water-bearing drift is, say, 30 feet below the land surface, a pit or well may be scouped or dug to a suitable depth, and the pump installed therein. The engine may then be placed at normal land level.

For deep supplies, the vertical spindle centrifugal pump becomes necessary. As the excessively long shafting required for this purpose demands adequate bearings, to assure true running, the heavy channel iron supporting frame for such a layout adds considerably to the installation cost. However, it is essential for efficient working with deep supplies of underground water.

A so-called "one-stage" centrifugal pump is satisfactory provided the total pumping head does not exceed, say, 100 feet. With greater heads, the efficiency of the pump falls off at such a rapid rate that a two- or three-stage unit should be employed. Naturally, this will increase the installation cost to some extent, but it makes for reduced costs of operation.

To provide some indication of the manner in which the pumping costs per million gallons of water will vary with variation in the pumping head, the following examples are given. In each case a pump supplying 50,000 gallons of water is stipulated:—

Overall Head.	Nature of Pump.	Pump Speed.	Engine Power Required.
Feet.		Revolutions per Minute.	Horse Power.
25	Single stage-low head	1,230	11·5 net.
50	Single stage-low head	1,480	19·0 net.
100	Single stage-high head	1,550	38·0 net.
200	Two stage-high head	1,550	76·0 net.

In making these calculations, allowance has *not* been made for the power transmission loss, which is often very considerable with an inefficient belt drive. Direct coupling of the pump to engine eliminates this loss, but is seldom practicable.

The selection of a suitable power unit offers considerable scope. Four types are commonly employed—(*a*) steam, (*b*) suction gas, (*c*) internal combustion oil engine, or (*d*) electric motor. The older units were almost all steam operated; then came the era of the suction gas engine, where an abundance of suitable firewood was available. More recently petrol and kerosene internal combustion engines were introduced, while the latest types are almost exclusively so-called "diesel" engines, which

operate on crude oil. The last-named type has practically superseded all others. Occasionally, electrical power is employed, either from general service mains or from a central installation employing, say, crude oil or coal to generate electricity, which may be used to operate at will any or all of a number of pumps suitably located over the area to be watered.

It is reasonable to dismiss consideration of steam units in laying down a modern plant. Suction gas may warrant attention in particularly favourable circumstances, but, like steam, it demands the continuous attendance of an operator, which adds substantially to pumping costs.

The internal combustion oil engine—and notably the crude oil type—does not suffer from this handicap. While it must not be assumed that an engine of this class may be allowed to run unattended, it is true that intermittent supervision only is demanded, and the operator may devote attention to other duties as well. At the present cost of crude oil, and with the high efficiency of this type of engine, a maximum fuel cost of ½d. per horse power per hour may be assumed.

The power of the engine required must also be considered carefully. While it is obviously unwise to attempt to overload the engine, it is not good business to over-capitalise the plant by installing an unduly high-powered unit. Expert advice is most helpful in arriving at a satisfactory decision; however, the following formula will provide the farmer with a fair estimate of power of a suitable engine, making due allowance for transmission and friction losses and overload margin:—

$$\text{H.P. required} = \frac{\text{Total head (suction, delivery and friction), in feet} \times \text{gallons of water per hour.}}{100{,}000}$$

That is, multiply the vertical distance in feet, from the water-level to the highest point of the delivery pipe, plus an allowance for friction losses, by the estimated volume of water the pump will deliver hourly, and divided by 100,000.

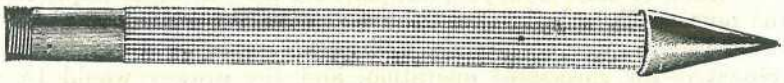


Plate 247.
An irrigation spear.

It has already been observed that the pump speed is very important, and care must be taken to select suitably sized belt pulleys for engine and pump to give the desired revolutions.

Plate 248.
New type of slotted spear.

Where water is drawn from an open supply, it is only necessary to provide that the suction opening has access to an adequate depth of sand-free water, and to assure that it is not drawing air. Where an underground drift is tapped, care must be taken to ensure complete separation of all sand or gravel from the water entering the pump. The selection of suitable parts for the spear system is therefore of importance. It is found that, where the drift is of medium or fine sand, the rate of passage of water to the spear is relatively slow, and it is then desirable to connect a number of 3-inch spears to a common suction pump. With coarse sand or gravelly drift, fewer large-sized spears (6 inches) are a distinct advantage; they are simpler to install and also

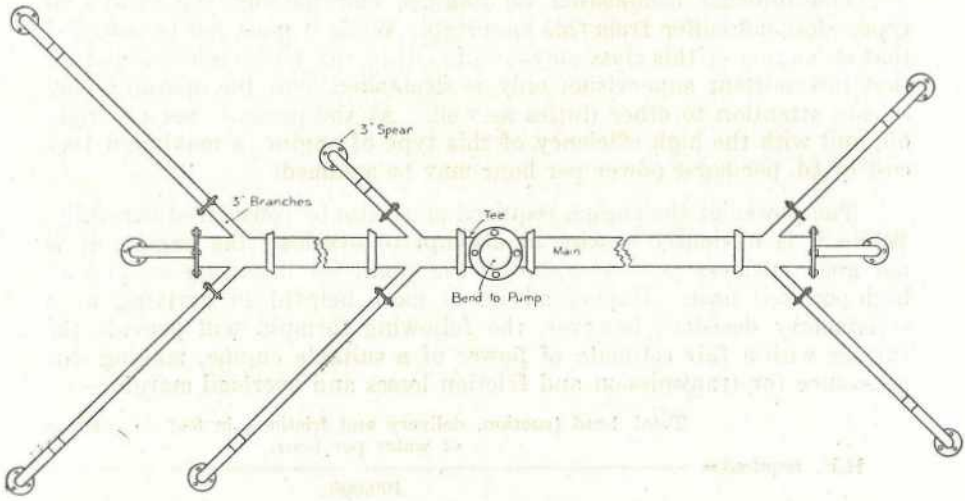


Plate 249.
Typical arrangement of a spear system.

less costly and troublesome to maintain. The accompanying illustration indicates the manner in which the spear system is spread out, to assure that a volume of drift is tapped, adequate for the full water requirements of the pump. Though there is nothing particularly difficult in installing a spear system, there are certain well recognised principles which must be observed for successful operation, and the grower would be well advised to seek expert guidance in this regard.

Wells are sometimes employed to provide the source of supply to the pump. In general, these do not have a high capacity unless combined with a spear system radiating outwards from the bottom of the well. However, it is frequently possible to obtain at least a 4-inch pump supply from open water in this way; such a unit is working successfully at the Mackay Sugar Experiment Station. The dry, upper portion of this well is lined with corrugated galvanised iron, in the form of a cylinder; when the water-bearing stratum was encountered, a brick lining was employed, and this was built up as the water-bearing sand was removed and the brick ring subsided. During the sinking of a well of this nature it is necessary to pump out the water at the same rate as that at which it enters; a centrifugal pump, the speed of which can be varied as required is desirable in this connection.

ECONOMICS OF PUMPING.

The grower will naturally be highly interested in determining what expenditure it is economical to incur in delivering the water to his crop. Over-all costs (allowing fully for interest and redemption on the installation and maintenance and running costs) vary very considerably. In certain favoured areas water may be obtained for a total cost as low as 22s. 6d. per million gallons. In general, it will be considerably higher.

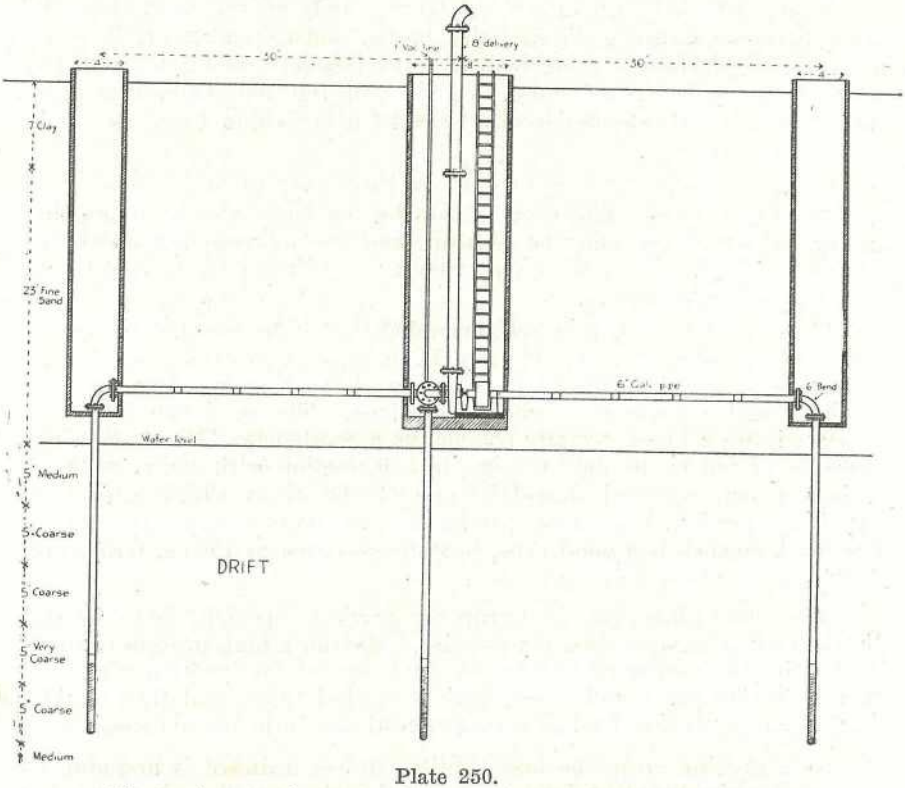


Plate 250.
Illustrating use of concrete lined wells for deep spear installations.

The farmer may take it as a safe guide that, provided he is able to finance the layout, water costs not exceeding £5 per million gallons will prove highly economical, particularly in the drier areas of the State.

FEEDING OF CONCENTRATES.

Farmers are often averse from feeding concentrates, which impart a flavour or "taint" to the butterfat. Peanut products are a typical example. In many cases the difficulty may be overcome by feeding the material immediately after milking. The animal then is assured of sufficient time, before the next milking, in which it can utilise the constituents which give the off flavour.

The Growing of Cowpeas.

L. HODGE, Biloela Research Station.

THE cowpea should undoubtedly be grown much more extensively—as a cash crop for seed, a grazing crop for stock, and for green manure —by Central Queensland farmers than it is at present.

It is a summer annual related more closely to the bean than the pea, and while it thrives best under warm, moist, conditions, it grows satisfactorily in the inland agricultural districts and during dry weather, provided that it is warm enough. In addition, this accommodating plant does well on poor soils and is thus useful for enriching them, as it is a supplier of nitrogen.

Cowpeas should be sown from mid-November to mid-December to get the best results. The rates of sowing are very elastic, depending on the nature of the soil, the rainfall, and the purpose for which the crop is required. The sowing may vary from 10 to 12 lb. of seed to the acre, according to variety.

If grown for seed, it is recommended that it be planted in rows 2 feet 3 inches apart at a rate of 12 to 14 lb. to the acre, and from 2 to 2½ inches deep. Seed yields of from 15 to 20 bushels an acre may be obtained under moderately good conditions. The seed can be either harvested and sold—it usually commands a good price (15s. to 20s. per bushel)—or fed in the field to pigs, in conjunction with other foods. A variety grown for seed should be one of the kinds which have been especially developed for seed production, as against vine production. The black cowpea is a good type, but others—such as Poona, Groit, and Brabham—are now gaining favour.

The cowpea is an excellent crop for grazing, especially for soils and districts where lucerne does not flourish. Having a high protein content, it supplies the necessary balance to the crops of low protein content—such as Sudan grass and other fodders of that type—and thus enables the farmer to provide feed of a proper nutrient ratio for his stock.

As a grazing crop, the best results—unless rainfall is abundant—are obtained by planting in rows 2 feet 3 inches apart and cultivating once or twice. The crop will be ready for grazing in 50 days or so, and yields of from 12 to 14 tons an acre of green fodder may be produced in 70 days, under good growing conditions. Many varieties suitable for grazing are available, but Victor cowpea has yielded the heaviest growths in the shortest time at the Biloela Cotton Research Station, producing over 15 tons green weight to the acre in 70 days.

As a green manure crop, cowpeas are valuable for orchards, or general farm rotation—their deep rooting, and nitrogen-fixing habits making them especially suitable for this purpose. Such a planting may be broadcast or sown through a grain drill, and will require 15 to 20 lb. of seed to the acre.

In rotations, the cowpea is an excellent predecessor to a cereal, and is recommended to the notice of dairymen who are growing winter wheat or oats for their cows. It should not precede cotton, however, as the nitrate stimulus which follows induces a rank growth of the cotton plant that usually results in a reduced yield.

Menace of Standover Cotton.

A. NAGLE, Senior Instructor in Cotton Culture.

THE soundness of the grassland-cotton rotational method has been demonstrated amply during the past season. As a consequence many farmers in the main cotton-growing areas are planting the whole or part of their acreage of cotton on newly-broken grassland, and intend planting the old cottonfields with Rhodes grass. It seems probable, however, that many old cottonfields that have not already been planted to Rhodes grass will be left for some time as standover cotton.

Experience has demonstrated beyond all doubt that standover fields, through the prolific weed growth associated with them during the spring and summer months, are breeding centres for some of the major cotton pests, such as cutworm and corn ear worm. That being so, they unquestionably are a menace to adjacent fields of growing cotton.

Over a series of years there have been recorded migrations of cutworms, and during the 1934-35 and 1935-36 seasons migrations of corn ear worm, from weedy standover fields to nearby seedling cotton, which have caused substantial loss of stand. The weed growth is also responsible for a big increase in corn ear worm population during January and February, and heavy loss of squares and bolls in crops adjacent to a weedy standover field has occurred even in seasons of generally moderate corn ear worm attack. It is thus imperative that the grassing of standover fields be effected as soon as practicable, to eliminate completely the danger associated with weed growth adjacent to the new cotton.

Although fair stands of Rhodes grass have been obtained occasionally by sowing the seed between the rows of old cotton stalks of the "standover" field during February and March, this practice is not recommended, as more often a thin scattered stand results, and this is insufficient to smother weed growth. The growth made by Rhodes grass planted under such conditions usually is slow, for the reason that the surface soil has been packed hard by the summer rains. It, therefore, is recommended that all standover fields be ploughed before any spring weed growth is apparent, further cultivation being given as it becomes necessary to destroy any weed growth occurring afterwards and to establish a fine seed-bed.

The preparation of a suitable seed-bed for Rhodes grass undoubtedly is advisable, particularly on the old cotton cultivations of the forest soils, as this assists in the establishment of the seedlings and, in addition, ensures a good supply of nitrate-nitrogen in the upper soil to promote a quick vigorous growth of grass.

As the idea of sowing the Rhodes grass on the old cotton cultivation is to check weed growth, improve the physical condition through the development of a large population of grass roots and reduce the nitrate content of the soil, it is advisable to sow the grass at a rate sufficient to give a thick even cover. In this respect it should be borne in mind that usually Rhodes grass germinates only moderately well, so a good rate of sowing should be used—preferably 8 to 10 lb. per acre. Care also should be exercised to avoid sowing too deeply—dragging a brush harrow after broadcasting the seed usually gives ample cover in a normal season.

Seeds Every Farmer Should Know.

F. B. COLEMAN, Officer in Charge, and R. J. HOLDSWORTH, Inspector, Seeds, Fertilizers, Veterinary Medicines, Pest Destroyers, and Stock Foods Investigation Branch.

[*Continued from p. 606, Part 6, Vol. XLV.—June,* 1936.]

(PART III.)

DODDER.

AS an introduction to this article, it may be stated that there are several kinds of Dodder (*Cuscuta* sp.) found in Queensland, the difference between them being in most cases minute.

It has therefore been decided to describe and illustrate a dodder actually found growing on lucerne in Queensland.

The following descriptions of dodder and its most common host plant (in Queensland) lucerne, should be of value in assisting in the identification of these seeds:—

Cuscuta spp. (Fig. 9).

Common name.—Dodder.

Description.—Dull rough seed, brown to very dark brown colour, rounded on one face, flattened maybe on one or more faces, very irregular in shape, could easily be mistaken for a piece of coloured dirt.

Size.—Very variable, diameters from ½ to 1½ mm.*

Occurrence.—Found in seeds of the following cultivated crops:—Lucerne, clovers, linseed (flax).

Medicago sativa (Fig. 10).

Common name.—Lucerne. In the U.S.A. referred to as alfalfa.

Description.—Seeds dull surfaced, of colours varying from light yellow to dark brown, also green, darkens with age, distorted kidney shape but very variable; the hilum mark is a ring with a depression in the middle.

Size.—Variable, average 2 to 3 mm* long by 1 mm thick.

Occurrence.—A commercial crop of great value for feed and seed. Often referred to as "The King of Fodder Crops."

Sometimes one finds a lucerne seed sample containing red seeds. This is the result of action taken by the Commonwealth authorities at the port of entry of the seed to cause a portion of each consignment

* mm = millimetre 25.4mm = 1 inch.

DESCRIPTION OF PLATE 251.

Fig. 9 Dodder x 5.
Fig. 9A Dodder natural size.
Fig. 10 Lucerne x 5.
Fig. 10A Lucerne natural size.
Fig. 11 Lucerne Plant with Dodder half natural size.
Fig. 11A Capsules x 2.
Fig. 12 Lucerne Seed and Dodder Seed x 5.

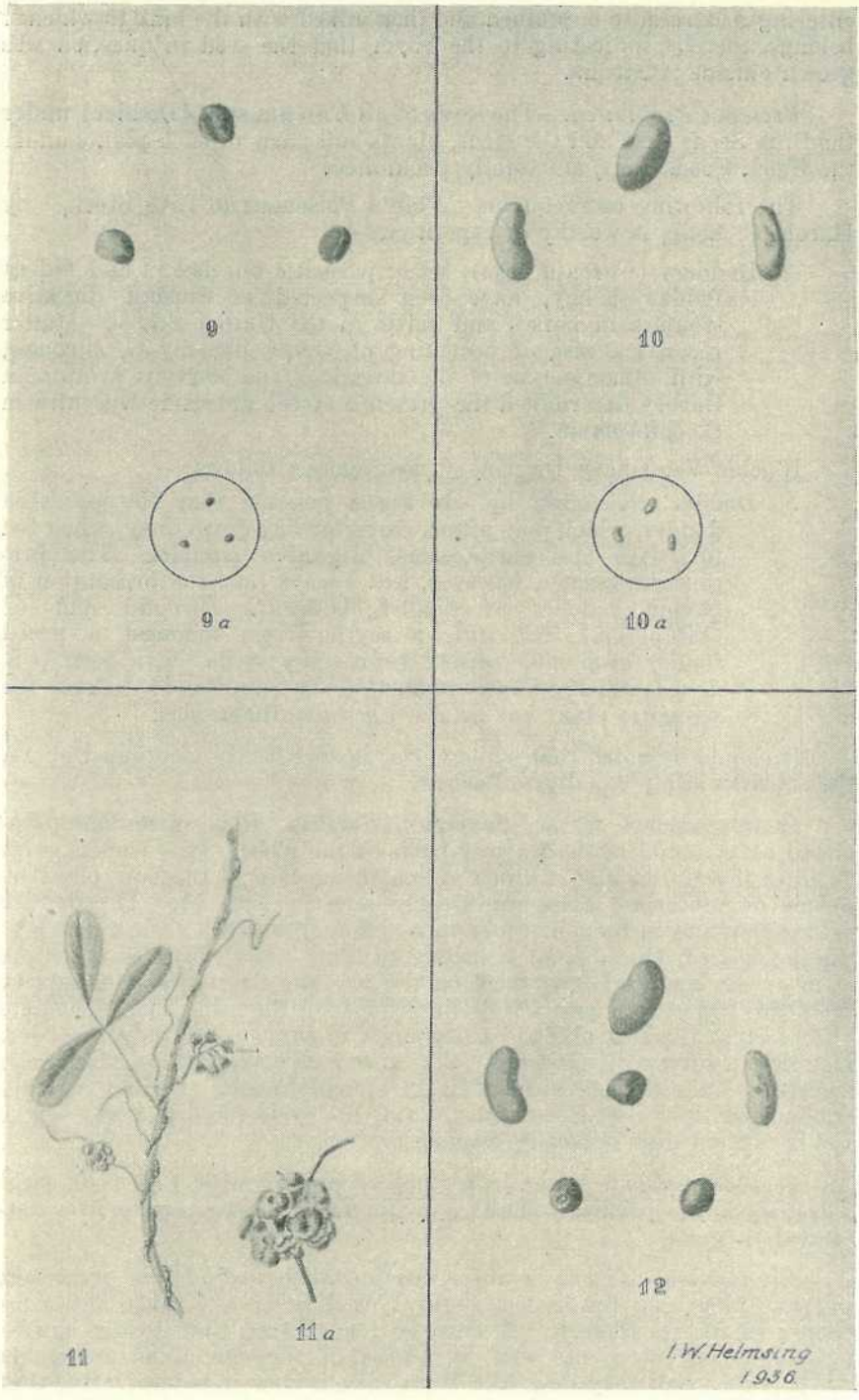


Plate 251.

entering Australia to be stained and then mixed with the bulk to which it belongs, thereby indicating to the buyer that the seed in question was grown outside Australia.

Presence Prohibited.—The seeds of all *Cuscuta* spp. (Dodder) under the Pure Seeds Acts and the seeds, plants and parts of such plants under the Stock Foods Acts, are totally prohibited.

The following extract from "Plants Poisonous to Live Stock," by Harold C. Long, is worthy of repetition:—

> "Dodders (*Cuscuta* spp.), when parasitic on clovers and fed as fodder or hay, have been suspected of causing digestive troubles in horses and cattle in the United States. Muller records a case of poisoning of young pigs by *C. europæa,* with inflammation of the intestines and nervous symptoms. Barbey determined the presence of the glucoside Cuscutin in *C. epithymum.*"

Black's Veterinary Dictionary mentions as follows:—

> "Dodder, Poisoning by.—It seems possible that the parasitic dodder, which may attack clover or hay crops, may, when fed to horses and cattle, cause digestive troubles. The progressive farmer, however, will always take the precaution of having patches of dodder (*Cuscuta europæa* and *C. epithymum*) cut with a scythe from amongst a green fodder crop and burned before any seeds have been produced which will contaminate his samples, or before the parasitic plant has attained serious dimensions."

It should be noted that while clover is specifically mentioned above, the remarks apply equally to lucerne.

Dodder belongs to the convolvulus family. It is an annual parasitical plant found in the warmer parts of the globe. It is leafless, with twining thread-like stems which attach themselves to the host plant by means of tubercles; these are clearly seen in Fig. 11. The dodder seed germinates in the soil, sends up a stem and attaches itself to the host plant which in Queensland is mostly lucerne. The tubercles enter the stem of the host and from then on the parasite draws its nourishment from this source and severs its connection with the soil. The immediate effect is that the host plant is called upon to support not only itself but also the Dodder until ultimately the exhausted plant dies, in most cases smothered in a tangled mass of light brown threads. Dodder quickly produces seed, so that it can run the full life cycle (seed to seed) before the host plant dies—literally from starvation.

Dodder seeds are borne in a globular capsule with 4 seeds in each. These seeds are pressed together, giving them their characteristic flattended surfaces.

Eradication.—If one is unfortunate enough to find this pernicious parasite in a crop the sooner steps of eradication are taken the more chance of success there is. It must be remembered that dodder can be propagated by seed and also by pieces of the threadlike stems, no matter how small they may be. With this in view it is imperative that the method of destruction be such that can take place on the site where the parasite is growing and the best way to achieve this is to burn out the infested patch by covering same with litter, straw, or other readily

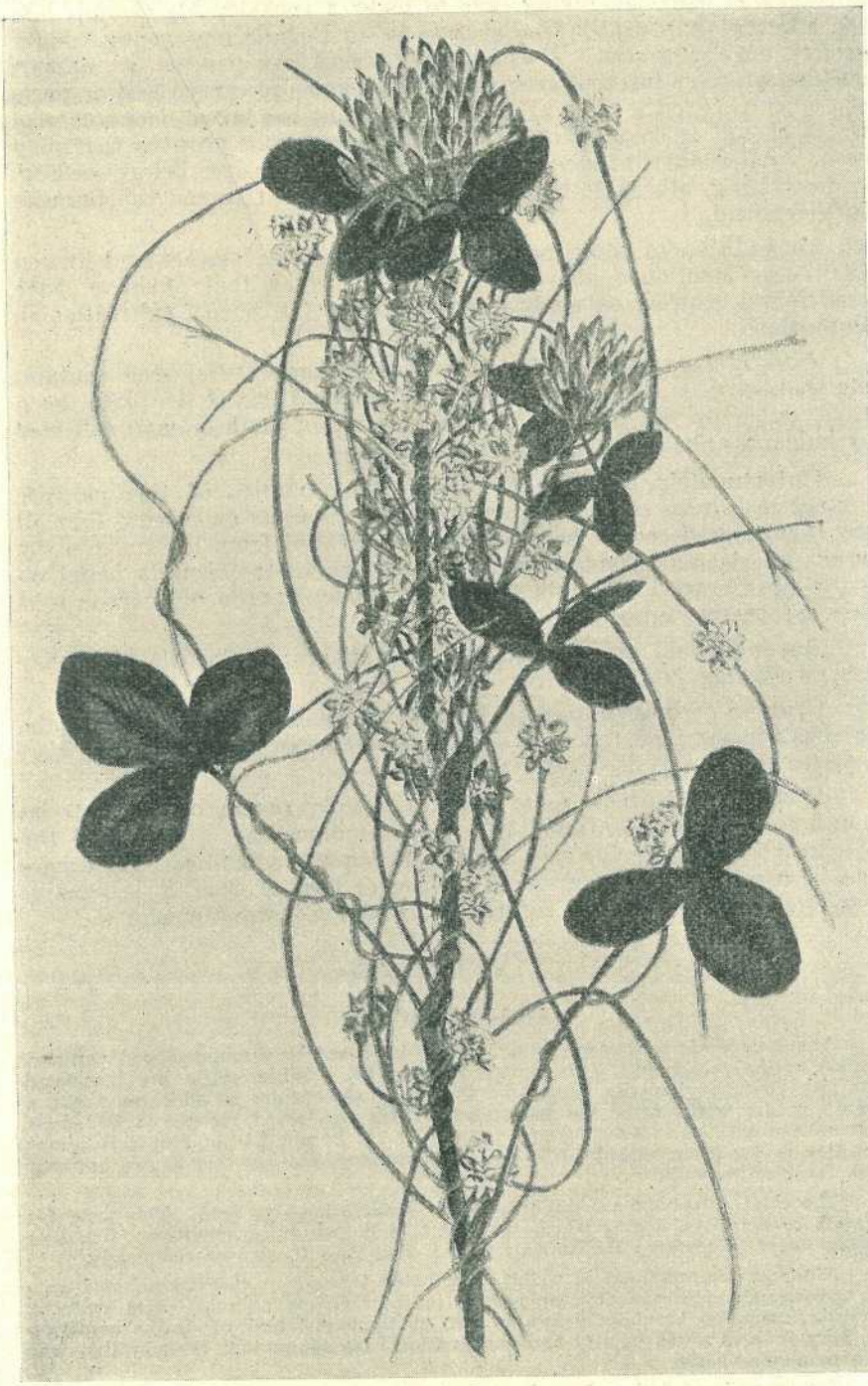


Plate 252.
Red clover heavily infested with Dodder.

inflammable material, taking care to make a considerable overlap into the adjacent apparently free area so as to include any young dodder growth not easily seen. It is best to prevent any persons or animals walking over the infested area, as they are liable to carry seeds or parts of the parasite to the clean area. After burning has taken place a careful watch should be kept in order to detect any minor growths that may occur. All dodder-infested patches should be burnt over before seeding, or harvesting, otherwise harvesting machinery will spread the parasite further afield.

In addition to being parasitical upon lucerne, clovers and linseed (flax)—as mentioned above—it should be noted that Dodders have been found growing on many different kinds of weeds of cultivation in Queensland.

Infestation can result from purchasing agricultural seed containing Dodder seeds, by floods washing the seed or parts of the plant down from higher up the creek or by being carried in earth or mud collected by humans, animals, vehicles or implements.

Unfortunately, there is a considerable quantity of this parasite present in lucerne grown in this State and it is our experience that all the Dodder seed cannot be satisfactorily removed from lucerne seed by means of cleaning machinery or sieving; this statement is based on many unsuccessful attempts to make saleable, parcels of lucerne seed that are Dodder-infested.

Buyers should always insist upon an assurance that the seed they are purchasing is Dodder-free.

Growers of lucerne seed in fairness to themselves as well as to the persons who may sow the seed, *should never harvest seed from a Dodder-infested field.*

It should be borne in mind that any seed for sowing or any material found to be Dodder-infested is subject to immediate seizure and the person offering same for sale is liable to legal proceedings. No excuse can be accepted for the presence in seed or feed of such a destructive parasite which can well be considered as lucerne's worst enemy.

ANAPLASMOSIS.

Anaplasmosis is a disease of cattle which is caused by a minute blood parasite. Under natural conditions it is spread by the tick. When cattle are inoculated for tick fever, it happens frequently that they show signs of sickness about a month to six weeks after the inoculation. This was often recognised by stock-owners and was called the "second reaction." It is now known that this second reaction is due to an entirely different organism from the one that causes ordinary tick fever or redwater.

The chief symptoms are dullness and a disinclination to feed. This lasts for a week to ten days, during which the animal may lose much condition. Jaundice is also seen. Sometimes the animals take a long time to recover completely.

Although the anaplasm is widely distributed throughout the tick-infested area of Queensland, outbreaks of anaplasmosis in the field are unusual. Just recently, however, attention has been drawn to two or three instances of deaths occurring in dairy cows in which inquiry and examination have shown that the mortality was due to anaplasmosis.

Treatment is of little value. It is best to leave the animal alone. Driving the animal is particularly harmful. A mild purgative is useful. Drastic drug treatment of any kind is to be avoided.

—*Dr. John Legg.*

A New Trash Plough.

N. J. KING.*

IN the Canegrowers' Quarterly Bulletin of October 1st, 1935, was printed a short note regarding a new trash-cutting device. This attachment has been considerably improved since that time and has now reached a stage where the experimental period has practically passed. No doubt some minor improvements will still be made, but up to date the plough has made an excellent job of covering some heavy crops of trash.

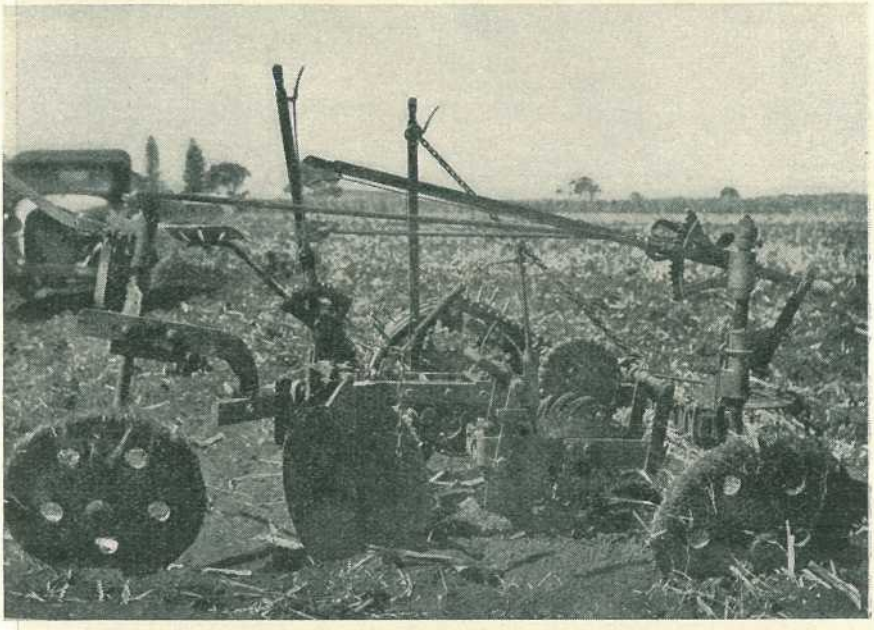


Plate 253.

New trash plough: position and drive of cutting wheel.

The land wheel of the plough acts as the driving wheel for the cutter. By means of a chain drive and a counter-shaft from the land wheel a second chain drives the cutting wheel at a considerable speed. The cutting wheel, on which the knives are curved, takes the trash against a stationary blade, thus cutting off a length of trash equal to the width of the plough-cut. A shoe runs along the surface of the ground, lifting the trash and guiding it to the revolving cutter. To avoid inequalities in the surface making the shoe dig into the soil the entire cutting device and shoe are swung on two shafts. Should the shoe strike a rise or some high stubble the entire arrangement swings back and up, still cutting the trash, and returns to the normal level when the obstruction is passed.

* In the "Cane Growers' Quarterly Bulletin" (Bureau of Sugar Experiment Stations).

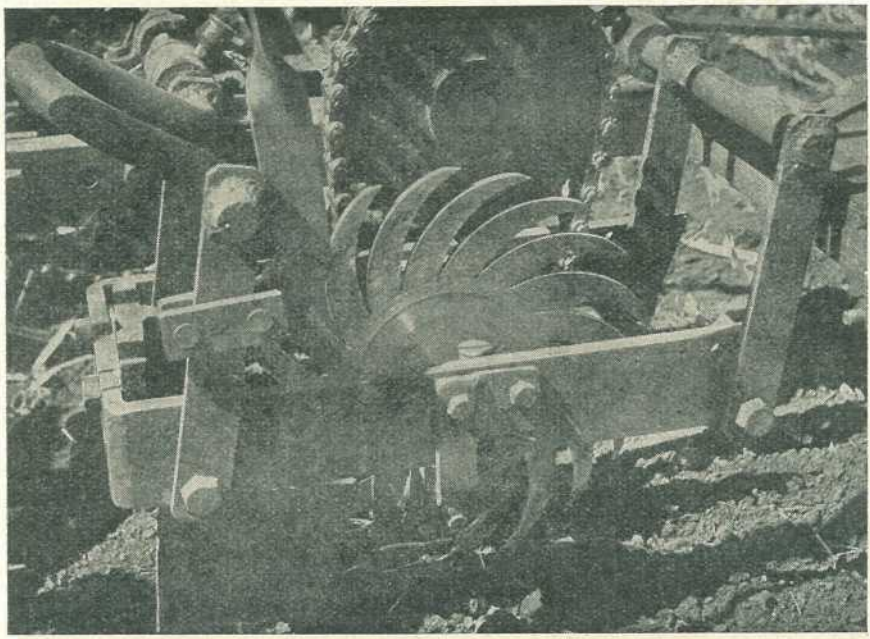


Plate 254.
New trash plough: detail of cutting wheel.

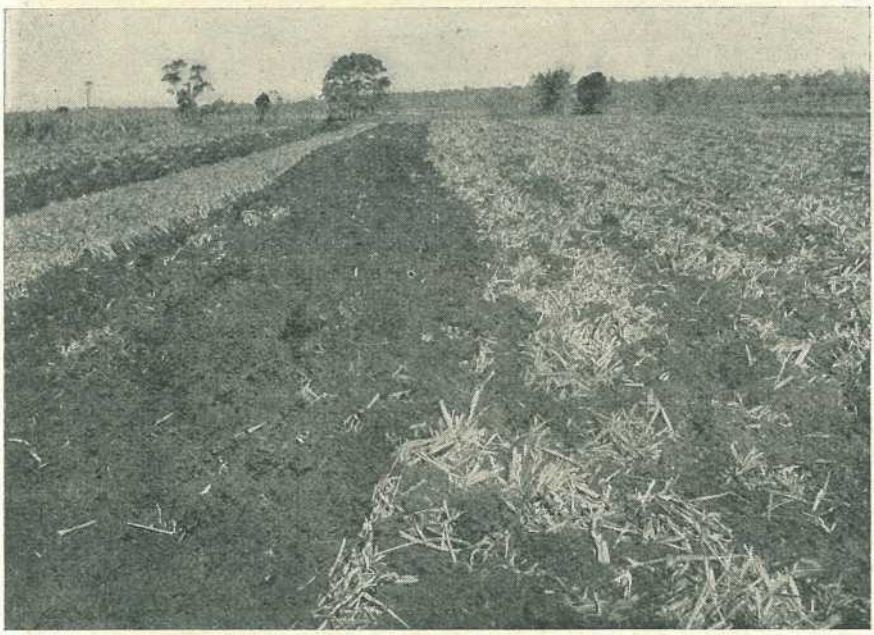


Plate 255.

Illustrating the work of the new trash plough; left: trash covered unploughed land; centre: trash ploughed in with trash plough; right: trash ploughed in with single disc plough.

The photographs illustrate the plough and the cutting device. Plate 255 shows the type of work done; on the right is the result of ploughing in the trash with a single disc plough, while in the centre is shown the result of the trash plough, and on the left the unploughed, trash-covered ground. Dead sticks did not interfere with the cutter. The outstanding advantage of turning in the trash with such a plough is that the trash is directed after cutting into the bottom of the furrow by means of a small mould-board. The cover of soil then covers the trash to a depth depending on the depth being ploughed. In the above case eight inches of soil covered the trash. An ideal seed bed for a green manure crop is thus obtained, and the trash is not mixed up with the soil as is often the case, providing air spaces and allowing rapid drying out. The trash plough illustrated is the invention of a Bundaberg farmer, and undoubtedly promises to overcome the long-felt need for an implement capable of dealing with this difficult material.

SEEDLING HOTHOUSE AT BUNDABERG.

The erection of a new hothouse for the propagation of cane seedlings has just been completed at the Bundaberg Sugar Experiment Station. The house is heated by a hot water pipe system, during cold nights, while the warm humid atmosphere which is maintained throughout the daytime, provides those conditions which make for speedy germination of seed, and rapid growth of the young plants.

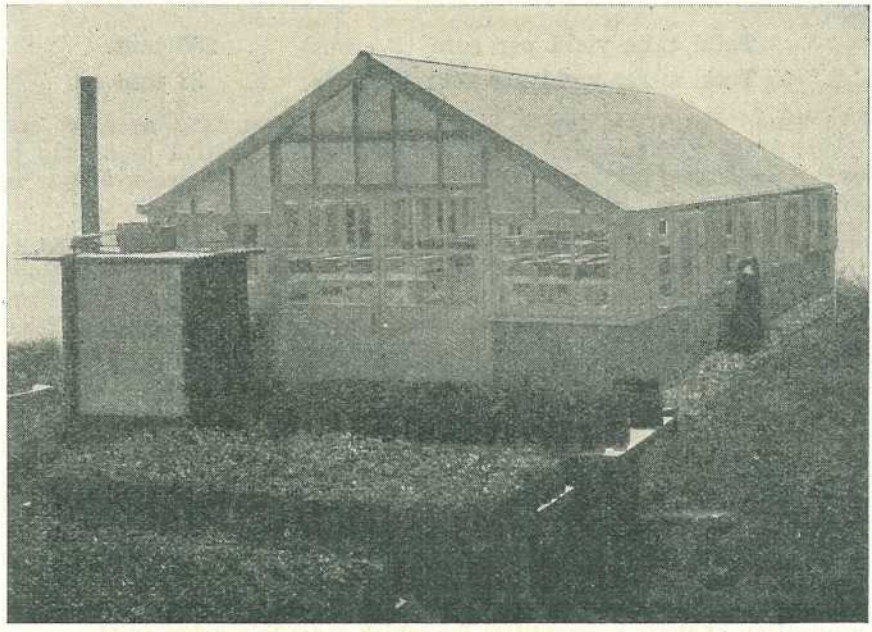


Plate 256.
New seedling house, Bundaberg Sugar Experiment Station.

In the construction of the house, free use has been made of a modern material which has been used successfully elsewhere as a glass substitute. It consists of a cellulose preparation, reinforced by stainless wire gauze, which is highly translucent, and allows free passage of the light rays most active in growth promotion. This material makes for economy in that it is cheaper than glass, both in purchase price and fixing costs, and it is, in addition, hail proof.

In front of the hothouse will be seen the concrete seedling benches on which the potted seedlings are grown. They are set out in a double row, between which runs a tramline, so that the seedlings, in flats or pots, may be transported expeditiously.

N.J.K., in the "Cane Growers' Quarterly Bulletin."

INTENSIVE CANE PRODUCTION.

H. W. KERR.*

It will be recalled that four years ago we commenced a small scale irrigation trial at the Bundaberg station, to demonstrate what could be grown on the red volcanic soils of Bundaberg, when soil moisture and fertility ceased to be limiting factors. The new variety P.O.J. 2878 was planted in the experimental area, and the crop was liberally fertilized and watered throughout its growth period.

We have now the results of three crops—plant, first and second ratoons. The aggregate yield per acre of cane and sugar are as follows:—

Total cane yield per acre (3 crops) .. **233 tons.**
Total sugar yield per acre (3 crops) .. **28 tons.**

These yields are far in excess of the Queensland average, and demonstrate still further the extreme value of irrigation as an aid in cane production, particularly where deep fertile soils are available in areas of light and erratic rainfall.

The benefits of the practice have been so vividly proven to growers in the Southern districts that in all mill areas, it is pleasing to note, many growers are attempting to turn all available water resources to good account. Unfortunately, the frequency with which suitable local supplies are encountered is far from high, and in most cases, collective action would be necessary to finance the cost of a scheme designed to effect wider utilization of natural streams.

We have also been able to demonstrate that the fears of serious over-production of cane, due to the adoption of intensive production methods, need have no foundation; growers could reduce their cane acreages proportionately to their tonnage-per-acre increases, and devote the land thus liberated to the production of alternative crops, the growth of which, under irrigation, could also be made worth while. Care in the choice of the supplementary crop selected would also assume the production of those commodities for which a ready market exists.

* In the "Cane Growers' Quarterly Bulletin."

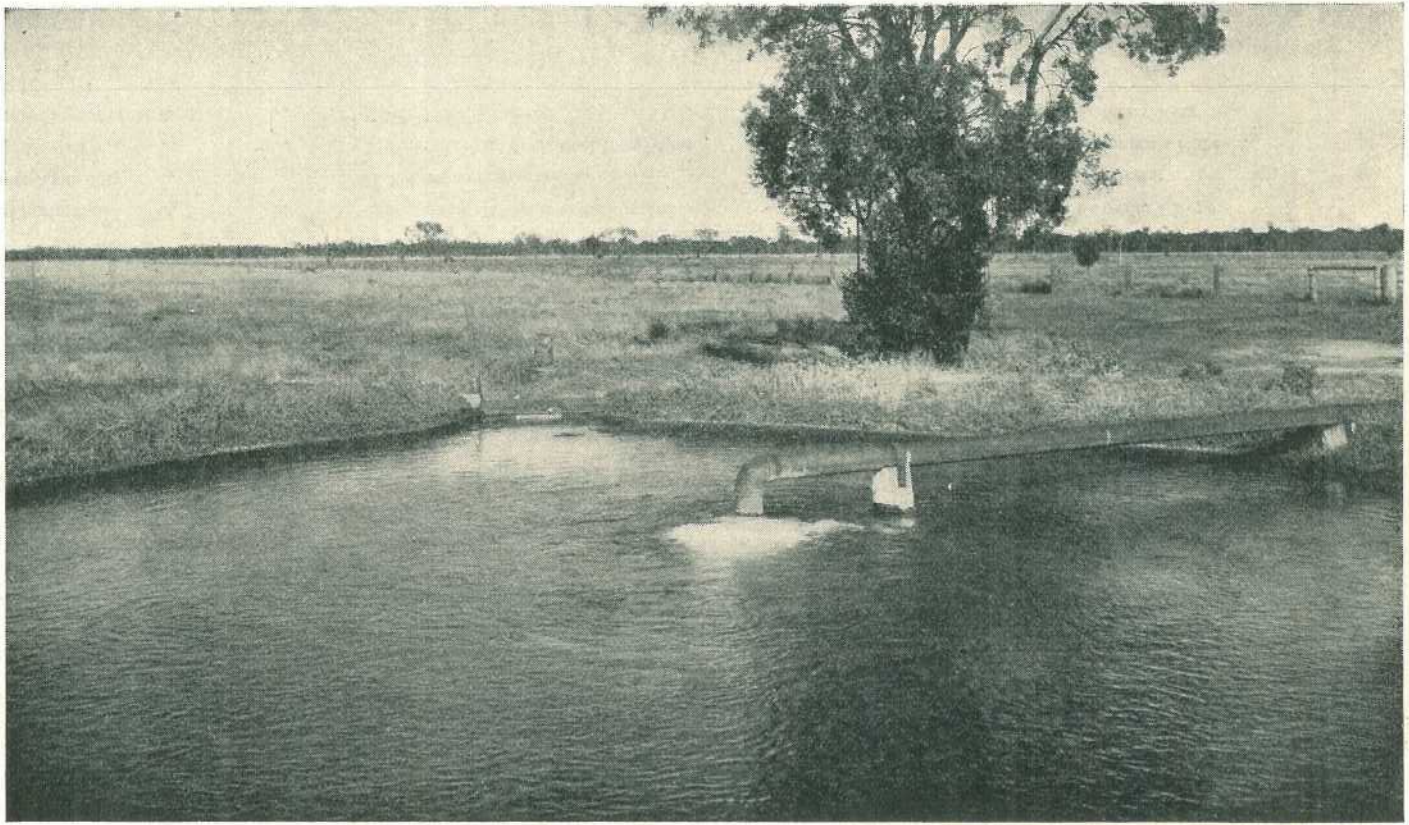


Plate 257.
Artesian bore on Yamburgan Station, near Dirranbandi, Queensland. Capacity, 600,000 gallons a day.

PRODUCTION RECORDING.

List of cows and heifers officially tested by Officers of the Department of Agriculture and Stock which have qualified for entry into the Advanced Register of the Herd Books of the Australian Illawarra Shorthorn Society and Jersey Cattle Society, production charts for which were compiled during the month of September, 1937 (273 days unless otherwise stated).

Name of Cow.	Owner.	Milk Production.	Butter Fat.	Sire.
		Lb.	Lb.	
AUSTRALIAN ILLAWARRA SHORTHORNS.				
Mature Cow, Standard 350 Lb.				
Empress 32nd of Sunnyside	P. Moore, Wooroolin	9,835·8	436·128	Bruce of Avonel
Senior, 2 Years, Standard 250 Lb.				
Sunnyview Rosemary	C. Stumer, Cooranga	6,311·91	250·468	Lovely's Commodore of Burradale
Junior, 2 Years, Standard 230 Lb.				
Trevor Hill Cinderella	G. Gwynne, Umbiram	6,112·1	238·35	North Glen Emblem.
College Pigeon 4th	Queensland Agricultural High School and College, Lawes	5,721·5	246·491	College Butterman
JERSEY.				
Junior, 2 Years, Standard 230 Lb.				
Glenview Springtime	F. P. Fowler and Sons, Coalstoun Lakes	4,973·3	250·443	Trinity Governor's Hope
Glenmoore Xmas Lily	L. J. Comiskey, Warra	6,024·62	262·316	Wheatlands Jester
Glenview Mayfair	F. P. Fowler and Sons, Coalstoun Lakes	4,741·7	279·854	Trinity Gover nor's Hope
Medowvale Chrysalis (258 days)	Young Bros., Kingaroy	5,613·3	335·227	Kathleigh Jersey King

The Tropics and Man

The Capacity for Work.

DOUGLAS H. K. LEE, M.Sc., M.B., B.S., D.T.M., Professor of Physiology, University of Queensland.

Second Series: No. 4.

NO part of tropical physiology forms a more active battle-ground for opinions based upon prejudice than this question of work capacity. I have endeavoured, as far as I possibly can, to base my opinion upon observed facts and unbiased reasoning from these facts. I am quite aware that my opinion will be assailed from one camp, at least, and possibly from more than one. This fate cannot, however, alter facts, and facts must in the end prevail. I want to run quietly over the observed facts with you first, and then let you make the obvious deductions with me. I am sure that, if you banish prejudice from your minds, you will reach the same conclusion.

Muscular Exertion.

What requirements must be satisfied for the body to do muscular work? First of all, the muscles themselves must be in good order and condition. They must, amongst other things, have enough water, enough of the different salts and the right balance between acid and alkaline substances. Secondly, there must be an ample and continuous supply to the muscles of food substances (especially glucose) and oxygen by the blood-stream. Thirdly, the waste products, particularly lactic acid, must be taken away at a sufficiently rapid rate to avoid undue accumulation. Lastly, but very importantly, the nervous system which stimulates the muscles to action, and co-ordinates the action of muscle to make possible delicate, smooth and efficient movements, must be in the pink of condition.

This list of requirements sounds fairly simple; but anyone who has had to probe the intimate life of body tissues will be well aware of the huge complexity and delicate adjustment underlying each of these requirements. I hinted in the last article at the extraordinary complexity of the human nervous system, for instance. If anything goes wrong with this, it does not matter how efficient the actual muscle is, it cannot be directed to the best advantage.

Faulty Blood Circulation.

The most common disturbance which arises in the tropics, or in hot industries, is a relative failure of the blood circulation. The blood vessels in the skin are often so dilated in an attempt to get rid of heat from the body, that the volume of blood, even when the reserves have been mobilised, is insufficient to fill all the blood vessels properly. The tissues which suffer most are naturally the more delicate ones, and of these the nervous system is the most important. As regards work, the first effect is often a dwindling of the will to work, and a growing irritability which tends to find fault unduly with minor affairs. If care is not taken to combat this mental attitude, and "snap out of it," a vicious circle is often set up, in which necessary exercise and work is neglected

and the bodily condition made worse instead of better. In the less severe degrees of heating the body is inclined to "cry wolf" and utter warnings before they are necessary, and undue notice of them might actually make the condition of the body worse.

If the circulatory failure is more severe, then very definite interference with muscular power is brought about, and if too strenuous attempts are made to overcome this, harm may easily result. The man with the very stable nervous system can often outstrip his more delicately adjusted fellow-workers, but he is the man who is liable to get heat-stroke from a very high rise in body temperature.

Circulatory failure also interferes with muscular action by allowing waste products to accumulate in the active muscles. The familiary muscular soreness following unaccustomed work is due to this, and the sore tiredness of the leg muscles on a hot day is also the result of impoverished circulation in the legs. Muscular tiredness, which is so familiar in hot weather is due partly to nervous disturbance, and partly to an accumulation of lactic acid in the muscles improperly supplied with blood.

Loss of water from the body—dehydration—is a further disturbing factor. As I have said previously, tropical residents as a whole do not drink enough water. Dehydration accentuates circulatory troubles and interferes still further with muscle action.

Loss of salt, if severe, produces very painful muscle cramp and may be fatal. A less severe reduction of salt may be another factor reducing muscle power, although this has not been proved.

A rise of body temperature up to 102 degrees is not a handicap; in fact, it may be an advantage. A rise beyond this is a handicap which increases as the temperature rises. Above this temperature the cells are being worn out too quickly and consequently cannot do their job properly. At 108-110 degrees, the nervous tissue is killed. This is the true heat stroke.

The Net Result.

As a result of experiments conducted in different laboratories and in view of one's knowledge of bodily working, it seems that the position as regards muscular work in the tropics can be crystallised in the following conclusions:—

(1) At effective temperatures below 74 degrees, hard muscular work can be carried out by the average man with little detriment to his body or loss of efficiency. (Only the south-east corner and the mountainous regions of Queensland satisfy this condition at 9 a.m. during the hottest month of the year.)

(2) As effective temperature rises above 74 degrees, the severity of the work which can be carried out by the average unacclimatised man without loss of efficiency or detriment decreases to none at 86 degrees effective temperature. (The highest average 3 p.m. effective temperatures reached in the hot months in Queensland are 84 at Normanton and Croydon, with a little less at Urandangie and Winton.)

(3) The severity of the work can often be temporarily increased above these limits, but it cannot be maintained at this high level, at least without detriment to the body. The body seeks to protect itself against damage by reducing the work capacity.

(4) Training, acclimatisation, social conditions, nutritional state, and interest in the work affect work capacity more readily than at lower temperatures. The extent to which the first two affect local reaction badly needs working out, and will become a point of major research by the Physiology Department in the near future.

Practical Points.

It seems clear from the considerations I have mentioned that at least during the hottest month, a very large part, if not the whole of Queensland, is under conditions during the ordinary working day which threaten or even force a reduction in work capacity as compared with colder climates. It remains to be decided by careful observation and research to what extent it remains a threat and to what extent it is actually, or need be, operative. Training, acclimatisation and deliberate attention to working and living conditions are all important factors and may tip the balance one way or the other.

Even at this stage, certain broad principles stand out whereby the threatened or actual interference may be reduced. In the first place, the fullest use should be made of the very wide range of information available in the field of industrial hygiene, with regard to simple measures for ensuring a maximum of both comfort and productivity in industry. In "industry" I include primary, secondary and tertiary industries, and by "worker" I mean every man who uses his muscles in productive labour. Measures which improve these in temperate countries are even more necessary and useful here. Fatigue in industry has been greatly reduced by attention to details of work, many of them very simple.

In the second place, the effective temperature should be reduced as much as possible by free ventilation and air movement in humid climates and by insulation and evaporation in arid climates.

Thirdly, clothing should afford full movement of limbs and the freest circulation of air over the body, particularly in humid climates.

Fourthly, the nutritional plane of the tropical dweller and worker should be raised to the highest possible point under local conditions, not only by quantity of food, but, more importantly still, by the quality of food, according to modern nutritional ideals.

Lastly, social amenities should be raised and kept at the highest possible plane. Lack of social amenities is one of the biggest deterrents to land settlement and development.

HOME-MADE ANVIL.

A home-made anvil can be constructed from a 4-feet piece of railway metal

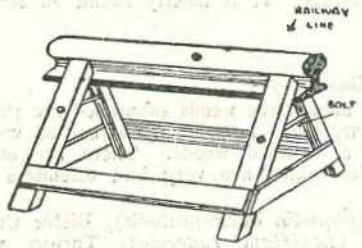


Plate 258.

mounted on a trestle as shown in the sketch. This will stand a lot of heavy pounding and comes in handy in many ways on the farm.

Answers to Correspondents

BOTANY.

Replies selected from the outgoing mail of the Government Botanist, Mr. C. T. White, F.L.S.

Annual Hibiscus.

R.A.T. (Ardenlea, via Stanthorpe)—

The specimen forwarded represents *Hibiscus trionum*, a small annual hibiscus sometimes known as *bladder ketmia*.. It is widely spread over the warmer regions of the world. In Queensland it is very abundant on the black soil parts of the Central-West, and is often seen as a weed on the Darling Downs.

It is not known to possess any poisonous or harmful properties, and does not seem likely to become an aggressive weed.

Wild Rice.

J.M.R.C. (Emerald)—

The specimen submitted is *Chionachne barbata*, a grass with a fairly wide distribution in the Central-West and North-West. We have not heard a distinctive local name applied to it. About Hughenden it frequently is known as wild paddy or wild rice, although these local names belong more correctly to a true wild rice which grows in North Queensland, particularly about the Gulf country.

Native Tobaccos.

C.S.C. (Mackay)—

The specimens forwarded represent *Nicotiana Debneyi*, one of the commonest of our native tobaccos.

The Australian species of *Nicotiana* have been under review recently, and several species are recognised now which were all listed in the Queensland flora as *Nicotiana suaveolens*.

Variety of Grasses from West Moreton

J.C. (Calvert)—

1. *Cynodon dactylon*, common couch grass. A very nutritious grass, and one of the best fodders we possess. It makes only a light leaf growth, however, and its carrying capacity is not very high.
2. Not received.
3. *Heteropogon contortus*, bunch spear grass. This grass is very palatable in its younger stage, and even when older, I have known it to be made into chaff during drought periods.
4. *Vicia sativa*, var. *segetalis*. This is a variety of the common vetch. It is quite a good fodder.
5. *Digitaria marginata*, summer grass. This grass is very widely spread over the warmer regions of the world. It is mainly a weed of cultivation in the ordinary pasture. It is mostly found on sandy land, and is quite a good fodder.

Milk-tainting Weeds.

G.H. (Booinbah, via Goomeri)—

The worst offenders among the weeds submitted are the various members of the family *Cruciferæ*, which includes a number of weeds frequently known as turnip weeds or mustard weeds. There are other weeds belonging to different families which are very bad offenders in this respect. These include:—

Shepherd's Purse (*Capsella bursa-pastoris*), Bitter Cress (*Senebiera didyma*), Pepper Cress (*Lepidium ruderale*), Turnip weed or wild mustard (*Brassica juncea*), Wild carrot (*Apium leptophyllum*), Fish weed (*Chenopodium triangulare*), Turkey weed (*Rivina lævis*), Melilot or hexham scent (*Melilotus indica*).

Common Weeds. Rattle Pod.

A.J.B. (Proserpine)—

The specimens have been determined as follows:—

17. *Bidens pilosa,* cobbler's pegs.

18. *Crotalaria striata,* rattle pod. This plant is very widely spread over the warmer regions of the world; it is probably a native of Queensland as well as of Asia. It is largely used in some countries as a green manure, particularly in Ceylon as a green manure for tea. It has been proved poisonous to stock, although they do not eat it in sufficient quantities.

19. *Richardsonia brasiliensis*—a very common weed in coastal Queensland. It was boomed some years ago as a fodder under the name of Mexican clover, but so far as our experience goes stock did not take readily to it. It is in no way related to the true clovers or trefoils, but belongs to the family *rubiaceæ.*

20. *Physalis minima,* wild gooseberry. A very common weed in coastal Queensland. It is closely related to the Cape gooseberry.

21. *Boerhaavia diffusa,* tar vine. A very common weed in Queensland, found from the coast to far inland. It is generally looked upon as quite a good fodder for stock. The name tar vine comes from the small sticky fruit the plant possesses.

Weed from East Indies.

K.L. (Ingham)—

The specimen forwarded by the Director, Bureau of Sugar Experiment Stations, in your behalf is *Cleome aculeata,* a native of tropical America, now a common naturalised weed in most tropical countries. It is very abundant in parts of the East Indies, and probably was introduced into Queensland from either Java or Singapore.

The plant has been established in Queensland for many years. We first received specimens of it from Mr. Newport in 1904, when he stated that it was a common weed in paddocks about Kamerunga (Red Lynch). No common name has been applied to the weed. No report has been received as to its having a serious effect upon cane, other than ordinary weeds would have; and neither it nor its allies are known to be parasitic. Although the weed has been established in Queensland for some time it has not generally manifested itself as an aggressive plant.

Yellow Dock.

S. E. McC. (Greenmount)—

The plant you describe as spinach with the deep red root is the curled dock or yellow dock (*Rumis crispus*), a fairly common weed on the Darling Downs, having a very deep red root with a yellow flesh. It is rather difficult to get rid of, as it has to be dug out carefully, and all roots removed. When cut or cultivated the root sends out a new crown. Unless kept in check it is apt to spread from fresh seeds produced every year in the spring and early summer. Mostly only a few plants are seen, but on some farms it is a serious pest.

Perhaps you had better send a leaf or two of the plant to make sure that the yellow dock is the weed you describe.

Grasses and Sedges.

M.W. (Kanighan, via Gootchie)—

(*a*) *Brachiaria foliosa,* leafy panic grass. A broad- leaved palatable native grass.

(*b*) *Bromus unioloides,* prairie grass. Seed heads are necessary to be certain of a determination. Prairie grass is one of the most extensively-cultivated winter grasses in Queensland.

(*c*) *Themeda australis,* kangaroo grass.

(*d*) *Capillipedium parviflorum,* scented top. A rather coarse forest grass, but a useful cattle food.

(*e*) *Cyperus cyperoides,* a sedge and not a true grass. We hope to publish a book in a short time on "Principles of Botany for Queensland Farmers." This will give you the differences between grasses and sedges.

Ironwood. Scrub Wilga. Yellow-wood.

D.F. (Brisbane)—

The specimens forwarded with your letter have been determined as follows:—

1. *Myrtus acmenioides*, ironwood.
2. *Geijera Muelleri*, a scrub wilga. We do not know how the name Johnstone River hardwood could be applied. It perhaps has some superficial resemblance, but the true Johnstone hardwood is confined to North Queensland.
3. *Rhodosphæra rhodanthema*, deep yellow-wood.

Turkey Bush. Ellangowan Poison Bush.

L.A.B. (Brisbane)—

1. *Eremophila brownii*. A plant moderately common in South-Western Queensland, although we have never heard of its becoming a serious pest. It has no local name, but it belongs to the same genus as the common turkey bush of Charleville, and the native Fuchsia (*Eremophila*).
2. *Myoporum deserti*. Ellangowan poison bush. This plant is very widely distributed in Queensland, and grows right from the coast to the far interior. It is particularly abundant in timbered country and grows very rapidly once this country is ringbarked or cleared. It is generally regarded in Western Queensland as a poisonous plant, and feeding tests have proved its poisonous properties. Much of the trouble, however, so far as we have observed in Queensland seems to be with travelling stock. Constipation and acute inflammation of the digestive tract are results of myoporum poisoning.

Native Marjoram. A Suspected Plant.

W.A.K. (Clermont)—

Ocimum sanctum, holy basil, commonly known as native marjoram in North Queensland. The Australian plant is a form or variety of one widely spread in Asia, particularly in India. In that country it is much used as a decoction in fever and bowel complaints. It is also used as a flavouring. The seeds are mucilaginous, and used as a native remedy in the treatment of gonorrhœa.

Pterigeron odorus—A native plant, for which we have not heard a local name. It has been suspected of poisoning stock on one or two occasions.

Caustic Weed.

G.H.S. (Chinchilla)—

Your specimen is *Euphorbia Drummondii*, the caustic weed, a plant very widely spread in Australia. In New South Wales tests for the presence of a prussic acid yielding glucoside have given positive results. Repeated tests with Queensland plants, however, have always yielded negative results, and the symptoms, as described by experienced stock-owners, are certainly not those of typical prussic acid poisoning.

The animals mostly affected are sheep. The head and neck of affected sheep swell considerably; but, if the swelling is pierced, an amber-coloured fluid exudes, and the life of the sheep may be saved, although the head of the animal has the appearance of having been badly burnt.

It is mostly travelling stock that is affected by the plant, and ordinary paddock-resting stock feed on it with impunity.

Age of a horse, as indicated by the teeth.

A.W. (Sarina)—

A few months before three years old, the horse sheds the two centre milk teeth, which are replaced by permanent. Thus the jaw contains at three years old, two centre permanent teeth and two milk teeth on each side. A few months before four, the horse sheds the two next milk teeth, which are replaced by permanent. The jaw now contains four permanent and one milk tooth on each side. A few months before five, the horse sheds the two remaining milk teeth, which are replaced by permanent. Thus the jaw is now furnished with six permanent incisors, but the corner teeth are mere shells, having no internal wall. A few months before six the inner wall of the corner teeth has grown up level with the outer wall. The mouth is now fully complete in incisors, and no further structural changes take place in them. As a general rule, we may add that the upper temporary teeth fall out a little before those in the lower jaw.

General Notes

Staff Changes and Appointments.

Mr. W. A. Winchester (Bundaberg), Mr. A. McTavish (Yeppoon), and Mr. J. T. Littleton (Inspector of Stock, Innisfail) have been appointed honorary rangers under the Animals and Birds Acts.

Mr. F. F. Walcott (Eagle Heights, Tamborine) has been appointed an honorary ranger under the Animals and Birds Acts and the Native Plants Protection Act.

Sergeant (2/C) J. C. Harris (Blackbutt) and Constable P. Tracey (Bedourie) have been appointed also inspectors under the Slaughtering Act.

Messrs. D. R. L. Steindl and C. W. Leece, assistants to pathologist, Bureau of Sugar Experiment Stations, Department of Agriculture and Stock, have been appointed also inspectors under the Diseases in Plants Acts.

Mr. F. W. Olney, gatekeeper, Border Gate, Coolangatta, has been appointed also an inspector under the Diseases in Plants Acts.

Miss E. A. Crees (Ayr) has been appointed assistant cane tester at the Inkerman mill.

Transfers of officers of the Department of Agriculture and Stock include those of Mr. J. A. L. Rheuben, inspector of slaughterhouses, from Maryborough to Ipswich; Mr. C. Caswell, inspector of slaughterhouses, from Ipswich to Maryborough; and Mr. B. Funnell, banana agent, from Brisbane to Cairns.

Mr. J. J. Leather (officer in charge of waterworks, Teddington, near Maryborough), Mr. M. A. New (Maryborough), and Mrs. W. M. Guymer (Rangeville, Toowoomba) have been appointed honorary rangers under the Animals and Birds Acts.

Messrs. H. V. Damm, D. Krueger, J. Neuendorf, and A. C. J. Herrmann (Fassifern Valley), and G. E. Neuendorf (Kalbar), and T. Von Kistowski (Mt. French) have been appointed honorary rangers under the Animals and Birds Acts.

Dr. G. M. Davidson (Eagle Heights) and Mr. F. W. Taylor (North Tambourine) have been appointed honorary rangers under the Animals and Birds Acts and the Native Plants Protection Act.

Sergeant, 2nd Class, A. S. Gordon (Atherton), and Constables F. Purtle (Calen) and J. V. Kelly (Marmor) have been appointed also inspectors under the Slaughtering Act.

Mr. W. I. Coates, "Eversley," Loganlea, has been appointed an honorary ranger under the Animals and Birds Acts.

Broom Millet Board.

An Order in Council has been issued under the Primary Producers' Organisation and Marketing Acts, extending the operations of the Broom Millet Board for the period from 1st November, 1937, to 31 October, 1943.

Trans-Border Stock Restrictions Rescinded.

An Order in Council has been issued under the Diseases in Stock Acts, rescinding two Orders in Council approved in November, 1930, and May, 1933, which placed certain restrictions on the introduction into Queensland of cattle from New South Wales through the crossing place at Killarney.

Trans-Border Fruit Trade.

A Proclamation has been issued under the Diseases in Plants Acts declaring that the introduction of fruit into the South Coast fruit district of Queensland shall be permitted via the border crossing between Coolangatta and Tweed Heads only at the following times:—

Monday to Friday, inclusive: From 8 a.m. to 4 p.m.
Saturday: From 8 a.m. to 12 noon.

Notice of the arrival at the crossing of any fruit or vegetables shall be given immediately to the inspector at the crossing by the person introducing them. The inspector shall inspect all such fruit or vegetables, and if found to be free from disease, shall, upon the payment of the prescribed inspection fees, issue a certificate for their importation.

Northern Pig Board.

Two Orders in Council have been issued under the Primary Producers' Organisation and Marketing Acts in relation to the Northern Pig Board. The first provides that elections of growers' representatives on the Northern Pig Board shall be held triennially and that members elected shall hold office for a period of three years.

The second amendment covers the delivery of pigs to the Northern Pig Board, and provides that pigs shall be delivered to the Board or its authorised agents by the nearest usual practicable road or railway, within such times, at such places, and in such manner as the Board may fix, or as may be prescribed. At present, it is a condition that pigs shall be delivered in such quantities, description, and condition as the Board may fix by notice approved by the Minister, published in a local newspaper or newspapers.

Anzac Festival Competitions.

Details of the competitions in music, literature, and art generally, arranged by Anzac Festival Committee in connection with the commemoration for 1937-38, have been announced. A prize of £5 is offered for the best script for a pageant epitomizing a cycle of British history embracing the birth of Shakespeare, St. George, the patron saint, the landing of the Anzacs on Gallipoli, the arrival of Captain Cook in Botany Bay, and other prizes, will be open to competition, particulars of which can be obtained from the honorary secretary, Miss Merle Harvey, Scot Chambers, Hosking Place, Sydney. A stamped addressed envelope for a reply must be enclosed with each letter of inquiry.

Cane Growers' Council.

The Queensland Cane Growers' Council Regulations, issued under the Primary Producers' Organisation and Marketing Acts, provide, among other things, that a member of the Queensland Cane Growers' Council, a district executive, or mill suppliers' committee must derive at least 60 per cent. of his net annual income (from personal exertion) from the growing and supplying of sugar cane. These Regulations have been amended to the extent that a farmer deriving 80 per cent. of his income from personal exertion from diversified agricultural pursuits and having not less than ten acres of land under cultivation for sugar cane, may be eligible for membership on such council, any district executive, or mill suppliers' committee.

Co-operative Hail Insurance.

A Regulation issued under the Primary Producers' Organisation and Marketing Acts in November, 1936, empowering the Committee of Direction of Fruit Marketing to make a levy on fruitgrowers in the Stanthorpe district to raise moneys to be applied in establishing and maintaining the Stanthorpe Fruit Co-operative Hail Insurance Fund, has been amended to provide that it shall be a condition of cover that all contributions to the fund shall have been regularly and punctually paid by the grower, and it shall be a condition precedent to his right to receive any payment from the fund that he shall have established to the reasonable satisfaction of the board of control that all contributions payable by him have been so paid.

Plywood and Veneer Board.

Orders in Council (2) have been issued under the Primary Producers' Organisation and Marketing Acts, amending the constitution of the Plywood and Veneer Board and the Northern Plywood and Veneer Board, in relation to the number of elected representatives on such boards, and providing that elections of growers' representatives shall be held triennially and that members shall hold office for a period of three years.

Two Diggers who fell at Pozieres—Who were they?

The Defence Department announces that enquiries have been instituted by the Imperial War Graves Commission with a view to ascertaining, if possible, the identity of two Australian soldiers whose bodies have been exhumed from a spot approximately 500 yards north-east of the village of Pozieres (Somme), France.

In one case a 9-carat gold ring engraved "T.R. to A.R." was found in one dead Digger's pocket, whilst the remains of the other were wrapped in a waterproof sheet upon which the following particulars can be traced:—

"4540, A. F. . . . . nn, D. Company, 16 Platoon."

Any person who may be able to assist in the identification of these two soldiers is asked to communicate with the Officer-in-Charge, Base Records Office, Department of Defence, Melbourne, S.C. 1.

Rural Topics

Improving Production of Cows.

The success achieved by dairymen in the production of their herds depends very largely on the skill and care bestowed upon the cows. It is an easy matter to pick out two classes of dairymen by the condition of their herds. One group has found it pays to keep cows in good condition, and especially at calving time. The other group, not being alive to the necessity for supplying plenty of the right kind of feed at the right time, and, further, assuming that cows need be fed only while they are giving milk, have cows whose condition is anything but satisfactory at the beginning of a new lactation period. These are the men who should make some improvement in their skill in feeding and caring for cows, if the cows are to make them as much money as they are capable of making under right conditions.

Pastures have been deficient in many parts of the State, and as a result a lot of cows will not be in proper condition to calve and carry on their next lactation period. There, however, is still time to give these cows a fair chance to make good before they settle down actually to milk production.

Good dairy cows should have from six to eight weeks' rest between the close of one lactation period and the beginning of the next. More than this, they should be fed well enough to permit them to regain any condition which has been lost because of the short pasture. It is a very difficult matter to feed cows back to condition after they have calved.

The advice given is:—Look over your cows now and pick out those that need some extra feed, and, most important of all, give it to them. Calving troubles, retained afterbirth, and premature calving are costly. Many of these troubles are due to ill condition and may be prevented by proper care before calving.

The Apiary.

This month nectar will be coming in freely in most of the beekeeping districts, and the bees will need an extracting super. This is a hive body exactly similar to a brood-chamber, and is provided with drawn-out combs, or failing these, with frames containing full sheets of foundation. Most beekeepers put only nine frames equally spaced in a ten-frame hive body when used as a super, because the extra space between the combs allows the bees to make thicker and more even combs, which are much easier to uncap. Further, if these "fat" combs are cut down to normal when uncapping, there will also be a material increase in the wax production of the apiary.

If the colony is strong enough, the bees will immediately take possession of the super, but should they be disinclined to go up, a frame of brood may be taken from the brood-chamber and placed above, exchanging it for an empty comb, and this will usually induce the bees to commence storing honey in the super.

Many beekeepers work with a single super to each hive, but it is not the best method, as during a good flow honey is sometimes lost for lack of storage room, while if the unripe honey is removed in order to make room, trouble will occur later on through this watery honey becoming sour and fermenting.

In order to ensure that only thoroughly ripe honey is extracted, and at the same time to take full advantage of a sudden honey flow, several spare supers containing drawn-out combs are necessary. These are tiered up one above the other, as they are required. When adding an additional super to the tier, it should always be placed next to the brood-chamber, and the others containing partly-filled or unsealed comb placed above these two.

The thorough ripening of honey cannot be too strongly recommended, and tiering should be practised, especially in the more humid coastal districts, as the honey is improved in both density and aroma the longer it is kept in contact with the bees.

—*H. Hacker.*

Checking Small Washaways.

Old sacks filled with grass sods placed across small eroded gullies on cultivated land effectively dam up rain water and eventually cause the gullies to fill with soil again.

Colours in Concrete—How to Mix them.

Fine dry colour pigments are used in the preparation of coloured concrete. The usual mixtures are:—

Red: 86 parts of cement and 14 parts of red oxide of iron.

Yellow: 88 parts of cement and 12 of yellow ochre.

Blue: 86 parts of cement and 14 of azure blue or ultramarine.

Green: 90 parts of cement and 10 of oxide of chromium.

Chocolate: 88 parts cement, 6 of black oxide of manganese, 4 of red oxide of iron and 2 of black oxide of iron or copper.

Black: 90 parts of cement and 10 parts of black oxide of manganese or any carbon black.

Pink: 97 parts of cement and 3 of best quality crimson lake.

A few experiments should be made to determine the quantity required. Every batch of colour then should be balanced carefully to ensure regularity in the finished work.

The colour and cement should be blended thoroughly in the dry state. One method is to pass the mixture several times through a fine-mesh plasterers' sieve until a uniform appearance is obtained. The coloured cement should then be mixed with two and a half parts of clean sand until of uniform appearance again. Scoop the mixture out in the form of a crater and pour in the water. The wet mixture should be well shovelled for about ten minutes to obtain the best results.

Where a pure white cement is desired, it is obtained best by using white cement, which is made from pure white limestone and pure white clays. Pure white sand, crushed quartz or crushed marble are the usual constituents.

In the Days when the World was Wide.

The article in the Journal on the subject of overlanding with stock reminds me of the time when I followed the occupation of a drover, writes an officer in the Department of Agriculture and Stock.

My first experience of a long journey was in the early "nineties." Setting out from the Lower Flinders for Bathurst in New South Wales, a distance of 1,500 miles, with a mob of 1,050 bullocks, we reached the end of our journey in twenty-six weeks.

The first "town" was 250 miles from where we took delivery of the mob, and we travelled by way of Jundah, Stonehenge, Adavale, Eulo, Barringdon, and Brewarrina.

We first sighted the railway at Nevertire after a journey of approximately 1,200 miles, and a lapse of five months. With the exception of one beast, which could not be accounted for, the correct number, minus the "killers," were disposed of by auction.

The following year I overlanded a mob of 200 unbroken horses to Dubbo, Orange, and Bathurst.

Sore Teats in Milking Cows.

Sore teats cause much loss to the dairy farmer, and the condition should always be treated suitably on its first appearance. Chapped teats are caused by the sudden chilling of the teats after wet milking, after the calf has ceased sucking, or by contact with stagnant water, filth, or irritants when lying down.

The chapping may be slight, or, on the other hand, it may extend into gaping sores, inducing retention of milk or even causing mammitis.

Sore teats may be prevented by washing the udder and teats thoroughly with warm water and soap when the cow first comes in, carefully drying the udder before applying olive oil to the teats. If the cow already has sore teats, they should be washed with warm soapy water; then thoroughly dried and treated with carbolised vaseline. If the sores are extensive and the irritation great the teats should first be washed with a solution of 1 dram of sugar of lead to 1 pint of rain water, after which benzoated zinc oxide ointment should be applied.

The careful use of a sterile teat syphon is desirable when the sores are very deep and painful, as manual milking opens the sores continually. Wet milking is a dirty and undesirable practice from every point of view.

—*W. Dixon.*

Orchard Notes

DECEMBER.

THE COASTAL DISTRICTS.

THE planting of pineapples and bananas may be continued, taking care that the ground is properly prepared and suckers carefully selected, as advised previously in these Notes. Keep the plantations well worked and free from weeds of all kinds, especially if the season is dry. New plantations require constant attention, in order to give young plants every chance to get a good start; if checked when young they take a long time to pull up and the fruiting period is considerably retarded. Small areas well worked are more profitable than large areas indifferently looked after, as the fruit they produce is larger and of very much better quality. This is a very important matter in the case of both of these fruits, as there is but a poor demand for inferior fruit. Canners only want first-class pines of a size that will fill a can, and cannot utilise small or inferior fruit, except in very limited quantities, and even then at a very low price. Small, badly filled bananas are always hard to quit, and with a well-supplied market they become unsaleable. Pineapple growers are warned that the sending of immature fruit to the Southern markets is most unwise, as there is no surer way of spoiling the sale of the main crop. Immature pineapples are not fit for human consumption, and are liable to be condemned by the authorities of the State to which they are sent.

Citrus orchards require constant attention; the land must be kept well worked and all weed growth destroyed. Spraying for scale insects should be carried out where necessary. Spraying with fungicides should have already been carried out where necessary, and, except in the case of a heavy infestation with black spot or brown spot of the Emperor mandarin, no further applications of copper sprays should be required. A close lookout must be kept for the first indications of "maori," and as soon as it is discovered the trees should either be dusted with sulphur or sprayed with lime sulphur. Borer should be looked for and destroyed wherever seen.

Early grapes will be ready for cutting. Handle carefully, and get them on to the market in the best possible condition. A bunch with the bloom on and every berry perfect will always look and sell well, even on a full market, when crushed and ill-packed lines are hard to sell.

Peaches, plums, papaws, and lemons will be in season during the month. See that they are properly handled. Look out for fruit fly in all early-ripening fruit, and see that none is left to lie under the trees to rot and thus breed a big swarm of flies to destroy later-ripening varieties.

Look out for Irish blight in potatoes and tomatoes, and downy and powdery mildew on melons and kindred plants. Use Bordeaux or Burgundy mixture for Irish blight and downy mildew, and sulphur dust or lime sulphur spray for powdery mildew.

THE GRANITE BELT, SOUTHERN AND CENTRAL TABLELANDS.

EARLY ripening apples, plums, apricots, peaches, and nectarines will be ready for marketing during the month. They are unsatisfactory lines to handle. The season of any particular variety is so short that it must be marketed and consumed as quickly as possible. All early ripening deciduous fruits are poor carriers and bad keepers, as their flesh is soft and watery, deficient in firmness and sugar, and cannot, therefore, be sent to any distant market. The available markets are quickly over-supplied with this class of fruit, and a glut takes place in consequence. Merchants sometimes make the serious mistake of trying to hold such fruits, in the hope of the market improving, with the result that, instead of improving, the market frequently becomes more and more congested, and held-over lines have to be sent to the tip. There is only one way to deal with this class of fruit, and that is to get it into consumption as rapidly as possible. Most early ripening fruits are useless for preserving in any way, their only value being what they will bring for consumption whilst fresh. This being so, it is only a waste of time and money to forward

immature, undersize, and inferior fruit to market, as it is not wanted, and there is no sale for it. It should never have been grown, as it is frequently only an expense to the producer. Early ripening fruits should, therefore, be carefully graded for size and quality, handled and packed with great care, and nothing but choice fruit sent to market. If this is done, a good price will be secured, but if the whole crop—good, bad, and indifferent—is rushed in to the local markets, a serious congestion is bound to take place and large quantities will go to waste.

Orchards and vineyards must be kept in a state of perfect tilth, especially if the weather is dry, so as to retain the moisture necessary for the development of the later ripening fruits. Where citrus fruits are grown, an irrigation should be given during the month if water is available for this purpose, excepting, of course, there is a good fall of rain sufficient to provide an ample supply of moisture.

Codlin moth and fruit-fly regulations must be observed in order to keep these pests under control; otherwise the later-ripening fruits are likely to be attacked severely by these pests.

Grape vines must be carefully attended to and sprayed where necessary for black spot or downy mildew or sulphured for oidium.

THE EFFECTS OF RAINFALL ON GRASSHOPPER INFESTATION.

Most of the country people in grasshopper-infested districts are at present remembering that the plague grasshopper is normally abundant only in the drier parts of the State and are hoping that the rain will terminate the present outbreak. There is reason to believe that the prolonged dry weather during the past few years was responsible for the present infestation on the eastern Darling Downs and in the Moreton District. Unfortunately, experience during 1934 indicated that once the insect is temporarily present in large numbers in a district, normal or even greater than normal rainfalls may not prevent further large scale breeding for one or two generations. There is, therefore, no foundation for the hope that now rain has fallen the grasshoppers will necessarily disappear immediately from the districts that have benefited. Rather, the rain will ensure a plentiful supply of food for the insects now present.

This somewhat pessimistic viewpoint is not, however, the only one. Rain should definitely improve the position, if it is necessary to deal with another generation later in the season. Baiting work was complicated in this present generation by the fact that hatching took place over a protracted period and repeated baitings of individual egg beds were often necessary. This may have been due to the exceedingly dry condition of the soil during recent months, and it is probable that with normal soil conditions in early summer, delayed hatchings should not be a complicating factor in any future baiting. One realises also that the free growth of grass and herbage should somewhat lessen the seriousness of grasshopper injury on pastures and at the same time provide some measure of counter-attraction which will lessen the risk of injury to standing crops. It is obvious, therefore, that the rain that has fallen will give certain benefits, but it should not be assumed that there will be no further outbreaks in the closely settled districts which are infested at the present time.

While a great amount of valuable work has been done in controlling the present generation by baiting, it must still be realised that in spite of the rains continued vigilance is necessary in order to deal promptly with such swarms of plague grasshoppers as emerge in the next generation.

—*J. W. Weddell.*

Farm Notes

DECEMBER.

ALTHOUGH November is regarded generally as the best period for planting the main maize crop, on account of the possibility of the tasselling period synchronising later on with the summer rains, December planting may be carried out in districts where early frosts are not prevalent, provided a known quick maturing variety of maize is sown.

To ensure a supply of late autumn and winter feed, dairymen are advised to make successive sowings of maize and sorghums, to be ultimately used either as green feed or silage. The necessity for such provision cannot be urged too strongly. Farmers who have not had any experience in building a silage stack can rest assured that, if they produce a crop for this purpose, information and instruction on the matter will be given on application to the Under Secretary for Agriculture and Stock; also that, whenever possible, the services of an instructor will be made available to demonstrate methods of making silage for the benefit of the farmer concerned and his immediate neighbours.

In districts and localities where supplies of lucerne are not available, sowings of cowpeas should be made, particularly by dairymen, as the lack of protein-yielding foods for milch cows is a common cause of diminished milk supplies and of unthriftiness of animals in dairy herds. Cowpeas and lucerne can be depended upon to supply the deficiency. The former crop is hardy and drought-resisting. When plants are to be used as a fodder, it is customary to commence to feed them to stock when the pods have formed. Animals are not fond of cowpeas in a fresh, green state; consequently the plants should be cut a day or two before use. Economy is effected by chaffing beforehand, but the plants can also be fed whole. Chaffed in the manner indicated, and fed in conjunction with green maize, or sorghum, when in head, in the proportion of one-third of the former to two-thirds of the latter, a well-balanced ration is obtainable. The plant also is a good soil renovator. Pig-raisers will find it invaluable also.

A great variety of quick-growing crops, suitable for green fodder and ensilage purposes, may also be sown this month, notably Sudan grass, white panicum, giant panicum (liberty millet), and Japanese millet. Well-prepared land, however, is required for crops of this description, which make their growth within a very limited period of time.

Successive sowings may be made of pumpkins and melons.

Keep down all weed growth in the cotton field by scarifying as long as the growth will admit of the use of horse-drawn implements.

AERATION AND SOIL PESTS.

Soil aeration has a direct effect on the growth of crops. By soil aeration is meant allowing the air to reach the roots of plants. Access of air to the roots results in better crops. Not only does it mean quicker growth and heavier yields, but the quality will be better. The result of providing a good friable root run, such as can only be obtained by constant soil movement, is that the root hairs or filaments are able to spread rapidly in all directions, and find all the nourishment they need to keep progressing towards a really heavy harvest. If the roots of the plants have a free root run they will use up the biggest possible proportion of the fertilizer, and the farmer will receive the full possible return for his outlay. Another point is that the constant working of the soil disturbs large numbers of soil pests, and gives insect-eating birds a chance to destroy them.

OUR BABIES.

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

THE HOT WEATHER BOGY.

BABY enjoys the hot weather. There is nothing that pleases him better than to exercise his limbs freely in the most scanty attire, or in nothing at all, unless it is to splash about in a tub of tepid water. He is released from the burden of clothing which oppressed him in the cold season and cramped his movements.

Of course special care is needed during the hot season in some respects. If you over-clothe baby he will suffer from prickly heat. This is caused by excessive sweating, when the sweat is not allowed to evaporate freely. Dress him in cool singlets, not in heavy woollens. Outside the singlet he should wear only the coolest of airy garments, and these should be taken off when he is indoors. Do not torment him with flannel binders. Prickly heat is worst on his back, because he lies on that, and the perspiration cannot dry off quickly. Let him lie on cool sheets or, better still, on cool vegetable mats. Turn him over sometimes when he is asleep and train him to lie on his side.

He does not now need so much heat-forming food. Give him rather less solid food, rather less sugar and fat (clinic emulsion, for instance). But he needs more fluid, so let him drink as much boiled water as he likes between his meals. Do not forget that this is necessary for babies who are on the breast.

During warm weather all kinds of bacteria grow very rapidly, and so food does not keep but undergoes changes which make it unwholesome and sometimes even dangerous. Especially is this true of milk.

You know how quickly it goes sour. Unfortunately it changes in other ways which are more harmful than sourness. Therefore be careful to boil your milk as soon as you get it; then keep it in a cool place carefully protected from flies. Pasteurised milk delivered in bottles does not need to be boiled. It will keep good for twenty-four hours on ice; but otherwise, if you have only one delivery, you will need to boil it within twelve hours if it is to be kept till next morning. Should your milk be stale or dirty before it is boiled it will cause loose motions. When good fresh milk cannot be had you may use dried milk (Glaxo or Lactogen).

Loose motions or diarrhœa is common in warm weather, and needs careful watchfulness. Should your baby suffer from this you must at once stop giving him milk or any kind of food except very thin barley water slightly sweetened. Let him drink as much as he wants; he will be thirsty but not hungry. It may be even necessary to take him off the breast for one or two days. You may also give him one teaspoonful of castor oil to clear out any undigested food. Within twenty-four or forty-eight hours he should be much better, and probably a little hungry. A little breast milk may then be given, or you may then give him whey made with junket tablets, but the whey must first be brought to the boil. If he is over nine months you may also give him some arrowroot, cornflour, or sago boiled with water without milk, or a finger of bread baked hard and crisp. Do not give him milk foods until his motions become natural, and give the milk at first in very small quantity, increasing it gradually.

By this treatment attacks of simple diarrhœa are usually easily cured. But it is very different with diarrhœa caused by infectious bacteria. Of these the most dangerous is dysentery, which attacks us every year in the early summer during the fly season, not, be it observed, in the hottest time of the year, when the epidemic usually subsides.

We hope that our advice will be carefully observed, and that it will save many lives. The cause of the increased sickness and more frequent deaths among our infants during the summer is not the hot weather; it is the prevalence of dysentery and other bowel infections during this season. This infection occurs so frequently because mothers do not know how dysentery bacilli get into their babies. Babies have died from want of knowledge.

IN THE FARM KITCHEN.

EGGS FOR ALL MEALS.

Eggs Tartare.

Take 6 hard-boiled eggs, 1 lettuce, 1 teaspoonful chopped onion, 4 oz. boiled ham, ¼ teaspoonful made mustard, small quantity mayonnaise, pepper, salt, and cayenne to taste.

Shell the eggs and cut in halves lengthwise. Remove yolks and mix to a smooth paste with the onion, minced ham, mustard, pepper, salt, and cayenne to taste, adding mayonnaise to moisten. Fill egg-whites with the mixture. Arrange in a salad bowl lined with lettuce leaves. Place a dab of mayonnaise on top of each before serving.

Scotch Eggs.

Take 4 eggs, ½ lb. sausage meat, flour, egg, and breadcrumbs, nutmeg, flour, salt, and pepper.

Remove the skin from the sausages and season with a little salt, grated nutmeg, and pepper. Boil the eggs hard and remove the shells, dip each egg in flour. When cooking eggs, see that the water covers them completely. Roll each in a cake of sausage meat. Dip in beaten egg and crumb twice. Fry in deep smoking hot fat till crisp and golden. Serve when cold. Set in halves in a dish lined with watercress or lettuce.

Egg and Rice Pie.

Take 4 hard-boiled eggs, ½ pint milk, ¾ oz. flour, 3 oz. grated cheese, 1 oz. butter, 4 oz. rice, 1 teaspoonful chopped parsley, salt, and pepper.

Melt the butter in a saucepan. Stir in the flour. When frothy, stir in the milk. Season to taste with pepper and salt. Boil rice in salted water. Drain when cooked. Hold under tap for a moment or two to separate grains. Drain and re-heat, then arrange round a hot dish. Stir cheese into sauce. Quarter and add eggs. Stir till piping hot. Pour into centre of rice. Sprinkle filling with chopped parsley. Serve with a green salad.

Yorkshire Eggs.

Take 4 eggs, 4 rashers bacon, 4 rounds fried bread, ½ teaspoonful butter, 1 teaspoonful chopped parsley.

Grease four ramekin dishes with butter. Sprinkle with parsley. Drop an egg into each ramekin dish. Place in a saucepan containing hot water, coming half-way up the sides. Cover each with buttered paper. Steam for ten minutes or until set, taking care the water does not boil into the dishes. Remove rind from bacon, and chop and lightly fry bacon. Sprinkle over the bread. Turn out an egg and place on each round of fried bread. Surround with fried bacon. Serve with a green salad.

Anchovy Eggs "In the Nest."

Take 2 eggs, 2 small dinner rolls, 2 oz. butter, a little anchovy essence, chopped parsley, a little milk, seasoning.

Take the dinner rolls and slice off the tops. Scoop out the crumbs inside, mix the anchovy essence with the butter, and spread on the inside of the rolls. Break the raw eggs into these, and season. Put the rolls on a baking tin or sheet. Brush over the outside of the rolls with a little milk, and put into a moderate oven until eggs are set. Sprinkle with chopped parsley. Serve with the lids off or on as preferred. Care must be taken that the eggs are not broken when putting them into the rolls.

Eggs with Cheese Stuffing.

Take 3 hard-boiled eggs, 4 tablespoonfuls grated cheese, ½ pint white sauce, 1 tablespoonful butter, 3 tablespoonfuls breadcrumbs, 1 teaspoonful chopped onion (if liked), pepper, salt, and grated nutmeg to taste.

Shell and cut eggs in halves lengthwise, scoop yolks into a basin, and mash till smooth. Then stir in the cheese, crumbs, pepper, and onion, salt, nutmeg, and a little white sauce to moisten. Stuff each egg-white with the mixture. Mould stuffing until the stuffed half looks like a whole egg. Sprinkle each with a few breadcrumbs, and arrange all in a buttered fireproof dish. Pour remainder of sauce round eggs, place a dab of butter on top of each, and bake in a hot oven till a pale brown.

Egg and Potato Nests.

Take 6 large potatoes, 6 hard-boiled eggs, 6 pats butter, 6 tablespoonfuls grated cheese, cayenne and salt. Bake potatoes in their jackets in the usual way. Cut a slice neatly off the top of each. Carefully scoop out half of the inside of each potato. Shell the eggs and drop one into each "nest." Season to taste with salt and cayenne pepper. Add one pat of butter, then a tablespoonful of cheese. Bake in a hot oven for four minutes.

Egg and Fish Scallops.

Take 5 eggs, 2½ tablespoonfuls grated cheese, ¾ cupful well-seasoned white sauce, salt and pepper to taste, ¾ cupful flaked smoked fish.

Mix the smoked fish and sauce together in a saucepan. Boil for three minutes, and divide mixture between five buttered ramekin dishes. Break an egg into each. Sprinkle lightly with pepper and salt, then with grated cheese. Bake in a moderate oven until eggs are set, in about ten minutes.

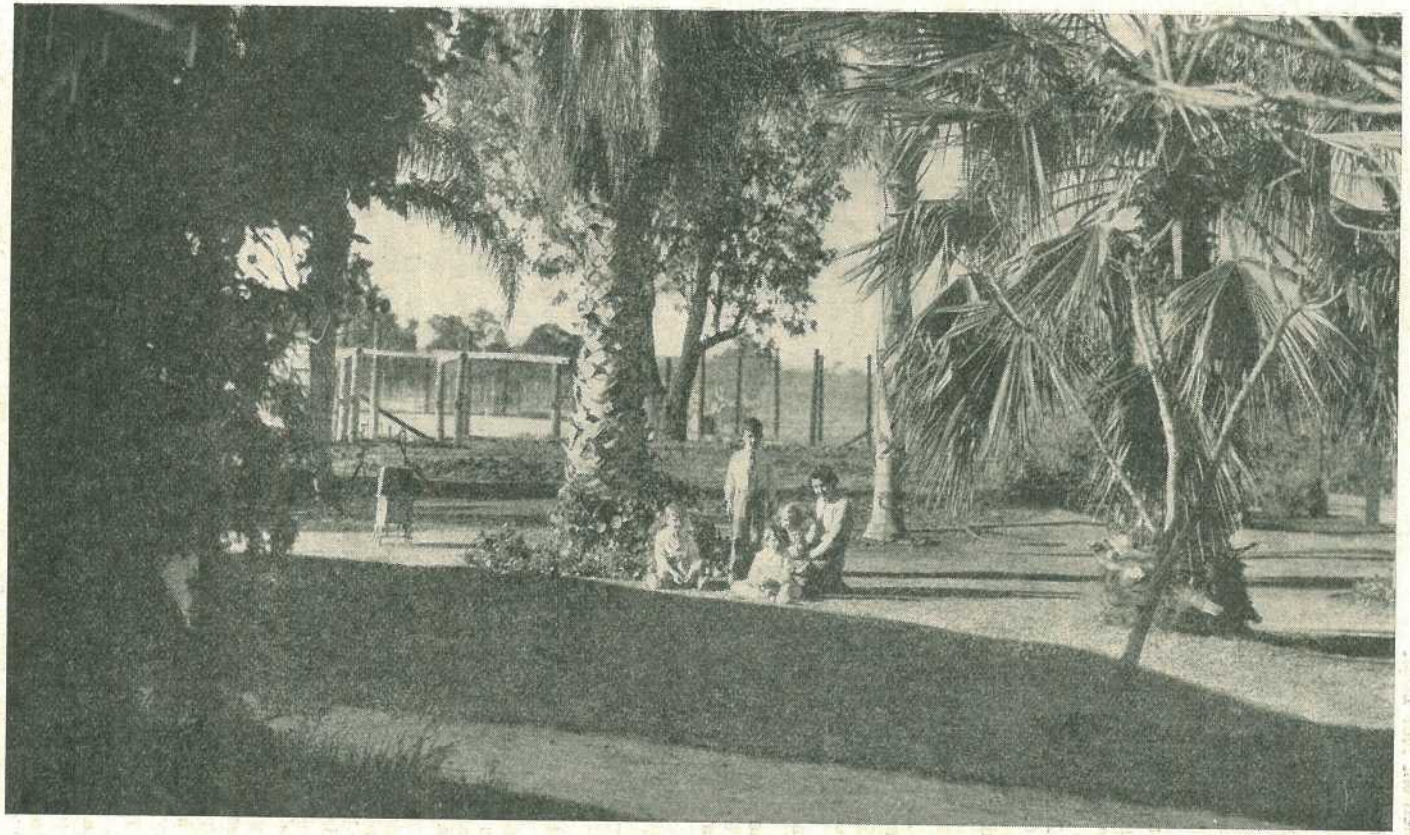


Plate 259. [*Photo.: Department of Agriculture and Stock.*

IN A WESTERN STATION GARDEN.—This charming scene was photographed on a recent visit to Yamburgan Station, in the Dirranbandi District, Q.

SOME WHEAT RECIPES.

Wholemeal Nut Loaf.

Ingredients.—Two cups wholemeal flour (finely ground), 1 teaspoon cream of tartar, ½ teaspoon carbonate of soda, 1½ tablespoons butter, 1 tablespoon sugar, ½ cup nuts, ½ cup raisins, ½ cup sultanas, 1 tablespoon golden syrup, 1 egg, 1 good cup milk.

Method.—Mix flour, sugar, cream of tartar, and soda, and rub in butter; add nuts and fruit. Dissolve golden syrup in milk and add to well-beaten egg. Mix all together, put into greased tins with lids on, and bake about three-quarters of an hour in a moderate oven.

A raisin loaf without nuts can be made if desired.

Wheatmeal Fruit Cake.

Ingredients.—Half pound butter, ½ lb. sugar, 1 lb. fine wheatmeal, 6 eggs, 1 teaspoon cream of tartar, ½ teaspoon carbonate of soda, ½ lb. chopped dates, 2 oz. nuts, ½ lb. raisins, ½ lb. currants, 1 oz. mixed peel.

Method.—Beat butter and sugar to a cream. Add eggs one at a time and beat for ten minutes. Add fruit, nuts and peel, and wheatmeal, cream of tartar, carbonate of soda, and a little milk if necessary. Put into greased tin and bake from one and a-half to two hours.

Wheat "Coffee."

Ingredients.—Three large cups of wheat, 2 tablespoons treacle, 1 tablespoon golden syrup, 3 teaspoons salt.

Method.—Wash wheat; drain and put into shallow baking dish, sprinkle salt on and mix in treacle and golden syrup, covering well all the wheat. Put into a hot oven and cook for one hour to one and a-half hours, stirring to prevent burning. When well cooked and the colour of the coffee bean when well roasted, remove from oven and allow to cool. Grind through wheat mill and store in sealed tins to keep in the strength.

Use one dessertspoonful of wheat "coffee" powder to each person, and add the hot milk to the coffee when ready to serve.

IN THE FARM GARDEN.

In planning the farm vegetable garden several points have to be kept in mind. The garden should be protected from prevailing winds and livestock, especially poultry, as well as being handy to the water supply and home. All perennial crops should be on one side of the garden, so as not to interfere with tillage operations. When space is limited, too much room should not be taken up with vine crops.

The garden should be planned so as to be economical of labour, and where possible the vegetables should be sown in rows to allow of inter-row cultivation, and the rows should run the long way of the garden. The garden should not be located near large shade trees, as vegetables require plenty of sunshine. The different crops should be grouped according to their cultural requirements and length of time taken to mature. The best soil is one well drained and rich in organic matter, and an abundance of farmyard manure is almost a necessity.

The home vegetable grower has a wide range of crops to chose from, but there are some crops that are outstanding for growing in the home garden.

The true spinach is rarely grown in Queensland, although when properly prepared it is a delicious vegetable, and superior to the silver beet. Varieties like Bloomsdale Savoy and Viroflay should always find a place in the home garden.

The growing of onions in the home garden is quite a simple matter if sets are used. These sets are miniature onions obtained by planting the seed thickly, late in season. The sets produce large early onions.

Peppers or chillies are rarely grown at all in this State. Being so suitable for savouries, relishes, condiments, and stuffed dishes, they are particularly valuable for home growing. The gherkins, or small black-spined cucumbers, find favour with home growers for pickling. They are grown like cucumbers, but are harvested when one inch to three inches long. The Boston Pickling is a very suitable variety to grow.

Something Different.

By way of providing something different, sweet corn, not field corn, should appeal to country people. Sweet corn may be grown in the garden to shade such crops as melons. It is advisable to have a succession of plantings to provide corn for a considerable period. It is important to harvest the corn at the correct stage—that is, when the grains are plump and still in the milk stage. It should be gathered just previous to cooking, as the quality is injured if kept for long periods.

Peas and beans give best results for home use when grown on trellises.

A bed of rhubarb is always valuable, and is a good substitute for fruits in the winter.

No home garden is complete without tomatoes, and both early and late staked crops should be grown.

Lettuce cannot be neglected. There are many other vegetables that can be given attention, such as asparagus, herbs, carrots, parsnips, cauliflowers, and melons.

GARDEN SEED SELECTION.

In selecting and saving seed for future plantings, the most vigorous, healthiest, and heaviest-bearing plants should always be reserved for the purpose. Type and production are essentials that should always be observed.

Various methods are used in the harvesting and cleaning of garden seeds, but the actual principles remain more or less steadfast. Seeds should not be harvested until fully ripe or mature. It is equally important that the crop should be promptly gathered when the proper time has arrived. If seed be left too long on the plant, sprouting or moulding may occur, and the seed, at least, will discolour. This is always objectionable when they are required for commercial purposes. Seeds are generally ripe when the pods or seed capsules turn yellow, or the fruits—such as tomatoes and melons—lose their firmness.

Bright sunny weather should be selected, if possible, for the harvesting of crops which require threshing—such as beans and peas. The plants should be dried thoroughly before threshing, and it is always better to select days of low humidity for this operation. No matter how the seed is threshed, the greatest care should be exercised to prevent breaking the seeds or the seed coats. Winnowing is often necessary for the final cleaning of the seed.

In securing clean seed of such fruits as tomatoes and melons the ripe fruits must stand for some time in their juices to remove the mucilaginous covering. A common method is to throw the cut specimens or the scooped-out pulp into any convenient vessel, such as a bucket, tin, or small barrel, and stir daily until fermentation has loosened the covering about each seed. This requires from three to six days. To prevent the discolouring of seeds, the fermentative process should not be continued longer than is necessary.

After fermentation the seeds are separated from the pulp and the skin by washing as often as may be required to obtain clean seeds. The good seeds settle to the bottom of the vessel, while the pulp, skin, and light seeds rise to the top and may be poured off. Three or four washings are usually sufficient, and the use of sieves in this process of separation is recommended.

After winnowing or washing, as the case may be, all seeds must be cured thoroughly before storing. They should be spread in layers upon trays in well ventilated places until thoroughly cured. It is an advantage to wash early in the mornings of bright days to facilitate drying, which should always be done under shade. Seeds may be stored in either cloth or paper bags. The greatest enemy to the preservation of seeds is moisture, but usually the conditions in an ordinary living-room are satisfactory. Provided the seeds are well cured and the humidity remains low ordinary fluctuations in temperature do not affect the vitality of the seed. It is a well-known fact that seeds do not keep well in North Queensland, because of the great amount of moisture in the atmosphere. Some seeds—such as cabbage, turnip, and radish—stand a very great chance of becoming mouldy unless kept in well-ventilated containers.

—H. J. Freeman, Senior Instructor, Fruit Culture.

Plate 260.

MORNING IN A BRISBANE GARDEN.—The charm of rockeries, winding paths and palms.

SOME FERTILIZING POINTS.

With the coming of the best rains since March, renewed interest will be taken in the garden, which should be a feature of every farm home. Most soils can be made to produce successful gardens, although the process requires time, energy, some expense, and an appreciation of certain fundamental principles, as well as attention to such important matters as seed and plant selection, and insect and disease control.

Intensive gardening demands a higher degree of soil fertility than does ordinary field crop culture. Not only should an efficient system of soil management make allowance for the present crop, but it should aim at an ever-increasing reserve of fertility. It should determine the necessity and value for the particular soil or organic matter, how most economically to apply this material, then attempt to supplement this where necessary, by liming and the addition of artificial fertilizers.

For the maintenance of fertility the city gardener has to place his chief dependence on chemical fertilizers, and the grower who lacks information as to the plant food content of his soil, and who desires to grow a wide range of crops of whose requirements he knows little, should play safe by using a high-grade "complete" fertilizer, and give a liberal application. Though he applies more than the plants actually require, the increased cost is so slight that the assurance of having enough is worth the additional expense.

A complete fertilizer is one supplying nitrogen, phosphorus, and potash in forms readily available to plants. A generally applicable complete fertilizer for home garden use consists of a mixture of dried blood, superphosphate and sulphate or chloride of potash. These substances in the proportions by weight of 3, 4, and 1 respectively give a 5-11-6 fertilizer, or one containing 5 per cent. nitrogen, 11 per cent. phosphoric acid, and 6 per cent. oxide of potash. On light-textured soils potash could be increased by using the same substances in the proportions of 2, 3, and 1, when a 4-11-8 fertilizer would be obtained.

Dried blood has many advantages as a source of nitrogen. It does not damage seeds or seedling roots; it becomes available when the root system is developing, and therefore is not lost. It is a useful basal form of nitrogen application, carrying plants up to the stage where it may be advantageous to apply forcing soluble nitrogenous fertilizers.

Sulphate of ammonia may be used in place of dried blood in the complete mixture, but should be used in two-thirds the quantity. The use of sulphate of ammonia results in loss of lime from soils, and in time develops strong acidity. These harmful effects are easily overcome by liming, but it is not advisable to use this fertilizer on acid, lime-deficient soils.

The tendency in home gardens is to use quantities of manure without the application of potash and phosphate, and results in a bad nutrient balance, which accounts for the frequent reports of plants producing excessive vegetative growth, with poor flower, fruit, or tuber production. Under such conditions the addition of a mixture of four parts of superphosphate and one of sulphate or chloride of potash would result in a better nutrient balance.

For crops such as lettuce, cauliflower, cabbage, Brussels sprouts, spinach, and celery, where vigorous growth must be maintained, liquid fertilizers can be applied when the plants are well established. The following flowers, provided a complete fertilizer has been used initially, have been found to respond to nitrogenous top-dressing:—Dahlia, chrysanthemum, calendula, Iceland poppy, sweet pea, primula, &c. The soil should be moist before the application of liquid fertilizers.

The most efficient forms of nitrogen for liquid application are nitrate of potash, nitrate of soda, or a mixture of these salts, and nitrate of lime. Sulphate of ammonia, phosphate of ammonia, or a complete liquid fertilizer consisting of nitrate of potash and superphosphate may be used. These substances are soluble in water (superphosphate will leave a considerable residue) and can be dissolved at the rate of 1 to 2 oz. per gallon, and the solution run along the rows from a watering-can with the sprinkler removed, or applied with a measure in the case of larger, spaced plants.

If the liquid comes in contact with the leaves, these may be hosed down after the application has been made, to obviate the possibility of injury.

The practice of broadcasting fertilizers is wasteful, since much of it will not come within the absorbing range of roots. When seeds are planted in drills, these should be opened up several inches broad at the bottom and from 1 to 3 inches deeper

than the seed is to be placed. The fertilizer then is distributed along the bottom of the row, at the rate of an ounce or two to the yard, the drill filled in to the desired depth, and the planting made.

With large growing plants that are spaced, such as tomatoes, cabbages, and potatoes, a hole a foot in diameter and several inches deep can be made with a spade, and a small handful of fertilizer scattered in the hole before filling in and planting above the fertilizer. Fertilizers for potatoes should be slightly below and in a ring about the tuber, rather than directly beneath it.

FERTILITY OF THE HOME GARDEN.

Intensive gardening demands a higher degree of soil fertility than does ordinary field crop culture. An efficient system of soil management, therefore, should not only make allowance for the present crop but should aim at an ever-increasing reserve of fertility. To achieve this end a plentiful supply of organic matter is essential.

Organic matter improves both the physical condition of the soil and its water-holding capacity. It also helps to modify extremes of soil temperature. In addition to providing some of the better known mineral constituents required by the plant, organic matter provides certain other necessary elements, usually not considered in the preparation of artificial fertilizers. Some heavy acid soils which fissure badly on drying can be improved in texture often by liming and the addition of organic matter.

The richer the food of animals the richer will be their excreta. Urine contains a great deal of the nitrogen and potash but only a small proportion of the phosphate excreted by the animal, and all three substances are in a form which is readily available for the plant. It is important, therefore, to realise that unless precautions have been taken to include the urine with the solid excreta the value of the manure is much less than it should be.

Horse manure is richer than cow manure, since the mineral requirements of the milking cow are much greater than those of the horse.

Poultry manure, when fresh, is a richer fertilizer than horse or cow manure. It contains more than twice as much nitrogen and phosphate, but has only about the same amount of potash. The bulk of its nitrogen is present in an easily available form, hence it is a quick-acting or forcing nitrogenous manure.

Animal manure, as commonly procurable, has not been carefully conserved, and must be regarded as an unbalanced fertilizer which should be supplemented by the application of artificial manures to the crop.

An annual application of 100 to 150 lb. per 100 square feet is necessary usually to maintain the fertility of the garden soil.

—*H. W. Ball.*

SHEEP LANDS FOR GRAZING SELECTION.

WELLSHOT RESUMPTION.

Portions 3 and 7, parish of Hazlemere, comprising part of Wellshot resumption, will be open for Grazing Homestead Selection at the Land Office, Longreach, on Thursday, 2nd December, 1937, at 11 a.m.

The portions are situated about 30 and 43 miles southerly from Lonreach.

The areas of the portions are 26,278 acres and 23,075 acres.

The term of each selection will be 28 years and the annual rental for the first 7 years is 4d. per acre.

Each selection must be stocked to its reasonable carrying capacity with the applicant's own sheep within a period of 3 years.

Both portions are artificially watered by tanks, but more water will be required. They comprise downs country and are first-class sheep areas, suitable for fattening, woolgrowing and breeding.

Free lithographs and full particulars may be obtained from the Lands Department, Brisbane, the Land Agent at Longreach, and the Queensland Government Tourist Bureaux at Sydney and Melbourne.

RAINFALL IN THE AGRICULTURAL DISTRICTS.

TABLE SHOWING THE AVERAGE RAINFALL FOR THE MONTH OF SEPTEMBER, IN THE AGRICULTURAL DISTRICTS, TOGETHER WITH TOTAL RAINFALL DURING 1937 AND 1936, FOR COMPARISON.

Divisions and stations.	Average Rainfall.		Total Rainfall		Divisions and stations.	Average Rainfall.		Total Rainfall.	
	Sept.	No. of years' records.	Sept., 1937.	Sept., 1936.		Sept.	No. of years' records.	Sept., 1937.	Sept., 1936.
North Coast.	In.		In.	In.	*Central Highlands.*	In.		In.	In.
Atherton	0·72	36	1·19	1·89	Clermont ..	1·02	66	0·04	0·06
Cairns	1·69	55	1·62	4·22	Gindie	1·08	38	0·05	0·11
Cardwell	1·54	65	1·15	2·41	Springsure ..	1·31	68	0·09	0·26
Cooktown ..	0·57	61	0·47	0·68					
Herberton ..	0·56	51	0·60	0·85					
Ingham	1·59	45	1·46	3·75					
Innisfail	3·53	56	2·96	6·94					
Mossman Mill ..	1·73	24	1·26	7·09	*Darling Downs.*				
Townsville ..	0·77	66	..	0·21					
Central Coast.					Dalby	1·69	67	0·66	1·07
					Emu Vale ..	1·78	41	0·78	1·59
					Hermitage ..	1·58	31	0·75	1·18
Ayr	1·34	50	0·01	0·11	Jimbour ..	1·49	49	0·35	1·25
Bowen	0·81	66	..	0·06	Miles	1·36	52	0·31	0 89
Charters Towers ..	0·81	55	..	0·11	Stanthorpe ..	2·31	64	0·17	1·50
Mackay	1·57	66	0·51	1·08	Toowoomba ..	2·14	65	0·59	1·70
Prosperine ..	2·10	34	0·99	2·28	Warwick ..	1·83	72	0·76	1·50
St. Lawrence ..	1·27	66	0·05	0·08					
South Coast.									
					Maranoa.				
Biggenden ..	1·57	38	0·33	0·69					
Bundaberg ..	1·60	54	0·07	1·24	Roma	1·43	63	0·27	0·44
Brisbane	2·02	85	0·20	0·84					
Caboolture ..	1·86	50	0·30	0·73					
Childers	1·82	42	0·13	0·48					
Crohamhurst ..	2·68	44	0·23	1·09					
Esk	2·13	50	0·35	1·09					
Gayndah	1·58	66	0·52	0·55					
Gympie	2·12	67	0·74	0·07	*State Farms, &c.*				
Kilkivan	1·72	58	0·70	1·13					
Maryborough ..	1·95	66	0·16	0·18	Bungeworgorai ..	0·97	22	..	0·25
Nambour	2·53	41	0·32	0·64	Gatton College ..	1·58	38	0·20	1·27
Nanango	1·84	55	0·53	0·99	Kairi	0·68	21	..	..
Rockhampton ..	1·31	66	..	0·13	Mackay Sugar Experiment Station	1·50	40	0·42	0·94
Woodford	2·18	50	0·20	0·43					

A. S. RICHARDS, Divisional Meteorologist.

CLIMATOLOGICAL TABLE—SEPTEMBER, 1937.

COMPILED FROM TELEGRAPHIC REPORTS.

Districts and Stations.	Mean Atmospheric Pressure, at 9 a.m.	Shade Temperature.						Rainfall.	
		Means.		Extremes.				Total.	Wet Days.
		Max.	Min.	Max.	Date.	Min.	Date.		
Coastal.	In.	Deg.	Deg.	Deg.		Deg.		Points.	
Cooktown	30·01	81	70	87	22	59	23	47	4
Herberton	..	75	51	85	20	40	6	60	6
Rockhampton	30·15	82	59	91	20	50	23	Nil	..
Brisbane	30·19	77	56	87	19	46	12	20	1
Darling Downs.									
Dalby	30·18	77	48	85	17	34	12, 22	66	1
Stanthorpe	..	69	40	79	29	26	12	17	1
Toowoomba	..	72	48	80	18	32	12	59	2
Mid-Interior.									
Georgetown	30·01	90	62	96	18	52	5	Nil	..
Longreach	30·11	85	55	94	16, 17, 18	43	4	Nil	..
Mitchell	30·16	79	44	96	28	31	12	16	3
Western.									
Burketown	30·02	89	64	94	4	57	6	Nil	..
Boulia	30·07	86	54	100	17	44	2	Nil	..
Thargomindah	30·13	79	52	97	17	42	4, 5, 12	7	2

ASTRONOMICAL DATA FOR QUEENSLAND.

TIMES COMPUTED BY A. C. EGLINTON.

TIMES OF SUNRISE, SUNSET, AND MOONRISE.

AT WARWICK.

	November, 1937.		December, 1937.		Nov. 1937.	Dec. 1937.
	Rises.	Sets.	Rises.	Sets.	MOONRISE. Rises.	MOONRISE. Rises.
					a.m.	a.m.
1	5·3	6·9	4·49	6·31	3·28	3·19
2	5·2	6·10	4·49	6·32	4·4	4·0
3	5·1	6·11	4·49	6·33	4·40	4·44
4	5·0	6·12	4·50	6·34	5·21	5·32
5	5·0	6·12	4·50	6·35	6·2	6·22
6	4·59	6·13	4·50	6·36	6·48	7·16
7	4·58	6·14	4·50	6·37	7·36	8·9
8	4·57	6·15	4·50	6·38	8·27	9·3
9	4·57	6·15	4·51	6·38	9·21	9·57
10	4·56	6·16	4·51	6·39	10·14	10·48
11	4·56	6·17	4·51	6·39	11·9	11·48
					p.m.	p.m.
12	4·55	6·18	4·51	6·40	12·5	12·44
13	4·55	6·18	4·52	6·40	1·1	1·45
14	4·54	6·19	4·52	6·41	1·58	2·49
15	4·54	6·20	4·52	6·41	2·58	3·55
16	4·53	6·21	4·52	6·42	4·2	5·4
17	4·53	6·22	4·53	6·42	5·10	6·8
18	4·52	6·23	4·53	6·43	6·21	7·9
19	4·52	6·23	4·53	6·43	7·29	8·7
20	4·52	6·24	4·54	6·44	8·33	8·55
21	4·51	6·25	4·54	6·44	9·28	9·40
22	4·51	6·26	4·55	6·45	10·20	10·18
23	4·51	6·27	4·55	6·45	11·4	10·56
24	4·50	6·28	4·56	6·46	11·44	11·39
25	4·50	6·28	4·56	6·46	..	..
					a.m.	a.m.
26	4·50	6·29	4·57	6·47	12·20	12·4
27	4·50	6·29	4·58	6·48	12·56	12·42
28	4·49	6·30	4·58	6·48	1·29	1·19
29	4·49	6·30	4·59	6·49	2·4	2·0
30	4·49	6·31	4·59	6·49	2·40	2·42
31			5·0	6·50		3·28

Phases of the Moon, Occultations, &c.

3rd Nov.	●	New Moon	2 16	p.m.
11th „	☽	First Quarter	7 33	p.m.
18th „	○	Full Moon	6 10	p.m.
25th „	☾	Last Quarter	10 4	a.m.

Apogee, 6th November, at 8·0 p.m.
Perigee, 19th November, at 11·0 a.m.

On the 18th a very small partial eclipse of the Moon will occur, of which the ending will be seen in Eastern Australia. When the full Moon is in exact opposition to the Sun, with the Earth between both, our satellite is totally immersed in the Earth's shadow; but when, as on the 18th, it is a little north of the Sun only a very small curve of the circular shadow of the Earth will here be seen on its edge for a short time after sunset.

Mercury rises at 5.10 a.m., 7 minutes after the Sun, and sets at 6.16 p.m., 7 minutes after it, on the 1st; on the 15th it rises at 5.26 a.m., 32 minutes after the Sun, and sets at 7.6 p.m., 46 minutes after it.

Venus rises at 4.0 a.m., 1 hour 3 minutes before the Sun, and sets at 4.24 p.m., 1 hour 45 minutes before it, on the 1st; on the 15th it rises at 3.54 a.m., 1 hour before the Sun, and sets at 4.50 p.m., 1 hour 30 minutes before it.

Mars rises at 9.58 a.m. and sets at 11.42 p.m. on the 1st; on the 15th it rises at 9.49 a.m. and sets at 11.27 p.m.

Jupiter rises at 9.54 a.m. and sets at 11.34 p.m. on the 1st; on the 15th it rises at 9.7 a.m. and sets at 10.49 p.m.

Saturn rises at 3.6 p.m. on the 1st and sets at 3.22 a.m. on the 2nd; on the 15th it rises at 2.8 p.m. and sets at 2.26 a.m. on the 16th.

When, at the beginning of the month, the Southern Cross has disappeared from the evening sky, and of Centaurus only the Pointers are seen above the horizon, somewhat later Argo, the Ship, will arise in the south-east, with its one great light, Canopus, the second brightest of all stars.

At about 9 o'clock, when the Great Square of Pegasus stands four-square on the meridian, the northern constellation Andromeda can be traced by three stars in line with the brightest one on the eastern side of the Square. The star nearest the horizon points westward to the Great Nebula in Andromeda, faintly visible to the naked eye, or in a field-glass, a Spiral Nebula, whose light takes 900,000 years to reach us.

3rd Dec.	●	New Moon	9 11	a.m.
11th „	☽	First Quarter	11 12	a.m.
19th „	○	Full Moon	4 52	a.m.
25th „	☾	Last Quarter	12 20	a.m.

Apogee, 4th December, at 3 a.m.
Perigee, 17th December, at midnight
Apogee, 31st December, at 4 a.m.

For places west of Warwick and nearly in the same latitude, 28 degrees 12 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.