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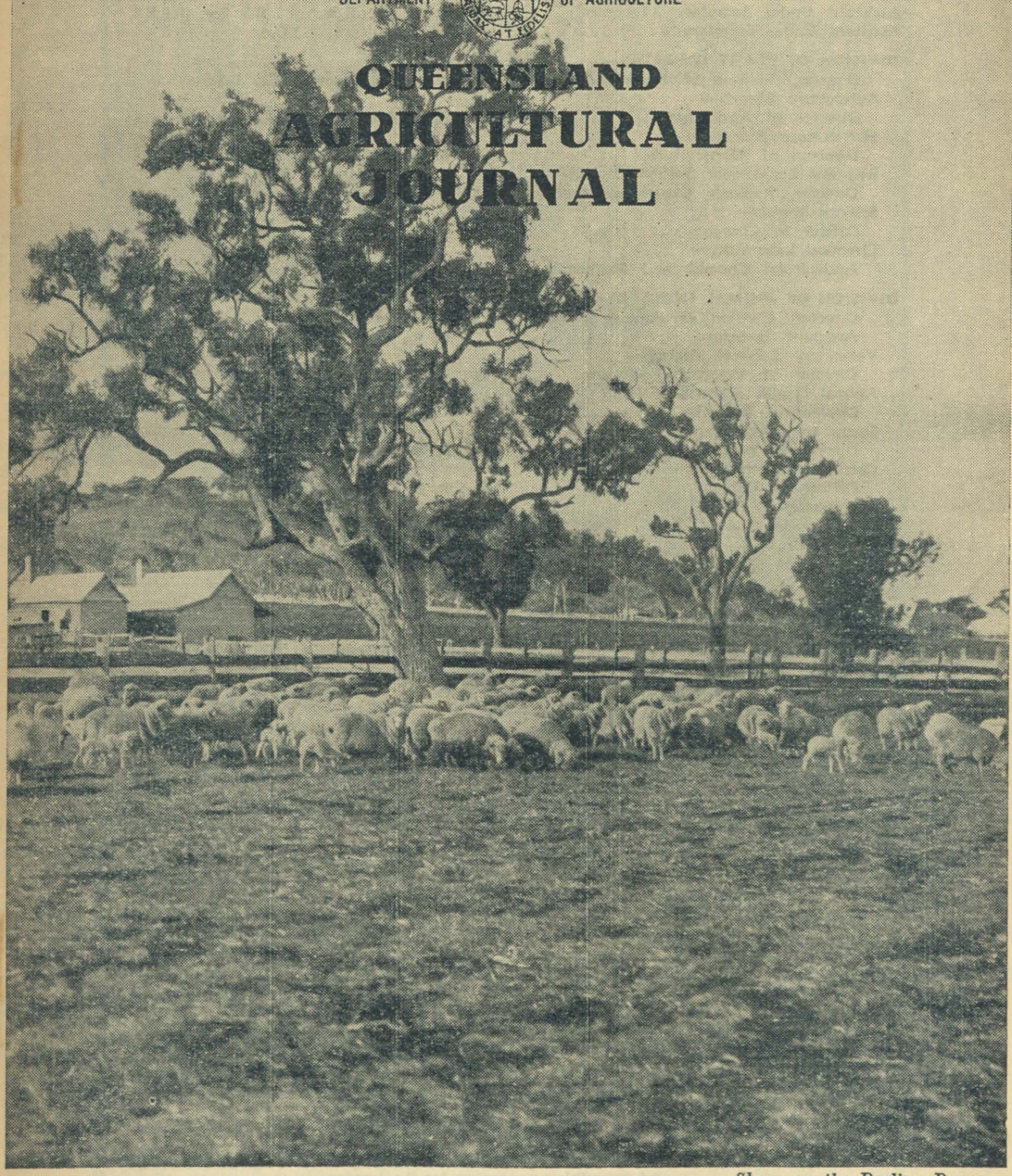

Sheep on the Darling Downs.

LEADING FEATURES

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Contents

The Pineapple.

P. MITCHELL (Senior Adviser in Horticulture) and R. C. CANNON (Senior Horticulturist).

(*Continued from page 84 of the August issue.*)

PLANTING.

When large and small plants are grown together, the larger plants develop more quickly than the smaller and tend to suppress them, thus accentuating any differences. Block planting of graded material results in greater uniformity within each section of the plantation. This is particularly important from the point of view of ease in harvesting, as it reduces the area to be covered at any one time.

Before planting, the material should be graded on the basis of thickness of the base and size of the leaf portion. A large, leafy plant with a small base has comparatively small food reserves, whereas a small, hard plant with a large base and little leaf would be slow to grow. As a general guide for grading, weight is a very useful criterion. It is not necessary to weigh every plant, but weights can be checked at intervals during grading to maintain the standard.

It is usually convenient to grade the plants on the site where they are to be planted. Sufficient plants for the whole area should be assembled before planting commences; otherwise there is likely to be unnecessary duplication of areas with the same grade of plants.

Spacing.

For many years, the double-row system of planting has been standard practice in Queensland. In this system, weeding is reduced to a minimum, for once the plants are sufficiently large to shade the spaces between the paired rows, weed growth is suppressed. At this stage, the plants also protect the soil surface from the hot rays of the sun during the summer months.

The two rows of each pair are usually 24 in. apart, and the double rows 6 ft. apart, centre to centre. This spacing permits movement along the rows during harvesting when the plants have spread out in the ratoon stage. In replant land, where growth is likely to be less

vigorous and where weeds are frequently more troublesome, it is often an advantage to reduce the spacing of double rows to 5 ft. 6 in. Within the rows, plants are normally spaced 12 in. apart, the positions of plants in adjacent rows being staggered. Crops planted with the double rows 6 ft. apart will require about 14,500 plants per acre, while at 5 ft. 6 in. centres, 15,800 plants will be needed.

Planting Methods.

Planting of tops, slips and suckers is usually done with a hand tool, such as a short-handled, narrow-bladed hoe. Plants should be set firmly but not too deeply; otherwise growth will be slow and the plants will be weak and spindly. Tops are planted to a depth of about 2 in., whilst slips and suckers are set 3½-4 in. in the ground, depending on their size. In the case of the suckers there is usually about an inch of dead tissue at the base; if this is not cut off before planting, it should be allowed for in determining the depth of planting.

Butts are planted in a furrow which is deep enough to allow a covering of about 4 in. of soil. They are laid horizontally, head to tail, in the furrow, which is then completely filled in. A cane dropper-planter is a very useful implement for the mechanical planting of butts. Care should be taken to ensure that the furrows are completely filled in without any depressions along the rows. Such depressions act as water channels and the soil may be scoured out round the plants during heavy rain, or water may accumulate around the base of the plants.

Where the rows are straight, a planting line, with markers 12 in. apart, is used to facilitate accurate spacing of plants in the row. The plants are laid out close to the line and planted on the side of it most convenient to the operator. The second row of the pair is then planted in the same way, with the plants in it opposite the spaces in the adjacent row.

When planting on the contour, the method of laying out the rows is somewhat different. The inter-row drains serve as a guide to the direction of the rows, and there are several methods of marking plant positions. A light wheel of suitable size, with spikes at intervals of 12 in. around its circumference, may be propelled along parallel to the inter-row drain, or a marking stick with a projecting arm and spike at its base may be used. In other cases, it may be convenient to use a planting hoe with a 12-in. handle which can be used to measure the distance between plants as they are being planted.

Planting through Paper Mulch.

Although not used extensively in Queensland, paper mulch has certain advantages. It keeps the soil warm, reduces evaporation losses and is useful in the control of weeds. The material is a light paper impregnated with a bitumastic preparation. It was originally available in rolls 3 ft. wide, but current stocks are only 2 ft. 6 in. wide, which is rather narrow for a standard 24-in. row spacing.

The paper is laid down on mounded beds and the plants dibbled through it. These beds are usually 3 ft. 3 in. wide and can be prepared quite easily by turning a plough furrow on to each side of the measured bed and then giving the surface an even camber with a rake or wide hoe. The land must be brought to a fine tilth and should be thoroughly moist before planting; otherwise soaking rain will be necessary before growth begins.

The free end of the roll of paper is firmly embedded in the soil at the end of a row and then unrolled on the surface, the edges being covered with about 3 in. of soil to keep them in position. A band of soil is also placed across the strip at intervals of half a chain or so. A still day is required for the work.

Planting through paper mulch requires some care. The paper is pierced with a trowel or a short-handled special tool with a flat blade 10 in. long by 3 in. wide and tapered to a point. The blade is forced through the paper into the soil and at the same time pulled forward. The plant is placed in the cavity behind the planting tool, which is gently withdrawn, leaving the plant in position. When planting tops, slips or suckers in paper mulch, the basal leaves must be stripped off to avoid damaging the paper.

FERTILIZING.

Very few pineapple crops are grown in Queensland without fertilizer. Virgin scrub soils of high natural fertility may produce good plant crops without fertilizer, but applications are usually needed in the ratoon crops.

Of the three major nutrients, pineapples require more nitrogen and potash than phosphoric acid. For general usage, a mixture known as 10-6-10, containing 10% nitrogen, 6% phosphoric acid and 10% potash, was devised many years ago and is still the standard fertilizer for pineapples in south-eastern Queensland. In view of the extremely high nitrogen requirement of the pineapple, it is usual to make alternate applications of the 10-6-10 mixture and sulphate of ammonia.

Placement of Fertilizer.

The placement of fertilizer in pineapples is peculiar to this crop. The fertilizer is applied directly to the base leaves of the plant rather than to the soil. Moisture from heavy dews and light rains is collected by the trough-like leaves and runs down to the bases of the leaves, where it dissolves some of the fertilizer lodged there and carries it down in solution to the roots near the base of the plant. In this way, the plant receives a more or less continuous supply of dissolved nutrients, even during relatively dry periods.

In the early stages of growth, while the plant is still small, application to the base leaves is impracticable and the fertilizer is applied directly to the soil adjacent to the young plants.

Methods of Application.

The fertilizer is usually applied to the base leaves by hand from a suitable container, such as a galvanized iron bucket. From about six inches above the ground, the fertilizer is thrown by a flick of the wrist so that most of it lodges on the base leaves and the balance falls to the ground near the plant. High placement is undesirable, for some of the fertilizer may reach the heart of the plant and burn the tender young leaves. Care and practice are necessary in this operation, and fertilizing on a windy day should be avoided.

When fertilizing newly planted tops or small slips, the back of the hand is placed against the lower leaves, which are raised by a slight pressure so that the operator can place the fertilizer close to the plant without risk of its reaching the growing point.

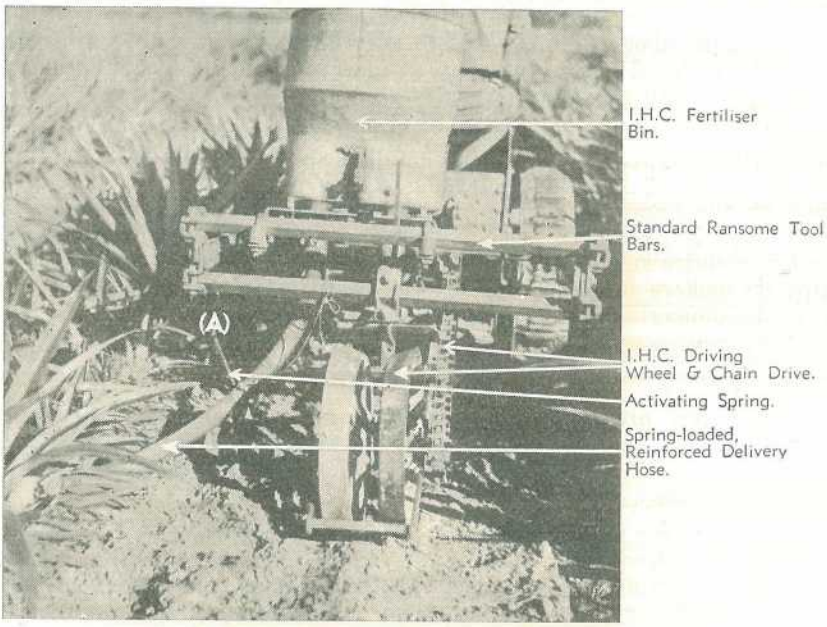


Plate 17.

Fertilizing Machine. Fertilizers are usually applied by hand, but some farmers have devised machines to do the work. One type is illustrated above.

In recent years several types of hand distributors have been developed for fertilizing pineapples. In addition, some larger units for the mechanical application of fertilizer to pineapples have been devised (Plate 17). These reduce the labour costs of the operation but tend to place the fertilizer in a band on the soil rather than directly into the base leaves. However, the speed of operation and the saving of labour may compensate for any loss of efficiency in placement.

Fertilizing Schedule.

As the cropping cycle of a pineapple plantation extends over several years, applications of fertilizer must be made to both plant and ratoon crops. Four applications are usually required each year. All are applied at periods when growth is in progress and the plants can utilize the nutrients supplied. The first application should be made within a few weeks of planting, when the plants have commenced to establish a root system. The actual time will depend on whether planting takes place in the autumn or the spring.

The spring application is usually made from September to early October. This is followed first by a midsummer application in December or January, and then by a late summer application in mid-March. The fourth application is made in early May before the crop enters the semi-dormant winter period, in which the intake of nutrients becomes negligible.

The following fertilizing schedule has proved effective under most conditions:—

Time.	Fertilizer.	Rate per Acre.	Rate per 1,000 plants.
		Lb.	Lb.
Sept.–Oct.	10–6–10	700	50
Dec.–Jan.	Sulphate of ammonia	420	30
Mid–March	10–6–10	700	50
Early May	Sulphate of ammonia	420	30

(50 lb. per 1,000 plants equals 1 large handful to 4 plants.)
(30 lb. per 1,000 plants equals 1 large handful to 6 plants.)

Fertilizer applications should not be postponed merely on account of dry weather, as a heavy dew or a light shower will dissolve some of the fertilizer from the leaf bases and carry it down to the roots.

With experience, nutritional deficiencies in the pineapple can be detected by eye and quickly corrected. A normal healthy plant is dark green in colour and has large broad leaves. Any departure from the normal colour and shape of the leaf is indicative of some form of malnutrition. If there is a deficiency of nitrogen the leaves assume a paler colour and may even become quite yellow, with only a tinge of green showing in the youngest leaves. If the plant is deficient in potash the leaves become brittle and stunted and lose most of the bloom on the under surface. In cases of severe malnutrition, the generally poor growth and stunted appearance of the plants are obvious symptoms of the need for fertilizer. The fertilizer schedule may be amended or supplemented on the basis of such deficiency symptoms when they are recognised.

TRACE ELEMENT DEFICIENCIES.

In addition to the major nutrients, in common with other plants pineapples require certain other elements in very small quantities. These are known as trace elements. In Queensland, two troubles due to trace element deficiencies—crookneck and iron chlorosis—occur in certain pineapple areas.

Crookneck.

Crookneck has been known on many sandy soils on the coastal plain since 1934. Typically, the leaves are very narrow, light green to yellow in colour and thickly waxed. In acute cases, the centre leaves bunch and bend over almost parallel to the ground, hence the name "crookneck".

The disorder is associated with a soil deficiency of the trace elements copper and zinc. It may be prevented or corrected by the inclusion of copper sulphate and zinc sulphate in the standard fertilizer. A "special" 10-6-10 mixture, containing 56 lb. each of copper sulphate and zinc sulphate per ton, is available and should be used for pineapple crops grown on soils where these deficiencies occur or are likely to occur. This mixture is more liable to burn the plants than 10-6-10 alone, and extra care is necessary in its application if damage is to be avoided.

Usually a single application of the mixture containing copper sulphate and zinc sulphate is sufficient to prevent crookneck. For obvious reasons, this mixture should be used for the first application after

planting. If this practice has not been followed and the disorder appears in a crop, an application of the special mixture will eventually restore growth to normal.

Crookneck is particularly common in the Wamuran-Caboolture-Beerwah area, but also occurs to a greater or smaller extent in many other districts. In the former area, the use of a special copper-zinc mixture after planting should be standard practice. In other areas its use is optional, but it is still a reasonable precaution to apply the special fertilizer, since the increased cost is not great.

Iron Chlorosis.

Iron is essential for the formation of the green colouring matter in the leaves, and a deficiency reduces the intensity of green colour in the plant. This is known as iron chlorosis. The typical symptom is a yellowing of the leaves, which is first apparent at the growing point. This latter characteristic usually serves to distinguish iron deficiency from nitrogen shortage, in which the youngest leaves usually show some green colour, while the older leaves are chlorotic.

Iron deficiency symptoms are due to a lack of available (or soluble) iron in the soil. They often appear on red soils which, though rich in iron, contain very little in an available form.

In some red soils, such as those of Mary Valley and Yeppoon, where the presence of excessive manganese reduces the availability of iron, chlorosis of the leaves is accompanied by a pronounced reddening of the skin colour of the fruit of affected plants. On these soils, a 3% solution of iron sulphate must be used as a foliage spray. This is prepared by dissolving 1 lb. of ferrous sulphate in 3½ gall. of water and is applied as a fine mist over the plants. Excess spray or too high a concentration is liable to injure the foliage, and care is necessary when using it. Applications should be made at about monthly intervals throughout the growing period of the crop—that is, from September to April. Winter applications are not necessary.

WEED CONTROL.

Weeds compete with the pineapple plant for plant foods, moisture and light. On account of the shallow root system of the pineapple, deep inter-row cultivation is undesirable. Any weeds which appear in the crop should be eradicated when they are small. The removal of a dense stand of well-established weeds is not only harmful to the plants but is also a slow and costly process.

In recent years, chemical weedicides have been extensively used for weed control purposes, particularly before the weeds have emerged, although hand-hoeing is still practised to some extent.

Chemical Weed Control.

The materials used for weed control in pineapples (pentachlorophenol and sodium pentachlorophenate) are commonly known as PCP. These chemicals may be used safely at the recommended concentrations provided the spray does not reach the hearts of the plants in any quantity. When sprayed on to bare ground, PCP will effectively prevent the germination of weeds and grasses, but it gives only a temporary setback to established weeds and grasses. The addition of suitable oil emulsions, however, increases the toxicity of PCP sprays to large broad-leaved weeds, but grasses are relatively tolerant.

Forms of PCP.

Sodium pentachlorophenate is the most suitable form of PCP for use in sprays applied to bare ground (that is, pre-emergence sprays), since it is directly soluble in water to the extent of 25%. Pentachlorophenol, on the other hand, is insoluble in water but soluble in certain oils, which themselves have to be rendered miscible with water by the addition of suitable emulsifiers.

Pre-emergence Sprays.

For use as a pre-emergence weedicide, sodium pentachlorophenate is dissolved directly in water in the spray vat, and applied at a rate of 10-20 lb. per acre, irrespective of the quantity of water used. About 100 gall. per acre, applied to the bare surface of the ground as a fine mist spray, is usually sufficient for normal requirements (Plate 18). The only precaution necessary is to avoid spraying directly into the hearts of the plants; otherwise the growing points may be injured.

The best results are obtained when the ground is reasonably moist at the time of spraying. If the soil is so dry that weeds are not likely to germinate, it is usual to postpone spraying until rain has fallen. If, for any reason, dry soil must be treated, the quantity of water per acre should be increased. Heavy rain, even if it falls soon after spraying, does not lessen the efficiency of treatment.

The success of the pre-emergence weed control depends on the land being clean and free from growing weeds at the time of treatment. PCP applied under these conditions will keep land virtually free from weeds for a period of at least two months.

PCP-Emulsion Contact Sprays.

The only oils at present available in Queensland of interest in the pineapple crop are mineral oils of the diesel type and creosote. The former, when used alone, have virtually no effect on weeds at concentrations which are within the limits of safety for pineapples. Creosote emulsion is slightly more toxic to weeds at the safe concentration of 1 in 30, but not sufficiently so for it to be of any consequence in practice. The real importance of both lies in their use in combination with PCP.

Combination sprays of this kind, containing 3 lb. of PCP and 1 gall. of oil emulsion per 100 gall., give practically complete control of broad-leaved weeds. If the dominant weeds are grasses, the spray concentration may be increased to 6 lb. PCP and 2 gall. oil emulsion per 100 gall. This spray will destroy most weeds, and the surviving grasses are so severely checked that their removal by hand chipping is greatly facilitated, provided the work is done before recovery takes place.

For all practical purposes, the mineral oil emulsion is just as satisfactory as creosote emulsion for the control of broad-leaved weeds, but the latter is preferred if grasses are also involved. If grasses are not present in the crop, there is nothing to be gained by using higher concentrations than those specified.

In applying contact weedicides, it is important to completely wet the foliage of the weeds. The quantity required will, therefore, depend on the number and size of the weeds present, and no fixed rate per acre

can be prescribed. In most cases it will be considerably more than 100 gall. per acre, which is the amount normally required for pre-emergence treatment.

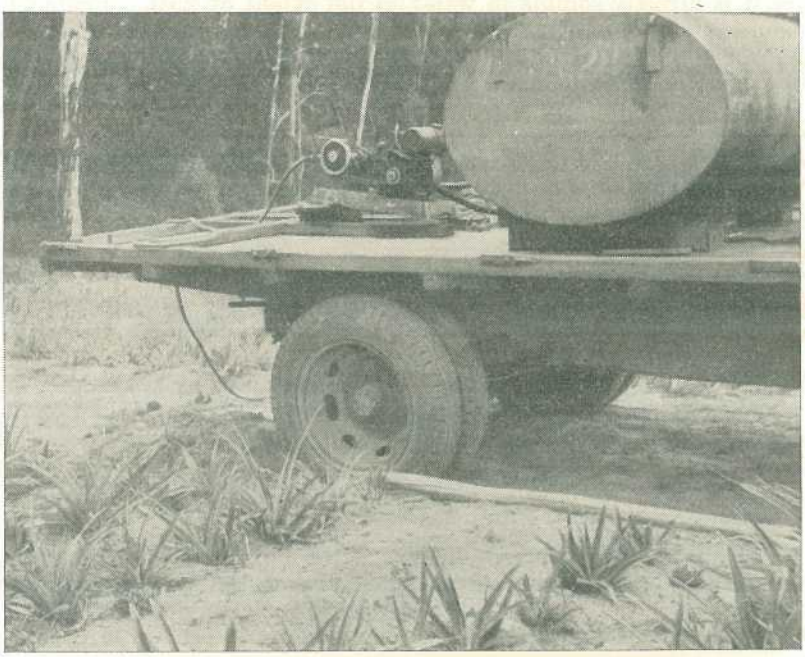


Plate 18.

Low Pressure Spray Unit for Applying Pentochlorophenol to the Pineapple Crop. Top, mounted tank with pump. Bottom, spray lines in operation.

Difficulty may be experienced in preparing PCP-oil emulsion sprays if hard water is used, more especially during drought periods, when the salt content of underground supplies tends to increase. Instead of mixing freely, the emulsion breaks, and free oil, or an oily scum, accumulates on the surface of the mixture. This not only blocks the jets, but also reduces the effectiveness of the spray. In order to overcome the trouble, the water may be treated with a proprietary water softener, such as "Calgon." The hardness of water does not materially affect its suitability for use with sodium pentachlorophenate in pre-emergence sprays, where oil emulsions are not included.

Of the two methods of chemical control, pre-emergence spraying is pre-eminently desirable, since the best way to control weeds is to prevent their establishment. Contact sprays are of value when the weeds have temporarily got out of hand.

Mechanical Weed Control.

The control of weeds by hand chipping requires no explanation beyond pointing out the desirability of working the hoe so that the loose soil is drawn towards the plants rather than away from them. If it is to be efficient, chipping must be done when the weeds are small, which necessitates frequent attention during the wet summer months. The frequency of chipping will naturally depend largely on weather conditions.

Flame-throwers are sometimes used for weed control. They do a good job against small weeds in young plantations and the cost of operation is low. In older plantations, where the amount of trash and dry leaves is greater, the fire hazard is considerable and flame-throwers can be used only in wet weather.

Where weed growth is out of hand, small motor mowers may be used to temporarily alleviate the position. This practice is sometimes useful in an emergency and may be successfully combined with spraying.

IRRIGATION.

During the period of most active growth, extending from early spring to autumn, the pineapple plant uses comparatively large amounts of water. In most parts of Queensland this requirement is usually met by the summer rainfall, but in the drier districts of the tropics particularly, irrigation is an advantage during spring and autumn. A 2-inch application each month should normally meet requirements in this area. In winter, when plant growth is slight, irrigation appears unnecessary; in summer, the rainfall is usually adequate for normal plant development.

CROP MANAGEMENT.

Good crop management aims at the maximum production of fruit per acre in the shortest period of time. Since the pineapple is a perennial plant, the whole cycle of plant and ratoon crops must be taken into account. The behaviour of the plant crop is, however, important, since it influences sucker production, on which the ratoon crop yields depend.

The best suckers are produced by a summer plant crop, in which they are usually fairly numerous, large, vigorous and low-set. Under natural conditions, most crops include some plants known as "hold-over" plants; each produces a medium-sized fruit which frequently falls over, and the suckers are borne 12-18 in. above the ground.

A winter plant crop, though the fruit may be large, usually produces relatively few suckers and its ratoons are less satisfactory. Hence, the first objective in plantation management is to ensure a uniform summer plant crop; if this is obtained a good first ratoon will follow automatically.

Control of cropping throughout the life of a plantation depends on the time of planting, the type of planting material used, and the treatment it receives. In southern Queensland, tops and butts take about 24 months to produce a crop, whereas slips and suckers fruit in about 18 months.

To obtain a summer crop, tops and butts should be planted in the autumn (from February to March), and slips or suckers in the spring, preferably during September. In the tropics, where temperature differences are not so great as in southern Queensland, suckering is not affected by seasonal factors to the same extent. In these areas, satisfactory results have been obtained by planting tops, slips or suckers from October to April, but butt planting should be restricted to the November-February period. If for any reason natural flowering does not take place, even though the plants are large enough to bear fruit, artificial flower induction may be practised on the backward plants. Flower induction at an earlier stage may also be applied to ensure a full summer crop.

Artificial Flower Induction.

A number of substances, such as smoke, acetylene and certain plant hormones, are known to induce flowering in pineapples. The first material to be used commercially was a solution of acetylene, but this has now been largely superseded by hormones, of which alpha-napthalene-acetic acid (ANA) is the best known.

ANA is available in tablet, powder and solution forms and is used at a dilution of 10 parts per million. This is obtained by dissolving the tablet or powder in water or diluting the solution according to the makers' directions. Acetylene solution is prepared by adding 5-6 fluid ounces of commercial calcium carbide to 4 gall. of water; acetylene is generated immediately and a saturated solution of the gas is available when bubbling has ceased.

Treatment consists in pouring into the heart of the plant about 2 fluid ounces of the ANA or acetylene solution. One gallon is sufficient to treat about 80 plants, which is roughly equivalent to 200 gall. per acre. On small areas, the solution may be applied from a small vessel with a spout, or with a knapsack spray from which the pump has been removed. For treating large areas, power sprays fitted with trigger releases, and with the spray nozzles removed, are quite efficient.

Artificial flower induction (or "gassing," as it is commonly called) has many applications in commercial pineapple production. There are, however, three main periods when it is most commonly applied in southern Queensland, namely:—

(1) *February to March*—to produce an early summer crop in November or December, when the markets are frequently under-supplied.

(2) *May*—to ensure uniformity of flowering in the plant crop.

(3) *September to early October*—to induce flowering in plants which failed to flower naturally in September. In this case, the normal summer crop of fruit will be followed by an intermediate crop from the gassed plants in May or June.

Flower induction can be of great value in the control of cropping, but treatment should be applied with discretion. The plants must be sufficiently large and vigorous to produce commercial fruit. That is, they should be comparable in size with plants which normally produce a satisfactory crop under natural conditions. Premature gassing (that is, the treatment of small plants) is liable to give a crop of under-sized fruit and suppress sucker development, with disastrous results on the ratoon crops. On the other hand, the judicious use of flower induction can often reduce the number of holdover plants and improve the yield during the life of the plantation.

Cropping Control.

Although a pineapple plantation will continue to bear fruit for many years, yields and fruit size decline with each succeeding ratoon crop. The rate of decline is influenced by a number of factors, but in practice it is seldom worth while retaining an area of pineapples beyond the second ratoon crop. By that time, irregularities in the stand resulting from variable vigour and disease are usually apparent, and the plants are so overgrown that efficient fertilizing and harvesting are almost impossible. In some cases it may be preferable to terminate the cropping cycle with the first ratoon crop.

Under average conditions, yields (tops on) are approximately:—Plant crop, 20 tons; 1st ratoon crop, 15 tons; 2nd ratoon crop, 10 tons. Yields substantially in excess of these figures have, however, been recorded in well-managed plantations during favourable seasons.

PLANTATION MANAGEMENT.

The aim of plantation management is continuity of production with a reasonably stable annual return to the grower. This can only be achieved by regular annual plantings to compensate for the areas which progressively go out of production and have to be destroyed. At the same time provision must be made to arrest any decline in soil fertility.

It is common experience on most soils that, in spite of heavy applications of artificial fertilizers, pineapple yields decline with each successive replanting. This is due to a natural decline in soil fertility, loss of soil structure and a steady build-up of pests and diseases. These factors may be modified by crop rotation and green manuring.

Maintenance of Soil Organic Matter.

Soil fertility is not simply a measure of the amount of plant food in the soil. It also involves its tilth or physical condition, which regulates the supply of air and water to the plant and influences the activity of organisms which play an important part in making nutrients available to the plant. Soil structure depends a great deal on the amount of organic matter present and soil management is consequently largely the practice of replacing the organic matter lost during cropping.

In the pineapple plantation where weeds are suppressed, the organic matter present in the soil is rapidly destroyed by exposure to the sun. In practice, organic matter may be supplied from the pineapple crop residues which remain when an area is broken up, by ploughing under green manure crops during the intercycle period, or by a combination of both.

The value of such material depends on its eventual decomposition and incorporation in the soil. Old pineapple plants are very bulky and if left whole take a long time to disintegrate. It is therefore desirable to hasten the process by breaking up and shredding the material. This operation should be carried out while the plants are still succulent, as they are more difficult to handle when they become dry and tough. The rotary hoe is a popular implement for this purpose, but if improperly used it pulverises the soil, so it should be set to work as near the surface as possible. Portable chaffcutters are sometimes used to shred the crop residues, but this practice entails a considerable amount of hand work and is rather laborious. Overseas, gangs of heavy, multiple serrated-disc harrows drawn by powerful tractors are used to break up old pineapple areas, but the smaller plantations and steep slopes in many parts of southern Queensland preclude the use of such heavy equipment. Smaller cutaway disc harrows might be more adaptable to local conditions.

Crop Rotation.

Where one crop is grown continuously, pest and disease organisms tend to multiply. A rotation of crops has the opposite effect, and when a green manure forms part of the rotation a considerable amount of organic matter is regularly added to the soil.

A number of green manures have proved satisfactory in Queensland. Of the annual crops, the Poona, Cristaudo, Reeves and Giant varieties of cowpea, and velvet beans, have been used in summer, and New Zealand blue lupin in winter. Of the perennial crops, pigeon pea (Plate 19) may be useful but there is still some doubt as to its value where certain species of nematodes are a factor in production.

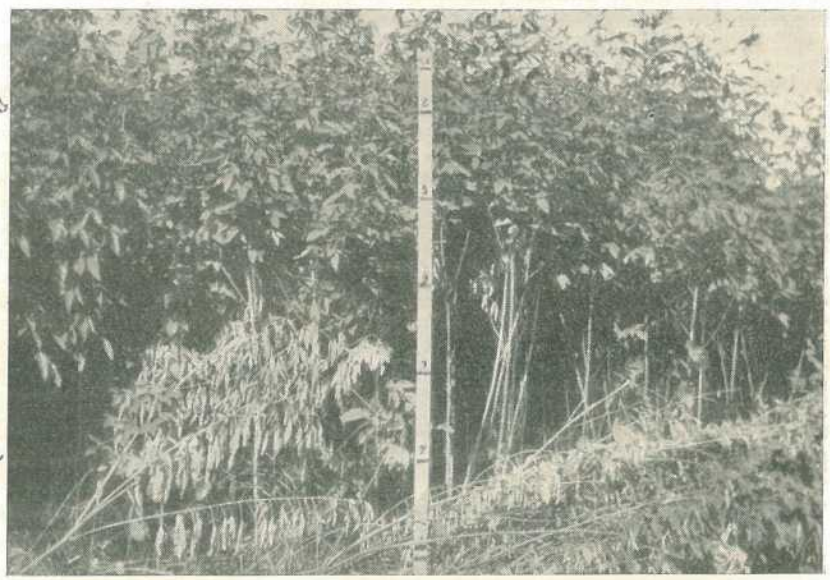


Plate 19.

Pigeon Pea, a Leguminous Cover Crop Grown during the Intercycle Period on the North Coast.

The optimum intercycle period between successive crops of pineapples is probably about 13 months. This permits two summer crops of a summer legume and one winter crop of lupins, or alternatively a single sowing of a perennial. In either case, the old pineapple trash should first be fairly well shredded and worked into the soil before the legume is sown. Typical sowing rates are:—cowpeas, ¾ bushel per acre; New Zealand blue lupin, ¾ bushel per acre; and pigeon pea 20 lb. per acre. The green manure should be ploughed under at least six weeks before the following crop is planted, to allow time for the material to rot down.

Cropping Units.

The area planted to pineapples each year on any farm will be governed by the annual production desired, the commercial life of an area and the particular rotation system followed. For average conditions, the total cropping area may be subdivided into 6 units of equal area, as follows:—

(1) Young plants not yet in bearing.
(2) Plant crop in bearing.
(3) First ratoon crop.
(4) Second ratoon crop.
(5) Under green crop.
(6) Area in course of preparation for planting.

If the size of each unit is 2 acres, the total cropping area would be 12 acres, with 6 acres bearing each year.

HARVESTING.

Pineapple fruit must be placed on the market in good condition and at the right stage of maturity. Several precautions are necessary in the summer months to protect the maturing fruit from sunburn, which can sometimes account for considerable losses.

Protection from Sunburn.

Although the top and surrounding suckers and slips afford some protection to the fruit, this is not always adequate, especially if the fruit is not very low-set on the plant. Fruit which leans or has fallen over is particularly prone to severe sunburning.

It is, therefore, a wise precaution to go through the plantation early in the summer and to cover any fruit which is unduly exposed. For this purpose brown paper sleeves are quite effective; they may be slipped on the fruit over an inverted funnel of suitable size. When harvesting, the bottom end of the sleeve is raised slightly to expose the base of the fruit so that its stage of maturity can be determined. Alternatively, woodwool may be lightly wrapped round the exposed portions of the fruit. In this case, the stage of maturity can usually be observed without removing the woodwool. Most of this material can be salvaged for further use. In windy weather it is advisable to go through the plantation at regular intervals and replace any covers which may have become dislodged.

Harvesting for Fresh Fruit Markets.

Pineapples for fresh fruit markets should be harvested at the stage of maturity suitable for the particular market (Plate 20). This will be influenced by the distance of the market, less mature fruit being packed

as the distance increases. Since the appearance of fruit is important in the fresh fruit market, malformed fruit or fruit bearing multiple tops or basal knobs should be rejected in the packing shed. Very large fruit is also usually not very acceptable to fresh fruit markets.

Plate 20.

Fruit for Special and Export Packs. The fruit is cut from the plant and protected with woodwool.

Harvesting Cannery Fruit.

Since cannery fruit is processed within a relatively short time after harvesting, it may, and should, show more colour than fruit which has to travel a long distance to fresh fruit markets. In this case, the tops are removed before packing and misshapen tops are of less importance. Fruit which is not sufficiently attractive in appearance for a fresh fruit market may be still quite suitable for canning. This does not mean, however, that the cannery can serve as a dumping ground for all inferior fruit; the quality of the canned product is largely governed by the quality of the fruit processed.

Handling of Fruit.

The pineapple fruit is very susceptible to bruising and should therefore be handled with great care. Bruising permits the easy entry of organisms responsible for fruit rots, in particular water blister. Although bruised fruit may be quite sound when it leaves the plantation, it may be a rotten mass by the time it reaches its destination.

As a rule, fruit is harvested into baskets and carried out to the ends of the rows, where it is transferred into lug boxes, crates, trailers, trucks or slides, as the case may be. Careless handling at this point is often responsible for considerable bruising and ultimate losses.

Packing Shed Hygiene.

Apart from being untidy, an accumulation of tops and trimmings in the vicinity of the packing shed is an ideal breeding ground for the water blister fungus. Hence, all such material should be regularly and frequently removed at least 200 yards away. Tops which are valuable planting material should be dealt with promptly and stored as already described.

As an additional precaution, the building, cases and other equipment should be sprayed with a 2% solution of formalin, preferably prior to each harvest.

PLANT PROTECTION

Stem Rot of Cowpeas.

G. S. PURSS, Assistant Pathologist, Science Branch.

IN the past, cowpeas in southern Queensland have been singularly free from serious diseases. However, early in 1952, following on the discovery of stem rot in North Queensland, severe outbreaks of this disease were reported from cowpea crops in the Fassifern and Lockyer Valleys, the Darling Downs, and in districts surrounding Gympie and Kilcoy. This disease recurred in the 1952-53 season, causing considerable damage in many areas.

Cowpeas in Queensland perform two valuable functions. In localities where soils are naturally rather poor, their use as a cover crop to increase soil fertility is widespread. This crop also provides valuable summer grazing for stock, particularly dairy herds. The disease now threatens to limit the use of this crop, especially the widely grown Poona variety, and unless some measure of control is introduced, a very useful soil-building and grazing crop may be lost to farmers and dairymen.

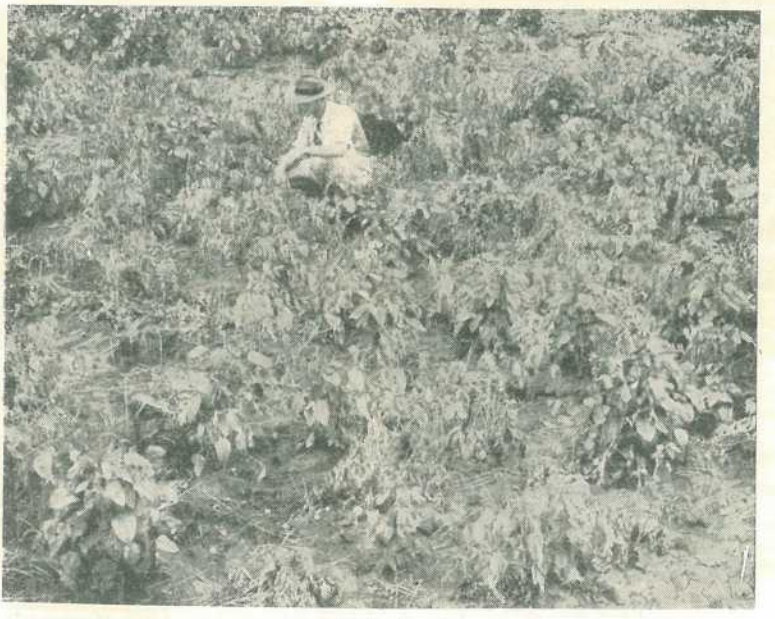


Plate 1.

A Crop of the Poona Variety Infected with Stem Rot.

Symptoms.

Isolated yellowing patches occurring within a field of cowpeas are usually the first indication that the disease is present. Under favourable weather conditions these patches rapidly expand, and eventually all the field may be involved. It is not uncommon to find a 100 per cent. infection of individual plants in such cases. If conditions remain moist, the diseased plants may survive for a considerable time, but in dry weather there is a rapid wilting followed by dropping of leaves and death (Plate 1).

Close examination of an affected plant reveals a diseased area, usually light brown in colour, completely girdling the base of the stem. The area of decay often extends well up the stem and may even embrace the tip. The tissue immediately in advance of this usually

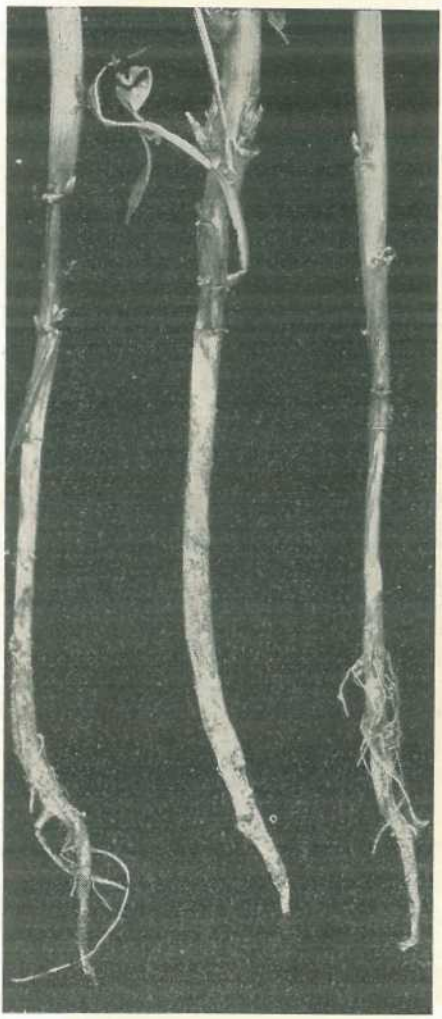


Plate 2.

Typical Stem Rot Symptoms on the Base of Cowpea Plants.

Plate 3.

Stem Decay Resulting from Aerial Infection.

has a "water-soaked" appearance. The root system is invariably quite dead and often covered with a mass of pink and white spores (Plate 2). The fibrous tissue of the stem for a short distance ahead of the decay is often discoloured brown, but this is not a constant feature.

Under very moist conditions the upper part of the plant may be attacked direct, without any connection with rotting nearer the ground, and a withering and collapse of the stem tissue is produced (Plate 3).

The disease attacks plants at all stages of development, with crops approaching flowering most commonly affected. Plants in the seedling stage are often attacked, particularly when grown on soil which has carried an infected crop during the previous season. In this case symptoms are similar but on a rather reduced scale.

Cause and Spread of the Disease.

The disease is caused by a fungus, a species of *Phytophthora*. Sufficient evidence has been accumulated to show that this fungus is definitely soil-borne and capable of living there for at least two years.

Evidence would also indicate that the fungus may move in the soil through agencies such as free soil moisture. It is likely to be transferred between paddocks on cultivation implements or on the hooves of grazing animals. Considerable spread in the field under very moist conditions by aerial spores is a distinct possibility.

There is no evidence to suggest that the disease is seed-borne but this possibility has not been completely eliminated.

Control.

Control of the disease offers a difficult problem. The two varieties commonly grown in southern Queensland, Poona and Reeves, are completely susceptible to the disease. Once infected, a paddock is not suitable for further crops of susceptible cowpea varieties for at least two seasons. This period may, as knowledge of the disease increases, prove to be a much longer one.

Crop rotation is a method often used to control this type of disease. Where it is practicable, growers should avoid planting successive crops of cowpeas on the same land. In many areas, however, the use of a summer grazing or cover crop is desirable every year, and as there is at present no satisfactory substitute for cowpeas, crop rotation is not an entirely satisfactory method of controlling stem rot where suitable land is limited.

The use of varieties resistant to the disease is the only real answer to the problem. During the past two years numerous varieties, comprising most of those available, have been tested with a view to finding resistant types.

The variety Cristaudo, commonly grown as a cover crop in northern sugar-growing areas, possesses a high degree of resistance to the disease (Plate 4). It is a somewhat later variety than Poona or Reeves. Under good seasonal conditions it gives an excellent cover and has also shown promise as a grazing cowpea.

Plate 4.

The Cristaudo Variety of Cowpea Growing on Infected Soil.

Another northern variety, Giant, also appears to possess a fair degree of resistance. This is a somewhat coarser growing type which would not be as suitable as Poona for grazing. It is also rather late-maturing but provides an excellent cover.

Although these varieties may not be as acceptable for general use as the Poona pea type, they are well worth considering where this variety cannot be grown because of the ravages of stem rot. A further search is being made amongst promising introduced varieties and local strains with the object of obtaining a cowpea satisfactory in all respects and completely resistant to the disease.

Diseases of Potatoes.

R. B. MORWOOD (Formerly Senior Pathologist, Science Branch).

POTATO diseases are caused by the action of parasitic fungi and bacteria and by infectious viruses. There are also a number of disorders, known as physiological diseases, which are due to unsuitable conditions of growth or storage. The diseases occurring in Queensland are discussed in the following pages.

IRISH BLIGHT.

Irish blight is capable of causing the most devastating effect on a crop when no adequate control measures are adopted and conditions favour the disease. It is first recognised as black spots on the leaves. These spots may be dried out by the sun, or may spread to involve all the leaf tissue, the leaf stalks, and finally the stem (Plate 1). When the stem is severely attacked the plant dies right down to the ground.

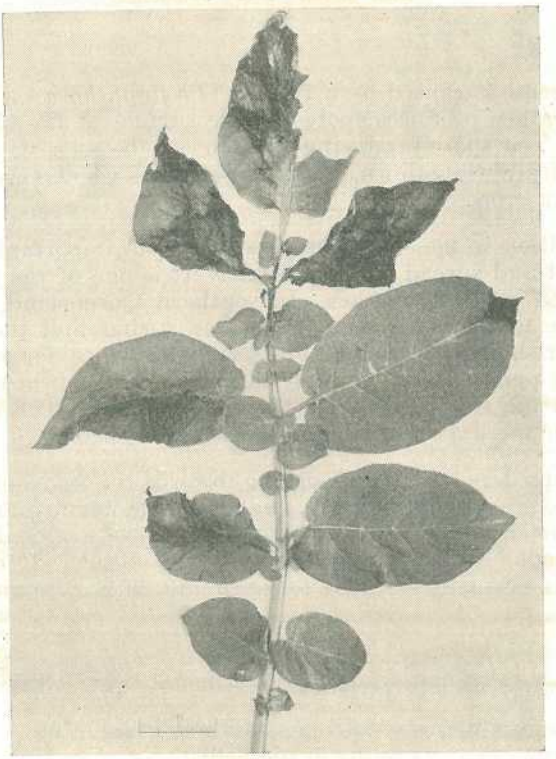


Plate 1.

Irish Blight. Foliage symptoms.

The tubers, if present, may be affected either by the disease spreading down through the underground stems or by direct infection of exposed surfaces before or after digging. The tuber symptoms consist of a sunken and darkened skin, beneath which are areas of brown tissue extending to varying depths into the potato (Plate 2). Under moist conditions of storage the tubers may rot away completely.

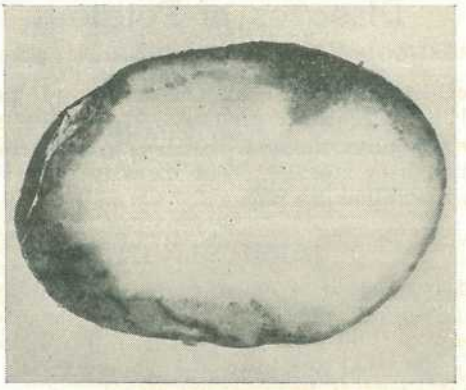


Plate 2.
Irish Blight. Tuber symptoms.

The disease is caused by a fungus (*Phytophthora infestans*), which in moist weather produces spores on the surface of the black spots just described. The spore-producing portion can be seen with the unaided eye as a delicate white down. It is these spores which spread the disease throughout a crop.

In addition to moisture, temperature is an important factor in the development and spread of this disease. It is one of the diseases which are favoured by cold weather. In southern Queensland, two crops of potatoes are normally grown, one in the spring and the other in the autumn. Irish blight is liable to be serious in the colder months of these two growing periods—that is, early in the development of the spring crop and late in the development of the autumn crop. The disease seldom occurs in the more northern potato-growing districts.

Plant breeders have been working towards the development of potato varieties resistant to Irish blight and there are now available a number of good commercial varieties with field resistance to this disease. These include Sebago, Exton, Sequoia, Monak and Adina. If one of these is used there is normally no need for spraying with a fungicide.

Control.

(1) Grow resistant varieties.

(2) Use certified seed and practice a rotation of crops so as to avoid having a source of the fungus in the field.

(3) If for any reason a susceptible variety is grown, spray with Bordeaux mixture (4-4-40) or another suitable copper spray when conditions favour the disease—that is, during cold, showery weather. Repeat the spray application at intervals of 10-14 days, three to five times. A copper dust may be used instead of the spray but it should be applied more frequently. The amount of spray required will vary from 100 to 150 gallons per acre per application, while the amount of dust will be approximately 20 lb.

TARGET SPOT.

Like Irish blight, target spot (*Alternaria solani*) also causes leaf spotting. The spots, however, are somewhat smaller, with more definite margins, and frequently show concentric markings resembling a target (Plates 3 and 4). The disease is not confined to cool weather, and

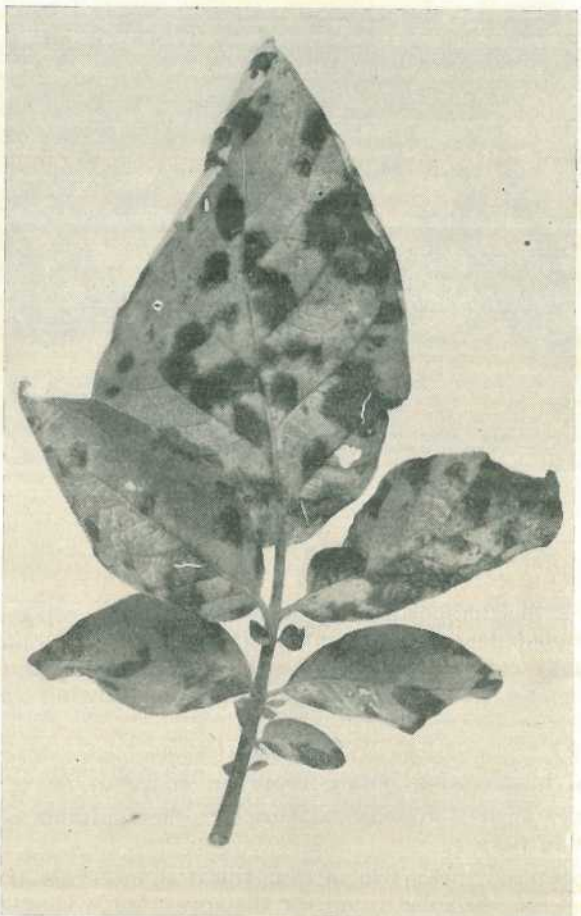


Plate 3.
Target Spot. Foliage symptoms.

provided there is adequate moisture in the air, it can develop during the summer months. However, in southern Queensland it reaches the peak of its development towards the end of the autumn. In northern Queensland, where potatoes are planted in April to May and harvested in early spring, target spot is probably the most serious potato disease.

While its effect on the plant is not so spectacular as in a severe attack of Irish blight, it can in some circumstances cause severe crop losses. A lightly infected earlier crop with comparatively few spots

Plate 4.
Target Spot. General appearance.

may produce sufficient spores to seriously infect a late crop grown nearby. In such circumstances the amount of infected material builds up till the disease may completely defoliate the late crop. This explains the incidence of severe disease towards the end of the growing season.

Control.

(1) Avoid successive potato crops in adjacent areas.

(2) Spray with Bordeaux mixture or other suitable copper spray at the flowering period.

(3) Repeat the spray two to four times at intervals of 10-14 days. A copper dust may be substituted for the spray but it should be applied more often.

FUSARIUM WILT AND DRY ROT.

Fusarium wilt in the field is typified by the drooping of individual plants as though they lacked water. On cutting the stem of an affected plant lengthways at ground level, it will be seen to have running along it a number of internal brown streaks corresponding with the water-conducting vessels of the plant. A tuber rot may also occur as an irregular, dry, brown rot with obvious patches of white or slightly coloured mould either on the surface or in internal spaces in the tuber.

The diseases are caused by closely related fungi, the wilt in the field being due to one species (*Fusarium oxysporum*) and the tuber rot to it and a number of other species.

Plate 5.
Bacterial Wilt. Foliage symptoms.

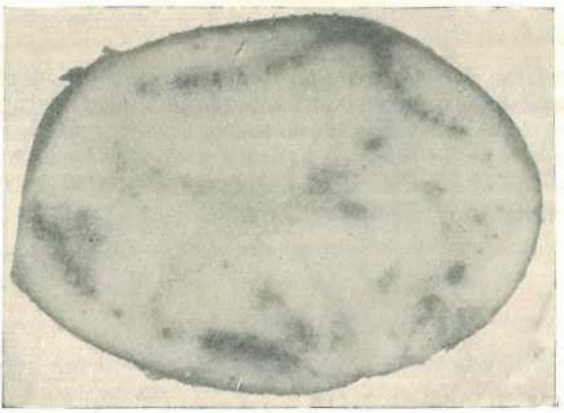


Plate 6.
Bacterial Wilt. Tuber symptoms.

Control.

The control of the tuber rot consists of bagging only sound healthy tubers and careful digging and handling to avoid injury to the skin of the potato. The wilt of the plant is generally confined to a small percentage of the crop and no specific control measures are required except rotation of crops.

SCLEROTIAL STEM ROT.

The potato, in common with many other crops, is liable to infection with the fungus *Sclerotium rolfsii*, which produces a rot of the stem at about ground level. The fungus can be seen as a white mould on the surface of the soil and on the plant. It produces resting bodies about the size of radish seed, which remain in the soil and carry the disease over from season to season. Rotation of crops is the only feasible control measure.

POWDERY MILDEW.

A white superficial fungous growth on leaves and stems of potatoes can sometimes be seen on otherwise healthy plants. This consists of a parasitic fungus allied to the powdery mildew of pumpkins and many other plants. Control measures are seldom warranted on potatoes, but when necessary the use of sulphur is recommended.

BACTERIAL DISEASES—BACTERIAL WILT AND BLACKLEG.

Bacterial wilt resembles Fusarium wilt in its general effect, but the internal symptoms are different (Plate 5). The water-conducting vessels are not turned brown, but they are filled with bacteria which appear, on cutting the stem, as drops of ooze on the cut surface. The tuber exhibits a wet rot which under moist conditions in a bag spreads rapidly and destroys the whole tuber, then spreading to neighbouring potatoes (Plate 6). The disease is caused by a bacterium (*Pseudomonas solanacearum*). It is of somewhat frequent occurrence on coastal river flats but is usually responsible for the loss of only a small percentage of the crop.

The most conspicuous feature of the bacterial disease known as blackleg, which is caused by *Erwinia atroseptica*, is a soft black rot of the stem about ground level. The tops above the affected area wilt. The tubers are affected by a soft rot similar to that of bacterial wilt.

Control.

Control of the bacterial diseases consists of rotation of crops, care in selecting seed to use only sound tubers, and good storage conditions for all tubers, but especially those to be used for seed. In the case of blackleg, treatment of the seed to destroy surface-borne organisms has been shown to be of some benefit. The methods used in treating seed are discussed later in connection with scab.

[TO BE CONTINUED].

Onion Thrips in the Lockyer District.

T. PASSLOW, Assistant Entomologist, Science Branch.

ONIONS and related crops in the Lockyer district are usually infested with thrips (*Thrips tabaci* Lind.), which, by causing serious injury to the growing plants, may reduce yields of bulbs and seed.

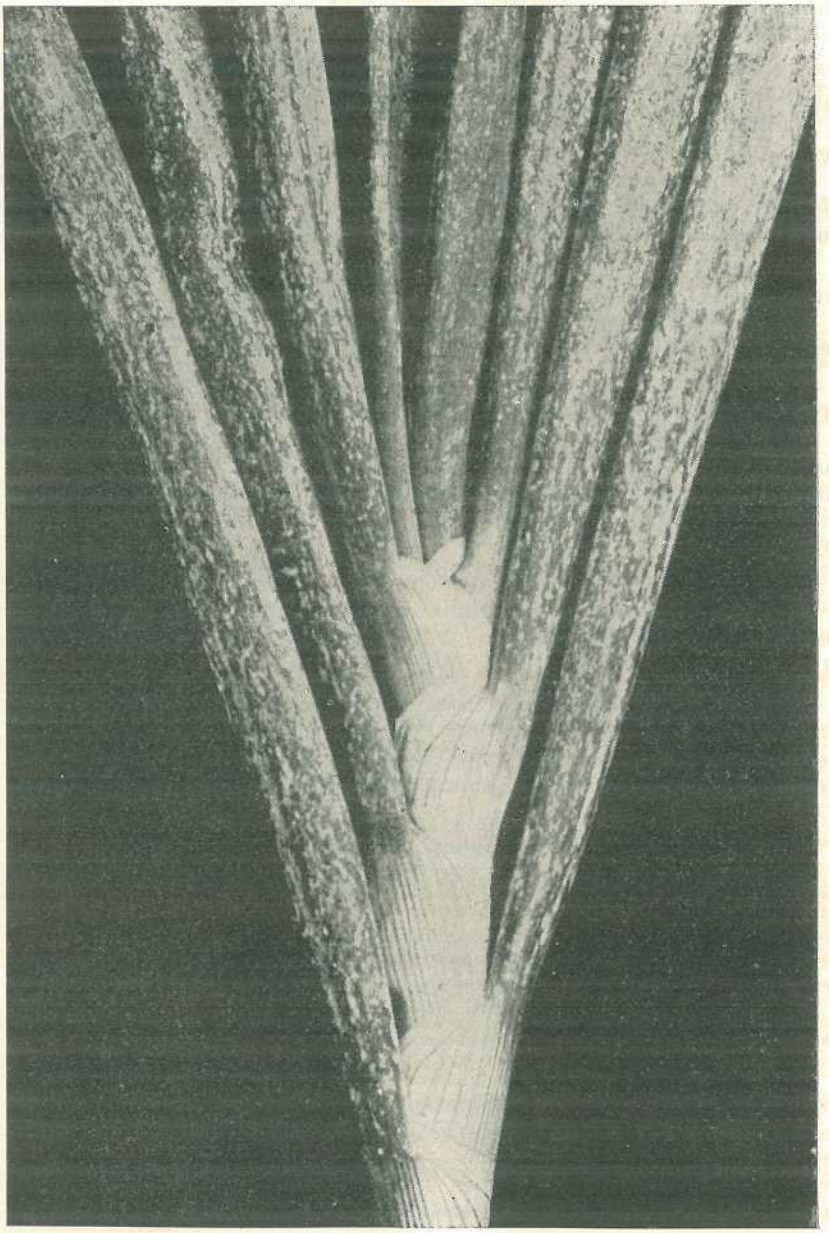


Plate 1.

Symptoms of Thrips Injury to Maturing Onion Leaves.

The immature onion thrips is a small, creamy-yellow, elongate insect which lives and feeds within the shelter of the leaf bases until the prepupal stage is reached, when it moves to the soil and pupates. On emergence the adults return to the plants to feed and deposit eggs, the entire cycle from eggs to adults taking up to a month. The mature insect is darker than the immature stages, about one-twelfth of an inch in length, and carries two pairs of narrow fringed wings. Although called the onion thrips it may be found on a wide variety of plants, including numerous weeds.

Thrips feed by rasping the tissues and extracting sap, and large numbers can cause severe injury and even kill onion plants. The bulk of feeding occurs on the newly formed leaves, and as these grow the feeding punctures expand and elongate to give the typical symptoms of onion thrips activity—small whitish spots and streaks. Following intensive pest activity the leaves present a silvery-white stippled appearance as they age (Plate 1).

In crops grown for seed, the thrips feed on the leaves until the flower heads commence to open, and then move up the flower stems to feed on the stalks of the florets. This may interfere with normal seed production.

Seasonal conditions are important factors influencing thrips numbers, and the pests breed most rapidly when a mild, dry winter is followed by a hot, dry spring. Damage may then be severe, particularly in mid-season and late-maturing crops. Usually, however, winter temperatures experienced in the Lockyer district restrict thrips breeding and the early crops are harvested during spring before appreciable plant injury occurs.

Thrips damage is also dependent to a certain extent on the vigour of the plants. Onions grown under poor conditions have not the same ability to withstand the ravages of the pests, and appear to carry larger numbers of thrips than those crops given better conditions.

With adequate irrigation and sound farming methods to ensure continuous rapid growth, onions can be produced profitably despite the presence of thrips. Under these conditions the application of suitable insecticides will not appreciably increase yields in either bulb or seed crops.

Chemical Control.

Some of the modern insecticides are more effective for killing thrips than the older materials such as nicotine sulphate, tartar emetic and derris. The most economical at present is DDT emulsion, applied at ½ lb. of active ingredient per acre (for example, 0·1% spray at 50 gallons per acre). Adjustments in the dilutions will depend on the outputs per acre of the spray units used. With knapsacks, 100 gallons is the most suitable rate per acre.

When numbers exceed 15 mature thrips per plant, spray treatments should be applied, and if breeding is intensive, treatments may be necessary at fortnightly intervals. For seed crops up to nine applications may be required, continuing until the seed is set. Spray treatments during flowering do not adversely affect pollination or impair the germination of the seed.

Insecticide control will seldom be necessary in other than non-irrigated onions.

The Honey Flora of South-Eastern Queensland.

S. T. BLAKE (Botanist) and C. ROFF (Adviser in Apiculture), Science Branch.

(*Continued from page* 101 *of the August issue.*)

Red Stringybark.

Botanical Name.—*Eucalyptus resinifera* Sm.

Other Common Names.—Red mahogany, red messmate, Jimmy Low, forest mahogany.

Distinguishing Features.—A stringybark (Plates 32-34) with a somewhat flaky bark approaching that of a bloodwood at first sight, with leaves distinctly paler on the lower surface, rather long stalks

Plate 32.

Red Stringybark (Eucalyptus resinifera). Portion of trunk.

to the flowers and capsules, buds with very long lids and somewhat cup-shaped capsules with stout, projecting valves.

Description: A tall tree up to 100 ft. or more high, with grey, thick, closely packed bark with a slightly furrowed surface that can be pulled away in long strips to expose a reddish inner bark. The leaves are spreading, with a dark green upper surface and a much paler lower surface; they taper to a sharp point and are about 5–7 times as long as wide and about 3½–4½ in. long. The flowers are carried in stalked bunches among the leaves and at the ends of the twigs. Each flower is nearly ½ in. wide and has a stalk about ⅛ to ⅓ in. long. The lid of the bud is about ½ in. long, about 3 times or more as long as the rest of the bud. The capsule has stout projecting tooth-like valves; excluding these valves it resembles in shape an egg with the narrow end downwards, about ⅓ in. long and nearly as wide; sometimes it is nearly cup-shaped.

Distribution.—Chiefly in Moreton and Wide Bay Districts, on sandy or stony soil with other eucalypts. It extends along the coast into North Queensland and south to about Sydney.

Plate 33.

Red Stringybark (Eucalyptus resinifera). Left, branchlet with leaves and seed-capsules. Right, branchlet with leaves and buds.

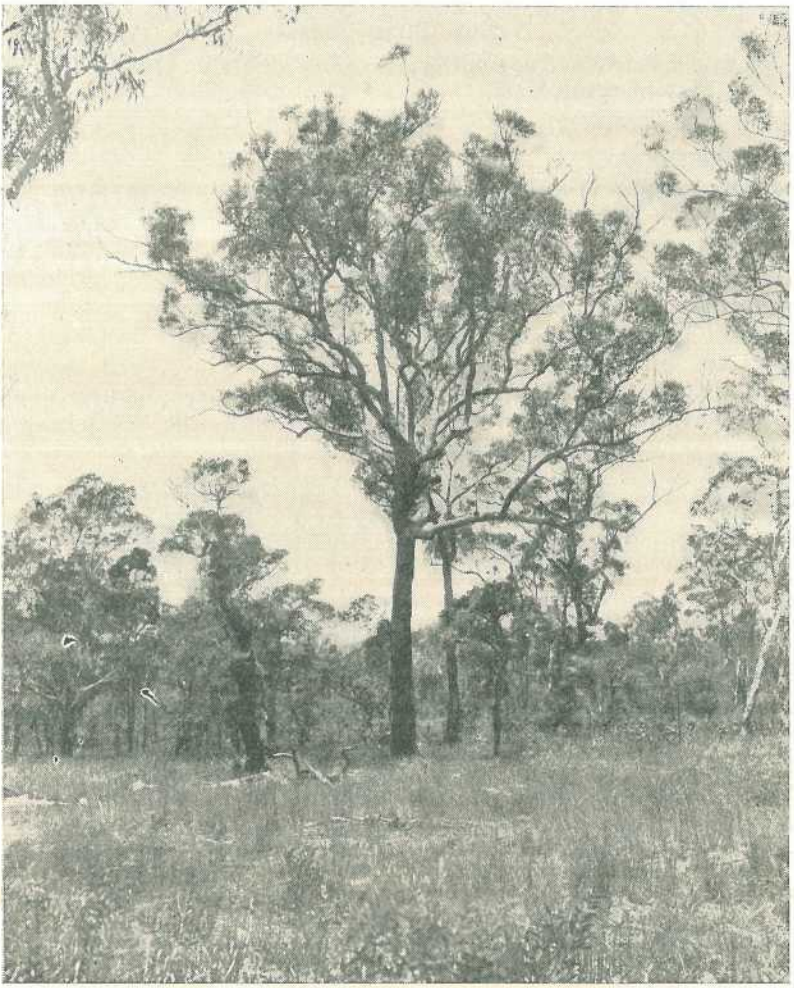


Plate 34.

Red Stringybark (Eucalyptus resinifera). Caloundra district.

Usual Flowering Time.—November to February.

Colour of Honey.—Medium amber.

Importance as Source of Honey.—Medium.

Importance as Source of Pollen.—Major.

General Remarks.—This is another good supporting species, as large supplies of pollen and a fair amount of honey are obtained about every second season. The crop is usually in the form of a natural blend with honey from several other species. In some favourable seasons the sharp flavour of red stringybark honey is dominant in such blends but generally it is detected only as a background flavour. Those who acquire the taste for red stringybark honey prefer it, irrespective of the dark appearance and weak density.

Care must be exercised in heating honey which is predominantly from red stringybark, as a layer of froth will be found on top of the heated product some time after it is tinned. This can be avoided by "flash" heating to 160 deg. F. Another feature is that this honey does not granulate readily.

Yellow Stringybark.

Botanical Name.—*Eucalyptus acmenioides* Schau., sometimes known as *Eucalyptus triantha* Link.

Other Common Names.—Yellow or white mahogany, yellow jacket, white stringybark.

Distinguishing Features.—A stringybark (Plates 35-36) with leaves distinctly paler on the lower surface, short but distinct stalks to the flowers and capsules, buds with lids about as long as the lower part of the bud, and cup-shaped capsules with the valves scarcely prominent.

Description.—A tree to about 100 ft. high, with a rather dense crown and grey thick bark that can be pulled away in long strips showing the brown inner bark. The leaves usually spread out from the twigs, taper to a sharp point, and are sometimes slightly curved or with one side slightly shorter than the other at the base; they are

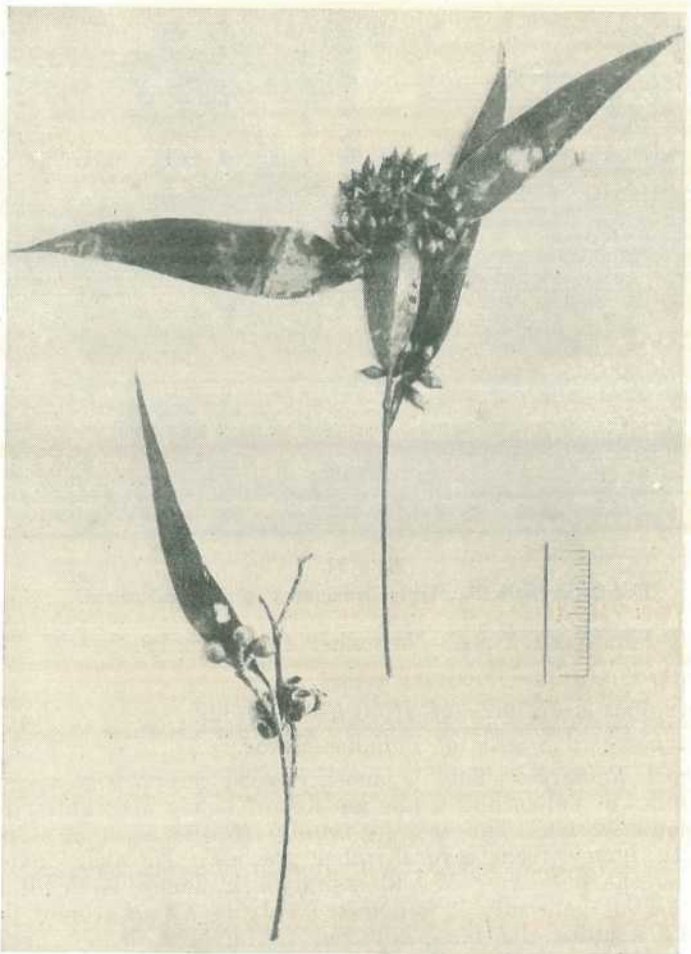


Plate 35.

Yellow Stringybark (Eucalyptus acmenioides). Branchlets with leaves, flower buds and seed-capsules.

much paler on the under surface, mostly 3-6 in. long and 5-8 times as long as wide. The flowers are carried in bunches at the ends of the twigs and in a few smaller ones among the leaves; they are about $\frac{3}{8}$ in. wide and have distinct stalks. The bud has a pointed lid about as long as the rest of the bud. The capsules are somewhat rounded or nearly hemispherical, about $\frac{1}{5}$ in. long and wide.

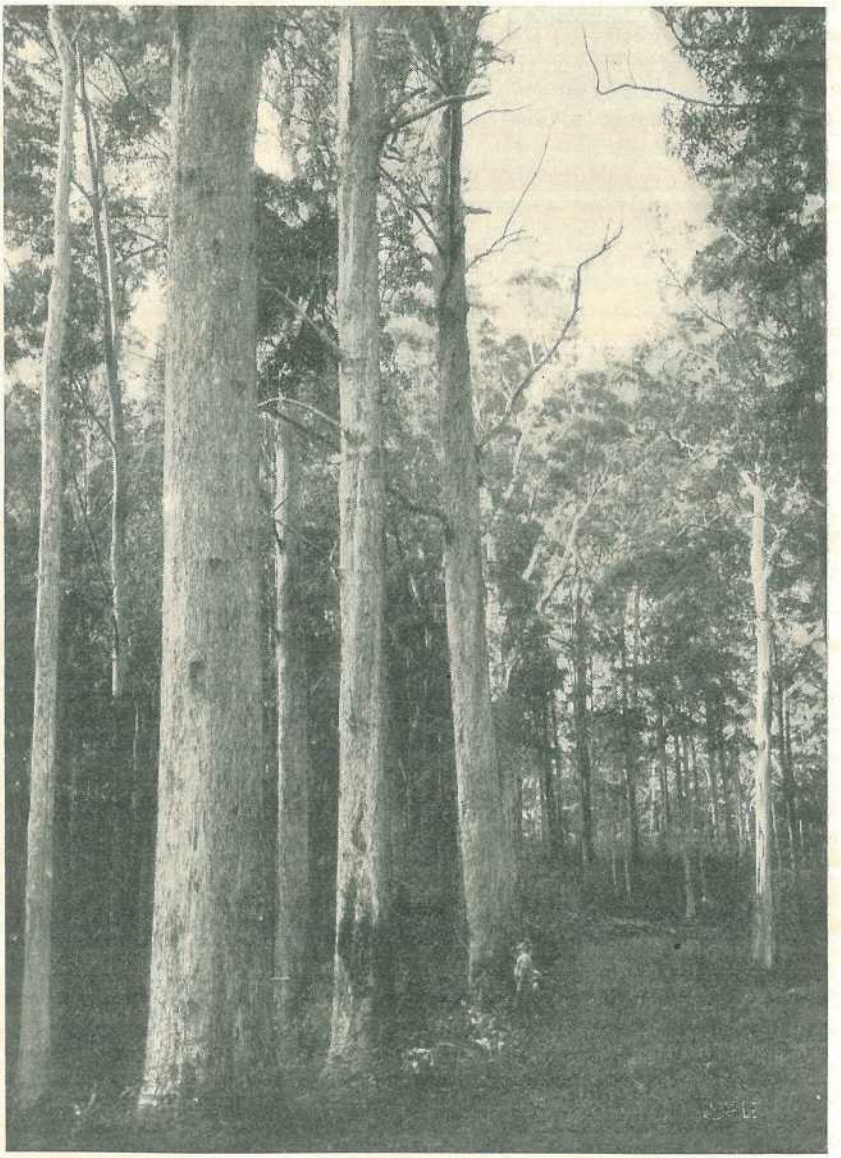


Plate 36.

Yellow Stringybark (Eucalyptus acmenioides). Swain Peak, near Eumundi.

[*Photograph by Forestry Sub-Department.*

Distribution.—In forest country in south-eastern Queensland, often on stony hillsides, sometimes near the edges of "scrub." It occurs along coastal and sub-coastal Queensland to the Atherton Tableland and into New South Wales as far south as Sydney.

Note.—There is another stringybark (*Eucalyptus umbra* R. T. Baker, also known as *Eucalyptus carnea* R. T. Baker) which closely resembles *Eucalyptus acmenioides* and is known by the same common names. It can be distinguished by the leaves, which are more drooping and thicker, not so sharply pointed, and not paler on the lower surface or only very slightly so; the capsules often have thicker walls and are sometimes slightly larger (Plates 37-38). It is found in forest country in the Moreton and Wide Bay Districts, extending north to the Atherton Tableland and south almost as far as Sydney.

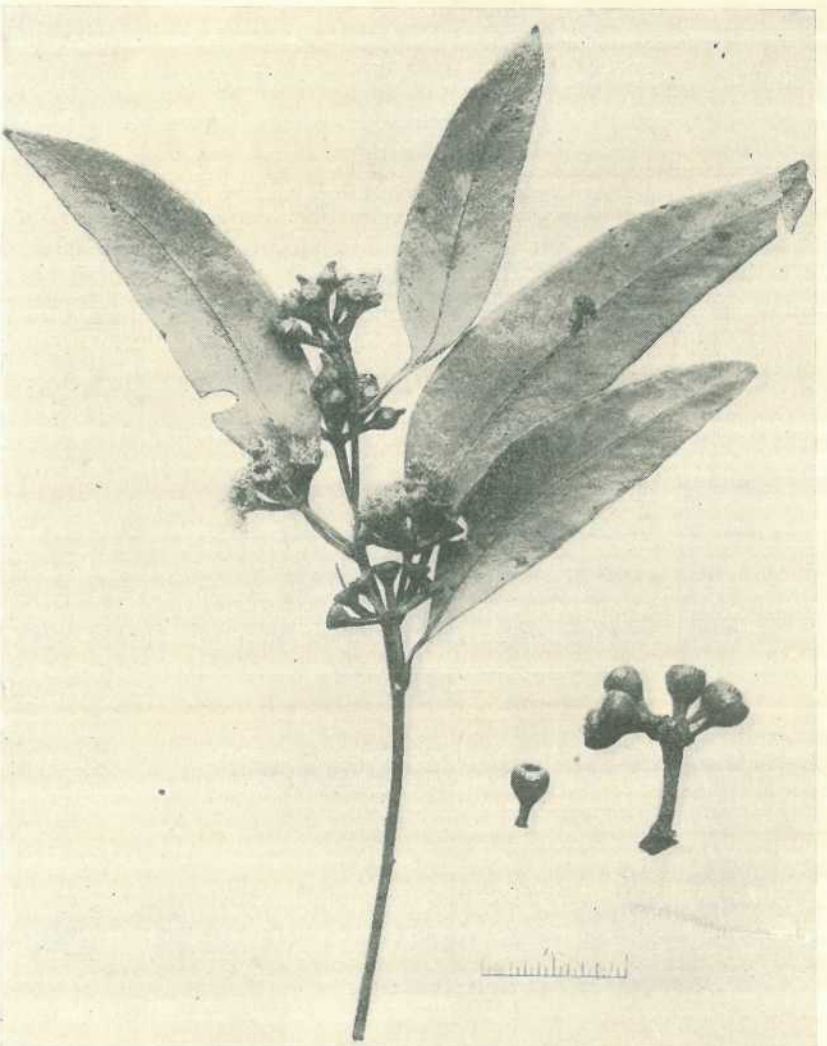


Plate 37.

Yellow Stringybark (Eucalyptus umbra). Branchlets with leaves, buds, flowers and seed-capsules.

Plate 38.
Yellow Stringybark (Eucalyptus umbra). Sunnybank.

Usual Flowering Time.—October to December.

Colour of Honey.—Medium amber.

Importance as Source of Honey.—Medium.

Importance as Source of Pollen.—Major.

General Remarks.—This tree is valuable to the beekeeper as a supporting species which yields large supplies of pollen and a moderate quantity of nectar practically every season. In addition, it flowers often in conjunction with the excellent nectar-producing grey ironbark. The ample pollen provided by yellow stringybark results in the pollen-deficient grey ironbark being worked more effectively and without impairment of colony strength.

The honey obtained from this stringybark tends to darken any honey with which it is naturally blended. In a grey ironbark-yellow stringybark blend, however, this tendency is not sufficient to lower the grading of the choicer grey ironbark honey. Like all stringybark honeys the flavour is sharp, the density weak, and a considerable amount of froth is thrown off when heated.

Beekeepers seeking grey ironbark sites prefer areas in which yellow stringybark is also present.

Honey from *E. umbra* exhibits similar characteristics to those described for *E. acmenioides,* although the tree is of only minor importance as a nectar and pollen producer.

White Stringybark.

Botanical Name.—Eucalyptus phaeotricha Blakely & McKie. In the past this species has been frequently called *Eucalyptus eugenioides* Sieb. ex Spreng., but this name properly belongs to a different tree of the Sydney district.

Other Common Names.—Grey stringybark, brown stringybark, Queensland stringybark, pink blackbutt.

Distinguishing Features.—A stringybark (Plates 39-41) with a somewhat silvery sheen to the foliage as a whole; thick-walled capsules shorter than wide, in close clusters.

Description.—A tree up to 100 ft. or more high, with grey, thick, closely packed bark that can be pulled away in long strips. The smaller branches are often smooth. The leaves often appear somewhat silvery from a short distance and hang vertically; they are curved, between 3 and 5 times as long as wide, mostly about 3-4 in. long, gradually narrowed to a pointed tip and with one side shorter than the other at the base. The flowers are borne in stalked clusters among the leaves towards the ends of the twigs and are nearly ½ in. wide when fully out;

Plate 39.

White Stringybark (Eucalyptus phaeotricha). Left to right, leaves, seed-capsules, coppice leaf and flower-buds.

the lid is rounded and much shorter than the rest of the bud. The seed-capsules are in clusters along the branches below the leaves, with hardly any visible stalk of their own, broader than long, with rounded sides and a relatively small opening, mostly about $\frac{1}{4}$ in. high and about $\frac{1}{3}$ in. wide; the four valves usually project a little beyond the opening.

Plate 40.

White Stringybark (Eucalyptus phaeotricha). Portion of trunk.

Distribution.—Moreton and Wide Bay Districts, in forest country with other eucalypts, chiefly on stony or sandy soil. Known also from North Queensland.

Note: In the Granite Belt other stringybarks occur, most of them difficult to distinguish from one another and from *Eucalyptus phaeotricha.*

Usual Flowering Time.—February to April.

Colour of Honey.—Dark amber.

Importance as Source of Honey.—Minor.

Importance as Source of Pollen.—Minor.

General Remarks.—Although this species flowers practically every year, little return in the form of pollen or nectar is obtained.

White stringybark is worked vigorously, more so than most other trees. Paradoxically, foraging activity on it progressively increases when flowering decreases and a lessening amount of nectar and pollen is obtained. This unusually intense period of work shortens the life of many field bees, and is therefore responsible for an abnormal mortality rate.

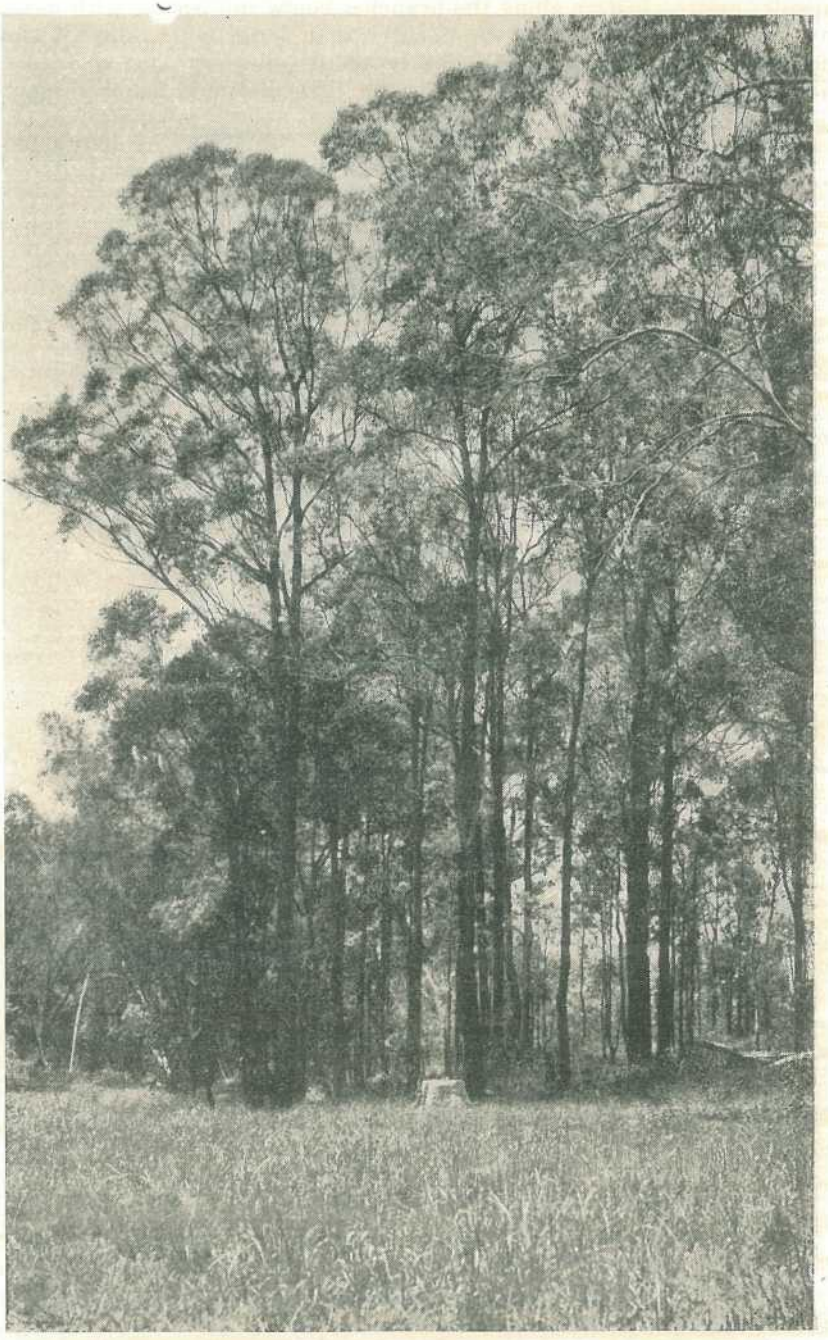


Plate 41.

White Stringybark (Eucalyptus phaeotricha). Slacks Creek.

The characteristics of the honey, apart from colour, are not known definitely. Some beekeepers state that it has a slightly acrid flavour and poor density.

Tallowwood.

Botanical Name: *Eucalyptus microcorys* F. Muell.

Distinguishing Features.—A stringybark (Plates 42-44) with brown to orange bark, especially beneath the surface, leaves distinctly paler on the lower surface, flowers and capsules tapering into short stalks and very short lids to the buds.

Description.—A tree up to 230 ft. high but commonly less than 100 ft., with a dense green crown and brown to orange bark that can be pulled away in long strips; the trunk sometimes appears grey, but the bright colour is readily seen on stripping off a piece of bark. The leaves spread out from the twigs and taper to a sharp point; they are much paler on the under surface, mostly 2½–5 in. long and mostly 3–5 times as long as wide. The flowers are carried in bunches at the ends of the twigs and in a few smaller ones among the leaves; they are ½ in. wide and taper gradually into their stalks. The buds have a very short, rounded lid. The capsules also taper to their stalks but are somewhat cylindrical in the upper part; they are about ¼ in. long and slightly narrower, with the valves projecting very slightly or not at all.

Distribution.—Moreton and Wide Bay Districts, usually not very far from the coast in the higher rainfall country. Pure stands are not found but the trees may occur on the fringes of "scrub" (where the largest trees are found) or in mixed forest, where they are often scattered. It is known in northern coastal New South Wales to about as far south as Newcastle.

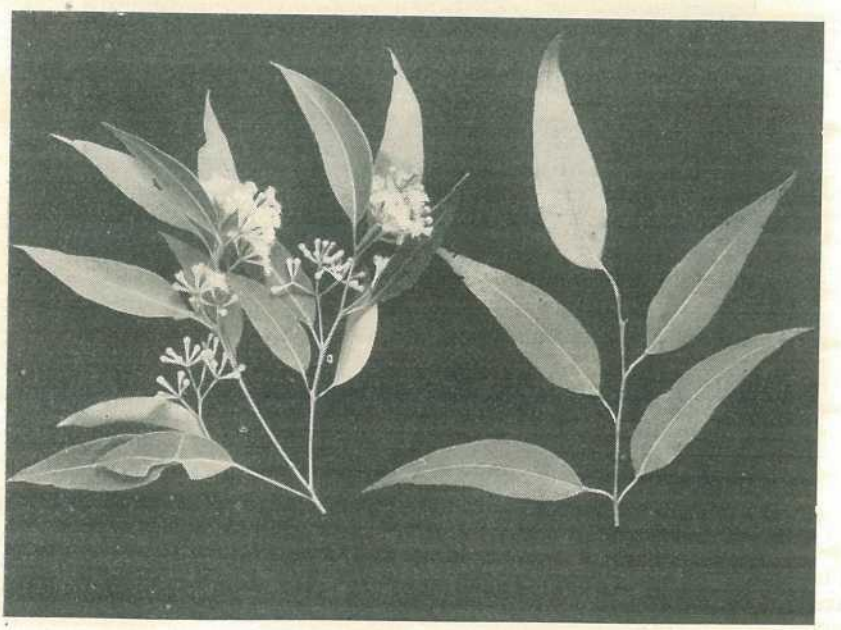


Plate 42.

Tallowwood (Eucalyptus microcorys). Left, branchlet with leaves, buds and flowers. Right, branchlet showing undersides of leaves.

Plate 43.

Tallowwood (Eucalyptus microcorys). Portion of trunk.

Usual Flowering Time.—August to October.

Colour of Honey.—Dark amber.

Importance as Source of Honey.—Minor.

Importance as Source of Pollen.—Medium.

General Remarks.—This picturesque tree is of value to beekeepers in only a few localities. In the Caboolture, Woodford, Kilcoy and Pomona districts a fair quantity of pollen and a small amount of nectar are obtained from late winter to early summer. In these areas tallowwood is also useful for stimulating broodrearing.

Many beekeepers are surprised that this well-known species, which flowers regularly and heavily, is not of more importance in coastal areas. Apparently, the ornamental characteristics of the tree, which

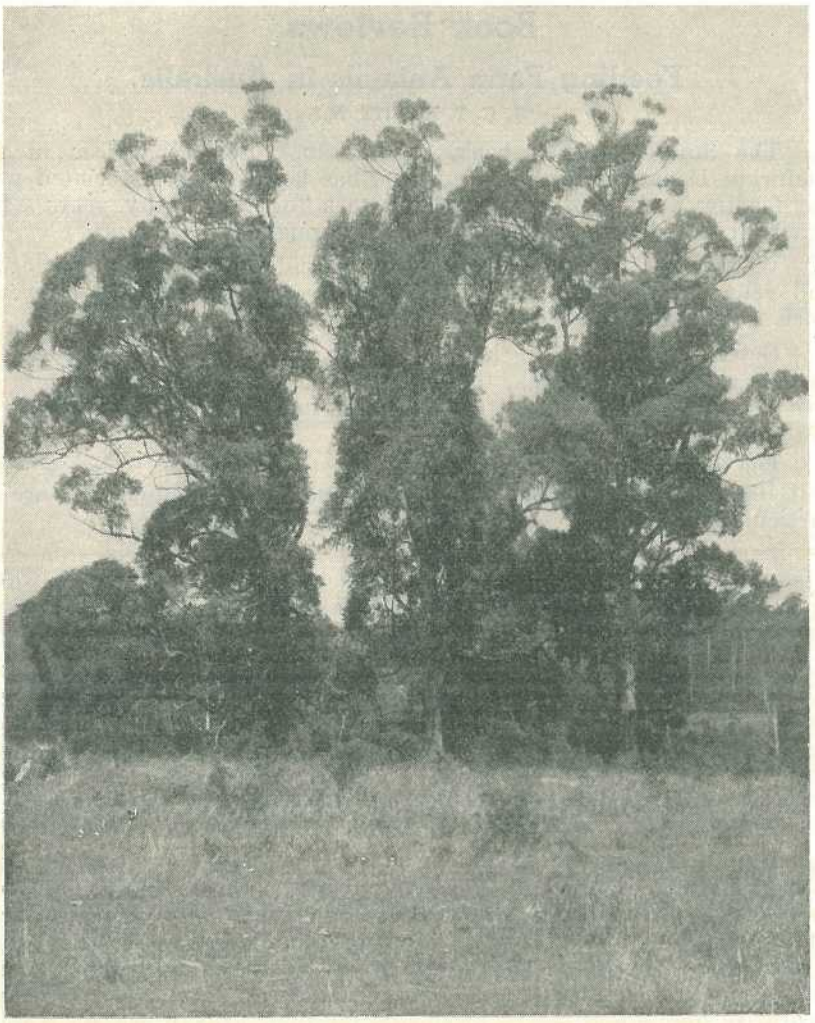


Plate 44.

Tallowwood (Eucalyptus microcorys). Daisy Hill.

make it particularly outstanding in the forest landscape, help to create a false impression of its abundance in many districts.

[TO BE CONTINUED].

ROCKHAMPTON ENTOMOLOGICAL FIELD STATION.

With an improvement of the staff position in the Science Branch of the Department, it has been possible to reopen the Entomological Field Station at Rockhampton.

The officer in charge is Mr. T. Passlow. The services of the Station are available to growers in connection with insect pest control in fruit and vegetables in the Rockhampton area and general insect troubles in the Central District.

Book Reviews.

Feeding Farm Animals in Australia.

By A. C. T. HEWITT, M.Agr.Sc.

The author of this book, as Livestock Science Officer in the Victorian Department of Agriculture, has been closely associated with the feeding and management of livestock for very many years. His practical knowledge of stock is evident throughout its pages.

Written primarily for stock-owners and students of agriculture and veterinary science, this book can be recommended as a reference work to those readers.

Before getting down in earnest to the subject of feeding the various classes of livestock, the author has written several chapters on the principles of feeding farm animals and the various foodstuffs available for use in Australia.

The chapter on pastures, shrubs and trees as stock foods contains well illustrated sections on haymaking and silage-making that are of particular interest.

Turning the pages at random, one finds interesting notes on such things as clearing stagnant water, teaching calves to drink, stock equivalents for expressing carrying capacity of pastures, feeding dogs and cats, and so on.

A worthy addition to Angus and Robertson's Australian Agricultural and Livestock Series, the book is available from booksellers for 45s.

Australian Plants for the Garden.

By THISTLE Y. HARRIS, B.Sc., M.Ed.

This profusely illustrated book of 350 pages, written by the author of *Wild Flowers of Australia,* presents several novel features. Australia is very rich in beautiful and unusual plants which are too often passed over in favour of the more publicised introduced trees, shrubs, flowering plants and ferns. This book is designed to awaken Australians to the beauty of their own flora. Hundreds of these decorative plants and the requirements for their growth are adequately described for the guidance of the home gardener.

A very useful section of the book is the inclusion of detailed plans of gardens composed solely of Australian plants. These plans are varied to meet the needs of gardens of different size, aspect and topography.

Early chapters deal with planning and preparation of gardens, garden craft, the propagation of plants by seed or cutting, pruning, and the control of diseases and pests. A chapter of interest to amateurs is that devoted to the naming of plants.

The book is well written by an author who obviously enjoyed her task. The foreword is by the late C. T. White, for many years Queensland Government Botanist and one of the leading botanists of the Southern Hemisphere.

Australian Plants for the Garden is published by Angus and Robertson, and is obtainable from all booksellers at 63s.

The Indian Breeds of Cattle and Their Crossbreeds.

G. I. ALEXANDER and K. F. HOWARD, Cattle Husbandry Branch.

THE cattle population of the world is widely spread and the various strains and breeds which have developed in the different areas have been peculiarly adapted to the particular conditions under which they have been bred.

The environment of the animal may be divided broadly into two main categories—vegetation and climate. The former is dependent on the latter and is adapted to the climatic conditions, as are the indigenous stock of the area. In areas where there is a rapid growth of coarse pasture and a long dry season or drought, the indigenous cattle have become adapted to such conditions. Where there is abundant growth of lush grasses throughout the year the stock have been more carefully selected by man to suit the environment. They are better able to utilise fodders of high nutritive value, but are badly adapted to less favourable environments.

Besides its effect on the vegetation, climate exerts a direct effect on the animal. In countries where there are severe winters, the cattle possess a seasonal growth of soft fine hair which helps them to withstand the cold. These cattle also lay down reserves of fat under the skin which insulates the beast against the cold.

Hot humid areas required the development of other adaptive mechanisms by the animal. Cattle from these regions possess the ability to sweat and their skin hangs in loose folds to provide a greater cooling surface. The pigment of the skin and hair is such as to promote reflection of the sun's rays and so limit the absorption of solar heat. Dark skin pigment combined with light hair colour is most efficient in preventing the absorption of the ultraviolet rays of the sun, which produce overheating. The hair is much sparser than that of the cattle of temperate regions and is not as fine.

Man upset this fine balance which nature had achieved when he commenced transplanting stock into environments to which they were not adapted. Cattle in the temperate region had been selectively developed for many decades into specialised types of either beef or

dairy cattle. The attempt was made to transplant them to other environments rather than develop the indigenous breeds. These cattle from the temperate regions proved remarkably adaptable and thrived under a great variety of conditions. However, in certain localities, usually with hot humid climates, they were found to deteriorate rapidly. In these areas the milk production dropped, as did the rate of growth and fattening. Sustained high temperatures appeared to be more detrimental than a relatively wide daily variation with hot days and cool nights.

In order to improve the adaptability of the British breeds, various crosses with the Indian breeds of cattle (*Bos indicus*) have been tried. These Indian breeds were indigenous to the tropics but were not as highly developed for beef or milk production as the temperate breeds (*Bos taurus*). The two scientific names indicate that the stock belong to two distinct families, so crosses between the two are actually hybrids (that is, crosses between different species) rather than crossbreds, which are crosses between breeds of the same species. While the Indian breeds of cattle are not as sharply differentiated as the British breeds, there are nevertheless distinct strains into which they can be classified.

THE INDIAN BREEDS OF CATTLE.

Many breeds of cattle exist in India, but often there is so little difference between breeds that the geographical areas of origin and shape of horns may be the only guiding factors in separating one breed from another.

Of the Indian breeds, those described here are considered to be the most highly developed and have been used widely as a basis for cross-breeding.

The two principal breeds of Zebu or Indian cattle used in America are referred to by Americans as Guzerat and Nellore. These names refer to portions of the geographical areas from which the animals were imported, but the names commonly used for these two breeds in India are Kankrej and Ongole respectively.

Beef Types.

Kankrej (Guzerat).

This is a fast, powerful breed of grey Indian cattle and has been exported to the United States in the greatest numbers. In India they are used principally as draft cattle. The milk production of the cows is very low. The chief characteristics of the breed are—

(*a*) Head carried high; forehead wide; the face with a flat or dished profile.

(*b*) Long drooping ears.

(*c*) Well developed hump.

(*d*) Heavy skin.

(*e*) Moderately heavy dewlap and rather pendulous sheath.

(*f*) A comparatively short tail with black switch.

Ongole (Nellore).

These are short-boned, white or light grey cattle much valued in India for heavy work, but not considered suitable for fast trotting. Considerable numbers have been exported to northern South America

and other tropical areas. Some animals have been introduced to the southern United States. They are of large size and are quite muscular. The Ongole has a dewlap and sheath of moderate size. The forehead is relatively flat, and the skull is coffin-shaped. The orbital arches are not prominent and the face is slightly convex in profile.

Krishna Valley.

This breed resembles the Ongole closely. In both breeds the usual tendency is for males to be some shade of grey over the neck, shoulders, hump and quarters, becoming darker with age, while females are of a lighter shade and eventually become white, or nearly so, with age. The bullocks are massive, powerful animals useful for slow draft and for heavy ploughing; the cows are fair milkers.

Hissar.

This breed was developed in order to obtain larger, stronger animals for draft purposes. Other breeds, however, have been preferred to the Hissar and this strain has lost much popularity in India.

They are lyre-horned, grey cattle with foreheads resembling the Kankrej and Tharparkar.

Tharparkar.

Found in the arid, semi-desert regions, these cattle are medium-sized and of compact build. The bullocks are good workers; the cows are only fair milk producers.

Dairy Types.

Gir.

Cattle of this dairy breed are quite ponderous and have a pendulous dewlap and sheath, prominent forehead and lateral (often curled) horns. Some animals are entirely red, but the colour is usually mottled and varies from yellowish red to almost black. Some strains are nearly white, with a few spots of colour. The ears are markedly long and pendulous, with a notch near the tip. The dewlap is only moderately developed, but the sheath is usually pendulous.

The bullocks are large and powerful. They are used for draft purposes, but are rather slow and lethargic.

Sahiwal.

Sometimes called the Montgomery breed, the Sahiwal is essentially a milk breed. It is native to the central and southern portion of the Punjab, but is now widely used throughout India and Pakistan. These cattle have recorded productions of over 10,000 lb. of milk in a 10 months' lactation.

Reddish dun is the common colour, with some white markings. The cattle are of powerful build, the bullocks being useful for slow draft work. The head is broad, with short stumpy horns, and the dewlap and sheath are heavy and pendulous.

Red Sindhi.

Originating from the country around Karachi, these cattle have gained wide popularity as dairy stock. They have apparently originated from small hill cattle. Their colour is red or fawn, frequently with some white on the face and dewlap (Plate 1). The sheath and dewlap are rather heavy and the udder is quite well developed. Many cows have been recorded as producing 4,000 lb. of milk in a 10 months' lactation.

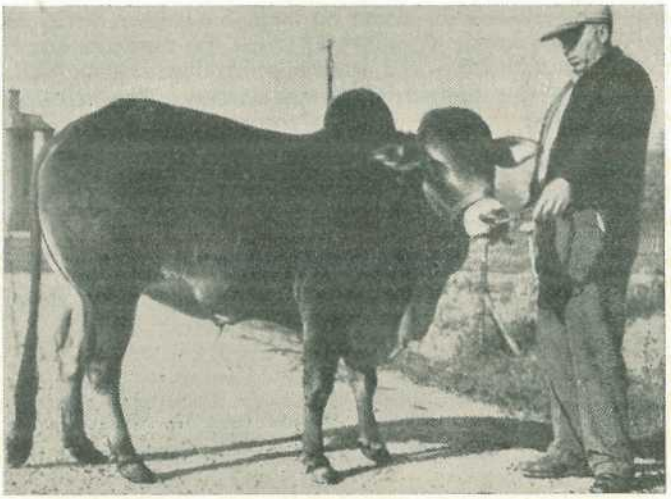


Plate 1.

A Red Sindhi Bull of a Type being Bred with Jersey Cattle in the United States.

[This and some other photographs from Texas Journal of Science.

The Afrikander.

Belonging to the family *Bos indicus*, the Afrikander (Plate 2) is closely related to the Indian breeds and has been used for cross-breeding purposes. These hardy animals are reputed to be extremely resistant to drought and show a degree of resistance to ticks and other insects.

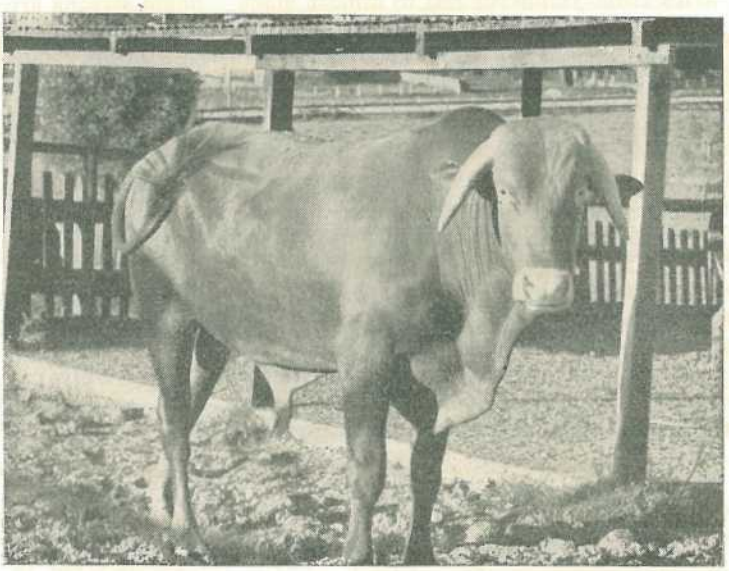


Plate 2.

An Afrikander Bull.

Afrikanders are big animals, but they are rather narrow of body, leggy and somewhat fine-boned, and lack some of the good qualities of the Indian strains of Kankrej and Ongole.

The American Brahman.

The popular name in America for the Zebu or Indian cattle is "Brahman". The first importations of Zebus to America were in 1849, but it was not until the early 1900's that appreciable numbers entered the country. Kankrej, Ongole, Krishna Valley, Gir and possibly others were introduced.

In the United States these breeds were not retained pure, but were crossed with purebred and grade cows of European origin. Further grading up with Indian breeds, plus selection for beef characteristics, led to the establishment of the American Brahman (Plate 3).

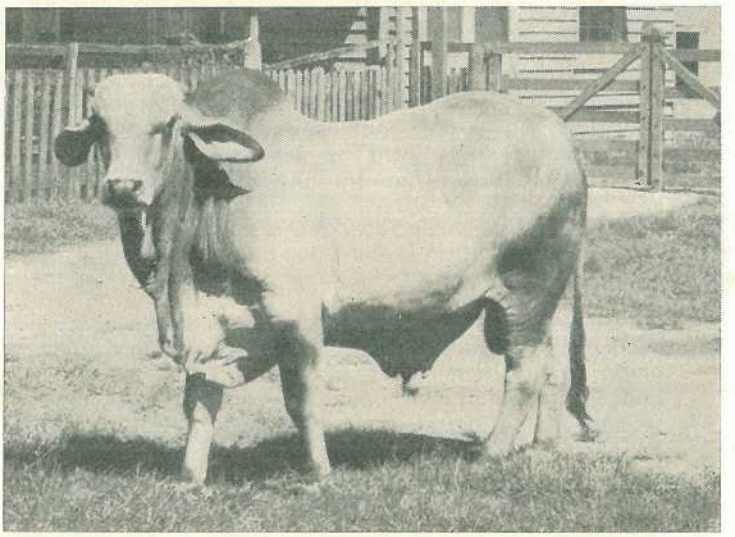


Plate 3.
An American Brahman Bull.

Selection within this relatively restricted number of cattle resulted in the standardisation of a type superior in beef qualities to the Indian breeds, but still retaining the distinctive characteristics of coat colour and ability to thrive under tropical climatic conditions.

To-day, Brahman blood is a feature of the cattle industry in the southern parts of the United States and in that region it is continuing to gain popularity. It has been claimed that . . . . "The Gulf Coast area of Texas and Louisiana has probably the densest cattle population of any similar geographical area in the world. The Brahman absolutely dominates this population and but for Brahman blood this area would support but a small part of this great beef industry."

Advantages.

The following advantages are claimed for Indian cattle:—

(*a*) Heat tolerance is the chief advantage attributed to Zebu cattle. This characteristic is dependent on a number of factors:—

(i) The large surface area of the hide of the Zebu is considered to assist in the elimination of heat.

(ii) Zebu cattle sweat freely and so are less inconvenienced by high temperature than are British breeds. This point has been the subject of controversy, as some people hold that British breeds have as many sweat glands as Zebu cattle.

(iii) Their light hair is responsible for greater reflection of the sun's rays than that of the British breeds.

(iv) The dark pigment of the skin prevents much penetration by the ultraviolet rays of the sun and so minimises their heating effect.

(v) The density of coat of Zebu cattle is much less than that of British cattle and so the coat absorbs less heat than the thicker coat of British cattle. The beast with a dense long coat is less likely to thrive in the tropical areas than the one with a sparse, short coat.

The above five factors make the Zebu a good grazier, eating at any time during the day or night. It does not have to rush its feed during the cooler periods of the day.

(*b*) They are capable of travelling long distances to water, as their walking pace is fast and they can jog along without being inconvenienced. This permits wider grazing by Zebus and, in times of feed shortage, enables them to maintain themselves in better condition than cattle of the British breeds.

(*c*) Their breeding span is longer than that of British breeds.

(*d*) Although they reach sexual maturity late, Zebu bulls are capable of serving more cows than bulls of other breeds.

(*e*) It is believed that Zebu cattle possess *some* degree of tick resistance, which may be associated with their short hair, dense skin and the secretion of sebum in their sweat, which seems to act as a repellent to insects. The muscular development under the skin enables the beast to twitch its hide and so dislodge insects in a manner impossible to British breeds.

Disadvantages.

Probably the Zebu's greatest disadvantage is its temperament. It is definitely a nervous, highly strung beast and different handling methods are called for from those used with British breeds. The Zebu and its crosses are, however, quite manageable when proper handling methods are employed.

Description.

The following is the standard of excellence as set out for American Brahman cattle by the American Brahman Breeders' Association.

(a) General Appearance.

	Score. Bull.	Cow.
1. *Colour.*—Solid or gradual blending of two colours. Unpigmented skin objectionable. Brindle is a disqualification. Muzzle and hoofs dark. A white nose, light coloured hoofs or white switch undesirable	1	1
2. *Size and Weight.*—Well developed according to age, bulls 1,600 lb. to 2,200 lb. at maturity in good flesh. Cows 1,000 lb. to 1,500 lb. at maturity in good flesh	8	8
3. *Form.*—Massive, broad, deep, medium low-set, moderately compact, symmetrical, smooth. Straight back with a slightly rounding rump. Any appreciable dropping off from hips to region of crops or hump undesirable. Bull should possess hump of ample size, located directly on top of shoulders, moderate in thickness, somewhat resembling a bean in shape and extending backwards. Females should show hump of moderate development, more oval in shape than that of bull and located on top of shoulders. Bottom line straight except for sheath in bull and navel in cow. Excessive development of sheath or navel objectionable. Flanks full. Bull should possess pronounced masculinity. Females should show all characteristics of refinement and feminity which would indicate a good producer. Walk straight, strong and active	8	8
4. *Quality.*—Hide soft and pliable, of medium thickness, densely covered with hair of medium texture, oily to the touch. Well developed dewlap with generous amount of soft pliable skin arranged in folds extending from lower jaw to chest floor. Moderate development of loose skin under belly. Bone ample in substance, clean cut and strong. Fleshing smooth	5	5
5. *Flesh Covering.*—Thick, firm, mellow and uniformly distributed.	7	6
	29	28

(b) Head and Neck.

1. *Head.*—Forehead broad, practically flat to moderately prominent, face short, slightly tapering toward nose; muzzle full, nostrils wide and open; lips dark. Eyes mild and full with good width between them. Distance from eyes to muzzle of moderate length. Ears ample in length, moderate in width, and characteristic of predominating strain. Horns wide apart at the base, thick, varying in length and shape according to predominating strain. Horns of cows should be thinner than horns of bulls	7	7
2. *Neck and Throat.*—Neck short with full crest in bull; neat in cows, blending smoothly into shoulders. Throat clean on sides, but with development of loose skin underneath	2	2
	9	9

(c) Forequarters.

1. *Shoulders.*—Moderately oblique, smooth and well covered on blades, broad on top and covered by hump	5	4
2. *Brisket.*—Not too prominent. Wide and moderately deep, covered with loose skin	1	1
3. *Legs.*—Moderately short, straight and squarely placed. The forearms should show heavy muscular development, bones strong and clean with dense joints	3	2
	9	7

	Score. Bull.	Cow.
(d) Body.		
1. *Chest.*—Wide and deep, round and full back of shoulders. Good width on chest floor and well filled in fore flank	6	6
2. *Ribs.*—Well sprung from backbone, arched, with ample length to give depth to body. Symmetrically joined to loin and crops, well covered with smooth, thick, natural flesh. There should be no appreciable depression behind the shoulders	7	7
3. *Back.*—Broad and level from hump to hooks; slightly rounding from hooks to pin bones or tail head. Well covered with thick smooth natural flesh. Hooks moderately wide and well laid in. A sharp angle of back between and extending above hooks objectionable	8	8
4. *Loin.*—Broad, thick, level, blending smoothly into back and rump	7	7
	28	28
(e) Hindquarters.		
1. *Rump.*—Long, wide, nearly level (slightly rounding toward tail head), smoothly joined to loin. Tail head smooth with tail coming neatly out of body on a line with or slightly below level of the back and hanging at right angles to it (steep slope objectionable)	8	8
2. *Hooks.*—Slightly below level of back, medium in width, well laid in and moderately covered with flesh	1	1
3. *Thighs and Twist.*—Broad, thick, full, and deep, extending well down to hocks. Twist deep and full	8	8
4. *Legs.*—Moderately short, straight, and squarely placed; perpendicular from rear view but slightly inclined forward below the hocks; muscular above hocks; bone with ample substance, clean and dense. Strong, short moderately sloping pasterns. Toes uniform and ample in size	2	2
5. *Tail.*—Neatly attached to the body on a level with the top line or slightly below, long, whiplike, with dark switch	1	1
6. *Udder.*—Ample in capacity, extending well forward in line with belly and well up behind; not fleshy. Teats moderate in size, squarely placed, well apart		4
7. *Scrotum.*—The scrotum should contain two testicles of equal size; only one testicle showing is very objectionable	1	
	21	24
(f) Disposition.		
Alert but docile (excessive nervousness highly undesirable) ..	4	4
Total	100	100

BRAHMAN CROSSES.

Beef Cattle.

Santa Gertrudis.

This breed is made up of approximately three-eighths Shorthorn and five-eighths Zebu. It is claimed not only to possess the advantages of both breeds, but also to have attained a high degree of uniformity. A breed society has been formed in America. The Santa Gertrudis is the only breed developed from a Zebu-British breed cross that is recognised by the United States Department of Agriculture.

A pamphlet on this breed and its possible application to Queensland conditions is available from the Queensland Department of Agriculture and Stock.

Beefmaster.

This breed (Plate 4) is made up of Zebu, Hereford and Shorthorn blood. Crossbreeding commenced on the Lasater Ranch in Texas in 1908, emphasis being placed on the development of a strain of cattle that would produce a choice, quick-maturing heavy calf at 8 months under range conditions. Progeny testing is being used to determine the superiority of bulls and all characters deemed non-essential have been disregarded. Great emphasis has been placed on fertility, weight, conformation, thriftiness and milk production. Colour is disregarded, but reds and dark browns are the predominating colours.

These cattle are bred under range conditions, so no exact pedigrees are kept, but the cattle are approximately one-half Zebu, one-quarter Hereford and one-quarter Shorthorn blood.

The original breeder claims that his Beefmasters will outweigh British breeds by 30 per cent. at any age without any supplementary foodstuffs.

The breed has shared with the Santa Gertrudis the honour of being the cattle gaining the most weight in tests carried out by the United States Department of Agriculture.

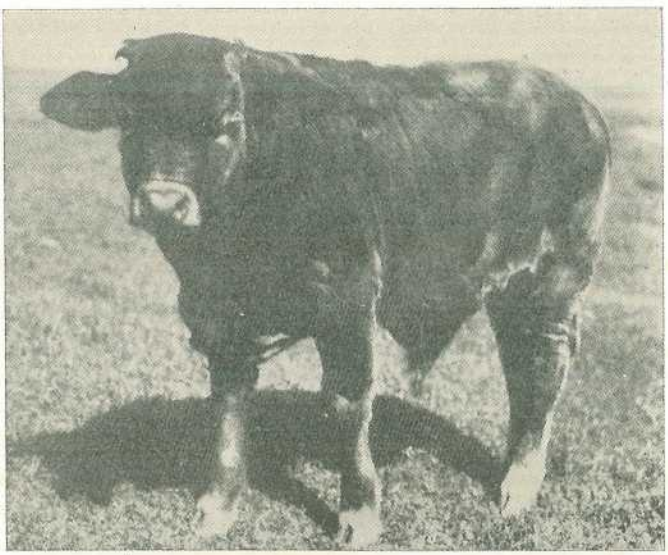


Plate 4.
A Beefmaster Yearling Bull.

Brangus.

This breed (Plate 5) was originated by the Paleface Ranch of San Antonio, Texas, as they preferred the Angus for crossing with Zebu on account of body conformation, distribution of flesh, amount of finish, dressing percentage and the ability to top off rapidly with the least food consumption.

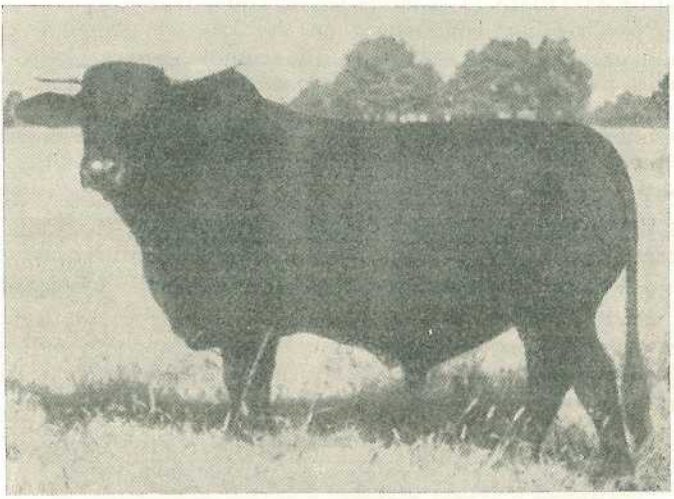


Plate 5.
Half-bred Brahman x Angus Herd Bull.

Various proportions of Zebu blood have been tried in this cross. The present strain of three-eighths Zebu and five-eighths Angus is considered to be well fleshed, with the ability to convert feed efficiently to high quality beef. The rumen is smaller than in the British breeds but the cattle feed often, so they obtain ample feed. The small rumen is an advantage, giving a high dressing percentage.

Braford.

On large open-range pastures of the Gulf Coast region of U.S.A., Brafords, which are Zebu-Hereford crosses (Plates 6 and 7), have proved to be better adapted to the climatic conditions than Herefords. Several proportions of Zebu and Hereford blood have been tried. The weaning weights of calves resulting from the various crosses are listed as follows:—

(1) Hereford bull on half-Zebu cows .. .. 460 lb.

(2) Hereford bull on quarter-Zebu cows .. 450 lb.

(3) Zebu bull on pure Hereford cows .. .. 330 lb.

(4) Hereford bull on pure Hereford cows .. 345 lb.

(5) Half-Zebu x Hereford bull on purebred Hereford cows .. .. 345 lb.

These results indicate that the best results were obtained with calves mothered by Zebu cross cows.

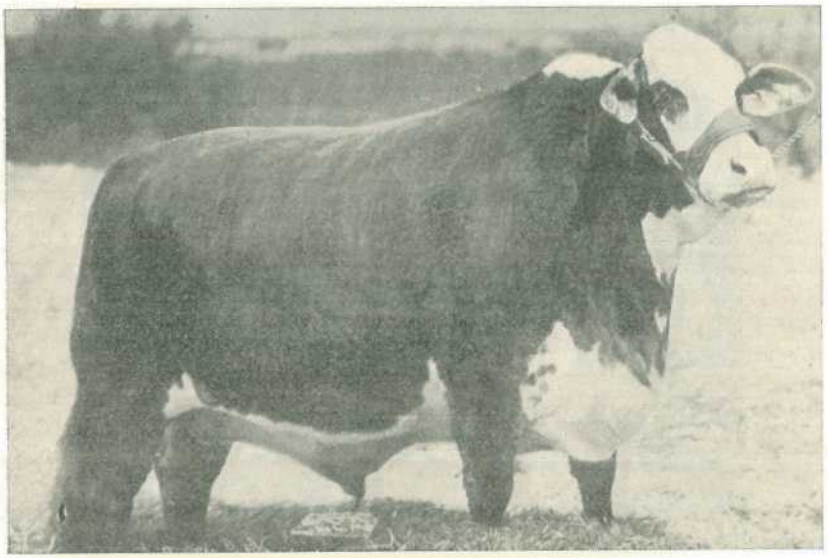


Plate 6.
Crossbred Brahman x Hereford Steer.

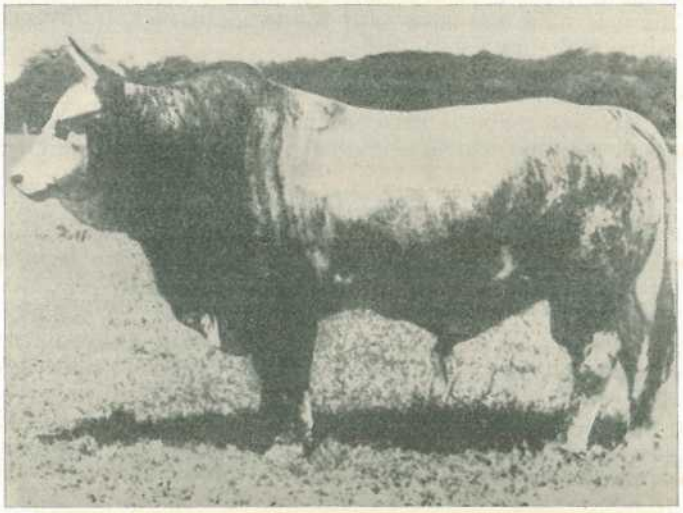


Plate 7.
A Braford Bull.

Charbray.

The Charolais, a French breed well known in America for its rapid growth, has been crossed with the Zebu to produce a well-rounded, very long animal with exceptionally heavy forequarters and a very deep body (Plate 8). The heart girth is very great in the better types. While the calves are usually very small at birth, they grow rapidly and bulls have been known to weigh 3,000 lb. liveweight, which is exceptionally heavy.

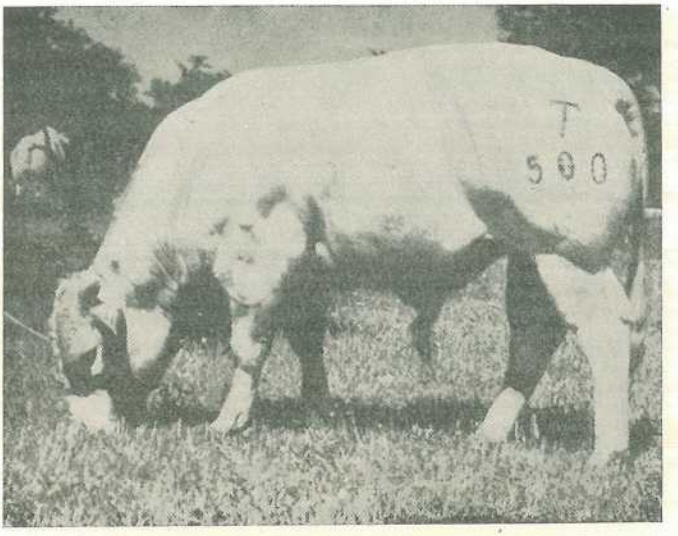


Plate 8.
A Charbray Bull.

Besides being used as a foundation for the Charbray in the United States, the Charolais has been used for crossbreeding in French Sudan and Morocco, Argentine and Brazil.

Brahorn.

This Brahman x Shorthorn cross has been largely overshadowed by the Santa Gertrudis, which originated from the Zebu and Shorthorn breeds.

Dairy Crosses.

The dairy breeds of Indian cattle have been intensively developed in India over recent years. Particular attention has been given to the Red Sindhi and Sahiwal, the latter tending towards a dual-purpose breed. The average annual milk production in India is about 600 lb. milk per cow, but Red Sindhi and particularly Sahiwal cows have produced far in excess of this figure with the assistance of good feeding and management.

The butterfat percentage of Brahman milk is above the average of the British breeds, being comparable with that of the Jersey and Guernsey breeds.

In India much crossing with Friesians has been carried out. The pure Friesian does not stand up to the severe summers, becoming thin, very distressed in hot weather and giving a greatly decreased milk production. The infusion of even a small proportion of Indian blood produces quite a considerable improvement in the milk production. Average production figures under conditions on the better-managed farms where the crossbreeding is being carried out, for animals with varying amounts of Friesian blood, are:—

Breeding of Cows.	No. of Records.	Average Amount of Milk.
⅛ Friesian	21	4,839 lb.
¼ Friesian	175	5,982 lb.
½ Friesian	589	6,977 lb.
⅝ Friesian	204	6,985 lb.
¾ Friesian	396	6,664 lb.
⅞ Friesian	86	6,180 lb.

In the United States, the Red Sindhi has been chosen by the Bureau of Dairy Industry for experimentation in the development of a breed of dairy cattle suitable for the hot humid areas. Two bulls were imported in 1946 and preliminary results indicate that Indian cattle can be used to introduce heat tolerance into domestic dairy breeds (Plate 9), a trait already inherent to some degree in the Jersey.

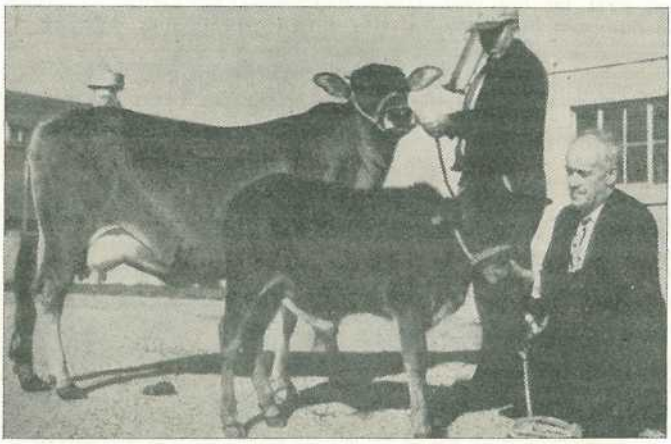


Plate 9.

Red Sindhi x Jersey Crossbreds. The cow is one-half Red Sindhi and one-half Jersey. The bull calf is three-quarters Red Sindhi and one quarter Jersey.

The Jamaican Department of Agriculture has developed a tropical dairy breed—the Jamaica Hope. This breed was developed over the period 1930-1950 by the infusion of Sahiwal blood into Jersey cattle. Originally Friesian and Guernsey cattle were also tried, but they proved less suitable than the Jersey for crossing and so were discarded.

It was found that animals with Zebu blood had a greater birth-weight and grew more rapidly than the pure Jerseys, the rate of growth increasing with an increase in the amount of Zebu blood. The difference in growth rate was more marked after the age of two years.

The milk production for a lactation increased with the amount of Zebu blood up to half, when it began to decrease. Animals with one-half Zebu blood appeared to be most suitable for milk production for Jamaican conditions.

The age at which heifers calved tended to increase with the amount of Zebu blood, and the length of the dry period increased also with an increase in the amount of Zebu blood.

CROSSBREEDING POLICIES.

The development of all these Zebu crosses has been the result of careful selection and, in many cases, progeny testing with a constant regard for the type being aimed at. The standardisation of the ideal type should be the aim of every cattle breeder. The crossing of two breeds, or more particularly species, introduces the possibility of obtaining a superior type, but the difficulty arises with the fixing of this improved type in succeeding generations.

Success or failure of any breed or cross in a particular locality will be governed to an extent by the presence or absence of an intelligently planned breeding programme. In an endeavour to obtain the advantages of the Zebu, breeding policies have varied from rigidly controlled programmes to that of indiscriminate use of Brahman blood with no apparent regard for type or uniformity.

Much can be learned from overseas experience. The following recommendations incorporate the basic principles followed by most overseas breeders in developing their new breeds.

There are three main methods of utilising Zebu blood, namely:—

(1) Crossing crossbreds.

(2) Grading up to a standardised breed.

(3) A combination of (1) and (2).

Crossing Crossbreds.

Assuming that the foundation herd is predominantly one British breed, it should be as uniform as possible. If this is not the case, the herd should be graded up by the use of purebred bulls of the British breed predominating in the herd. One generation may be sufficient to allow selection of a line of heifers sufficiently uniform in type to act as the foundation herd for the crossbreeding programme. These heifers are then mated to bulls whose ancestry is half-Zebu and half that of the British breed in the herd.

This breeding technique may be illustrated thus:—

DAMS.		SIRES.
Grade Hereford cows (basic herd)	x	Purebred Hereford bull
Grade Hereford heifers	x	½ Zebu, ½ Hereford bulls
¼ Zebu, ¾ Grade Hereford heifers	x	¼ Zebu, ¾ Hereford bulls
¼ Zebu, ¾ Grade Hereford heifers		

This policy calls for adequate subdivision so that the mating programme is not upset by mixed breeding. After a few years, there will be sufficient females with ¼ Zebu to form the entire breeding herd, so that the use of the ½ Zebu, ½ Hereford males may be dispensed with.

The ideal percentage of Zebu blood will vary according to the hardiness of the cattle already existing in the area as well as climate and other environmental factors. It is probable that the desirable amount of Zebu blood for the coastal country north of Rockhampton should be from three-eighths to one-half but much careful work will have to be done before this is decided.

As a general rule, the desirable proportions of Zebu blood would lie in the range between one-quarter and one-half, as cattle outside this range usually exhibit too few of the desirable features of both breeds.

To obtain stock having approximately half Zebu blood, the same procedure as before is carried out as far as the third mating. At this stage, the ½ Zebu, ½ Hereford bulls are used on the ¼ Zebu, ¾ Hereford heifers to produce ⅜ Zebu, ⅝ Hereford. By mating these back continually to ½ Zebu, ½ Hereford bulls, a near half Zebu-half Hereford herd can be built up.

To produce ⅜ Zebu cattle, the ⅜ Zebu, ⅝ Hereford cows are produced as before and this percentage is maintained by the continued use of ⅜ Zebu, ⅝ Hereford bulls.

It must be emphasised that the overseas experimental work has shown that the Zebu blood is essential in the female side. Indeed, it may be preferable to have the female section of the herd possessing too high a percentage of Zebu blood for a desirable carcase, and use bulls with a higher proportion of British blood than would otherwise be the case. For example, pure Hereford bulls mated to ½ Zebu, ½ Hereford cows will produce progeny of ¼ Zebu, ¾ Hereford blood, which gives a more desirable carcase.

In all breeding programmes, the breed other than Zebu should not be changed—that is, Hereford x Zebu cross bulls to Hereford x Zebu cows, or Shorthorn x Zebu bulls to Shorthorn x Zebu cows.

Purebred Zebu bulls could be used to produce crossbreeds, but price and availability of purebred Zebu bulls put a strict limitation on their use outside stud herds.

Plate 10.

Brahman Cross Cattle in Saleyards in California. These cattle are commonly seen in the Los Angeles stockyards, indicating that they are not confined to the eastern part of the United States.

The greatest disadvantage of crossbreeding is that the large degree of variation requires a high degree of culling until the desired uniformity is obtained. There is also need for strict supervision.

Grading-up to a Standardised Breed.

This simpler process requires the continued use of purebred bulls of the desired breed. Bulls of a fixed Zebu breed, however, are dearer than crossbred bulls. The principal Zebu x British breeds which would be suitable for grading-up purposes are the Santa Gertrudis, Beefmaster and Brangus.

When grading-up to these breeds, quickest results may be obtained by using ½ Zebu cows as the foundation herd. The other half of the cows' breeding should be the same as that in the basic breed of that to which they are being mated—that is, for Santa Gertrudis, ½ Zebu, ½ Shorthorn cows would be used; for Brangus, ½ Zebu, ½ Angus cows are used. Beefmaster bulls may be mated to Shorthorn x Brahman or Hereford x Brahman cows.

Combined Crossing and Grading-up.

An example of this would be the following breeding programme:—

DAMS.		SIRES.
Grade Shorthorn cows	x	Purebred Shorthorn bulls.
Shorthorn heifers	x	½ Zebu, ½ Shorthorn bulls.
¼ Zebu, ¾ Shorthorn heifers	x	½ Zebu, ½ Shorthorn bulls.
⅜ Zebu, ⅝ Shorthorn heifers	x	Santa Gertrudis bulls.

POINTS TO CONSIDER WHEN CROSSBREEDING.

When breeding crossbred Zebus for beef, it is imperative to retain those characteristics which make the breed useful under tropical and arid conditions.

The type bred should combine the following points:—

(*a*) Loose skin, indicated by looseness of the skin under the neck and belly; (*b*) short sleek hair; (*c*) pigmented skin; (*d*) ability to produce sufficient milk; (*e*) good length and depth of body; square rump; broad flat back; flank and twist full and deep; (*f*) quiet disposition.

The chief points which should warrant culling would be:—

(*a*) Extreme ranginess, with light hindquarters, narrowness of body and general lack of depth and breadth; (*b*) extreme shortness in leg and body; (*c*) wild disposition; (*d*) sloping rump; (*e*) woolly coat.

Uneven colouring should not be given much attention in commercial herds, though colour may be a consideration when paddock sales are made.

HANDLING ZEBUS AND THEIR CROSSES.

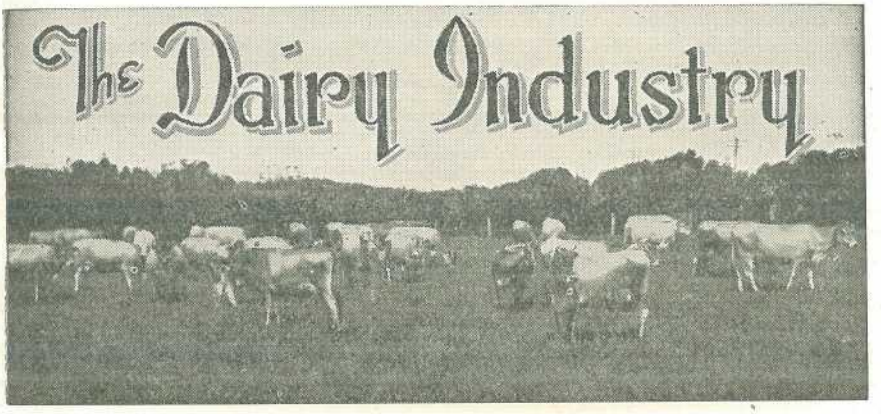
Stockmen who are used to handling Zebus assert that these cattle should be handled differently from British breeds. If handled well, however, Zebus may be less trouble than British breeds.

The main points in handling Zebus and their crosses are:—

(1) Handle steadily at all times.

(2) Avoid crowding and never attempt to hurry the cattle.

(3) Lead the cattle rather than drive them. (4) Avoid shouting.



The Manufacture of Cheddar Cheese in Queensland.

E. B. RICE and T. A. MORRIS, Division of Dairying.

AS was the case in most other countries, the cheesemaking industry in Queensland grew from the efforts of individual farmers to make more cheese than was required for their own needs. This surplus was sold in neighbouring townships to those people who were not able to make their own cheese.

Towards the end of the year 1888, a Government-sponsored travelling dairy began visiting farming centres to demonstrate factory methods of manufacturing butter and cheese. In the following year, a second travelling dairy came into being, and the adaptability of cheese manufacture to factory practice became more widely recognised. Until about 1892, all the cheese produced was made on farms. This production was 170,000 lb. in 1890 and 141,000 lb. in 1891. It rose to 460,000 lb. in 1892 with the advent of factory-produced cheese. In 1893 the first cheese factory of any pretension was erected at Yangan, in the Warwick district.

With the growth of the factory system of manufacture, cheese production increased, and the number of cheese producers decreased from 234 in 1898 to 115 in 1900 and only 62 in 1902. The accompanying graph (Plate 1) illustrates the changes in the quantity of cheese produced, the number of cheese-producing units, and the total quantity of milk produced which have taken place since the early years of the cheesemaking industry.

It will be seen that the quantity of cheese produced has always been more closely connected with the total milk production, which varies according to seasonal conditions, than with the number of cheese-producing units. The latter rose during the expansion of the industry from 1908 onwards, but fell later because of the tendency to centralise manufacture at larger establishments and eliminate the smaller factories. Cheese production reached a peak during the 1939-1945 war years and since has fallen towards the pre-war level of about 14,000,000 lb. per year.

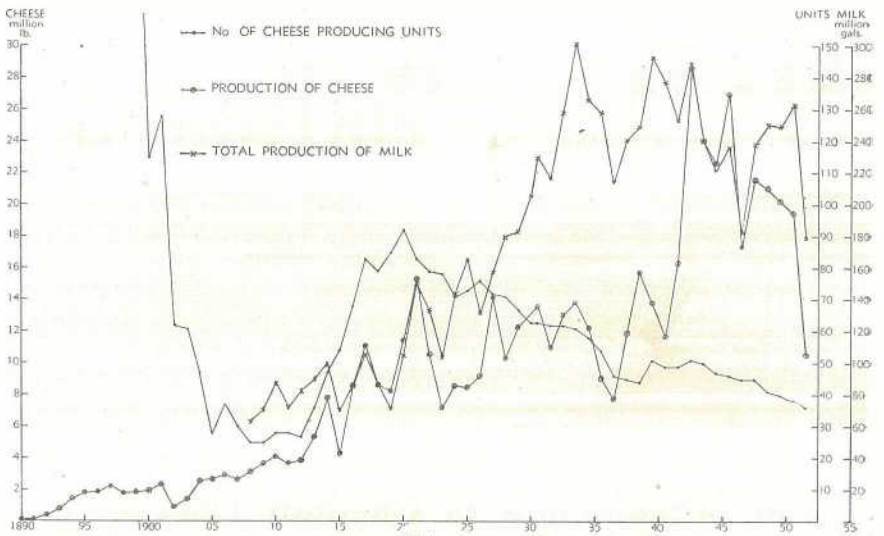


Plate 1.

Graph Illustrating the Development of the Cheese Industry in Queensland.

Since 1939, home consumption of cheese has taken a larger portion of production than in the preceding years. Whereas in the 20's and 30's approximately half of the cheese produced was exported, in more recent years the proportion exported has been closer to one-quarter of production. Great Britain has received the bulk of Queensland's exported cheese, but markets in the near north are also supplied.

The majority of the 36 cheese factories at present operating in Queensland are situated on the Darling Downs. The few others are located in the Burnett and Port Curtis districts. Closer settlement and more intensive farming reduce the area from which milk has to be drawn and these factors make the Darling Downs more suitable for cheese factories than most other areas. The cooler climate, favouring a better quality of milk and reasonable supplies of stock food throughout the whole year, are additional advantageous factors. The Atherton Tableland is another area which should be favourable for cheese factories, but at present there is none operating there.

The irregularity of the seasons in Queensland dairying areas is disadvantageous to seasonal dairying, which is practised in some other countries. Thus some cheese is made throughout the whole of the year. This, of course, ensures a more even supply of cheese but does not allow factories to cease operations for a time in order to carry out necessary maintenance work.

Mixed night's and morning's milk is used in manufacture and is delivered by individual suppliers or by motor transport services. The bulk of the manufacture is of the cheddar variety, which is being made from pasteurised milk in all but a few small factories. In addition, small amounts of Gruyere, Roman, Malling Red, Cottage and modified cheddar, such as Red Coon, are sometimes made. A non-fat-leaking cheddar cheese has been successfully manufactured by using homogenised cream and skim-milk. A considerable quantity of cheddar cheese is used in the production of processed cheese and cheese spreads.

The centralisation of cheese factories which is at present taking place is being accompanied to some extent by a much-needed modernisation of factories and equipment. In some cases, hand-operated cheese presses have been replaced by an hydraulic type which reduces the labour involved in pressing the cheese. Interest is being shown in mechanical curd-stirrers and temperature and humidity controls for cheese-curing rooms. These controls, which are very desirable under Queensland's summer conditions, have already been installed in a few cheese-curing rooms.

Plate 2.

A Modern Cheese Factory. A milk transport, with side-covers removed, is shown.

There is a growing realisation of the need for better facilities in many factories for the propagation and maintenance of cheese starters. The separation of whey is being carried out by several of the larger factories and the practice is becoming more widespread, due to an increasing appreciation of its economic soundness. The waxing of cheese can also be expected to become more generally adopted by factories in the future. Properly applied, suitable waxes will reduce shrinkage losses and give cheese of better appearance.

A development which has become apparent in recent times is the tendency to use cheese manufacture as a means of balancing supply and demand in connection with the liquid milk trade. Because cheesemaking allows the handling of variable quantities of milk, involves comparatively small overhead costs, and offers a good financial return, it is a very advantageous means of dealing with surplus milk.

Some Facts Concerning Cheese.

Legal Standards.

The Dairy Produce Acts of Queensland define cheese as follows:—

"Cheese shall be the solid or semi-solid food product obtained by coagulating the caseinogen of milk, cream, or skim milk by means of approved rennet, pepsin, or acids, with or without the addition of

ripening ferments or approved seasoning ingredients. It shall not contain any foreign fat or other foreign substance except approved quantities of harmless vegetable colouring matter."

The Acts also state that wholemilk cheese shall contain not more than 40% water and not less than 50% fat in the dry matter. A cheese containing 40% water would therefore have to contain at least 30% fat.

A normal average Queensland cheddar cheese might have the following composition when immature:—

Moisture	37.0%
Fat	33.5%
Protein	24.5%

Mineral matter 5.0% (salt 1.6%, other mineral matter 3.4%).

Cheese as a Food.

The main food constituents of cheese are butterfat and protein. Because of its high proportion of a very good type of protein, cheese is regarded as an excellent protein food. It forms a cheap but very satisfactory substitute for meat. One pound of cheese has practically twice the food value of one pound of meat and carries much less waste. There is a great demand for cheese in time of war, because, besides being a very sustaining and health-giving food, it is more easily transported and stored than meat.

In addition to containing a well-balanced proportion of protein to fat, cheese contains vitamins A, D and E, which are essential for the maintenance of normal health and vigour, disease resistance and reproductive ability. The minerals calcium and phosphorus, which are so important in the formation of teeth and bone in the human body, are also present. Cheese is a relatively concentrated, and, contrary to popular opinion, an easily digested food, with an appeal to a wide range of tastes. In either the raw or the cooked state it can be made up into a great variety of appetising and nourishing dishes. There is a need, from a nutritional viewpoint, for a greater consumption of cheese in Australia. This country lags well behind many other countries in its consumption of cheese per person. Europeans, particularly, eat much more cheese than Australians. It is possible that as a result of the influx of a large number of immigrants from Europe, Australians may become more educated in the ways of using cheese in the diet.

[TO BE CONTINUED].

NORTHERN DAIRY LABORATORY.

Dairy farmers in the far north are invited to visit the new dairy research laboratory recently opened by the Department of Agriculture and Stock on the premises of the Atherton Tableland Co-operative Butter Association at Malanda.

The Officer in Charge (Mr. C. C. Garrick) will be pleased to conduct visitors over the laboratory and explain to them the scope of its activities in their interests.

Brucellosis Testing of Swine.

The Department of Agriculture and Stock is operating a scheme whereby pig herds are tested at intervals for the occurrence of swine brucellosis (contagious abortion).

A herd listed by the Department as "brucellosis tested" is one in which all such animals as may be determined by the Director of the Department's Division of Animal Industry have been subjected to two successive tests for brucellosis, at intervals determined by him, without any positive reactors being found.

In order for a herd to be retained on the list of Tested Herds, a semi-annual or annual re-test of the herd, as determined by the Director, is required. If at a re-test any animal gives a positive reaction to the test the herd is removed from the list; it is not listed again until subsequent tests, as determined by the Director, have been carried out.

Full particulars of the Brucellosis Testing of Swine and application forms may be obtained from the Under Secretary, Department of Agriculture and Stock, William Street, Brisbane.

TESTED HERDS.

(AS AT 13th AUGUST, 1953.)

Breed.	Owner's Name and Address.
Berkshire	J. J. Bailey, " Lucydale " Stud, East Greenmount
	S. Cochrane, " Stanroy " Stud, Felton
	Garrawin Stud Farm Pty. Ltd., 657 Sandgate road, Clayfield
	G. Handley, " Handleigh " Stud, Murphy's Creek
	J. L. Handley, " Meadow Vale " Stud, Lockyer
	R. G. Koplick, " Melan Terez " Stud, Rochedale
	O'Brien and Hickey, " Kildurham " Stud, Jandowae East
	E. Pukallus, " Plainby " Stud, Crow's Nest
	G. C. Traves, " Wynwood " Stud, Oakey
	E. Tumbridge, " Bidwell " Stud, Oakey
	Westbrook Farm Home for Boys, Westbrook
	H.M. State Farm, " Palen " Stud, Palen Creek
	A. R. Ludwig and Sons, " Cryna " Stud, Beaudesert
	H. H. Sellars, " Tabooba " Stud, Beaudesert
	F. Thomas, " Rosevale " Stud, M.S. 373, Beaudesert
	D. T. Law, " Rossvill " Stud, Trout road, Aspley
	R. H. Crawley, " Rockthorpe " Stud, *via* Pittsworth
	F. R. J. Cook, " Alstonvilla," Wolvi, *via* Gympie
	Mrs. I. M. James, " Kenmore " Stud, Cambooya
	H. L. Stark, " Florida," Kalbar
	J. H. N. Stoodley, " Stoodville," Ormiston
	H.M. State Farm, Numinbah
	V. G. M. and A. G. Brown, " Bardell," Goovigen
	R. E. Paulsen, " Crest " Stud, Binjour Plateau, M.S. 670, Gayndah
	M. G. and R. H. Atkins, " Diamond Valley " Stud, Mooloolah
	L. Puschmann, " Tayfeld " Stud, Taylor
	Dr. B. J. Butcher and A. J. Parnwell, 684 Logan road Greenslopes
	W. F. Ruhle, " Felbar " Stud, Kalbar
	C. E. Edwards, " Spring Valley " Stud, Kingaroy
	G. J. MacLennan, " Murcott " Stud, Willowvale
	H. M. Wyatte, " Cumberland " Stud, Rocky Creek Yarraman
	C. F. W. & B. A. Shellback, " Redvilla " Stud, Kingaroy
Large White	H. J. Franke and Sons, " Delvue " Stud, Cawdor
	Garrawin Stud Farm Pty. Ltd., 657 Sandgate road, Clayfield
	J. A. Heading, " Highfields," Murgon
	K. B. Jones, " Cefn " Stud, Pilton
	R. G. Koplick, " Melan Terez " Stud, Rochedale
	R. Postle, " Yarralla " Stud, Pittsworth
	E. J. Bell, " Dorne " Stud, Chinchilla
	L. C. Lobegeiger, " Bremer Valley " Stud, Moorang, *via* Rosewood
	H. R. Gibson, " Thistleton " Stud, Maleny

TESTED HERDS—continued.

Breed.	Owner's Name and Address.
Large White	H.M. State Farm, Numinbah
	K. A. Hancock, " Laurestonvale " Stud, Murgon
	V. P. McGoldrick, " Fairymeadow " Stud, Cooroy
	R. S. Powell, " Kybong" Stud, Kybong, *via* Gympie
	E. B. Horne, " Kalringal," Wooroolin
	S. T. Fowler, " Kenstan " Stud, Pittsworth
	H. L. Larsen, " Oakway," Kingaroy
	C. Allison, "Colrene" Stud, Lake and Reserve roads, Slacks Creek
	E. G. Evans, " Lauraven" Stud, Box 22, Maleny
	Mrs. I. G. Utting, "White Lodge," Mountain Road, Cooroy
	N. E. Meyers, Halpine Plantation, Kallangur
	Dr. B. J. Butcher & A. J. Parnwell, 684 Logan road, Greenslopes.
	G. I. Skyring, " Bellwood " Stud, via Pomona
	O. H. Horton, " Manneum Brae " Stud, Manneum, Kingaroy
	M. E. Bryant, " Maryland Brae " Stud, Blunder road, Oxley
Tamworth	S. Kanowski, " Miecho " Stud, Pinelands
	N. R. Potter, " Actonvale " Stud, Wellcamp
	D. F. L. Skerman, " Waverley " Stud, Kaimkillenbun
	A. C. Fletcher, " Myola " Stud, Jimbour
	Salvation Army Home for Boys, " Canaan" Stud, Riverview
	F. Thomas, " Rosevale " Stud, M.S. 373, Beaudesert
	A. J. Surman, " Namrus " Stud, Noble road, Goodna
	Department of Agriculture and Stock, Regional Experiment Station, Kairi
	E. C. Phillips, " Sunny View," M.S. 90, Kingaroy
	T. A. Stephen, " Withcott," Helidon
	W. F. Kajewski, " Glenroy " Stud, Glencoe
	A. A. Herbst, Bahr Scrub, *via* Beenleigh
	R. G. Koplick, " Melan Terez " Stud, Rochedale
	H.M. State Farm, Numinbah
	D. B. Alexander, " Debreczen " Stud, Kinleymore, *via* Murgon
	Dr. B. J. Butcher and A. J. Parnwell, 684 Logan road, Greenslopes
	M. E. Bryant, " Maryland Brae " Stud, Blunder road, Oxley
Wessex Saddleback ..	W. S. Douglas, " Greylight " Stud, Goombungee
	D. Kay and P. Hunting, " Kazan " Stud, Goodna
	E. Sirett, " Iona Vale " Stud, Kuraby
	C. R. Smith, " Belton Park " Stud, Nara
	H. H. Sellars, " Tabooba " Stud, Beaudesert
	H. Thomas, " Eurara " Stud, Beaudesert
	D. T. Law, " Rossvill " Stud, Trouts road, Aspley
	J. B. Dunlop, " Kurrawyn " Stud, Acacia road, Kuraby
	A. Curd, " Kilrock " Stud, Box 35, Jandowae
	C. Allison, " Colrene " Stud, Lake and Reserve roads, Slacks Creek
	R. A. Collings, " Rutholme " Stud, Waterford
	M. Nielsen, " Cressbrook " Stud, Goomburra
	G. J. Cooper, " Cedar Glen " Stud, Yarraman
	M. E. Bryant, " Maryland Brae " Stud, Blunder road, Oxley
	A. H. Groves, " Kinvara " Stud, Ingleside, West Burleigh