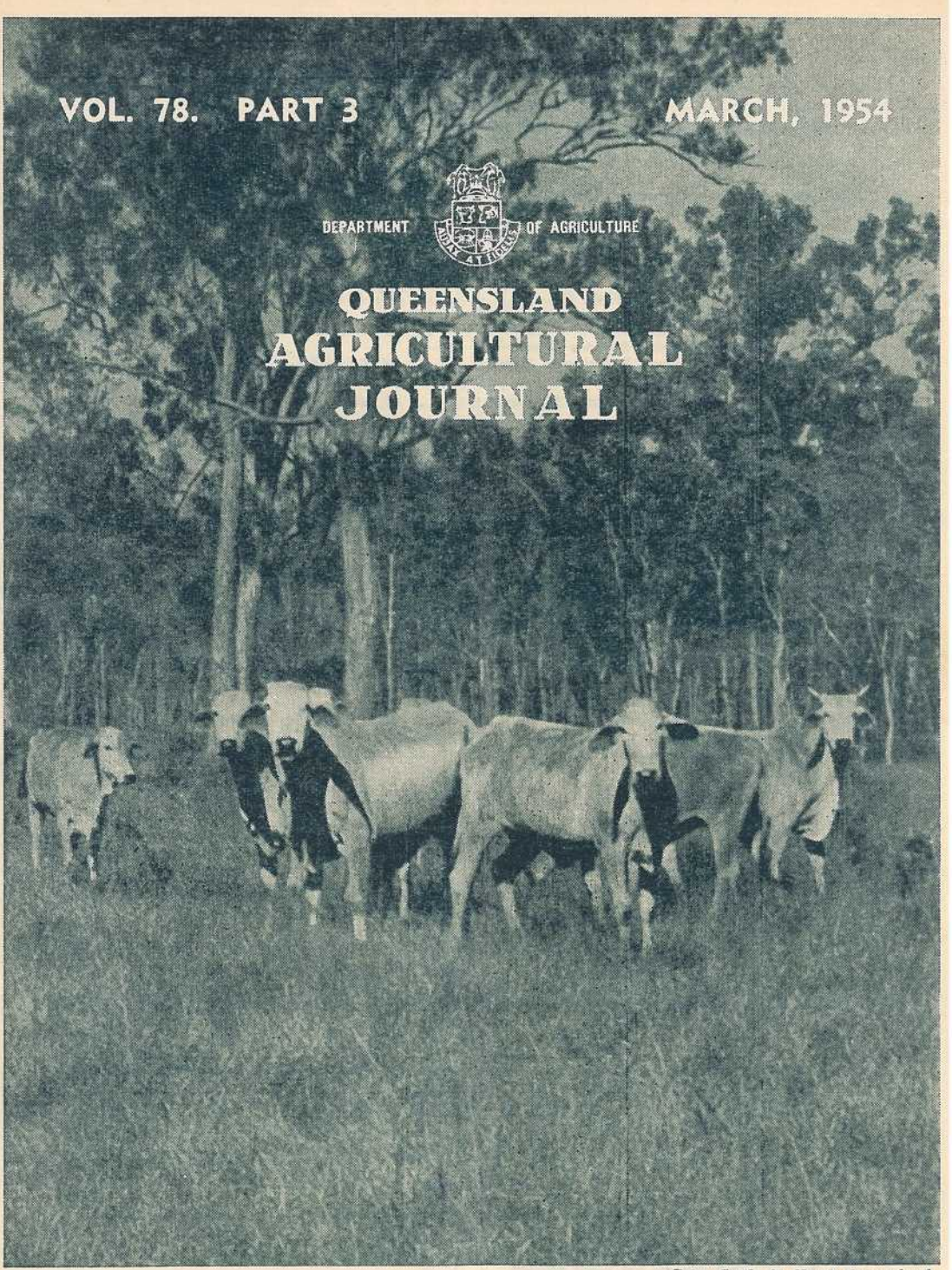
VOL. 78. PART 3 MARCH, 1954

DEPARTMENT OF AGRICULTURE

QUEENSLAND AGRICULTURAL JOURNAL



Zebu Cattle in North Queensland.

LEADING FEATURES

Registered at the General Post Office, Brisbane, for transmission by Post as a Newspaper.

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Irrigation Practice in Queensland.

Part 2. Methods of Irrigation.

A. NAGLE, Irrigationist, Agriculture Branch.

Various methods of applying water for irrigation are available. The diversity of method is due to the varied conditions and cropping systems found not only in widely separated areas but also on farms in the same locality.

In deciding upon a method of irrigation, it is necessary to consider all factors concerned, including the amount and incidence of seasonal rainfall, the slope and general topography of the ground surface, the amount of water supply, pumping facilities, the kind of crop to be grown and the porosity or imperviousness of the soil and subsoil. The capital outlay for the method involved, the permanency of the work and the economics of the crop irrigation programme will also need consideration. It is likely that in practice one of these factors will outweigh all others and decide the type of irrigation to be employed.

In Queensland, where community irrigation settlements are confined to a few areas, irrigation has developed with the use of individual plants on wells and creeks, mainly for crops of high monetary return, and for these crops, apart from sugar cane, the spray or sprinkler method has been widely adopted. Furrow irrigation is commonly used for sugar-cane, tobacco and tomatoes (in the Bowen area).

Where irrigation is in use, it is frequently found that the methods of irrigation are regional in pattern—that is, farmers use the method existing in that particular area or region. This is not always a sound procedure and farmers are urged to consider soil type and cropping programme first, before finally selecting an irrigation method.

The following discussion of the various methods of water application, in which the merits and disadvantages of each are pointed out, should be helpful in deciding the method most suitable for individual requirements.

The methods of water application in general use are spray or sprinkler, and surface or flood application (furrow and border) methods.

Each of these methods has certain advantages according to soil type and type of crop irrigated.

SPRAY IRRIGATION.

The portable spray system is in almost universal use in Queensland where individual pumping plants are in use on watercourses and wells and is used for the irrigation of all crops with the exception of sugar cane.

In the Lockyer district, 15,000 acres are watered by the portable spray system for the production of lucerne, potatoes, onions, pumpkins and fodder crops.

The main advantages of spray irrigation are, firstly, no land preparation in the way of grading and smoothing is required; secondly, it can be used to advantage on small areas of undulating land, where it would not be economical or practicable to grade and install head ditches for surface irrigation; thirdly, it is most suitable for sandy or porous soil types, where water usage can be controlled within closer limits than by the use of any other method. Nevertheless, some attention to grading and drainage as required for surface irrigation would lead to greater efficiency in the use of spray irrigation.

Even distribution of water throughout the field is possible with spray irrigation operating at high efficiency. However, with low pressure heads, due to insufficient power, leaking pipes and heavy winds, very uneven distribution can occur, especially when small quantities of water are being applied at each irrigation.

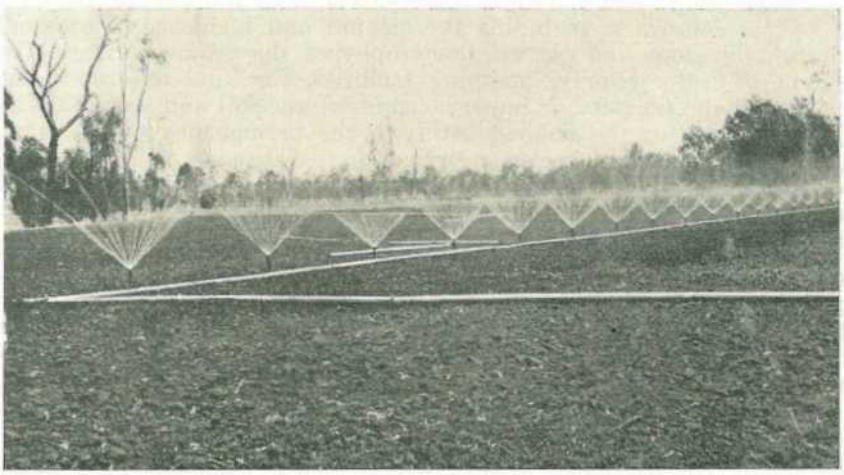


Plate 1.

Spray Irrigation of Seedling Cotton.

It is essential that spray plants be operated at the pressure recommended by the manufacturers. The operating pressure can be determined by fixing a pressure gauge to the spray standard furthest from the pump.

Greater efficiency and more uniform distribution of water will be obtained when spray heads are operated at the required pressure.

A particular advantage of spray irrigation is that where water supply is limited, lighter applications can be made. When deep-rooted crops such as lucerne and pastures are being irrigated, it is doubtful if spray irrigation would be more economical in total water usage. Light spray applications that do not effectively wet the root zone do not permit the plant to make efficient use of soil nutrients within the root zone. Frequent less effective light applications are therefore required, saving little or no water and increasing operating and labour costs. Evaporation losses in hot weather are also likely to be high, especially where heavy soils with slow intake of water are irrigated by the spray system. On the other hand, with spray irrigation, the water is conveyed to the spray heads in pipes, and no water is lost in transmission from the pump to the field. The pipe method of transmission is applicable and advisable in some instances for reticulation of water in the border and furrow methods, particularly where the use of earthen channels on porous soils would cause heavy water loss by seepage.

The disadvantages of spray irrigation are high capital costs and high operational costs as compared with surface irrigation. Thus the use of spray irrigation is necessarily restricted to crops giving high returns per acre. On 1953 figures, 4-inch spray and main line made of galvanised iron would cost approximately £25 per chain. An efficient unit for 40 acres would include 10 chains of main and 20 chains of spray line; thus the cost for portable pipe lines would be over £750. Depreciation of pipes is considerable, especially where water containing substances which corrode the galvanised iron is being pumped.

More power per unit of water applied is needed for spray irrigation than for surface irrigation methods, owing to friction head in pipes and sprays. This friction head varies with the farm layout and size of pipes used, but an average friction head is approximately 80 feet. This increase on head or load on the power plant means that more power is required to deliver a fixed quantity of water.

The rather high delivery rate of some spray heads, with water applied at the rate of 1-1½ inches per hour, is not suitable for heavy, relatively impervious soils. Compaction and puddling of the surface can occur, resulting in a reduced infiltration or soakage of water into the soil after the surface soil is wetted. Ponding and runoff of water may then happen before the soil is given the desired amount of water and wetted to the required depth. The selection of a spray head to give a slower delivery rate is often very desirable, consideration being given to the soil type, slope of land and type of crop to be irrigated. Lucerne and pastures generally allow of a moderately high rate of application because of the protection to the soil, prevention of runoff by the dense vegetative cover and increased infiltration rate resulting from the soil being under a perennial crop.

The low pressure portable spray system in general use in Queensland operates at a pressure of 15 lb. to 18 lb. per square inch, medium pressure sprays at 20 lb. to 60 lb., while high pressure systems require pressures of 80 lb. to 100 lb. per square inch.

The medium and high pressure systems deliver greater quantities of water per spray and the coverage is much greater, being from ½ to 2 acres per spray nozzle for the latter system. However, while these wide-coverage high pressure systems require less labour to operate because less frequent moving of pipes is needed, the size of the pumping

unit is much bigger and operating costs higher than for the low and medium pressure systems and special pipes are needed to take the greater strain imposed by the high pressure of water.

High pressure, wide-coverage spray systems are suitable for comparatively large areas (50-100 acres) and are also desirable where permanent pipes are being installed.

The low pressure sprinkler system is generally used as a permanent installation for irrigation of vegetables and small areas of high-value crops; the water is delivered from the pipe-line by drilling plain orifices in the perimeter of the pipe. These pipe lines rotate automatically or can be adjusted manually. A low water delivery is common, and as the pipe-lines are fixed in position, their use is limited to small farms.

SURFACE OR FLOOD APPLICATION.

In surface application, the irrigation water is applied at ground level on the surface of the soil. It is distributed over the land to be irrigated either in furrows spaced from 2 ft. to 4 ft. 6 in. apart or in borders or bays where the water is confined in the area between low earthen mounds, or "check banks," erected at regular intervals down the slope of the field to be irrigated.

Border Method.

Considerable interest is now being shown in the border system of water application for the production of irrigated pastures and lucerne, chiefly on account of the lower operating costs of this system in regard to both power and labour charges. Cereal and fodder crops can also be irrigated by the border method.

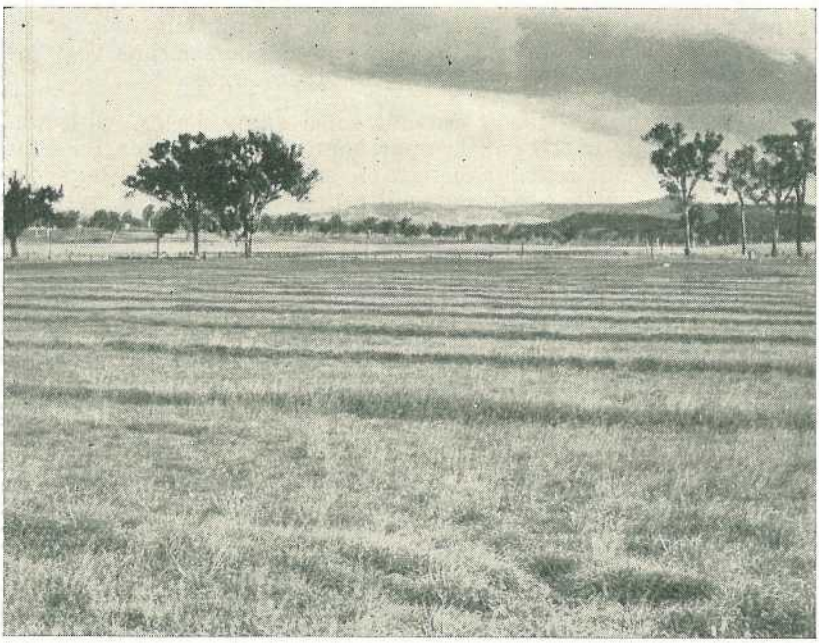


Plate 2.

Border Irrigated Pastures Containing H1 Ryegrass, Cocksfoot, Phalaris, Red Clover, White Clover and Lucerne.

In the border or bay system, water is conveyed to the area to be irrigated in open trenches or "head ditches" (or in pipes in certain circumstances). The flow of water is directed down the slope or gradient of the land, by the erection of small mounds of earth or "check banks" at intervals of from $\frac{1}{3}$ to $\frac{1}{2}$ chain; the land between the check banks is known as a border or bay. The lengths of the borders or bays are determined by the slope of the land and the soil type, ranging from 4–5 chains on sandy soil to 8 chains on relatively impermeable clays. On well-prepared land the water spreads across the border and moves slowly down the slope, wetting the soil in its advance towards the bottom end of the bay, where a "tail drain" is provided to remove excess water.

As the aim in irrigation is to effect control and even distribution of the amount of water applied, it is necessary that careful consideration be given to selection of suitable land in regard to soil type, suitable grades and efficient layout, where border irrigation is to be employed.

Where soil type is considered suitable, it is essential that a detailed contour survey be made. This will require levels to be taken on a 1-chain grid or checkerboard, the contours then being plotted in so that a field or farm design can be made. The position of head ditches and tail drains and the direction of flow of water and location of borders can be decided from this contour plan. It is now standard practice to run the borders in the direction of greatest fall or at right angles to the contour lines. This eliminates costly grading to prevent sidefall in borders. On land with rough topography, expense in grading can be further reduced by departing from the conventional parallel borders, the borders being constructed fan- or L-shaped to conform to the slope of the land. Careful grading to remove irregularities and to fill in hollows and depressions is required, followed by smoothing or levelling of land so that an even distribution of water is possible.

Head ditches and tail drains have to be constructed and maintained in good condition and structures have to be erected in the check bank to control or regulate the flow of water into the borders. The planning and direction of this work requires a considerable amount of experience and it is suggested that the services of the Department of Agriculture and Stock and the Irrigation Department be sought in selection and planning of land for border irrigation.

The preliminary work of grading and forming head ditches entails expense ranging from £8 to £12 per acre (1953), but should be viewed as a permanent asset. When the cost is spread over a number of years, the yearly charge is small. Some skill is required to achieve efficient distribution and application of water, otherwise overwatering of the top end of the borders may occur. This skill can be acquired with practice and a study of the principles involved.

A large supply of water is necessary for border irrigation, a delivery of 20,000 gallons per hour being considered adequate for large-area irrigation, though flows of half a cusec (that is, 11,300 gallons per hour) can be used for small areas of 10 to 15 acres. Smaller flows than these will result in more time being taken to cover the irrigated area, and in the case of lighter soils some change of layout (for example, shortening of length of run) may be essential if efficient use of water is to be made with smaller flows.

The special advantages of border irrigation, when installed, are the low cost of pumping, which is a third less than for spray, and the big saving in labour for distribution of water, which enables economic production of crops of low to moderate value. Furthermore, border irrigation is suited to heavy, relatively impervious soils, as better water penetration can be obtained than is the case with spray irrigation on these soil types. Deep sandy porous soils, however, are not generally suitable for border irrigation, as the water used may be unduly high, particularly at the top of the borders. Grades of up to two feet per chain can be irrigated by the border method when planted with permanent pastures, but grades of from two to three inches per chain are ideal.

Furrow Irrigation.

The furrow irrigation method is similar to border irrigation inasmuch as the water is conveyed by open earth ditches or pipes and distribution from the supply channel is controlled by the use of outlet boxes of varying design.

Irrigation of the field or crop is by means of furrows drawn in the soil, usually in the interrow space for row crops. The water is allowed to move slowly down the furrows, gradually wetting the soil along the furrows by lateral spread.

While the row spacing of the irrigated crop controls the spacing between furrows, the soil type being irrigated also exerts an influence on furrow spacing. Sandy soils with free downward percolation and little lateral movement of water require furrows spaced closely—that is, 2 feet apart. On clay soils with restricted intake and an appreciable lateral spread, water furrow spacings 3 ft. 6 in. to 4 ft. apart are used. Delivery of water from the head ditch to the furrows may be direct from a tube, pipe or box inserted in the head ditch opposite each furrow, or, more commonly, a larger pipe or control outlet is used to serve a number of furrows simultaneously. The water from the head ditch is directed into a small temporary ditch or turn row, usually a plough or cultivator furrow, the required number of rows, usually 8 to 10, being connected to the turn row. Flow of water can be controlled from the head ditch outlet or varied for each furrow by altering the opening into the turn row.

In this method, as for border irrigation, a detailed survey and contour plan, grading of land, erection of head ditches and tail drains and installation of water control outlets are required. A field layout design is essential.

Grading of land need not be carried out to the same degree of accuracy as required for border irrigation, as the irrigation furrows will carry the water over small irregularities on the surface of the land.

Steep grades of over one foot fall per chain cannot be watered satisfactorily in practice by the furrow method, as the flow rate per furrow must be reduced to prevent erosion. This reduced flow in turn increases the amount of water used, particularly at the top of the run in sandy soils. Uneven wasteful irrigation will occur when steep grades are irrigated. Since only portion of the surface of the land is wetted (that is, the furrow area), and since wetting of the remainder of the soil is by lateral spread, less evaporation occurs normally with furrow irrigation than with the border and spray methods.

As with border irrigation, costs for the furrow method are low and good control of water can be obtained with a properly designed furrow layout.

The furrow method is in general use in Queensland for the irrigation of row crops, orchards, sugar cane and cotton. It can be particularly useful in the development of new areas where little or no grading is required, because row crops such as cotton, maize and tobacco may be irrigated with a minimum of land preparation, thus enabling the farmer to obtain an income concurrently with development of his farm. Where land is graded heavily, the soil should be allowed to settle and mellow for several years before being planted to permanent crops.

COSTS OF IRRIGATION METHODS.

Although many factors have to be considered in selecting an irrigation method for a particular farm or field, in general it can be accepted that flood or surface irrigation costs less per acre-inch of water delivered to the field than does spray irrigation.

Few accurate data are available on comparative costs, but the Bureau of Investigation's Irrigation Research Station at Gatton has compiled some figures from a trial carried out over several years to compare spray with border irrigation for pastures. No provision was made for plant depreciation.

The plant used included a 4-inch pump and a 25 h.p. motor. The vertical lift was 40 feet and 6-inch main pipe was used. Electricity cost 2.5d. per unit and labour charges were based on a basic wage of £10 16s. per week.

The pump delivered water into the head ditch at the rate of 25,000 gallons per hour and the daily hours of work were 8.00 a.m. to 5.00 p.m. Half an hour was allowed each day for maintenance and starting operations. Rate of application of water was three inches; $3\frac{1}{6}$ acres comprised the test area in the case of surface irrigation, and $2\frac{1}{4}$ acres for spray irrigation. For the latter, 10 chains of 4-inch spray line covering $\frac{1}{2}$ acre at each run were used. It was found practicable to complete a run in $1\frac{3}{4}$ hours and make $4\frac{1}{2}$ runs each day, thus applying three inches on $2\frac{1}{4}$ acres for the day.

In the case of both methods, electricity cost £1 15s. 5d., but $3\frac{1}{6}$ acres were handled by border irrigation compared with $2\frac{1}{4}$ acres with spray irrigation. Labour costs per day were 10s. 9d. for the former and £2 3s. for the latter. Calculation of the data shows that it cost 14s. 7d. per acre to apply a 3-inch irrigation with the border method (4s. 10d. per acre-inch) and £1 14s. 10d. per acre for a 3-inch irrigation with the spray method (11s. 7d. per acre-inch).

No allowance has been made in the above calculations for maintenance of head ditches and tail drains or depreciation on spray lines. It would, of course, have only widened the cost difference further in favour of border irrigation.

The cost of preparation of land for bay or border irrigation will vary according to the amount of grading (that is, moving of soil required), but the average cost for grading, check banking and construction of head ditches and tail drains would be £8–£12 per acre (1953 costs). Construction and installation of water control outlets in head ditches cost in the vicinity of £3 per acre.

With the installation of spray irrigation considerable expense is involved in the purchase of portable main and spray lines. The minimum efficient spray unit comprises 10 chains of main line and 20 chains of sprays, these costing on present prices around £25 per chain, or £750 plus £100 for flexes, bends and other incidentals.

The capital outlay per acre irrigated by spray is high, being at least £20 per acre, since 40 acres would be the maximum area which could be irrigated by a spray unit of 10 chains of main and 20 chains of spray line. Therefore, where soil type and topography of the land are suitable for border irrigation of permanent fodder or pasture crops, this method is definitely more economical in capital outlay involved per acre irrigated and in cost of pumping and labour for distribution of water.

CHOICE OF IRRIGATION METHOD.

The choice of the irrigation method to be employed involves consideration of many factors, the ultimate choice being decided by those factors which have direct application to the farm layout, soil type, water supply and cropping programme of the individual farmer.

The spray method has special application for small areas of high-value crops; for deep porous soils where water application cannot be effectively controlled with surface application; for steep slopes or land with irregular contours where grading would be difficult and costly; and on farms where water supply is limited. In areas of high annual rainfall, where supplemental irrigation is required infrequently, the spray method would obviate the necessity for work of a permanent nature to be undertaken.

The furrow method, with relatively low water distribution costs, is suited for irrigation of large areas of row and fodder crops on a wide range of soil types, including heavy relatively impermeable soils where efficient penetration by spray irrigation is not possible. Furrow irrigation is not suitable for steep grades; the maximum grade which can be watered efficiently is 1 ft. per chain, grades of 1 inch to 4 inches per chain being ideal.

The border method of irrigation should find exclusive use for production of lucerne, pastures, cereals, hay and fodder crops where ample supplies of water are available. The low cost of pumping and the ease and effectiveness of water distribution should enable economic production of crops of low to moderate value.

The preliminary work of grading and forming head ditches and tail drains for both furrow and border irrigation is a capital cost and a permanent asset, and interest spread over a number of years would be an insignificant annual liability.

Managing Lucerne Stands.

J. L. GROOM (Agronomist), and E. C. DARLEY (formerly Assistant Agronomist), Agriculture Branch.

For the best management of a lucerne stand it is well to remember that the early life of the lucerne plant is primarily concerned with the formation of the extensive root system which will enable it to draw upon subsoil moisture.

During this period the cutting or grazing of the stand will divert development from the root system to the formation of new foliage. A similar reaction occurs in a well established stand, for, immediately after cutting, plant food reserves in the roots are used up in the production of new shoot growth. When this new shoot growth has developed sufficiently it in turn replenishes the food reserves in the roots. This cycle is upset when repeated cuttings are made long before the foliage is reaching maturity, with the result that food reserves in the roots are depleted too much. If this occurs consistently there is a decrease in vigour and a shortening of the life of the stand.

It is important, with non-irrigated crops, that the last cutting should be made early enough in the autumn period to permit adequate regrowth to occur to restore the food reserves in the roots before the dry winter weather induces partial dormancy. With the root reserves fully restored before winter, quick spring growth may be anticipated. Much valuable spring feed will be lost if this important aspect of lucerne management is neglected.

It is generally recognised that about nine inches of regrowth must be made before root reserves are replenished. Cutting or grazing earlier than this should be avoided. Stands stunted by drought may, of course, harden off before reaching this height.

Care of Young Stands.

The young stand requires little attention until the weeds which may be present have approached the flowering stage. The field should then be mown regardless of the stage of growth of the lucerne. The mower should be set to cut a few inches above the ground to avoid unnecessary damage to the young lucerne. In a grazing stand, the cut weeds and lucerne may be allowed to lie on the paddock, where they will have a very useful mulching effect and assist the young lucerne. However, if this practice is followed, it is generally best to remove the swath board from the mower to prevent undesirable bunching of the mown material, which would tend to smother a proportion of the lucerne plants.

If an early cutting has been necessary to destroy weeds, further mowing should not be done until the lucerne plants have entered the flowering stage.

Where the material is raked and removed to clean the paddock for subsequent hay cuttings, it is desirable to allow the cut plant material to dry and shed as much leaf as possible during the raking process.

Cultivation in the early life of the lucerne plant is not advisable owing to the danger of seriously damaging the plants.

Young stands intended for hay should not be grazed, but if needed urgently for stock feeding the lucerne should either be cut and carted from the paddock or mown in small portions which can be fenced quickly with an electric fence, stock can then be allowed in to pick up the mown material. This will prevent the crown damage which might occur if unrestricted grazing were permitted.

Care of Mature Stands.

Lucerne will yield well over a considerable number of years if properly managed. This means that the stand must be protected from drought, weed infestation, and disease and insect attack. The fertility of the soil should also be maintained or if possible increased.

Cultivation of the established stand with narrow tine implements (Plate 1) will do much to assist in the penetration of rain and in the control of weeds. Such cultivations are normally carried out when the crop is short after cutting or grazing. The number of cultivations will vary according to the weed incidence and also with soil type, sandy soils needing fewer cultivations than heavier types that tend to set hard on the surface.

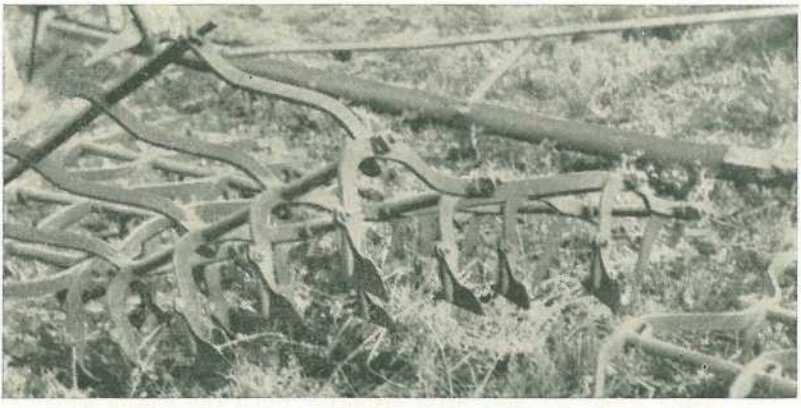


Plate 1.

Points Attached to Harrow for Renovating Lucerne Infested with Mint Weed.

As grass and weeds usually invade a lucerne stand after a few years it is common practice to plough out a stand used for hay production as soon as weed growth is excessive. The area can then be cropped to non-leguminous crops for several seasons before again sowing to lucerne in the rotation.

Grazing stands are generally improved by partial invasion by grass, which not only increases the variety of feed but also minimises the risk of bloating. Such stands are commonly carried on until either the land is needed for other crops or the percentage of lucerne in the stand has fallen too low for the paddock to yield useful fodder.

Over-frequent cutting, cutting at the wrong stage of growth, and close or continuous grazing, will hasten the rate of deterioration of a lucerne stand. Such practices must be avoided.

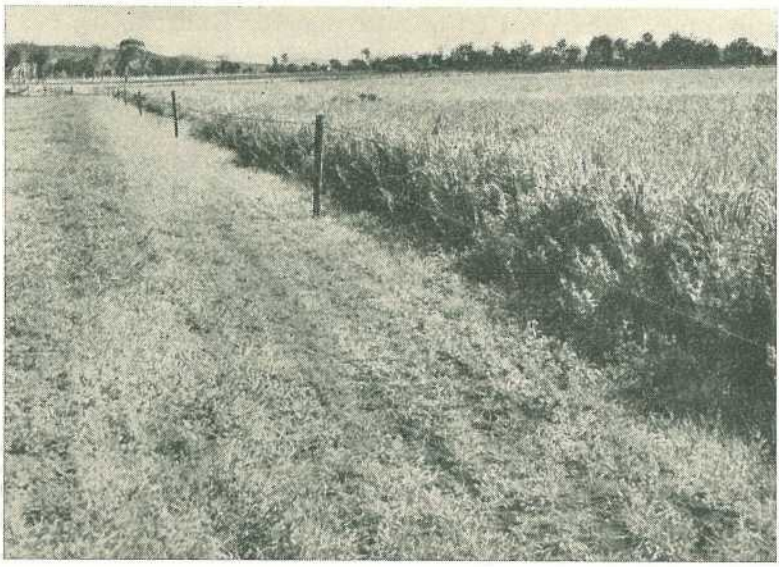


Plate 2.

An Old Stand of Lucerne Renovated and Oversown with Oats Has Produced an Excellent Hay Crop.

Of the plants which are particularly troublesome in lucerne stands, woolly-top Rhodes grass, couch grass and Urochloa grass are worth special mention. These cannot be eradicated satisfactorily by mowing or cultivation. They compete seriously with the lucerne and also reduce the market value of the hay.

Dodder, a parasitic plant, can sometimes cause severe damage to lucerne stands, especially in southern Queensland, where it appears to be more aggressive than in other parts of the State. Infected patches should be closely mown before flowering commences, and the hay destroyed by burning in the paddock so that any of the dodder remaining attached to the stubbles will be destroyed.

Topdressing.

Lucerne makes heavy demands on plant foods in the soil and on many soil types it may be necessary to topdress the stand with fertilizer.

Topdressing practices will be influenced to a large extent not only by the soil on which the lucerne is grown but also by the age of the stand, the frequency with which shoot growth is removed and whether or not the stand is subjected to grazing.

On the same soil type a greater response to fertilizers can be expected from a stand which is several years old, and which has produced consistently a number of hay crops per year under irrigation, than from a younger stand or from a stand of comparable age growing without the aid of irrigation and producing much less fodder per year. The lucerne plant has a high requirement for plant foods such as calcium, potassium, magnesium, sulphur and phosphorus.

On many soils a response in yield from treatment with superphosphates can be expected. The rate of application will vary with conditions but in general 1–1½ cwt. per acre is sufficient for non-irrigated lucerne. Larger

quantities may be required on irrigated stands. Owing to the fact that many soils render the phosphate in superphosphate unavailable fairly rapidly, drilling the fertilizer in rows as deep as possible after mowing and then cultivating is superior to broadcasting on the surface and harrowing in.

Reference has already been made in an article in the January issue to some deficiencies which retard lucerne growth in certain Queensland districts.

Generally speaking, many fields of irrigated lucerne in the main production centres will respond to an annual topdressing of a fertilizer containing sulphur (for example, superphosphate, gypsum or sulphate of potash), while periodic topdressing with a potash fertilizer would also be beneficial. For ease and convenience, applications of potassium sulphate at the rate of 56 lb. per acre can be used to relieve potash and sulphur deficiencies on most soils. Applications of superphosphate also meet sulphur requirements as well as supplying calcium and phosphorus.

All topdressings of fertilizer are best applied shortly after a mowing and preferably at the time of maximum growth in the late spring and early summer.

Grazing Lucerne.

Stands of lucerne are suitable for grazing by beef cattle, cows, sheep and pigs, while poultry also relish the crop. In many of the dairying and fat lamb raising districts of the State it is the practice to graze only during the winter months, when only small hay yields can be expected, and to reserve the summer growth for hay production. Provided this grazing is not continuous, and stock are kept off when the ground is wet, little permanent damage to the stand results. Stands grazed occasionally, however, tend to become invaded by weeds and grasses more quickly than a stand reserved for hay production.

Plate 3.

Regrowth in September, Four Weeks After Grazing, of a Three-Year Stand of Lucerne at Beaudesert.

If lucerne is to be grazed it should be borne in mind that those methods of grazing which closely simulate the accepted treatment of a stand used for hay production should be employed in order to keep damage to the stand at a minimum. The practice which most nearly achieves this object is the rapid grazing of small areas at one time, so that the animals will not be left on the same area for a period longer than one week. In thus concentrating animals on small areas, the value of subdivision of large areas is obvious. Electric fences are particularly suitable in this regard, as they can be erected quickly and moved to another area with little time and labour.

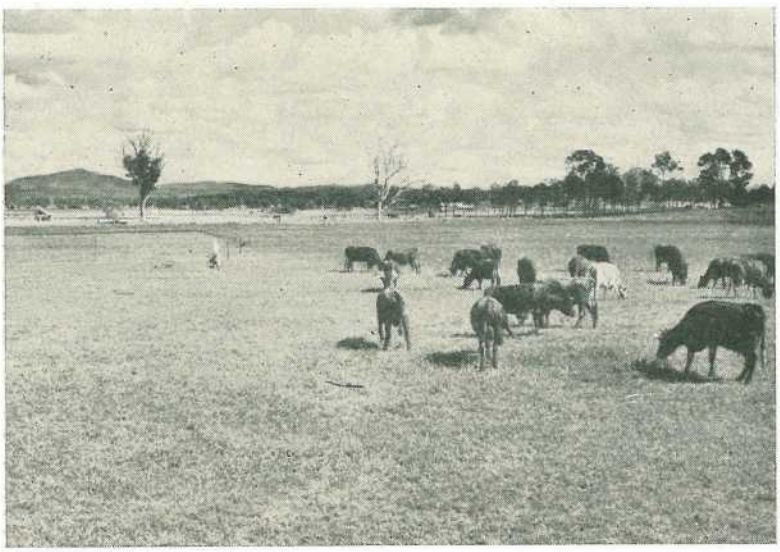


Plate 4.
Lucerne Being Grazed With the Aid of an Electric Fence.

Grazing should commence when flowers are beginning to appear, or at the first sign of new shoots appearing at the crown. At this stage lucerne is not quite so prone to cause bloat, and there is also less drain on the food reserves in the roots.

If a hay stand on clay loam soil has been grazed a few times it is advisable to loosen the surface soil by a renovation with a tined implement after feeding off, particularly in cases where it happens that grazing has occurred when the soil was wet.

When grazing lucerne it is always advisable to take precautions against losses from bloat. Cattle and sheep, being ruminants, are susceptible to this complaint, especially if the lucerne is very succulent and immature. The method of minimising the risk of bloat is to accustom the animals to the lucerne gradually, allowing them free access to dry feed and water. Sheep and lambs continually grazing lucerne are rarely affected, but dairy cattle must be kept under constant observation so that treatment can be promptly applied should bloating occur. Where grass is sown with the lucerne, or allowed to come in naturally, the danger of bloating is lessened.

Row Cultivation of Lucerne.

In areas of low rainfall where soil moisture is limited, reduction in the number of plants per acre by planting lucerne in rows (Plate 6), together with conservation of moisture by controlling weed growth in and between the rows, has merit. To date, attempts have met with varying success but the method is worth trial.

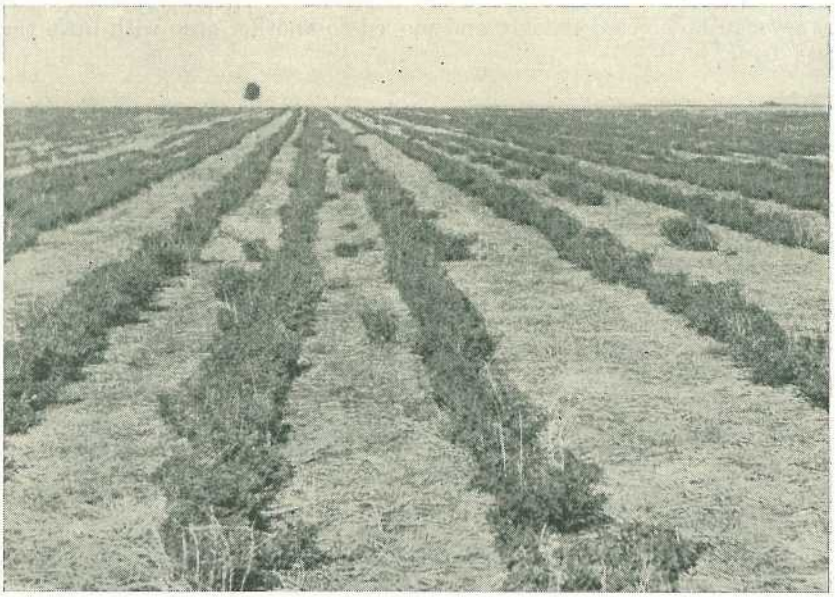


Plate 5.
Row Cultivated Lucerne in the Maranoa.

The greatest difficulty encountered has been that of controlling weeds in the row itself; inter-row weeds can be handled effectively by mechanical cultivators. Cross cultivation has been shown to be useful for checking weed growth in the row. However, it must be practised from the establishment of the stand, before ridges thrown up by inter-row cultivation are sufficient to impair the effectiveness of machine operation across the rows. It is important that inter-row cultivation should not result in the development of water channels which may erode in periods of heavy rainfall.

The lucerne rows should be sown 42 in. apart. Inter-row cultivation and cross cultivation can best be carried out after grazing when the stubble is short. Farmers who have practised inter-row cultivation of lucerne claim that cultivation costs are not excessive and that increased carrying capacity more than offsets the expenses incurred.

An alternative to row cultivation is the production of thin swards by light sowing rates. Such swards can be renovated in the early spring with lucerne points and have given satisfactory results in low rainfall areas which are suitable for row cultivation of lucerne.

Irrigation.

Water consumption by lucerne is high. The yield of hay is directly related to the amount of water available to the plant, so that sparing or infrequent waterings will not produce maximum growth.

Farmers who practise irrigation in Queensland pump the water from running streams, dams and wells. Before embarking on an irrigation project it is advisable to have the water analysed to ascertain its salt content and suitability for irrigation purposes. This is more important where clay loam soils are irrigated, as harmful salts are more likely to be retained in such soils than in freely-draining sandy loams. In some cases a slightly saline water can be used on mature lucerne because it is more tolerant to salt than some other crops such as beans and lettuce.

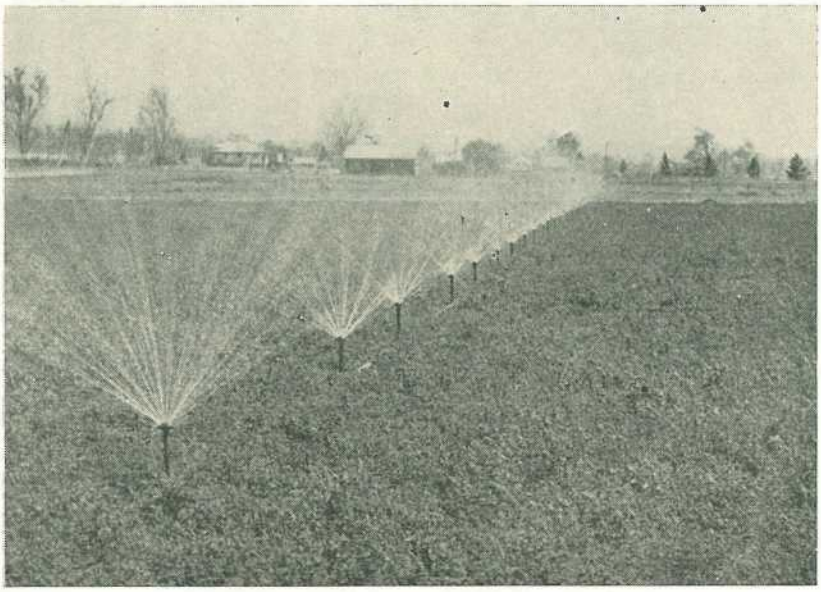


Plate 6.
Irrigation of Lucerne is Required for Maximum Production.

Generally speaking, lucerne is irrigated by the spray system in Queensland, as this system is adaptable to uneven land and to a wide range of agricultural and vegetable crops which may be produced on the same farm. Flood irrigation in general requires less labour, and could be used profitably on some farms where the gradient of the land is suitable.

The rate and frequency of watering will vary according to the seasonal conditions and the soil type. As a general rule the first watering is given in late July or early August, and should be sufficient to create a storage of moisture in the subsoil. Further waterings will follow each cutting and will normally amount to about 3 inches being given at each application. This should be sufficient to produce a growth which will be cut in 4–5 weeks' time. Under exceptionally dry conditions and high temperatures it may be found necessary to give two applications per cutting, or three applications for two cuttings. When this is so, the second watering is usually lighter.

From January until the end of March it is unnecessary to irrigate if rainfall is sufficient. However, it may be necessary in most seasons to irrigate from March onwards, and although growth is slower it is possible to cure excellent hay, free from weeds, under favourable weather conditions. It is usually the practice to cease irrigation during midwinter and allow

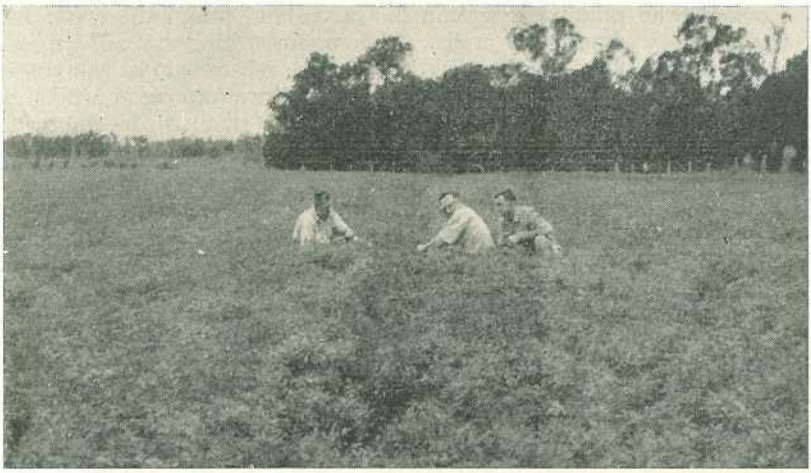


Plate 7.

Lucerne on a Cattle Station About 100 Miles West of Ingham.

the stand to remain almost dormant for a couple of months, as growth is bound to be slow despite adequate soil moisture. This practice permits clay loam soils to dry out and provides the opportunity for a thorough cultivation prior to the spring waterings.

TOBACCO GROWERS.

The Department of Agriculture and Stock now has for sale seed of the following varieties:—Virginia Bright Leaf, Mammoth Gold, 400, 401, 402, Yellow Special, Kelly, Gold Dollar, Hicks, and Virginia Gold.

The price of this seed, cash with order, or C.O.D., is 6s. per oz. to registered Queensland tobacco growers and 10s. per oz. to others.

Address enquiries to The Under Secretary, Department of Agriculture and Stock, Brisbane.

The Ayr Regional Experiment Station.

W. A. R. COWDRY, Officer-in-Charge.

The experiment station is situated four miles south-west from the town of Ayr on the main road to Clare. The area was originally developed by the Commonwealth Department of Commerce and Agriculture to provide fresh vegetables for the armed services. In 1948 it was taken over by the Department of Agriculture and Stock to provide facilities for the study of agricultural and pastoral problems.

Although the soils are representative of considerable areas of unassigned lands on the cane farms in the adjacent district, the investigational programme has been designed to provide information that will be of assistance to farmers on the alluvial soils of the Burdekin Delta and for the extended programme of farming that will be possible after the completion of the Burdekin dam and its subsidiary diversion weirs.

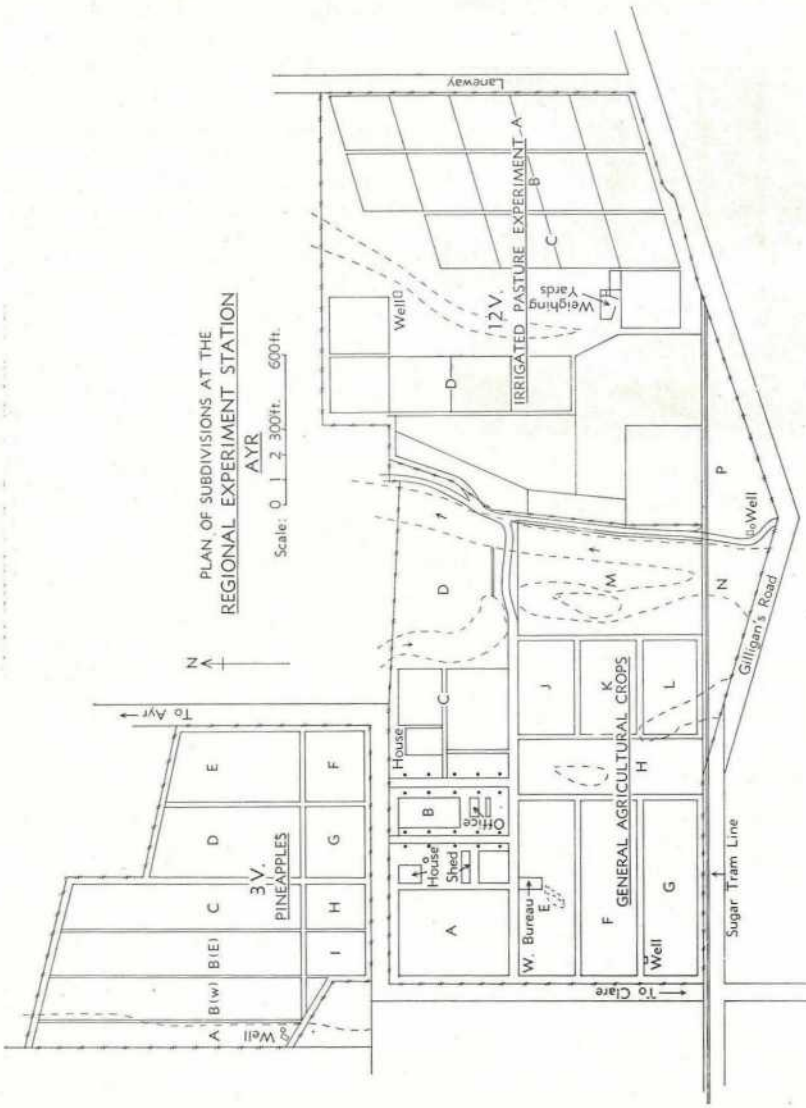


Plate 1. **Layout of the Station.**

The station has a total area of 140 acres and is utilised in sections covering three phases of the experimental programme, namely—

(1) An area where general agricultural investigations are conducted.

(2) An area where irrigated pasture investigations are combined with the grazing of beef cattle for fattening purposes.

(3) A leased area of 27 acres which is being used for investigations into horticultural crops, especially pineapples.

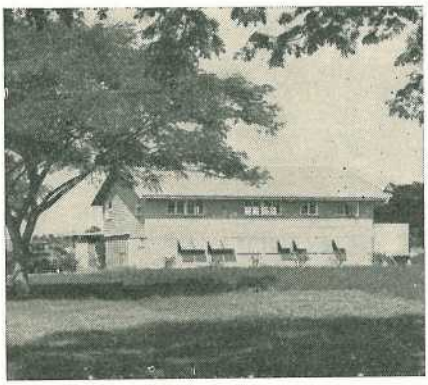


Plate 2.
The Office and Laboratory.

Plate 1 presents a general plan of the layout of the Station, and Plate 2 shows a view of the office building and laboratory.

CLIMATE.

The Station is located at longitude 147° 23′ E., latitude 19° 36′ S., and at a height of 34 feet above mean sea level.

This area is generally referred to as the "dry tropics," for although the total yearly rainfall average for Ayr is 41.54 inches (mean of 56 years), some 75% of this amount is received during the summer months from early in December to the end of March. The remaining period of almost nine months is normally dry.

Temperatures are equable—never very high and only a few light frosts are likely to be experienced in low-lying areas each year. Winds are strong at times, but for eight or nine months of the year in the March to November period steady south-east trade winds are recorded. Although this stream of moist air is fairly constant, there is a range of up to 50% in the relative humidity between night and day and the night registrations are almost constant. The absence of a near coastal range which would cause some precipitation of moisture

TABLE 1.

CLIMATOLOGICAL DATA FOR AYR.

Month.	Rainfall (in.).	Mean Maximum Temperature (°F.)	Mean Minimum Temperature (°F.)	Relative Humidity at 9.00 a.m.
	Means for 56 Years.	Means for 26 Years.	Means for 26 Years.	Means for 31 Years.
January	10·95	89·6	72·9	70
February	9·62	88·8	72·5	73
March	6·37	87·6	70·1	73
April	2·77	86·1	66·4	69
May	1·09	82·3	60·6	68
June	1·48	78·2	56·6	69
July	·73	77·0	53·1	68
August	·58	78·9	54·6	65
September ..	1·21	82·2	59·5	62
October	·87	85·2	64·7	60
November	1·67	87·9	68·8	61
December	4·20	89·6	71·7	64
Annual	41·54 in.	84·4 °F.	64·3 °F.	·67

has a large influence on the climate of this region, and the average humidity is relatively low for a coastal area in the tropics.

In Table 1, mean monthly rainfall, temperatures and relative humidity are tabulated.

SOILS.

In topography, the country might generally be classed as flat, but quite large depressions traverse it and carry overflow water from the Burdekin River in times of high flood. As a consequence, the soils of the Station are generally uneven, but they form a typical pattern of the rather large areas of alluvial land in the upper part of the Burdekin Delta.

The surface soils vary from sandy clay loams to rather stiff silt loams, and a sandy layer occurs reasonably close to the surface. The structure of the soils is poor, especially where cultivated without sufficient organic matter being incorporated.

Analyses reveal that the soils in general lack nitrogen, and responses to the addition of this element are regularly obtained. The soils appear to be reasonably well supplied with both potash and phosphate.

Analyses typical of two of the major soil types on the Station are given in Table 2.

NATIVE VEGETATION.

The original timber on this type of country is not of large size and comprises mainly Moreton Bay ash or carbeen (*Eucalyptus tesselaris*), cockatoo apple (*Planchonia careya*) and poplar gum (*Eucalyptus alba*): it is only along the numerous watercourses and swales which traverse this delta country that river gum (*Eucalyptus tereticornis*) is encountered.

The native herbage comprises a mixture of numerous species, grasses and legumes predominating.

TABLE 2.

ANALYSES OF TWO MAJOR SOIL TYPES.

Border.	F8.			C3.		
Sample Depth.	8–8".	8–12".	14–24".	0–6".	6–14".	18–24".
pH values	5·9	6·0	6·0	5·8	5·8	5·9
Total Nitrogen (%)	0·08	..	..	0·09	..	..
Total Carbon (%)	0·88	..	..	1·32	..	..
C/N ratio	11·0	..	..	14·7	..	..
Available Phosphoric acid (p.p.m. P_2O_5)	230	207	200	229	280	180
Total Replaceable Bases (m.e. per cent.)	21·27	21·90	23·19	27·80	28·10	33·06
Calcium (m.e. per cent.)	13·5	14·0	14·25	19·5	20·0	19·1
Magnesium (m.e. per cent.)	6·65	7·05	7·45	6·82	7·27	12·66
Sodium (m.e. per cent.)	0·57	0·33	0·33	0·58	0·37	0·35
Potassium (m.e. per cent.)	0·55	0·52	1·16	0·90	0·46	0·95
Percentage of total replaceable bases: Calcium	63·0	64·0	62·0	70·0	71·0	58·0
Magnesium	31·0	32·0	32·0	25·0	26·0	38·0
Sodium	3·0	1·5	1·0	2·0	1·0	1·0
Potassium	3·0	2·5	5·0	3·0	2·0	3·0
Mechanical Analyses.						
Percentage Moisture	1·5	1·9	2·1	1·8	1·9	2·3
Percentage Loss with Acid	1·1	0·6	0·6	1·1	2·6	0·8
Percentage Coarse Sand	4·1	4·2	0·9	1·8	1·9	0·1
Percentage Fine Sand	51·6	53·9	54·9	44·7	40·2	42·2
Percentage Silt	19·8	18·0	16·8	27·8	27·6	21·6
Percentage Clay	20·2	21·0	23·4	20·4	23·0	30·0

WATER SUPPLIES.

The district is particularly fortunate in possessing a plentiful supply of sub-artesian water at depths ranging from 15 ft. to 40 ft. from the surface. To tap this supply for use on the farms, spears are driven in the bottom of wells and equipped with pumps of a capacity ranging from 9,000 gallons to 50,000 gallons per hour according to requirements.

The quality of the water is quite good, the total solids averaging 12 grains per gallon for the five wells on the Station. The figure of merit for this water averages 1.25 and the water has been classed as good for both irrigation and domestic purposes.

INVESTIGATIONAL PROGRAMME.

The district is largely devoted to cane-growing, but cropping of potatoes, maize, and various horticultural crops is carried on in a relatively small way. Accordingly, a wide range of crops thought to have possibilities for this district have been tested on the Station. These have embraced varietal trials, fertilizer tests, time-of-planting trials, and experiments to ascertain irrigation water requirements. Although the relatively short time during which the Station has been functioning precludes the making of final statements, very satisfactory progress has already been achieved in the experimental work covering a range of crops such as cotton, maize, sorghums, sunflowers, linseed, wheat, oats, potatoes, jute, peanuts, castor beans, tobacco, various legumes, irrigated pastures, pineapples, tomatoes, and French beans.

Cotton.

Besides varietal trials (Plate 3), which have included some 13 varieties to date, experimental work in cotton has included plant spacing tests, height of thinning, defoliation and mechanical harvesting trials. Experiments have been planted at different times of the year and general results have indicated that cotton should be planted in March, and no later than mid-April if a March planting is impracticable.

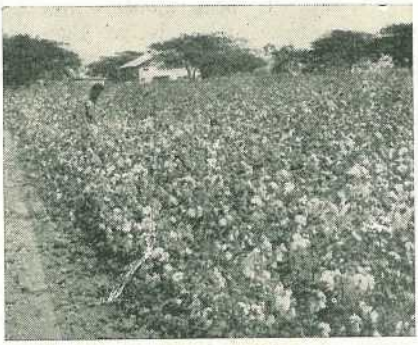


Plate 3.
Cotton Varietal Trial, 1952.

Cotton planted in March forms most of its crop before cooler weather is experienced and as a consequence the resultant crop of bolls tends to prevent rank growth of the plant after the weather warms up in the spring. Plantings after mid-April, however, practically cease growth during winter and are prone to insect attack. Moreover, the plants are likely to prove unsuitable for mechanical harvesting, which is a necessity in this district.

Yields have been variable, but have reached the high average figure of 1,573 lb. per acre for the earlier maturing group of cottons planted in March, and in some experiments yields of over 2,000 lb. per acre have been obtained. The mean yield of April-planted cottons has been 1,227 lb. per acre, while August plantings have yielded less even in those seasons when the summer rains have been delayed long enough to enable a good picking to be obtaned.

It would appear that, of the varieties tested so far, the earlier maturing strains, having plants of an open habit of growth, offer good prospects; and broadly speaking, the Miller variety seems to be well suited to the average soils of the district.

Row spacings of 40 or 42 inches are recommended, as this suits the harvester, and single plants spaced 12 inches apart in the row are desirable.

It has been found that up to four irrigations, each of 2–3 inches, will probably be needed, depending on the rainfall received prior and subsequent to the winter months. It has been found necessary to spray with insecticides at various times to combat various pests, such as rough boll worm, corn ear worm, loopers and aphids.

Maize.

Because the climate experienced here is so different from that under which maize is grown in other parts of Queensland, it was necessary to find out its effect on the growth of the maize plant itself. Observations on plant habit, cob characteristics and disease resistance, as well as yields, were therefore made on experiments embracing leading Queensland hybrids and commercial varieties.

The fertilizer requirements of this crop are also being studied. The results obtained indicate that following a preplanting application of a mixed fertilizer that includes a fair percentage of nitrogen and phosphorus, side dressings of sulphate of ammonia are required according to the fertility of the soil.

The yields obtained in varietal tests planted at different times of the year indicate conclusively that the maize plant requires very favourable conditions during its early development if highly satisfactory yields are to be obtained. Crops planted in August have yielded up to 120 bus. per acre, whereas those planted in May have produced only 50 bus. per acre. The possibilities of planting later-maturing strains during the wet season are also being investigated.

From the results so far obtained it would appear that 4–6 supplementary applications of water totalling approximately 9 inches are required to produce the highest yielding crops.

Disease incidence has not yet been very serious, but plantings during early summer are not advised because of the possibility of disease during the wet season.

Sorghum.

Some 12 strains of the Coastland variety (Plate 4) have been tested against the standard Kalo variety of grain sorghum, but difficulty is always experienced in small trials because of the depredations of birds. It was apparent, however, that Coastland was the superior variety of the two and that this crop possesses distinctly favourable prospects for the district provided it can be grown in sufficiently large areas to minimize damage by birds. Further varietal tests are in progress.

Plate 4.
Coastland Grain Sorghum.

Some 26 varieties of fodder sorghums, including 8 varieties of sweet sorghums and 18 varieties of the dual-purpose type, have also been tested. The sweet varieties reached heights of up to 12 ft. and Honey variety proved to be best of this particular type. The dual-purpose sorghums grew well; yields up to 9 tons per acre of green fodder material were obtained from the first cuts and up to 4 tons per acre from the ratoon crop. Protein content averaged approximately 5.9 per cent. for both crops.

Sunflowers.

Altogether six varieties of sunflower have been tested on the Station. In 1949 Giant Russian yielded best, but

in 1950 Advance (Plate 5) proved superior, and as it does not grow so vigorously, it is better suited for the mechanical harvesting which will ultimately have to be carried out. However, since Advance is a hybrid, seed production is difficult. Therefore, two other open-pollinated varieties, comparable to Advance in general characteristics, were introduced, and, after testing, seed of one, the Jupiter variety, has been multiplied.

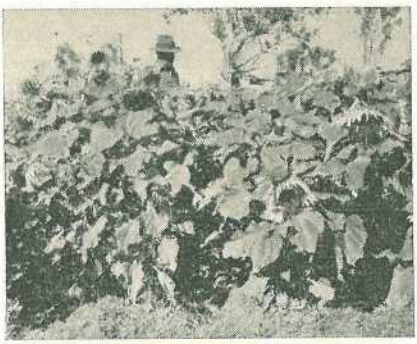


Plate 5.

The 1951 Crop of Advance Hybrid Sunflowers.

Spacing trials have given indications that 2 ft. row spacing is better than 3 ft.; moreover the heads tend to be smaller, thus permitting easier harvesting and threshing. Yields have been quite good, averaging 1,615 lb. of shelled seed per acre for all the trials grown so far. Some varieties have yielded up to 1,988 lb. per acre.

Potatoes.

From the several varietal, plant spacing and fertilizer tests that have been conducted here by officers of the Agriculture Branch, it would appear that Factor, Bismark and Brownell varieties give most promise, and because of the fact that ample supplies of water are available, the closer spacings with the greater number of plants per unit area tended to produce the larger yields.

Because the soils of this region are generally lacking in nitrogen, it is not surprising that the fertilizer tests have shown the value of this element. However, it does not appear that applications above the rate of 2 cwt. per acre of sulphate of ammonia are warranted. Furthermore, no increase has been obtained by the addition of either superphosphate or potash.

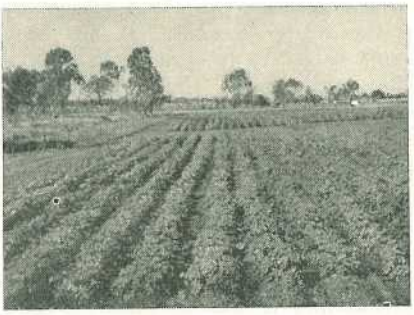


Plate 6.

A View of the 1950 Potato Varietal Trial.

Yields of 5 tons per acre of first grade tubers should be confidently expected.

Linseed.

Several varietal tests have been conducted, and nine different varieties included therein. Growth has been variable but disease incidence and insect damage have been negligible.

Plate 7.

Linseed in a Varietal Trial.

Row spacings have ranged from 8 inches to 28 inches, the wider spacings being used to simplify cultivation

practices and for furrow irrigation. Bolly Golden, Morocco and Golden Viking have given best results, the last variety, however, showing a distinct tendency to secondary branching.

Yields of up to 26 bus. per acre of threshed linseed have been obtained, but the average over the three seasons has been 15 bus. per acre.

Wheat.

A preliminary trial of several varieties was so successful that a comprehensive varietal trial was conducted in 1952. Yields of up to 43 bus. per acre of good quality grain were harvested mechanically.

Plate 8.
Wheat Varietal Trial, 1952.

The earlier maturing varieties (Gabo, Puora, Pusa and Spica) appeared to show promise for this district. A view of some of the plots is shown in Plate 8.

Oats.

In order to investigate the growth of oats in this climate, a range of 25 varieties has been grown.

Victoria x Richland (Vicland) has show consistently good results and produced up to 10 tons of green fodder per acre, which upon being dried out has yielded over 2½ tons per acre of dry hay. Ruakura also showed promise for fodder purposes, and it was obvious that the earlier-maturing varieties such as Sunrise, Mulga, Fulghum, Buddah, Ventura and even Vicland would be the better types to use if seed production was the objective.

Plate 9.
Oat Varietal Trial.

Jute.

Experimental plots of jute have been grown to investigate the growth, development and harvesting problems to be encountered if such a crop was grown to supply the need for bag-making material in Australia. It was found that December planting was best, and that a yield of over 30 tons per acre of green stalks could be obtained. This, when retted, produced over 1 ton per acre of dried fibre available for processing.

Many data have been obtained concerning the effect of plant spacing on branching as well as on the time and placement of fibres for retting in conjunction with the use of an experimental mechanical ribboning machine.

Castor Beans.

Five varieties of castor beans have been grown to investigate the possibilities of this crop in the north.

Two of the varieties (Q2804 and Q2893) have shown promise because of their shorter, less-branched and

more determinate habit of growth, which indicate their advantage over the others for mechanical harvesting.

It has been found that this crop tends to become too rank and tall if grown through the summer months, but that a much better type of plant is developed if planted in autumn and grown through the winter to be harvested in the dry spring. Yields of over 1,000 lb. of shelled kernels per acre have been obtained. A row spacing of approximately 24 inches is recommended.

Peanuts.

A trial area of the two principal Queensland varieties, Virginia Bunch and Red Spanish, was grown in 1950. However, because of the abnormally showery weather experienced, cercospora leaf spot was very prevalent and harvesting was also interrupted. An estimated yield of 1,200 lb. of nuts per acre was obtained. The Virginia Bunch variety showed better promise for this district.

Tobacco.

Work on this crop has been confined to experimental stands, in which breeding work on mosaic resistance has been carried out by officers of C.S.I.R.O. A great number of varieties have been used and considerable progress has been made, but it is too early yet to forecast the final results accurately.

Legumes.

Several plantings of various legumes have been made over the years. These have included both tropical and subtropical types and in the main have comprised the following species:

Centro (*Centrosema pubescens*)
Calopo (*Calopogonium mucunoides*)
Glycine (*Glycine javanica*)
Puero (*Pueraria phaseoloides*)
Clitoria (*Clitoria ternatea*)
Stylo (*Stylosanthes gracilis*)
Townsville lucerne (*Stylosanthes sundaica*)
Cowpea (*Vigna sinensis*)
Pigeon pea (*Cajanus cajan*)
Crotalaria (*Crotalaria novae-hollandiae*)

These species have all shown that they could be grown quite successfully, making their greatest growth and development during the warmer months. Most of them have been grown in conjunction with various grasses and their development watched under this competition, while some have also been tested under grazing conditions. Others have been used to recondition the soil and as a cover crop during the rainy season. For this purpose several varieties of cowpea have proved suitable and volunteer crops have been obtained over successive seasons on the areas being prepared for pineapple plantings.

Irrigated Pastures.

The major pasture work being conducted at the Station consists of a trial of various grass/legume mixtures grown with supplementary irrigation and grazed regularly by beef cattle. The investigation is being conducted to evaluate the various pasture mixtures under this particular climate and to ascertain the effect of the mixtures on the rate of fattening and the quality of the resultant beef.

The area of 25 acres originally embraced mixtures including the legumes Townsville lucerne and phasey bean, but it soon became obvious that they were unsuitable under competition and the mixtures were rearranged as under, and established for grazing pastures.

(1) Rhodes grass (*Chloris gayana*) and stylo.
(2) Para grass (*Brachiaria purpurascens*) and butterfly pea.
(3) Para grass and centro.
(4) Guinea grass (*Panicum maximum*) and centro.
(5) Guinea grass and stylo.

Each treatment is divided into four equal areas of 1¼ acres each and is

stocked according to its estimated carrying capacity, each plot being grazed for one week in every four.

Eighteen 2-year-old Shorthorn steers were introduced in September 1950 and turned off in the winter of 1951 with an average liveweight of 1,144 lb.

In the following year 23 head were grazed, as it was found that the pastures were improving. These were turned off after 10 months with a gain of 436.8 lb. per head, or 1.45 lb. per day over this period.

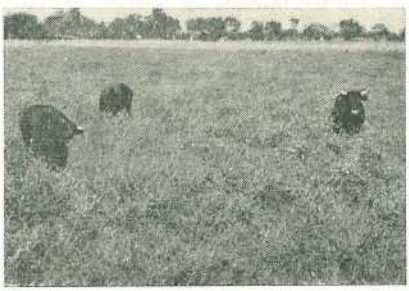


Plate 10.

An Irrigated Pasture of Para Grass and Centro.

During the latter part of the season it was found that the carrying capacity of all mixtures had greatly improved and accordingly 33 animals were purchased to commence grazing in September 1952. Although these animals have put on over 2 lb. per day it is certain that the full rate of stocking has not been obtained, judging by the rapid recovery of the pastures after each grazing period; it is proposed to graze 50 animals on the 25 acres during the coming season.

This investigation was initiated in conjunction with the Division of Plant Industry of C.S.I.R.O., but is now conducted wholly by officers of the Department of Agriculture and Stock, under the guidance of an advisory committee embracing representatives of C.S.I.R.O. and the Department.

Pineapples.

Prior to 1950, pineapples were grown only on a small scale in the dry tropics. They were sold principally on the fresh fruit markets in North Queensland, and to a lesser extent in the capital cities of the eastern States during the November-January period, when supplies from southern districts are not available in quantity. The recent establishment of processing plants in Central and North Queensland, however, opened up new outlets for the fruit and could well lead to an increase in the area under crop.

In order to standardise production methods in the area and determine the economics of the pineapple crop, 3 acres have been planted at the Station each year since 1951. On part of the area, the crop is grown under the best known cultural methods on a commercial scale and detailed costs of production are recorded. The balance is used for experimental purposes designed to clarify fertilizer requirements of pineapples grown in the Burdekin Delta, the most efficient methods of inducing flowering with alpha naphthalene acetic acid (ANA) and acetylene, the relative merits of spray and furrow irrigation, and the value of weedicides such as sodium pentachlorphenate (PCP).

Plate 11.

Pineapples in the Crop Management Trial, 1952.

The results to date leave no doubt that the dry tropics are admirably suited for pineapple production. Yields per acre under efficient plantation management are substantially higher than in most other parts of the State. In addition, the crop cycle is shorter. Both factors contribute to a

relatively low cost of production which should offset some of the disabilities inherent in the great distance of the area from the large centres of population where the canned product is sold.

Bananas.

Similar work has been initiated in the banana crop, which has so far been grown only for local consumption. The climate is suitable, but returns per acre must be substantially greater than in southern parts of the State to cover additional freight charges on fruit despatched to the principal markets in the eastern States. There are grounds for believing that yields from crops grown under irrigation in the Burdekin Delta will be high enough to warrant increased planting, and the present programme is therefore concerned with assessing costs of production as well as methods of plantation management which may be applicable in the area.

Tomatoes.

Yields of up to 12 tons of marketable fruit and 1½ tons of unmarketable fruit per acre were obtained in a varietal trial in which 11 varieties were tested during the winter of 1948. Bowen Buckeye Globe, Sioux, Granite Special, Rutgers 308 and Garden State showed promise for this district. Further trials are in progress.

French Beans.

In order to ascertain the practicability of growing this crop for seed during the winter months, a crop of Brown Beauty beans was grown in 1948. The crop grew well, and with four supplementary irrigations amounting to 6 inches in all produced a good crop of pods which matured in a reasonably close period of time and would thus have been suitable for mechanical harvesting.

Other Crops.

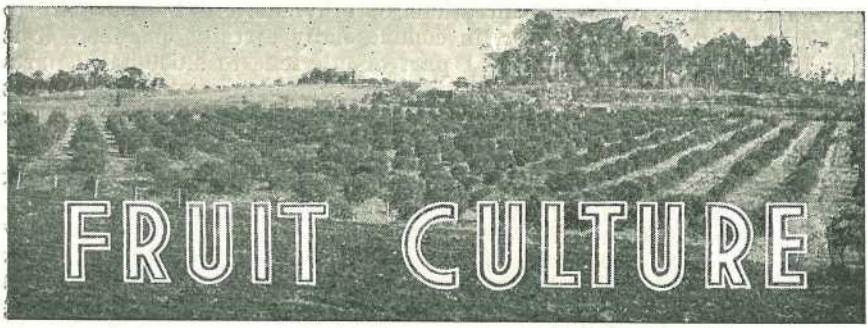
Investigations have more recently been extended to include lucerne, barley, soybean and passionfruit.

DISCUSSION.

The general results realised during the relatively short period since establishment of this Station must be considered very satisfactory and they have indicated the astonishing cropping possibilities of the district.

Under the unique combination of a very wet midsummer to provide ample subsoil moisture, supplementary irrigation for the drier periods, and mild winter temperatures, it has been possible to harvest high yields of out-of-season summer crops within a few weeks of harvesting winter cereals. Yields of 2,000 lb. of seed cotton, 1,078 lb. of sunflower seed and 120 bus. of maize per acre were obtained, while wheat yielded 40 bus. of grain per acre and oats gave satisfactory crops of hay.

The development of practices for such unusual agricultural and horticultural production timetables is receiving careful attention at the Station and many of the results will be applicable to the extensive areas of land to be utilised in the vast Burdekin irrigation project.



Artificial Colouring and Ripening of Fruits.

C. D. STEVENSON, Assistant to Physiologist, Horticulture Branch.

Artificial colouring ensures the marketing of a product enhanced in quality and appearance by its uniformity of colour. For a number of years it was known that mature green fruit could be coloured and ripened by exposure to the fumes of a kerosene stove. The active agent in these vapours was isolated and the identity of the active gases discovered. The use of the process is now widespread and various fruits are artificially coloured in normal marketing practice.

The process consists in exposing the fruits in an airtight chamber to low concentrations of a colouring substance under controlled temperatures and humidities. The colouring substances act as promoters, initiating the processes which bring about colouring or ripening of the fruit. Fruit such as bananas and pears are actually ripened as well as coloured by the process. These fruits are picked at the green mature stage when starch is present, and during the colouring process the starch is converted into sugar; the astringent flavours associated with immature fruit disappear while texture and flavour improve. These ripening changes proceed whether the fruit is left on the tree or harvested, but artificial methods of ripening hasten the process and reduce the vulnerability of the fruit to rots, insect damage, etc. Fruits such as citrus which contain no starch are not ripened by the process, and care must therefore be exercised to ensure that only mature fruit is coloured artificially. With these fruits the rind is merely coloured and there is no improvement in flavour or sweetness.

COLOURING METHODS.

There are four main colouring methods in use:—(1) ethylene gas; (2) acetylene gas; (3) coal gas; and (4) kerosene burner.

Ethylene Gas Method.

Ethylene is a sweet smelling, colourless gas obtained commercially in cylinders of 110 and 220 cubic feet capacity. The quantity of gas required to colour fruit artificially depends on the following factors:—

(*a*) the size of the colouring chamber;

(*b*) the degree of airtightness of the chamber;

(*c*) the type of fruit.

Very good results have been obtained experimentally in completely airtight chambers with concentrations of ethylene as low as 1 part to 35,000 parts of air. However, in commercially airtight chambers it is usual to use a concentration of 1 part of ethylene to 4,000-5,000 parts of air, but if the degree of airtightness of the chamber is subject to doubt, a concentration of 1 part of ethylene to 1,000 parts of air is used.

The gas is fed into the loaded chamber through a hose; a regulating gauge is attached to the top of the cylinder and by means of a watch the required amount of gas may be determined. Gassing is usually carried out three times a day. Before each addition, the chamber should be opened and ventilated for 5-10 minutes. Ventilation removes unused ethylene and other gases given off by the fruit during the colouring process. Ethylene is a non-poisonous gas, but is highly inflammable and will form explosive mixtures with air at a concentration of 3.02%. The concentrations recommended for artificial colouring are well below the explosive limit, but extreme care must be exercised to avoid overcharging a chamber, as explosive mixtures may result. There is always the possibility of high concentrations of the gas being found in isolated parts of the room, and lighted cigarettes or naked lights should therefore never be allowed near chambers charged with ethylene. If such precautions are not taken serious explosions may result.

Acetylene Gas Method.

Acetylene is the gas obtained from the reaction of calcium carbide and water. Commercial calcium carbide is a greyish coloured solid with a characteristic odour, and 1 lb. of the solid on reaction with water yields 5 cubic feet of acetylene. One-fifth of a pound of carbide will yield sufficient acetylene to give a concentration of 1 part of acetylene to 1,000 parts of air in a chamber of 1,000 cubic feet capacity. The best way to charge a chamber is to place a large vessel full of water on the floor of the chamber and place the required amount of carbide in the water. The door of the chamber is then closed. The chamber should be charged three times a day and ventilated just prior to each charging. The method of charging by dripping water on to carbide contained in a sealed vessel and delivering the gas generated into the chamber by a hose cannot be recommended. When carbide and water react, a considerable pressure of gas is built up if the reaction is conducted in a sealed vessel, and this sudden increase in pressure can cause an explosion. A considerable amount of heat is also evolved, and as acetylene is highly inflammable, an explosion may result. Acetylene forms an explosive mixture with air at a concentration of 2.5%. The same precautionary measures should be adopted as for ethylene.

Coal Gas Method.

This is the method used commercially in places where coal gas is available. Coal gas contains 1-3% of ethylene. The usual concentration used is 1 part of coal gas to 100-200 parts of air. The gas is admitted to the chamber through pipes and a flow meter is used to determine the quantity delivered. Coal gas forms explosive mixtures with air at a concentration of 5.32%. As the concentration of gas used is very much greater than that of ethylene or acetylene, extreme care must be exercised to avoid explosions.

Kerosene Burner Method.

Ethylene is one of the products of combustion of kerosene, and by placing a low-pressure kerosene burner in a chamber loaded with fruit, sufficient ethylene to colour fruit is produced by the burning of the kerosene. The room should not be airtight, as the burner will not function without sufficient oxygen for combustion. Usually one small blue-flame kerosene burner is sufficient to colour fruit in a chamber of about 300-400 cubic feet capacity. Under no circumstances should chambers containing these burners be charged with ethylene, acetylene or coal gas, as the explosive risk is extremely great if these substances are present.

CONSTRUCTION OF COLOURING CHAMBERS.

Chambers suitable for colouring may be constructed from timber, metal, concrete, bricks, asbestos-cement, etc. Double walls should be erected and the cavity between the walls should be at least three inches wide. This cavity should be filled with some insulating material such as granulated cork, charcoal, sawdust, etc. Insulation helps to maintain even temperatures within the chamber. To make the chamber airtight the interior should be lined with metal sheeting or coated with a sealing compound. As it is necessary to maintain sufficient oxygen in the chamber during the colouring process, the air must be changed each time before charging. In order to do this, ventilators should be placed in the wall opposite the door. The door and ventilator shutters should be filled with insulation and made as close-fitting as possible by lining with felt. By placing the ventilators at the opposite end of the chamber to the door, the air in the chamber can be quickly changed, thus reducing the risk of a high variation in temperature. It is advisable to have a 3 sq. ft. opening in the ceiling of the chamber with a loose hatch covering it. Should an explosion occur, the force of the explosion will expend itself through the opening, thus causing minimum damage to the chamber and reducing the possibility of injury to the operator. Although many colouring chambers are built in packing sheds, it is advisable to construct them away from buildings as a precaution against explosion. Such chambers can be protected from the weather by means of a galvanised iron shelter. The size of the room to be constructed depends on the amount of fruit to be coloured, but a room 6 ft. x 6 ft. x 7 ft. will meet the requirements of most growers. A room of this size will hold 50 bushel cases loosely stacked.

TEMPERATURE AND HUMIDITY CONTROL.

Colouring processes take place more rapidly at high temperatures and in most ripening rooms some form of heating is required. If electricity is available, the room can be heated by non-glow heater strips and the strips coupled with a thermostat in order to maintain a constant temperature. If a more uniform temperature is required a fan may be installed in the chamber. Care must be taken to ensure that the motor driving the fan is of the non-sparking type. If electricity is not available, the chamber may be heated by steam pipes or by buckets of hot sand placed in the chamber.

However, if ethylene, acetylene or coal gas is not used, the kerosene burner method will not only supply the necessary substances for the colouring process but will also supply heat.

Thermometers should be used as a check on chamber temperatures. The best types are mercury in steel capillary thermometers which have a clock-face recording dial. The bulb of the thermometer is placed in the room and the dial on the outside wall. This allows temperatures to be read without entering the room. If dial type thermometers are not available, bent stem types are quite satisfactory. The thermometer is bent at right-angles and the portion with the bulb is let in through the wall of the chamber; the graduated portion of the stem remains outside the chamber. Some experimenting will be necessary to determine the best position to put the bulb of the thermometer, as the temperatures within the chamber will vary. Half-way up a wall which has no door or ventilator is usually a satisfactory position. During warm weather it may be necessary to cool the fruit before commencing the colouring process. Fruit picked during the heat of the day should be cooled by stacking it loosely in the packing shed and holding it overnight.

Control of humidity is also important, and a humidity between 80% and 90% should be maintained if possible. Lower humidities cause withering of the fruit, and higher humidities favour mould development. The humidity can be raised if necessary by placing wet sacks or vessels of water in the chamber.

LOADING THE CHAMBER.

Care should be exercised to ensure that the chamber is loaded in such a way that air can circulate freely between the cases. By building a slotted false floor at least three inches above the true floor, air can circulate at the bottom of the chamber. Cases should never be jammed tight against the walls but an airspace of an inch or two should be left between the stack and the walls of the chamber. Placing 1 in. x 1 in. timber dunnage strips between cases keeps the air circulating and also prevents damage to the fruit through case rubbing.

The fruit should be loosely packed in field boxes, roughly hand graded for maturity and size, and the more advanced fruit placed at the bottom of the chamber. The less mature fruit is stacked near the top of the room, which is generally warmer than other positions. Even colouring thus results.

BANANAS.

The most satisfactory ripening temperatures for bananas are 68°–70°F. in summer and 66°F. in winter. Higher temperatures may result in the development of good colour in some fruit but the flavour is generally unsatisfactory and the subsequent keeping quality of the fruit is impaired. Winter fruit is very susceptible to high temperatures, and ripening temperatures should not be allowed to exceed 66°F. Bananas will ripen at lower temperatures than those recommended, but the use of temperatures below 65°F. in the early stages of ripening may result in incomplete ripening of the pulp, although the peel may colour satisfactorily.

During the ripening processes, pulp temperatures should be measured by a stab thermometer, as it is this temperature which determines whether the fruit will ripen satisfactorily. In the early stages of ripening there is a tendency for pulp temperatures to rise and room temperatures should be lowered to counteract this.

Humidity should be maintained at 85% during the early stages of ripening; generally it is unnecessary to add any moisture to the air in the rooms to obtain this humidity. After the first tinges of yellow

appear the humidity should be reduced to 75%. This reduction of humidity may be achieved by ventilating the rooms with outside air. Ventilation is also of value in preventing accumulation of carbon dioxide in the room and at the same time prevents the depletion of the oxygen content of the room.

During winter when the fruit to be ripened is very cold (55°F. or lower), considerable care should be exercised in raising the fruit to the ripening temperature. If the temperature is raised rapidly, a considerable amount of water condenses on the fruit; this makes subsequent control of humidity and pulp temperatures very difficult. With very cold fruit the temperature of the chamber should be adjusted so that it will take 12–24 hours to bring the fruit temperature to the ripening temperature. It is often beneficial to reventilate the chambers during the warming process to remove the condensate. Normal ripening takes 3–7 days.

CITRUS.

Oranges colour best at temperatures between 70° and 75°F. Above 80°F. there is a danger of the fruit wilting. For lemons the best temperatures are 60°–65°F. The colouring period takes 4–5 days but may be much longer if the fruit is very immature.

Artificially coloured fruits frequently develop gas burn which impairs their marketable value. This injury can be caused by excessive concentrations of gas or by colouring wet, immature or unsound fruit. Only mature fruit should be coloured. Immature fruit will not colour satisfactorily, and is more subject to rind injuries. Wet or damp fruit will develop severe skin injuries during the colouring process, and may break down during transport to market. Care must be taken that no spray residue remains on the fruit during treatment, otherwise the fruit will become blotchy and unsightly during the colouring. Fruit with damaged skin will not colour properly, and only sound fruit should be placed in the colouring rooms.

PAPAWS.

The best results with this fruit are obtained with temperatures between 85° and 90°F. At these temperatures humidity control is usually not necessary, but if required the humidity may be increased by placing wet bags in the room. Fruit to be ripened should be free from blemish and showing about quarter colour. Forty-eight hours in the chamber is usually sufficient to obtain a good result.

TOMATOES.

Tomatoes to be artificially coloured should be picked when "green mature" (that is, the same stage as they are picked when packed and sent to market to be sold as uncoloured fruit). The fruit should be roughly graded when picked and packed loosely into cases; final grading and packing can then be carried out when the coloured fruit is removed from the ripening room.

The temperature used is usually between 65° and 75°F., but it has been found that, with temperatures of 65°–70°F., no control of humidity is necessary. Although higher temperatures may accelerate colouring, it is necessary to increase humidity and any time gained is not considered worth the trouble of controlling humidity. The time for artificial colouring is usually 3–7 days, depending upon the colour required and the stage of maturity at which the fruit is picked.

Tuberculosis-Free Cattle Herds.

TESTED HERDS (As at 15th February, 1954).

The Tuberculosis-Free Herd Scheme (which is distinct from the tuberculosis eradication scheme operating in commercial dairy herds) was initiated by the Department of Agriculture and Stock for the purpose of assisting owners of cattle studs to maintain their herds free from tuberculosis and so create a reservoir of tuberculosis-free cattle from which intending purchasers can draw their requirements.

The studs listed here have fulfilled the conditions to the date shown above.

Full particulars of the scheme and Agreement for Testing forms may be obtained from the Under Secretary, Department of Agriculture and Stock, Brisbane, or from Divisional Veterinary Officers throughout the State.

Breed.	Owner's Name and Address.
Aberdeen Angus	The Scottish Australian Company Ltd., Texas Station, Texas F. H. Hutton, "Bingegang," Dingo
A.I.S.	M. E. & E. Scott, "Wattlebrae" A.I.S. Stud, Kingaroy F. B. Sullivan, "Fermanagh," Pittsworth D. Sullivan, "Bantry" Stud, Rossvale, *via* Pittsworth W. Henschell, "Yarranvale," Yarranlea Con. O'Sullivan, "Navillus" Stud, Greenmount H. V. Littleton, "Wongalea" Stud, Hillview, Crow's Nest J. Phillips and Sons, "Sunny View," Benair, *via* Kingaroy Sullivan Bros. "Valera" Stud, Pittsworth Reushle Bros., "Reubydale" Stud, Ravensbourne H. F. Marquardt, "Chelmer" Stud, Wondai W. G. Marquardt, "Springlands," Wondai A. C. and C. R. Marquardt, "Cedar Valley," Wondai A. H. Sokoll, "Sunny Crest" Stud, Wondai W. and A. G. Scott, "Welena" A.I.S. Stud, Blackbutt G. Sperling, "Kooravale" Stud, Kooralgin, *via* Cooyar C. J. Schloss, "Shady Glen," Rocky Creek, Yarraman W. H. Thompson, "Alfa Vale," Nanango S. R. Moore, Sunnyside, West Wooroolin H.M. State Farm, Numinbah D. G. Neale, "Groveley," M.S. 195, Pittsworth Edwards Bros., "Spring Valley" A.I.S. Stud, Kingaroy A. W. Wieland, "Milhaven" A.I.S. Stud, Milford, *via* Boonah W. D. Davis, "Wamba" Stud, Chinchilla Queensland Agricultural High School and College, Lawes C. K. Roche, Freestone, Warwick Mrs. K. Henry, Greenmount
Ayrshire	L. Holmes, "Benbecula," Yarranlea J. N. Scott, "Auchen Eden," Camp Mountain "St. Christopher's" and "Iona" Studs, Brookfield road, Brisbane E. Mathie and Son, "Ainslie" Ayrshire Stud, Maleny C. E. R. Dudgeon, "Marionville" Ayrshire Stud, Landsborough
Friesian	C. H. Naumann, "Yarrabine" Stud, Yarraman
Guernsey	C. D. Holmes, "Springview," Yarraman A. B. Fletcher, Cossart Vale, Boonah W. H. Doss, Degilbo, *via* Biggenden
Jersey	Queensland Agricultural High School and College, Lawes J. S. McCarthy, "Glen Erin" Jersey Stud, Greenmount J. F. Lau, "Rosallen" Jersey Stud, Goombungee G. Harley, Hopewell, M.S. 189, Kingaroy Toowoomba Mental Hospital, Willowburn Farm Home for Boys, Westbrook F. J. Cox and Sons, "Rosel" Stud, Crawford, Kingaroy Line R. J. Browne, Hill 60, Yangan P. J. L. Bygrave, "The Craigan Farm," Aspley R. J. Crawford, "Inverlaw" Jersey Stud, Inverlaw, Kingaroy P. H. F. Gregory, "Carlton," Rosevale, *via* Rosewood E. A. Matthews, "Yarradale," Yarraman A. L. Semgreen, "Tecoma," Coolabunia G. & V. Beattie, "Beauvern," Antigua, Maryborough L. E. Meier, "Ardath" Stud, Boonah A. M. and L. J. Noone, "Winbirra" Stud, Mt. Esk Pocket, Esk W. S. Conochie and Sons, "Brookland" Stud, Sherwood road, Sherwood Estate of J. A. Scott, "Kiaora," Manumbar road, Nanango F. W. Verrall, "Coleburn," Walloon C. Beckingham, Trouts road, Everton Park W. E. O. Meier and Son, "Kingsford" Stud, Alberton, *via* Yatala G. H. Ralph, "Ryecombe," Ravensbourne Mrs. I. L. M. Borchert, "Willowbank" Jersey Stud, Kingaroy W. and C. E. Tudor, "Boree" Jersey Stud, M.S. 498, Gayndah C. A. Edwards, "Grasmere" Jersey Stud, Woodford Weldon Bros., "Gleneden" Jersey Stud, Upper Yarraman D. R. Hutton, "Bellgarth," Cunningham, *via* Warwick
Polled Hereford	W. Maller, "Boreview," Pickanjinnie J. H. Anderson, "Inverary," Yandilla D. R. and M. E. Hutton, "Bellgarth," Cunningham, *via* Warwick

The Honey Flora of South-Eastern Queensland.

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

(*Continued from page 93 of the February issue.*)

Hairy Bush-Pea.

Botanical Name.—*Pultenaea villosa* Willd.

Other Common Name.—Kerosene bush.

Distinguishing Features.—This is a more or less hairy, small-leaved bush with chiefly orange yellow pea-like flowers along the branches (Plates 71 and 72).

Description.—A shrub up to 8 ft. high or so with rather long and slender hairy branches. The leaves are narrow and blunt, about $\frac{1}{4}$ in. long or less with the upper surface concave. The pea-like flowers are about $\frac{1}{4}$ in. long and wide, orange yellow, usually stained red in the centre. The pod is small and rounded, hardly protruding from the calyx.

Distribution.—Coastal parts of Moreton and Wide Bay Districts, in forest country on sandy or stony soil; also in coastal New South Wales.

Usual Flowering Time.—August–September.

Importance as Source of Honey.—Nil.

Importance as Source of Pollen.—Major.

General Remarks.—In coastal districts this bush flowers annually and is worked freely by bees for large amounts of pollen. It blossoms during late winter and spring, and thus assists to strengthen colonies early in the season. Beekeepers, particularly those in the Maryborough and Caloundra districts, rely on the hairy bush-pea for regular pollen supplies.

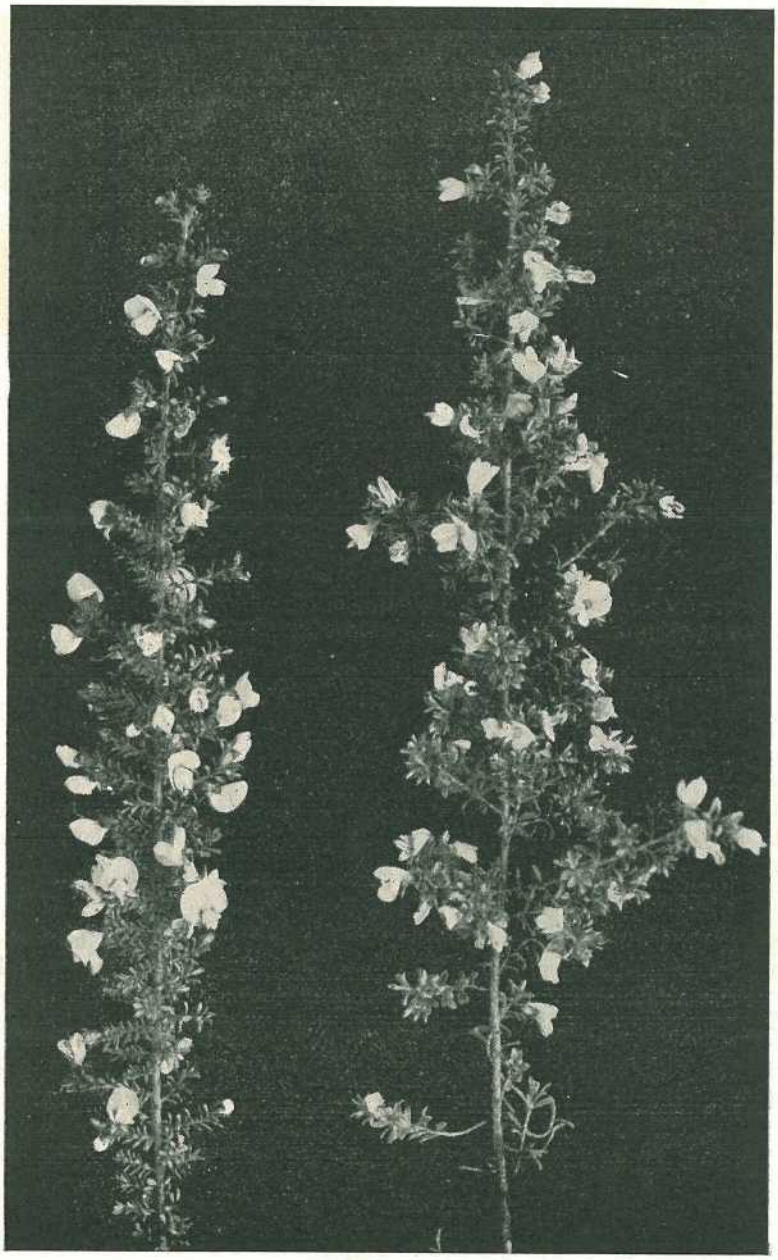


Plate 71.

Hairy Bush-Pea (Pultenaea villosa). Branchlets with leaves and flowers.

Plate 72.
Hairy Bush-Pea (Pultenaea villosa). Tarragindi.

Brucellosis Testing of Swine.

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.

TESTED HERDS (As at 15th February, 1954).

Berkshire.

J. J. Bailey, " Lucydale " Stud, East Greenmount
S. Cochrane, " Stanroy " Stud, Felton
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
M. K. Collins, Underwood Road, Eight Mile Plains
H.M. State Farm, " Palen " Stud, Palen Creek
A. R. Ludwig and Sons, " Cryna " Stud, Beaudesert
H. H. Sellars, " Tabooba " Stud, Beaudesert
D. T. Law, " Rossvill " Stud, Trouts 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. McLennan, " Murcott " Stud, Willowvale
H. M. Wyatte, " Deepwater " Stud, Rocky Creek, Yarraman
C. F. W. and B. A. Shellback, " Redvilla " Stud, Kingaroy
R. J. Webber, " Webberberry " Stud, 35 Caxton st., Petrie Terrace
J. C. Lees, " Bridge View " Stud, Yandina
F. Thomas, "Rosevale" Stud, M.S. 373, Beaudesert

Large White.

H. J. Franks 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
M. K. Collins, Underwood Road, Eight Mile Plains
B. J. Jensen, "Bremerside" Stud, Rosevale, *via* Rosewood
E. J. Bell, " Dorne " Stud, Chinchilla
L. C. Lobegeiger, "Bremer Valley" Stud, Moorang, *via* Rosewood
H. R. Gibson, " Thistleton " Stud, Maleny
H.M. State Farm, Numinbah
K. A. Hancock, " Laurestonvale " Stud, Murgon
V. P. McGoldrick, " Fairymeadow " Stud, Cooroy
S. T. Fowler, " Kenstan " Stud, Pittsworth
H. L. Larsen, " Oakway," Kingaroy
C. Allison, " Colrene " Stud, Lake and Reserve roads, Slacks Creek
Mrs. I. G. Utting, " White Lodge," Mountain road, Cooroy
N. E. Meyers, Halpine Plantation, Kallangur
Dr. B. J. Butcher and A. J. Parnwell, 684 Logan road, Greenslopes
G. I. Skyring, " Bellwood " Stud, *via* Pomona
O. J. Horton, " Manneum Brae " Stud, Manneum, Kingaroy
M. E. Bryant, " Maryland Brae " Stud, Blunder road, Oxley
Miss G. R. Charity, Coondoo, Kin Kin.
W. J. Blakeney, "Talgai" Stud, Clifton
F. K. Wright, Narangba, N. C. Line

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
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
F. N. Hales, Kerry Road, Beaudesert
T. A. Stephen, " Withcott," Helidon
W. F. Kajewski, " Glenroy " Stud, Glencoe
A. A. Herbst, " Hillbanside " Stud, 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
G. H. Sattler, Landsborough
F. Thomas, "Rosevale" Stud, M.S. 373, Beaudesert

Wessex Saddleback.

W. S. Douglas, " Greylight " Stud, Goombungee
D. Kay and P. Hunting, " Kazan " Stud, Goodna
J. Gleeson, " 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, Trout road, Aspley
J. B. Dunlop, " Kurrawyn " Stud, Acacia road, Kuraby
A. Curd, " Kilrock " Stud, Box 35, Jandowae
F. K. Wright, Narangba, N. C. Line
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
J. E. Heath, "Springlea" Stud, Murgon

Painting Dairy Buildings.

D. K. HOGAN, Division of Dairying.

Regulation 50 of the Dairy Produce Acts reads as follows:—

"The owner of dairy produce premises shall, when so required by an inspector, cause such premises or any room therein which is used for containing dairy produce for sale or intended for sale or storage, to be disinfected, painted, lime-washed or cleansed in any other manner approved by him."

This article is intended to give the farmer a better understanding of paints, the ingredients in them, and their specific and economical use on dairy buildings.

The Necessity for Painting.

Apart from the decorative aspect, dairy buildings require painting to protect them from decay and corrosion and for reasons of sanitation and cleanliness. It is highly uneconomical to build good dairy premises, then allow them to rot away for want of preservative paint coatings.

The chief materials requiring such preservation are timber and iron. If left untreated, timber surfaces deteriorate from constant changes of temperature and the effects of moisture, which cause wet and dry rots. Iron surfaces left unprotected soon rust in a damp atmosphere; it is necessary to paint iron before any sign of rust appears.

No matter how well constructed a dairy building may be, it will never look its best unless it is painted inside and out, nor does it look quite finished or clean with bare timber showing. The ease and saving of time in cleaning a well-painted or enamelled surface more than compensates for the initial cost of painting.

Handling of Paint and Brushes.

Paint is a dear commodity and every ounce must be made to give an account of itself. This may be accomplished by common-sense handling. If a can of paint is left standing for any length of time a skin will form on it, and according to the time left standing, the thickness of the skin will vary from 1/60th to half an inch. The skinning can only be termed waste, as it is irrecoverable. It must not be stirred into paint, but gently cut around the edges, lifted out and disposed of. In a linseed oil base paint, this waste can be prevented simply by placing enough linseed oil on the paint in the can to cover it then lidding the container. For enamel and enamelised paints, a half-inch layer of mineral turpentine should be placed on the top to prevent skin formation.

Silver paint will not skin, but all water paints will do so rather badly. Water should be placed on the top of all paints thinned with water. Water paints which have been left to stand for any length of time tend to become putrid and once the faintest sign of this is noticed they should be thrown away, as they are of no further use. It will be found, too, that the pigment in these paints will settle to the bottom if the paints are left standing. If this is mixed in again, the paint finish will be found to be lumpy and unsatisfactory.

Another factor in paint wastage is the splash from the brush. This may be overcome by not dipping the brush in too deeply—no more than half the bristle. Tap gently on the side of the pot, tip the brush quickly and apply to the surface. Always brush the paint out well, as it will go much farther if well spread on the surface. Do not endeavour to apply paint to any surface if it is too thick, as this is also wasteful and causes wrinkling. Thin the paint with linseed oil for the priming paint and finish coat, and with turpentine for all other intermediate coats, to a consistency resembling that of cool cream.

The paint brush requires special attention. The brush which receives such care will be found to give longer life, and will be a pleasure to use. The principle of the brush is that of transferring the paint from the container to the surface and spreading it evenly, under pressure, with the least possible wastage. A good bristle brush is composed of hog's hair. These bristles are minutely hollow. This accounts for the great quantity of paint that may be held in a brush, and for the instruction on all bristle brushes not to soak in water before use. Water entering the hollow cavities prevents the paint entering and restricts the holding capacity.

A new brush should first be flipped out on a clean piece of timber to remove any dust that may be present, placed directly into the paint, and the paint worked into it. Painting may then begin.

After painting is finished for the day, wipe the brush on the side of the pot and place in a clean can of water, deep enough only to cover the bristles. A little kerosene may be added to this water to prevent evaporation. It is an excellent idea to bore a small hole in the thickest portion of the handle and thread onto a wire wider than the container. This will suspend the brushes in water and prevent the bristles from being put out of shape by the weight of the brush itself. Do not use more water than will completely cover the bristles, otherwise the rubber setting of the brush, located under the metal ferrule, will perish, causing the brush to become loose and fall to pieces.

At the completion of the painting do not place the brush in water and forget it, as it will eventually go hard and be worth very little. Clean it up thoroughly and store it away for further use. A quick and effective method is to place the brushes in a container holding some mineral turpentine or petrol, wash them in this, rinse in petrol, wash in soap and hot water, rinse in cold water and allow to dry out.

If oil paint has become hardened on the brush, wash or soak it in lacquer thinners, then in petrol. In the case of water or emulsion paints, wash first in cold water, shake to dry, then wash in petrol or turpentine, next in soap and warm water and finally rinse in clean cold water.

The sizes of brushes recommended for painting of dairy buildings are 2 brushes 1 inch, 1 brush 2 inches, 2 brushes 3 inch. With these brushes on hand, practically any painting job may be attempted.

Do not buy a 2-inch brush to paint weatherboards or other hardwood timber; use nothing smaller than 3 inches. Brushes of the 1-inch type are mainly used for awkward places, corners, edges and for cutting in window sashes. The 2-inch brush has its application in the painting of smaller surfaces such as machinery, sills, guttering downpipes and sterilizers. Large

surfaces, such as fibro sheets, which are to be enamelled or water painted, require the use of a very good 4-inch bristle brush. Only the best brush obtainable should be used for either of these tasks.

Removing Old Paint Films.

This is one task hardly ever carried out thoroughly, even by tradesmen. It is not a very pleasant job, but it is a very necessary one. In dairy buildings the technique would hardly ever be used, except in the case of old limewash. This must be removed thoroughly if a really satisfactory job is to be done.

The simplest method of removing old limewash is to wet the whole surface by using a knapsack spray or stirrup pump. After the lime-wash has softened, scrape it off with an old knife or a wide wedge paint scraper. Let the timber dry out thoroughly, dust off with a stiff brush, and painting may begin. Treat old water paint in the same manner. In removing old oil paint, the time-honoured blow-lamp is still the best but can be very dangerous.

Tradesmen often use paint-dissolving strippers. This task is very laborious, as the whole surface must be covered with a stripper, the paint removed, then very thoroughly washed down, and allowed to dry, as most of these strippers contain caustic soda. Providing the old paint work is not too loose or scaly, there is little need to remove it at all. The usual sand-papering and/or wire-brushing will remove anything that may cause future trouble. This may tend to give the surface an uneven finish, but is overcome by using a thicker primer and a thicker undercoat paint to fill up.

Paint Odours and Dairy Produce.

Paint odours cause serious taints in milk and especially in cream. Therefore, it is necessary to arrange the painting programme and the storage of milk and cream so that they do not clash. It is necessary to store all milk and cream away from fresh paint for 48 hours after drying has occurred; this enables the paint odours to pass away in the atmosphere.

In the case of water paints, the carbolic nature of their odour is likely to persist for up to 30 days, depending on how fresh the paint was when used. It is wise to mix this paint and let stand for 24 hours to become deodorised.

Points on Paint Application.

There are many points to the application of paints that are entirely unknown to the ordinary man outside the painting trade.

Every surface to be painted should receive a priming coat. If new or burnt off, it also requires an undercoat. Finally, a finish coat is needed. This is the only way to paint successfully anything at all, unless repainting, when an undercoat and finish coat are all that is necessary. These rules do not apply to silver paint, which is applied in only one coat.

It must be remembered that gloss oil paint was made for two main purposes, firstly to give a hard glossy covering to the undercoats, and secondly with an amount of elasticity to allow for expansion and contraction with varying temperature without cracking, as undercoats do if left unprotected.

This paint was never meant to be used as a primer, an undercoat, and a finish. No paint is capable of as much service as this. The use of this gloss oil paint for all three purposes may not at the time cause any trouble, apart from wrinkling or cissing, but it is at later stages that defects begin to appear. These defects are cracking, crazing, peeling, crocodiling, dulling, sheering, and general inability of the paint to stand up.

The one great trouble experienced during the application of one gloss coat on another gloss coat is known as cissing, and is caused by the inability of one coat of paint to adhere to another. The paint when being

applied appears to run into little droplets, or leave little spaces uncovered; in effect, no matter how much the paint is brushed, the surface cannot be entirely covered. This is brought about by the fact that the coat being painted over is greasy and hard. There are many old-fashioned methods of stopping this cissing after it has begun, but the only way is to stop it before it begins, by using an undercoat as an intermediate coat.

Cissing may be reduced somewhat by wiping the surface, before painting, with a cloth moistened with mineral turpentine. Allow to dry, then paint.

Painting a New Building.

The extent of this painting will be determined by the time and labour available and the cost of the materials required.

The use of tar in the bails is gaining in popularity. It may be applied cold by adding one pint of petrol to each gallon of tar, mixing well, and using immediately. As petrol is a volatile spirit it will evaporate, causing the tar to dry quickly with a hard, glossy surface. The bails should be tarred to a height of four feet, and a second coat of tar should be applied two days after the first. It will be found that this surface will wear well, and if a fresh coat is applied every two years, the surface will be renewed. To remove the tar from the brush, wash in either kerosene, petrol or mineral turpentine. The use of tar as described above is restricted to the bails and cannot be approved for any other part of the dairy building.

The next portions of the building to be attended to are the upper structure, the remaining parts of the walls, and the posts. It is desirable to paint these timbers with three coats of ordinary paint (oil base and pigment) to ensure a worthwhile finish that will wear and be lasting.

Alternatively, they may be effectively coated with one coat of silver paint, which will give adequate protection, be dirt-free, unattractive to spiders and flies and effectively and easily cleaned down by hosing. The appearance may not be quite equal to oil-painted surfaces, as no gloss is apparent. The method is to apply one coat of aluminium paint, probably best known as "silver frost," to all timber not previously coated with tar. If the building is not ceiled, the inside of the iron roofing also may be coated. Five years would be a fair expectation of its life, after which a further coat would renovate it.

It is important to point out that there are two types of silver paint. One is a bituminous base paint which is not recommended for use inside dairy buildings. The other is of the long oil or varnish base type which is highly inflammable before it is dry, but the most desirable for dairy use, as it is intended for interior application. One gallon of this silver paint will cover 360 square feet, and 1½ gallons would complete the painting of an ordinary three-unit dairy building —that is, bails, air space and wash-up room. The cost of this paint would be about £5. The separator room requires special treatment, and will be discussed later.

The painting of the parts of the building mentioned would take about 6 gallons of oil paint costing £16 10s., together with brushes costing £3, making a total of approximately £20.

If the farmer has a definite colour scheme in mind for the interior part of his dairy building, silver paint does not leave much room for variety but as a base for any other colour or trimming there is no other undercoat to equal it. However, a dash of colour, such as red, blue, green or brown, in silver-coloured bails, with tar on the lower 4 feet, is very pleasing to the eye, adds colour harmony to the working life in the dairy, and generally makes it a more pleasant place in which to work.

Use of Limewash and Water Paints.

These materials in the past have been used widely, but with limited success. The main disadvantage of limewash is that, lacking adhesion to timber and iron, it flakes off when it dries out. It requires renewing at least twice yearly, and limewashing is a thoroughly messy job. Actually, limewash is not satisfactory for dairy use, due to this characteristic flaking and falling.

With the advent of emulsion-type water paints (that is, paints with the pigment bound in oil and thinned with water), limewash lost most of its popularity. These water-thinned emulsion paints were used widely in bails and dairies on timber work previously unpainted. People who have used them know only too well the outcome—the paint either discoloured or fell off and was generally unsatisfactory. These paints were manufactured primarily for use on fibrous plaster and fibro sheeting and they were never meant to be used on bare timber. However, it was found that these water and oil emulsion paints could be used on timber with success if the timber was first given a coat of flat oil undercoat paint to seal the timber and give the water paints an adhesion without drawing out their moisture, which these paints rely on for holding together.

The use of water paints is limited in the dairy because, firstly, they contain phenolic compounds which will taint dairy produce, and, secondly, they will not stand up to washing in any shape or form. Once they become dirty, they stay so until re-painted.

The new type of oil paints thinned with water must also be put on over a primary coat. They will wash a little better than the old types, but their use is strictly limited to fibro ceilings in separator rooms only. They are essentially house-decorating preparations which have no timber preservative qualities.

Painting Galvanised Iron.

New iron should never be painted while the newness remains, as the salts used in the process of galvanising are harmful to paint. If it is desired to paint new iron, special treatment is necessary. The procedure is to wash the iron with a solution of six ounces of copper acetate to each gallon of water. Allow the iron to stand until the metal darkens, wash well with clean water, leave for 24 hours, and then paint as usual.

Many mistakes are made when painting galvanised iron on the roof, which is exposed to all weathers. The main one is that one coat of paint is often expected to withstand all this, and still last three or four years. This is impossible. It is necessary for a first-class roof painting job to set about the task in a proper manner. Sweep the roof down well, apply one coat of roofing paint of the desired colour and leave this for at least six months to settle down and dull a little. Another coat of the same colour will give the required protection. This paint work should last for five years, when it would be found that the film is still in good order, though dull. As paint wears from the outside inwards, the surface will remain protective provided there is no cracking or peeling.

Paint Finish in Separator Room.

The painting of this room should receive special attention, as the paint is subject to much splashing of milk and water. The finish must necessarily be a durable one to enable the surface to be regularly scrubbed and washed. Ordinary oil-base paint will not stand up to any great degree of washing and scrubbing. It is much more suitable to use an enamel finish in this room. Enamel will give a smooth glossy surface, durable enough to be scrubbed very frequently.

The method of preparation of the surface for an enamel differs very little from that for an ordinary oil paint. If fibro is being painted it must first be sealed (that is, the pores

of the surface filled). Any proprietary sealer will do the job, but care must be taken not to miss any small areas. The sealer is allowed 24 hours to dry. Flat undercoat paint, not gloss oil paint, is next applied and allowed to dry for 24 hours, and another coat of the same paint applied. The surface is now ready for enamelling. The enamel must be applied as quickly as possible, but not too thickly.

The main thing to remember when using any enamel or enamelled paint is always to keep a wet edge, not take too large a sweep with the brush and not try to do too much at the one time.

Enamel is not a coat of paint but a glossy hard finish to a surface.

Should an enamel surface become soiled it is only a matter of washing over with a cloth and warm (never hot) water with a little of a good soap added. Wash again with clean warm water. This will ensure that the surface remains glossy for many years.

The wash room could be given the same treatment but it is hardly necessary, unless the two rooms are combined. For the separator wash-up room, use one coat of silver. However, if fibro has been used as a lining then it will have to be first sealed.

Never on any account attempt to use water or emulsion paints in the wash-up room. This practice can only end in failure, as the steam and damp atmosphere will cause a mould growth on the paint surface and the water paint will quickly deteriorate. Silver paint will also be found a desirable type of heat resistant coating for wash troughs, sterilizers, separator blocks, iron draining racks wood or metal vat stands, and especially copper or steel screen wire. This paint provides a protective coating on any metal or wood, preventing the entry of dampness, which may cause rot or rust.

Treating the Exterior of Buildings.

From the preservation angle, this is the most important part of painting any building, as the exterior of the building is subject to weather conditions.

The treatment need not be expensive. Actually, it can be accomplished quickly and effectively by a very old method.

First paint all fascia boards, windows, sills, doors and door stops and allow this paint to dry well. For weatherboards or other timber the same mixture may be applied in two coats four days apart.

For a three-unit double-bail shed and separator room, obtain 4 gallons of raw linseed oil and into this place 2½ lb. of either burnt sienna or burnt umber, depending upon whether a very dark-red colour or a dark-brown colour is preferred. For a pleasing chocolate colour, add 1½ lb. of burnt sienna and 1½ lb. of burnt umber to 4 gallons of raw linseed oil. These raw colours, or earth pigments, are best obtained ground in oil—that is, in paste form. They must be added to the oil 24 hours prior to use and the mixture stirred well for half an hour to incorporate thoroughly the two ingredients.

It is a wise plan to use a medium known as terebine to hasten the drying of the oil. Use 1 pint to 4 gallons of raw linseed oil, stirring all the time it is being added to prevent burning in the oil, which may cause wrinkling or stickiness.

A good bristle brush is used to apply this mixture, which must be stirred frequently while in use. Paint on a good coat. Wipe off any splashes from windows, doors and stops.

On no account use sump or any other mineral oil in place of linseed oil. This may seem quite a saving at the time, but can only cause trouble in later years, and will not give any great amount of protection.

If mineral oil is used and it is later intended to oil paint the surface, much trouble will be experienced. It will be found that the paint will not dry readily, will show up odd patches of varying colour, and, when it does eventually dry, will crack and crocodile, eventually destroying the paint surface long before deterioration is normally expected.

In the case of mineral oils having been used in the past on buildings, there is a method of treating or sealing the surface. This is to dust down the surface completely, paint one coat of silver paint and allow a week to dry and neutralise the greasy surface. Then proceed to paint one coat of undercoat and one coat of finish gloss paint. Any further trouble will be eliminated completely. The same treatment applies to any surface which has been tar-coated, or coated with wood-preserving oil or creosote.

Care and Cleaning of Paint Work.

Paint work in dairy buildings is subjected to a great amount of cleaning, which is harmful to ordinary oil-base paint and will eventually remove it in patches. This is why enamel is selected for the separator room and silver paint for the bails section. They are practically impervious to water and washing.

However, if oil-base paint is to be used, or has been used, then it must be cleaned. One method which gives successful results is: First soak well with warm water, then use any good soap powder, but not too much, wet again and wash well with a soft cloth. Wash down thoroughly with clean warm water and dry with a clean cloth. This treatment applies only to gloss finish oil paints; in the case of water paints and flat oil paints, wash down and repaint. Do not use washing soda, soda ash or caustic soda as a detergent for washing down paint or enamel work. They are paint removers, not a type of cleaner for paint work.

Butterfat and cow manure are injurious to paint work if left in contact with it for any length of time. Water if in constant contact with paint for any time will also cause its deterioration; hence the use of tar on the lower portions of the shed, which are almost certain to be wet for many hours each day.

Temperature and Paint Work.

In American investigations, surfaces were finished in various shades, with paints of different components, with a view to determining their effect on temperatures in buildings. The findings were as follows:

Black paint—a rise of 2 degrees.

White—a decrease of 10 degrees.

Red—no appreciable rise or fall.

Silver—a decrease of 10 degrees.

All other shades gave small variations, but none were of much consequence in the reduction of inside temperatures.

DAIRY FARM DEMONSTRATIONS.

Work has now commenced on all of the 82 dairy farms selected to demonstrate improved methods of pasture establishment and management and fodder conservation, as part of the activities under the Commonwealth Dairy Industry Extension Grant.

The scheme embraces the whole of the State's dairying districts, and farmers are advised to ascertain the location of district demonstrations and attend the field days which will be held in due course.

Ear Tattooing of Dairy Cattle.

S. E. PEGG, Herd Recording Section, Division of Dairying.

Ear tattooing is used extensively as a means of identifying dairy cattle. It is used by commercial dairymen, by members of the various Herd Book Societies, and in calf identification schemes allied to production recording of dairy cattle.

The commercial dairyman uses tattooing so that he can identify the individual members of his herd and thus keep a check on his breeding programme.

Under the rules of all Dairy Cattle Herd Book Societies, except the Friesian, it is compulsory for the breeder to ear tattoo all calves which are reared. The calves are tattooed in one ear with the distinguishing brand of the breeder. This brand usually consists of two letters and one numeral. In the other ear is tattooed a serial number to correspond with the number which is submitted to the appropriate Herd Book Society on the animal's calf roll registration form.

These tattoos are a means of identification for the owner, officials of the Herd Book Society and prospective buyers, and care should be exercised to see that tattoo marking is legible.

If a cow's ear is examined it will be seen that there are two main ridges of cartilage running lengthwise for about half its length, and there is room to tattoo a row of figures between these ridges as well as above and below them. The top section is usually preferred. Care must be taken not to tattoo across the ridges, as the ear may be mutilated. The haired-over area near the edge of the ear should be avoided, as it will be difficult to read the marks.

Before proceeding to tattoo, the ear should be wiped clean with a cloth dipped in kerosene or methylated spirit in order to remove grease, dirt or wax.

When the needles have been placed in the pliers it is essential to "try the bite" on a piece of paper or cardboard before the tattoo is placed in the ear. Care must be taken that the number is not inserted in the ear back to front.

The operator should always work only from either the top or the bottom of the ear.

When working from the bottom, the items in the holder should be set up to read from right to left. If this is done the tattoo will read correctly when placed in the ear.

When all is ready to use the pliers in the ear, a paste of indian ink or "Zebra" stove polish should be rubbed on the inside of the ear. The pliers should be applied quickly to prevent tearing the ear and then the paste rubbed in well from both sides of the ear.

If this procedure is followed, a legible tattoo marking should result.

Briefly the procedure is—

(1) Clean the ear thoroughly before tattooing.

(2) Make sure the correct letters and numeral are placed correctly in the pliers.

(3) Try the pliers on paper or cardboard.

(4) Apply a paste of a good ink or stove polish to the inside of the ear, make the tattoo, and rub the paste in well from both sides.

The Manufacture of Cheddar Cheese in Queensland.

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

(*Continued from page 124 of the February issue.*)

THE ROLE OF MILK CONSTITUENTS IN CHEESEMAKING.

The Composition of Milk.

The average composition of milk is :—

- MILK
  - Water, 87·1%
  - Solids, 12·9%
    - Fat, 3·9%
    - Solids not fat, 9·0%
      - Protein Compounds 3·2% .. .. — Casein, 2·5%; Albumin + Globulin, 0·7%
      - Milk Sugar, 5·1%
      - Ash (salts), 0·7%
  - Gases
    - Carbon Dioxide
    - Nitrogen
    - Oxygen
  - Milk Enzymes, colouring matter and vitamins.

The milk fat, casein, and some of the salts are held in suspension in the milk, while the albumin, lactose and most of the salts are held in solution by the water.

Butterfat is a mixture of a number of different fats or glycerides with small amounts of related substances and the fat-soluble vitamins A, D, E and K. The glycerides have different melting points and they vary in percentage according to seasonal and feed conditions. Butterfat is held in suspension as minute globules, one drop of milk holding an estimated 20,000,000 globules.

Milk Casein consists of a complex of carbon, hydrogen, oxygen, nitrogen, phosphorus and sulphur, combined with calcium to form a protein compound which, for convenience, is known as calcium caseinate. It consists of minute gelatinous particles held in suspension by the milk. Any acid, whether developed by lactic acid bacteria or added, brings about what is commonly known as curdling of the milk by withdrawing calcium from the calcium caseinate and causing a precipitation of the casein. Rennet causes the precipitation of the casein of milk as calcium paracaseinate. The action of lactic acid on this causes the production of mono-calcium paracaseinate, which imparts to the curd a smooth, mellow feeling and the ability to tear without breaking.

Milk Albumin belongs to the milk proteins, but differs from casein in that it is in solution in milk. It is not coagulated by rennet or acid, but is coagulated by heat above 160° F.

Milk Sugar or Lactose is less sweet and less soluble than cane sugar. It is converted to lactic acid by bacterial action and this has a special interest in cheesemaking.

Salts of Milk.—When milk which has been freed of fat and protein is dried to an ash this ash contains the minerals which are present in the milk in a true or colloidal solution. Ash consists of calcium, potassium, sodium and magnesium, as phosphates, chlorides, sulphates and carbonates. There are also traces of iron, copper and iodine.

Milk Enzymes.—Enzymes are chemical ferments. They have the power to produce changes in substances without themselves altering. The following enzymes are present in milk :—diastase, galactase, lipase, phosphatase, catalase, peroxidase, reductase.

Colouring matter of milk consists of carotin and lactochrome. The yellow colour of the fat of milk is due to carotin and the greenish colour of whey to lactochrome.

Vitamins.—As well as the fat-soluble vitamins, A, D, E and K, milk contains the water-soluble B group of vitamins and vitamin C. Cheese is a fairly good source of the fat-soluble vitamins.

The Functions of Milk Constituents in Cheesemaking.

Butterfat.—Butterfat imparts mellowness and smoothness to cheese. It is also concerned in the flavour and palatability. Too little butterfat gives a harsh-bodied cheese, while too much fat causes a greasy body.

Butterfat is also one of the main factors contributing to the yield of cheese.

Casein.—Casein makes possible the process of cheesemaking by its peculiar action towards rennet extract. In its coagulation by rennet extract it performs two functions—

(1) It retains the fat globules in the curd and continues to do so throughout the entire process.

(2) It retains some moisture (whey) in the curd while at the same time allowing superfluous whey to escape.

In the finished article the casein serves two important functions :—

(1) It provides firmness of body under a wide range of temperatures.

(2) It is the main source of the protein of cheese and the protein derivatives which are partly responsible for the flavour of cheese.

When the balance between the fat and casein is upset undesirable characteristics occur ; for example, the hardness of body which is evident in skim-milk cheese. Difficulty in cheesemaking results if the casein content of milk is lowered by factors such as drought, mastitis, etc.

Water.—Water has two functions in cheese :—

(1) It imparts a degree of mellowness and smoothness to the cheese, thus supplementing the milk fat in this respect.

(2) It provides a suitable medium in which bacteria and enzymes can change insoluble cheese proteins into soluble forms.

Lactose.—The only apparent function of lactose is to furnish material for making lactic acid. As soon as this lactic acid forms, it combines with salts of the milk (especially insoluble calcium phosphate) to form soluble calcium salts, which perform important functions in cheesemaking. About 90% of the lactose in the milk passes out in the whey at the wheying-off of the vat and 4% to 5% during other stages in manufacture.

There is 0·25% to 0·35% of lactose in the curd at the time of hooping and the formation of lactic acid continues until the cheese is 10–14 days old, by which time all the lactose will have been converted. During the whole process (under normal conditions), there is never enough lactic acid formed to combine with all the available calcium in cheese ; thus there is never free lactic acid in the cheese.

Salts of Milk.—The soluble calcium salts in milk favour the completeness and rapidity of rennet action. The salts in general provide the bases which react with the lactic acid formed and thus they play an important part in the conversion of the curd to cheese.

Colouring Matter and Enzymes.—The yellow pigment carotin, present in the fat in milk, passes into the cheese and imparts its colour to it. The green, water-soluble pigment lactochrome passes out in the whey.

Of the enzymes, galactase and lipase may be thought important owing to the ability of galactase to break down the milk casein and of lipase to cause hydrolysis of butterfat. However, galactase is inhibited by acidity and lipase is destroyed by pasteurisation.

Albumin and Globulin.—These proteins, which are water-soluble, largely pass off in the whey, except for some of the albumin which may be precipitated by pasteurisation. Should excessive albumin pass into the cheese (for example, as a result of too high a pasteurising temperature), undesirable flavours may develop from abnormal ripening.

Cheese Composition and its Relationship to Milk Composition.

The compositional standard for wholemilk cheese is laid down by the Dairy Produce Acts of Queensland as follows :—

" Whole milk cheese shall contain not more than forty parts per centum of water, and the water-free substance shall contain not less than fifty parts per centum of milk fat."

A normal, green cheddar cheese might have the following composition :—

Water 37·0%

Total Solids 63·0% .. .. { Milk Fat .. 33·5%; Proteins .. .. 24·5%; Salt, Ash, Etc. .. 5%

A cheddar cheese when matured might have the following composition :—

Water 33%

Total Solids 67% .. .. { Milk Fat .. 35·5%; Proteins .. .. 26·5%; Salt, Ash, Etc. .. 5%

Differences in cheese composition can be better illustrated by studying the composition of cheese made from milk with differing fat and casein percentages but all containing 63·0% of total solids. The table below represents Queensland results :—

Percentages.

Solids in Cheese.	Fat in Cheese.	Proteins in Cheese.	Fat in the Dry Matter of Cheese.	Ratio Fat : Protein.
63·0	32·5	25·3	51·6	1 : 0·78
63·0	33·5	24·5	53·2	1 : 0·73
63·0	34·5	23·8	54·8	1 : 0·69
63·0	35·5	23·0	56·3	1 : 0·65

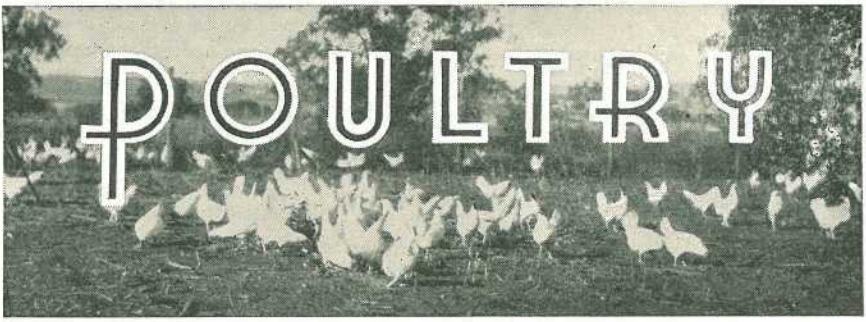
The main constituents of cheese are water, butterfat and casein. The proportion of water to total solids is greatly influenced by the manufacturing methods as well as the composition of the milk, while the proportion of fat to casein in the cheese is largely determined by the proportion of fat to

casein in the milk. The proportion of casein to fat, or the casein/fat ratio, is high in cheese made from milk with a low butterfat content and low in cheese made from high-fat-testing milk of normal composition.

In the case of wholemilk cheese the cheesemaker has to make cheese from the milk as it is received. Thus the proportion of fat to casein in the cheese is dependent on the casein/fat ratio of the milk, but the cheesemaker has it in his power to vary the percentage of fat and casein in the cheese by varying the amount of moisture he allows to remain in the curd. This feature is particularly important in that the cheesemaker must be capable of judging the amount of moisture to be left in the curd, according to the casein/fat ratio of the milk. The significant factor here is what is known as the percentage of moisture in the fat-free-substance of the cheese. A cheese with a high solids-not-fat content is capable of holding (and should contain) a higher amount of moisture than one with a low solids-not-fat content, without detrimentally affecting quality. A milk with a low casein/fat ratio produces a cheese with a low solids-not-fat content; the cheese must be made drier than normal if a weak pasty body (and possibly flavour defects) is to be avoided.

The inadvisability of stating that a cheese should contain a certain percentage of moisture is evident in the light of the above. The 40% moisture content stated in the Dairy Produce Regulations in connection with cheese composition is prescribed purely as a maximum figure.

[TO BE CONTINUED.]



Egg-Shell Quality.

F. N. J. MILNE, Assistant Husbandry Officer, Poultry Branch.

The egg-shell is "nature's wrapping" for a highly nutritious but highly perishable commodity. The better the shell the better the chance of the egg reaching the consumer in a presentable and attractive condition.

Poor shell quality is indirectly responsible for many cracked and broken eggs. As cracked and broken eggs occur daily, the financial loss is not always appreciated by the poultry raiser. Now let us examine the possible annual loss say from a thousand layers producing only 12 dozen eggs per year with eggs running at an average price of 3s. 6d. per dozen. One per cent. broken eggs would mean an annual loss of £21. One per cent. cracked eggs would result in a loss of £10 10s. due to their being down-graded. Unfortunately, the percentage of cracked eggs is generally much higher than 1 per cent.

A single "hair" crack can make all the difference between an egg being graded "first quality hen" and "second quality." Some cracks are unavoidable, but where a number of eggshells are thin and the percentage of cracked eggs high, it is time to take notice of the situation and try to do something about it.

Supply Shell Grit.

A month or so before a pullet comes into lay, it begins to store the materials required for egg production. During this pre-laying period, calcium derived from shell grit or limestone grit is stored as extra bone deposits in the skeleton. The amount of calcium stored is very limited, for it is only sufficient to provide enough calcium carbonate for shells for half-a-dozen eggs. Obviously, a good layer producing say 200 eggs per year will be totally dependent on outside sources for a continuous supply of calcium.

Vitamin D3.

Having plenty of shell grit in front of the birds at all times may not be enough. It may be unattractive, with the result that it is not consumed as freely as necessary for sound shell production. In cases such as this it is necessary to add a calcium supplement to the mash in the form of limestone flour. Now calcium can only be absorbed from the intestine provided vitamin D_3 is also present. Vitamin D_3 is obtained naturally from sunlight or can be given to the flock in the form of cod liver oil or a fish oil emulsion fortified with vitamin D_3. Ultra-violet rays in sunlight convert certain fatty substances in the skin of the fowl into vitamin D_3, so birds kept on the "semi-intensive" or "house and yard" system obtain their requirements from a natural source—sunlight. However, scientists are becoming more and more convinced that even this is not always a satisfactory method of obtaining vitamin D_3. Wet weather keeps the birds indoors and

away from any ultra-violet rays which may penetrate the overcast sky. In hot weather the birds crowd into every bit of shade they can find.

I really think that with flocks kept under semi-intensive conditions, a vitamin D_3 supplement such as cod liver oil or fish oil emulsion fortified with vitamin D_3 would help immensely in maintaining good average shell quality during the year.

Where birds are confined to the laying house—the "intensive system," as it is called—the use of vitamin D_3 supplements is a MUST. There would be very few people running "intensive" poultry farms who would put their trust in that small amount of sunlight entering the laying shed in the early morning to provide sufficient ultra-violet light to produce strong-shelled eggs.

Manganese Important.

Another mineral which is required in very small amounts is manganese. Of all the grains—maize, wheat, sorghum, oats, just to mention a few—maize has by far the lowest content of manganese.

All chick, growing and laying mashes used at the Kairi Regional Experiment Station on the Atherton Tableland contain at least 50% maize-meal and sometimes more. Manganese sulphate is added to these mashes at the rate of 6 oz. to the ton. The shell quality of pullets reared there over the past four years has been consistently and particularly good.

Bran and pollard are rich natural sources of manganese. Sometimes it happens that only limited quantities are available for mixing mashes. Where a mash contains less than 40% bran and/or pollard, the manganese content would be borderline. Commercial-grade manganese sulphate would be less than five shillings per ton of mash.

Age and Climate.

Shell quality is also linked with the age of the birds and climatic conditions.

It may take two months after a pullet has laid its first egg before a good-sized egg of reasonable shell quality and texture is obtained. This is due to the fact that with our tendency towards early-maturing strains, ovarian activity is sometimes ahead of the development of the shell-forming glands of the reproductive system. It is quite common for young pullets to lay a soft-shelled egg or two even though the food factors for production and shell quality cannot be faulted. This should not alarm you.

On the other hand, the sudden onset of a large number of soft-shelled eggs when the birds are well into production is a different matter, which may have as its cause a calcium or vitamin D_3 deficiency or the possibility of disease.

Climatic conditions quickly affect shell quality. During the first spell of hot weather, shell quality deteriorates rapidly. As soon as the birds have become accustomed to the warmer conditions, egg-shell quality improves rapidly. Just why the quality should temporarily fall and then return to normal has not been satisfactorily explained.

INCREASE IN SEXED CHICKS.

Registered chick sexers in Queensland last year sexed 2,699,857 chicks, which exceeded the 1952 figures by 778,581. As roughly half of the chicks sexed are pullets, it means that over 350,000 more pullet chickens were produced by Queensland hatcheries last year than in 1952.

The effect of the increased output from hatcheries is already evident in egg receivals in both southern and central Queensland.

ANIMAL HEALTH

Phosphorus Deficiency in Cattle.

K. M. GRANT, Assistant Director of Veterinary Services.

Phosphorus is an element which occurs in varying amounts in rocks and soils. It is a constituent of such commercial products as rock phosphate, superphosphate, guano and sterilized bonemeal.

It is one of the mineral elements that are essential for plant and animal life. In animals, phosphorus occurs mainly as a constituent of bones and teeth. It is, however, widely spread in the body, being present also in the blood, milk, liver, heart, muscle and brain. Bones represent the main storage depot of both phosphorus and calcium, and these elements are released as required by the animal. If the ration of the animal is inadequate in phosphorus, more has to be released than can be spared and the bones become brittle.

The requirement of phosphorus is closely linked with that of calcium. It is just as important that the intake of these two elements be properly balanced as that both be present in sufficient amounts. Too much of one of them interferes with the absorption of the other. There should be between one and two parts of lime for every part of phosphorus in the feed. Bonemeal contains roughly twice as much lime as phosphorus.

There is no evidence of widespread calcium (lime) deficiency in cattle in Queensland, though lime is lacking in many soils. Unfortunately, some farmers supply lime to cattle when they really need phosphorus, thus making things worse.

Relatively large quantities of iron, aluminium and magnesium in the ration may interfere with the absorption of phosphorus.

SYMPTOMS OF PHOSPHORUS DEFICIENCY.

Evidence of phosphorus deficiency in cattle in Queensland has been seen along the entire coast and in many inland areas.

The trouble is seldom seen in calves in Queensland owing to the natural conditions under which they are normally raised. Where young animals are affected, they show rickets, characterised by stunted growth, deformities of the joints, bending of the leg bones and enlargement of the rib endings. These symptoms may also be shown in cases of calcium and vitamin D deficiency.

In older animals on a phosphorus-deficient diet, the demands of the body for phosphorus are not met by the food and a call is made on the bones.

Large amounts of phosphorus are required for milk production and the formation of the calf, so larger amounts are needed by the high-producing dairy cow than by the beef breeder or the bullock. Steers can often be raised satisfactorily in an area where breeders show advanced phosphorus deficiency.

Affected cattle become stunted and rough-coated. Their bones become soft and fragile. Fractures, especially of the ribs, are common after slight

accidents. Healing of these fractures is slow and a large callus of spongy bone forms around them. The shoulder joints enlarge and cracking sounds are made when they are moved.

The appetite becomes perverted. Bark, tins and bones are chewed. Licking of dirt is common. When chewing bones, the animal carries the head high and thrust forward parallel to the ground. This attitude is so characteristic that it cannot be mistaken even if the bone cannot be seen.

In some cases, rotting carcass material may be eaten, leading to death from botulism.

Abnormal wear and early loss of teeth is shown in phosphorus deficiency, so cattle frequently appear older than they are.

The symptoms vary greatly in severity and in some instances deficiency is shown only by lowered production. The symptoms become more severe during the winter and dry periods as the phosphorus content of the pasture falls.

On post-mortem examination of phosphorus-deficient cattle, the long bones are found to be lighter than normal and in severe cases they can be cut easily with a knife. The extreme lightness of the bones is well shown if the organic matter is boiled or dried out, when the bone will be found to be spongy and only about a quarter of the normal weight of dry bone.

The marrow cavity is much enlarged, while the marrow itself is red and haemorrhagic, due to the disturbance of the blood-forming mechanism.

In early cases the changes are best seen in the ribs. In horses, the bones of the face are much altered, but this is not noticeable in cattle. However, in cattle which have suffered a deficiency of phosphorus during the growing period, the head looks too big for the body.

DIAGNOSIS.

Apart from the symptoms described, analyses of blood, soil and pasture are useful in diagnosing lack of phosphorus. Pasture and soil analyses show only the maximum amount of phosphorus present and not the amount actually being received by the animal.

Blood figures are more reliable, but vary considerably, being higher in young animals and falling with age and pregnancy. However, the blood phosphate level represents a balance between several opposing factors—absorption, excretion, deposition in bones and mobilization. Normal levels do not guarantee a normal state of bone nutrition, and in problem cases analyses over a period should be considered.

As bone is a storage depot for excess phosphorus and the quantity rather than the percentage present varies, bone is not a suitable subject for analyses in the diagnosis of deficiency.

The percentage of phosphorus present in the soil which is available for absorption is very variable, such substances as iron forming complex insoluble compounds with the phosphorus. Some plants take up phosphorus more readily than others and some forms of phosphorus in the plant are not readily available to the animals.

The taking of phosphorus samples, especially for inorganic blood phosphate determinations, requires some technical skill and stock-owners should contact their Stock Inspector or Veterinary Officer for assistance.

RELATIONSHIP TO STERILITY.

Lack of phosphorus in the ration is frequently associated with sterility. In extreme cases, cows may not come on heat for months, but under Queensland conditions this is probably more intimately connected with lack of feed in general than with a specific lack of phosphorus only. It has been noted, however, that sterility has been a problem in much phosphate-deficient country, and where no disease has been present the provision of adequate phosphate has alleviated the condition.

It is important that a competent examination for the presence of specific disease be made before relying on phosphate supplements for the cure of sterility.

In the opinion of the author, vaginitis of cattle is much more likely to cause sterility and its cure is likely to be much more difficult if an adequate supply of phosphorus is not made available.

With improved farming practices, especially the heavy use of lime and the growing of pasture plants such as the ryegrasses, which are high in lime and low in phosphorus, a form of sterility has been noted which is caused by the wide calcium/phosphate ratio rather than by an actual deficiency of phosphate. There is also evidence that too wide a ratio can cause sterile changes in the bull which cannot be overcome by improving the ratio later. This form of sterility is prevalent in New Zealand and England, where extensive use is made of heavily limed ryegrass pastures.

TREATMENT.

Treatment consists of supplying sufficient phosphorus in a digestible form for the needs of the animal.

The phosphorus may be provided through the pasture; stock management practices may be altered to make the available phosphate in the pasture sufficient; or a suitable supplement may be fed direct to the animals.

Topdressing.

Where a satisfactory response of pastures to topdressing with superphosphate is assured, this is the best means of supplying the necessary phosphate to stock. There are, however, limitations to the usefulness of superphosphate on pastures, and advice should be sought before embarking on a programme of topdressing to counter phosphate deficiency.

Management.

A change of management—such as running bullocks instead of breeding stock, moving stock from deficient to better pasture from time to time, or reducing stock numbers—may be sufficient to render the available phosphate adequate. The greatest care is necessary in the winter, when pastures are dry and their phosphate content at its lowest.

Supplementary Feeding.

This is the usual means of supplying additional phosphate in Queensland. Several methods of feeding are adopted.

(1) *Addition to feed.*—Where cattle are hand-fed, the dose of phosphate can be mixed in the feed. This method is very suitable for dairy cattle, but is usually not applicable to the dry cows and heifers. As these cattle usually get the worst paddocks, it is essential that they also receive a supplement.

Dairy cattle on deficient pasture should receive at least two ounces of bonemeal daily, as well as an additional ounce for each gallon of milk produced. With some cows up to eight ounces daily has been necessary to maintain reasonable phosphate reserves during lactation.

(2) *Licks.*—Phosphates, usually mixed with salt, are commonly placed in open troughs in the paddock to which the cattle have free access. The method is convenient and labour-saving, but has the disadvantage that some cattle eat more than they need and others do not eat enough.

A suitable lick is two parts of sterilized bonemeal mixed with one part of stock salt. When the lick is first used, it may be made more attractive by reversing the proportions to give two parts of salt to one of bonemeal.

Some farmers feed boiled bones to provide phosphate. There is nothing to recommend this practice except cheapness, and the value of one bullock lost from a bone jammed in the throat is equivalent to the cost of 30 bags of bonemeal. Moreover, the practice fosters bone chewing and does not supply sufficient phosphate.

(3) *Addition to water supply.*—Where all the drinking water is supplied through troughs, soluble phosphates can be provided through the water supply.

Superphosphate is a ready source of soluble phosphate, but it should be prepared for use by drawing off the soluble parts; otherwise the residues will rapidly corrode metal tanks and troughs, and the fluorine content may prove harmful to teeth and bones. A concentrated solution of phosphate should be prepared by adding superphosphate to water at the rate of 5 lb. of superphosphate to 1 gallon of water. The container is allowed to stand overnight, when the clear liquid is poured into the drinking water. The clear liquid resulting from steeping 5 lb. of superphosphate in 1 gallon of water is sufficient to treat 100 gallons of water.

If a green algal scum develops on the surface of the treated water, a dilute solution of bluestone should be added to destroy the organisms. Half an ounce of bluestone is sufficient to treat 3,000 gallons of water.

(4) *Phosphate-rich feeds.*—Some feeding-stuffs are richer in phosphate than others, and provided they are suitable from the point of view of supply and price, they should be used in preference to feeds of low phosphate content. The following feeds are listed in descending order of phosphate content—meatmeal, cottonseed meal, wheat bran, skim milk (dry basis), linseed meal, soybean meal, brewers' grains, wheat, oats, maize, maize silage (dry basis), good grass hay, clover hay, lucerne hay.

(5) *Injection.*—In extreme cases of deficiency, where drastic measures are required, large amounts of phosphate may be supplied by subcutaneous injection of three ounces of acid sodium phosphate in solution.

(6) *Spoon dosing.*—This is a common method in Africa, but owing to the labour involved it is not suited to Australian conditions. The animals are packed into a crush, the tongue pulled out, and the dose of phosphate placed on the back of the tongue with a wooden spoon. Dosing is carried out every two or three days.

Still More Wool!

2. The Factors which Contribute to Heavy Wool Cuts.

R. E. CHAPMAN and G. R. MOULE, Sheep and Wool Branch.

You all have different ideas about the type of sheep you need. This is partly because few people have shared the same experiences in sheep breeding. It is also because different districts grow different types of wool and may require different types of sheep. Some areas are well suited for fine wool production, others favour the stronger wools.

Very few properties are alike. Some have finer grasses, some have larger paddocks and fewer watering places. Some have more shade, some enjoy a winter rainfall. Some experience long, hot summers. All these differences influence the type and amount of wool that sheep will grow.

The first thing you need is sheep with good constitution, which are able to live and thrive in your district. But living and thriving are not enough. You need sheep which will cut the maximum weight of wool of the best type to grow in your district. You want sheep that will lamb successfully, too. The ewes need to be capable of bringing their lambs through to marking age and you want the weaners to grow well.

Lambing and wool production are the two most important aspects of sheep and wool production. Without successful lambings, you will have little scope for selection for increased wool production.

What Factors Contribute to Wool Weight?

Greasy fleece is made up of clean wool, wax, suint, dirt and vegetable matter. Your clip is bought and sold on the basis of its clean wool content. Therefore it is well to know the factors which contribute to clean scoured weight.

The clean fleece is made up of a large number of individual fibres, each of which has a definite weight, length and thickness. The weight (W) of each fibre depends on its volume (V) and the weight of a unit volume of wool, which we will denote by G.

That is, Weight (W) = Volume (V) $\times$ Weight of unit volume (G).

The volume of each fibre in turn depends on its length (l) and cross sectional area (a). Most wool fibres are round, and can be considered as long, thin rods (Fig. 1).

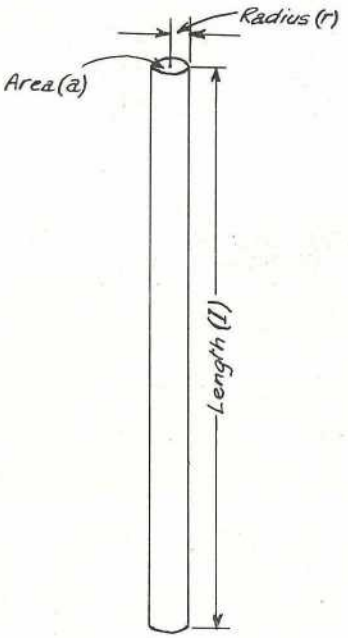


Fig. 1.

Representing a Wool Fibre as a Thin Rod of Length l, Radius r, and Cross sectional area a.

So we can write—

Volume (V) = Length (l) × Cross sectional area (a).

Hence, Weight (W) = Length (l) × Cross sectional area (a) × Weight of unit volume (G).

From your schooldays you may remember that the area of a circle equals π (pi) times the square of its radius (r) or half its diameter.

That is, Cross sectional area (a) = π radius $(r)^2$.

This gives Weight (W) = Length (l) × π radius $(r)^2$ × Weight of a unit volume (G).

Since the weight of the whole fleece (Wt) depends on the average weight of each individual fibre (W) and the total number of fibres (N), we can write—

Weight of whole fleece (Wt) = Weight of each fibre (W) × Total number of fibres (N)

= Length (l) × π radius $(r)^2$ × Weight of unit volume of wool (G) × Total number of fibres (N).

The total number of fibres, in turn, depends on the number of fibres per square inch (n), sometimes referred to as density, and the total area of skin growing wool (A).

That is, Total number of fibres (N) = Number of fibres per square inch (n) × Total area of the wool-growing skin (A)

Hence we find the formula $Wt = l \pi r^2 G n A$ gives a fair indication of the factors which influence total wool weight.

There is some variation in the relation between staple length and fibre length due to different crimpings. However, fibre length (l) is usually about 1·4 times staple length (L). Therefore the formula for fleece weight now becomes

$$W = 1{\cdot}4\ L\ \pi\ r^2\ G\ n\ A.$$

π and 1·4 are constant. The weight of a unit volume of wool (G) hardly varies from fibre to fibre or from sheep to sheep. So you can regard G as constant. This means that the clean wool weight depends on staple length (L), the square of half the fibre thickness $(r)^2$, the number of fibres per square inch (n) and the total surface area (A).

The extent to which these factors may influence the clean scoured cut of a sheep is shown in Table 1. This has been computed for a ram with a wool-growing area of 12 sq. ft. and a clean scoured yield of 60%.

TABLE 1.

SHOWING THE INFLUENCE OF VARIOUS FLEECE CHARACTERS ON CLEAN WOOL WEIGHT.

Skin Area = 12 sq. ft.

Staple Length (inches).	Average Fibre Thickness (microns).	Average No. of Fibres Per Square Inch of Skin.	Greasy Fleece Weight (lb.).	Percentage Yield.	Clean Scoured Wool Weight. (lb.)
3½	21 (= 64's)	30,000	10·3	60	6·2
3½	21	50,000	17·2	60	10·3
4	21	30,000	11·8	60	7·1
3½	23 (= 60's)	30,000	11·8	60	7·1
3½	23	50,000	20·0	60	12·0

$$1 \text{ micron} = \frac{1}{25{,}400} \text{ inch.}$$

(After Bonsma)

From this table you see that increased fleece weight can be obtained from a longer staple length, a larger fibre thickness or a greater number of fibres per square inch of skin. As well as these there is the effect of increased skin surface area, which is linked with increased size and body weight. Of course, there are breed limits to all these characters. And again, there are the environmental limits.

Many of you favour a certain type of wool as being suitable to your country. This will largely determine the fibre thickness. Therefore, to increase wool weight you should select for:—

(1) Longer staple length.

(2) Greater number of fibres per square inch of skin.

(3) Larger skin area.

This does not mean you should select wrinkly sheep in order to get larger skin area. The old catch cry, "Development for density," has been proved wrong. Sheep with more wrinkly skins frequently have fewer fibres per square inch than those with plain skins. So you would be well advised to choose sheep with soft, free skins that do not carry excessive wrinkle.

The Beef Cattle of the Central Highlands.

J. J. SULLIVAN, Cattle Husbandry Branch.

The total beef cattle population of the Central Highlands Region is approximately half a million (see Table 1), an increase of approximately one-third over the last decade at the expense of sheep numbers. There has been a progressive invasion by cattle of the heavy-carrying downs country of the Rolleston-Springsure, Emerald, Clermont and Capella areas on the one hand, and of the desert and semi-desert country of the Alpha-Jericho areas on the other hand, which has displaced sheep from hundreds of thousands of acres. Another factor influencing the increase in numbers is the general overall improvement in water distribution on cattle properties brought about by the use of earth-moving machinery in excavating earth tanks. The degree of this influence is hard to gauge, but that it does act to an appreciable extent is evident by comparing the losses during drought years on poorly watered properties with those where the cattle have improved watering facilities.

Generally speaking, the building up of the numbers of cattle has been accompanied by an improved herd standard, this being most noticeable as regards uniformity. This improvement has been brought about by improved cattle husbandry methods, principally on the breeding side, the first big forward step being the elimination of "mickies" and following a general herd improvement programme by the provision of good bulls and judicious speying.

TABLE 1.

BEEF CATTLE POPULATION OF THE CENTRAL HIGHLANDS, MARCH, 1953.

Shire.	Area.	Cattle.
	Sq. miles.	
Bauhinia	9,720	159,951
Belyando	11,490	147,152
Emerald	4,510	79,826
Peak Downs	3,150	48,155
Jericho (part)	5,600	61,090
	34,470	496,174

BREEDS REPRESENTED.

The foundation herds of the Central Highlands were of Shorthorn and Shorthorn-Devon blood; some time later Hereford blood was introduced. Of late years, Aberdeen-Angus cattle have gained some favour and a few cattlemen have introduced Zebu blood into their herds. Many of the older generation of cattlemen were firm believers in the practice of crossing the Shorthorn and Hereford. It became the popular thing to introduce Hereford bulls into the Shorthorn herd, and the immediate response brought about by hybrid vigour was naturally appreciated. After some years the adverse effects of cross-breeding—lack of uniformity, undesirable colours and other characters—became evident. Some cattlemen met the situation by embarking on what they regarded as a judicious alternation in the use of Shorthorn and Hereford bulls in the herds; others decided that they would improve along pure breed lines, having in view the building up of a good Shorthorn or Hereford herd. At first the Shorthorn was favoured and some very good Shorthorn stud herds became established in the region. The bulls from these herds played a big part in the general improvement. Later, good Hereford bulls became easier to obtain.

Plate 1.

Hereford Steers in the Gindie District.

As time went on there developed a concentration on Herefords in the southern part of the region at the expense of the Shorthorn, and in the northern part the reverse took place. This is an interesting phenomenon in that, off the coastal belt, all the country north of the Central Railway is Shorthorn country, while to the south of this line the Hereford definitely predominates.

In the Springsure-Rolleston areas there is a good southern demand for store cattle, and this demand is greatly in favour of the Hereford. Thus, when due to seasonal conditions it was desired to sell cattle as stores the Herefords sold more readily and at higher prices than the Shorthorns.

In the Clermont-Belyando area the coastal demand for stores has not been sufficient in the past to exert any great influence, and there was at the back door of this area a reservoir of Shorthorn cattle upon which it was found profitable to draw as the need arose.

Again, it is generally conceded that the Hereford is better suited to the Springsure-Rolleston environment, while it is believed that the Herefords tend to become wild and "run-out" on the generally bigger northern areas where control of herds is not so good.

Recently the Poll Hereford has gained in popularity, and there is a big demand for bulls of this breed. The same trend, though possibly to a lesser extent, is seen in the case of the Shorthorn, and the more progressive cattle breeders are convinced that the advantages of the polled beast, principally higher grading on the meat floor and reduced losses from bruising, far outweigh the disadvantages.

HERD COMPOSITION AND CLASSIFICATION.

In attempting an assessment of herd composition and classification on breeding and fattening properties in the Central Highlands, one is faced with all the variables operating in this region. They are such that the herd is in a state of flux from year to year, and there is a lack of data which prevents the compilation of accurate figures. The main factors operating against a balanced or stable herd are as follows:—

(*a*) The region is situated between the relatively cheap pool of cattle from the northern breeding area and the dearer coastal market. Practically all graziers at some time or other take advantage of this, and there is a steady stream of store cattle moving through the area from north to south, which to some extent is supplementary to breeding or to breeding and fattening. These introductions are a factor which throws the herd out of balance, and the resultant figures of the herd components do not give a true picture of the industry from the breeding and fattening angles.

(*b*) Generally no owner or manager of a property would know within 10–15% the correct number of cattle of any category in his herd.

(*c*) No systematic herd records are kept. Generally all herd figures are compiled from estimates the correctness or otherwise of which varies according to the standard of management and the degree of herd control.

(*d*) The management of the breeding herd makes the keeping of accurate records extremely difficult if not impossible.

(*e*) Generally there is no attempt to run a herd on a balanced basis. Almost invariably the number of breeders is greater than the capacity of the property. The main preoccupation is to build up the herd numbers in favourable seasons having in mind the inevitable lean years; there is safety in the knowledge that when the pressure of numbers become too great there will be a favourable market on which to unload.

Under these conditions it is inevitable that herd figures become subject to margins of error. That gross errors exist has been revealed by bang-tail musters following sales of properties. In the case of one large property which changed hands within recent years the number

of fattening age bullocks shown on the books was 3,200, an error of approximately 19%, as the actual number was found to be in the vicinity of 3,800. On a smaller property sold later, the book number of the herd was 2,000, but the bang-tail muster revealed the number as approximately 3,200, a margin of error of 60%. Many other cases of a similar nature could be quoted.

Despite the factors mentioned it may be instructive to consider the herd dissection on the following properties which are typical of those found in the region. As the influences operating are common throughout the region they will be as close to "average typical figures" as it is possible to get.

Property No. 1.

This property which is a Pastoral Development Holding, has an area of a little over 400 square miles, being typical of the larger properties in the Central Highlands.

The country consists of frontage, tableland, open gidyea, coolibah, brigalow, box, sandalwood, narrow-leaf and silver-leaf ironbark, wilga and yellowwood. There is a mixture of soils, red, black, grey, sandy and gravelly. The run goes back into rough mountainous country. The grasses are Mitchell, blue, Flinders, sago and other soft grasses, and the rougher country grows kangaroo, wire, spear and other coarse species. The frontage country grows good herbage in season. The carrying capacity is rated at about a beast to 30 acres.

The herd is of good-quality Shorthorns, founded on Shorthorn-Devon cross blood. Polled bulls have been used in this herd since 1936, and at least 75% of the herd is polled.

All the following herd figures presented are the book herd figures as shown in January, 1952:—

Females.

No. 1's (born 1951)	1,200	
0	1,000	
9	880	
8 (and older)	2,250	
Speyed cows	880	
Total	6,210	

Males.

No. 1's	1,200	
0	1,000	
9	900	
8 (including 340 purchased)	1,000	
Total	4,100	
Bulls	90	
Total Herd		10,400

The nominal number of breeders is 4,000.

The nominal average turn-off of fat bullocks is given as 90% of the male branding, the average age is 5 years, and the fats are usually sent off in July–August. The estimated average dressed weight is 680–700 lb. with an approximate range of 650–800 lb. The average weight of the speyed cows is 550 lb.

Property No. 2.

This has been taken as being representative of a typical "family unit" property. It has an area of 58 sq. miles; generally the country is similar to that described in property No. 1, but there is more scrub on the latter. The carrying capacity is approximately a beast to 17 acres.

The property carries a good quality Shorthorn herd, about 85% polled and like most Shorthorn herds in the region with Devon blood in its ancestry.

Breeder's Mob.

Breeders (nominal)	250	
Heifers (some breeding)	150	
Calves (branded and unbranded)	200	
Bulls	8	
	608	
Bullocks (No. 8's and 9's)	100	
Steers (No. 0's and 1's)	120	
Speyed cows (fattening)	90	
Culled females (to be speyed)	90	
Total herd		1,008

Some explanation of these figures is necessary. The number of calves indicates that the actual number of breeders would be in the vicinity of 300. The numbers of bullocks and steers, which are only about half of what one would expect, are the result of seasonal conditions (drought followed by floods) and unusual losses among young cattle caused by tick fever. At the beginning of the drought this herd numbered about 1,300. No speying was done during the drought years, and following the return of normal seasons the owner cut deeply into his herd to get rid of the undesirables.

CALVINGS, WASTAGE AND TURN-OFF.

The factors as set out previously operate to prevent anything like an overall assessment of herd percentages with a high degree of accuracy, so they are to a degree a matter of speculation.

The calving percentage is based on the branding figures, and pre-branding mortality is unknown, but drought and dingoes do take their toll, and any figures would have to be considered in the light of the seasonal conditions obtaining at the time, and the incidence of tick fever.

Notwithstanding all this, experience has shown that taken over a sufficient length of time, say 10 years, certain arbitrary figures of the percentage of herd profit and loss have in the past shown a surprising degree of accuracy. These annual figures are:—

Natural increase	66⅔%
Wastage among breeders	10%
Wastage among other components	2½%
Turn-off of fats	14%