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Stocking rate and rate of superphosphate in a higher rainfall area

Cover Page Footnote
Sincere appreciation and thanks are recorded for the help of the Directors of Twitcham Farm Co., Mr. Clive Napier, Manager, stockmen and all staff of the farm. This trial would not have been possible without their wholehearted co-operation and assistance with land and stock. The members of the Forest Hill Pasture Improvement Group are again thanked for erecting the fencing of this trial. The technical assistance of Field Technician L. F. McKay in all phases of the trial has been an important contribution to the experiment. The trial is conducted by officers of the Wheat and Sheep and Plant Research Divisions of the Department of Agriculture.
Stocking Rate and Rate of Superphosphate in a Higher Rainfall Area

By P. P. Mann, B. J. Gorddard, R. N. Glencross and E. N. Fitzpatrick

This trial is located on a private property 18 miles west of Mt. Barker. Annual average rainfall is 30 inches and the area experiences a reliable winter growing season of about eight months.

In its virgin state the area carried a forest association of red-gum and jarrah, and the soils are typical of large areas in the south-west of Western Australia. Two main soil types can be distinguished (a) those with gravel at the surface, and (b) those with a sandy surface overlying gravel. Both overlie clay at depths ranging from 6 inches to 3 feet, and both are represented on the trial site.

These gravelly soils have a high requirement for phosphate during their first years under pasture, and this trial was designed to investigate the relationship between rate of phosphate, stocking rate and pasture production over a number of seasons.

The Trial

The trial area was sown to subterranean clover (Mt. Barker and Yarloop strains) and Wimmera rye grass in 1958 and was in its 6th year when the trial started in 1963. During this period it had received about 10 cwt. of superphosphate per acre.

In 1962 the area was boundary fenced, and stocked continuously at 5 sheep per acre from mid June 1962 until late May, 1963.

In May, 1963, the area was divided into 18 paddocks of varying size, each carrying six sheep. The treatments are the combinations of three stocking rates and three superphosphate rates:

Superphosphate:
- 112 lb. per acre per year.
- 224 lb. per acre per year.
- 336 lb. per acre per year.

Grazing Intensities:
- 4 sheep per acre.
- 5 sheep per acre.
- 6 sheep per acre.

There are two replications, giving 18 plots in all.

Trace element applications have been copper and zinc at standard rates in 1958 and 1964, and molybdenum at the standard rate in 1963.

Management

The trial sheep have been strictly set stocked since May, 1963, when they were allocated to the plots on the basis of equal body weights—not fleece weight.

It has not been necessary to drench the sheep to control worms. Periodic worm-egg counts have been made to keep the situation under observation. No supplementary feed has been given at any time. The sheep are inoculated against enterotoxaemia each year after shearing.

RESULTS

Wool Production
With three shearings completed, the trial has demonstrated that:

- Stocking rate has not adversely affected wool cut per head.
- Inadequate superphosphate at the higher stocking rates (5 and 6 sheep per acre) has resulted in lower wool cuts per head. This suggests a shortage of pasture at the 1 cwt. per acre level—a fact which has been confirmed by the body weight and pasture studies. However, at 2 and 3 cwt. of superphosphate per acre the sheep at 5 and 6 per acre have cut the most wool per head and per acre.
- The wool has been notably free from tenderness. Only three tender fleeces have been recorded in three years; these were from sheep affected by sheath rot and blowflies.
- Wool quality has remained constant and has been uniformly good on all treatments. Samples from each fleece are tested annually by the Department of Agriculture Fleece Measurement Laboratory. The sheep (May, 1960, drop) are now more than 6 years old, yet wool quality has been maintained and there was no marked deterioration at the 1966 shearing.
- Seed Fault: At the 1965 and 1966 shearings, wool from the grass-dominant plots showed seed fault.

The sheep were shorn on April 14, 1964, March, 30 1965 and April 1, 1966.

In Table 1, fleece weights (greasy) represent the unskirted fleece + belly. Crutchings are not included. They averaged ½ lb. per head in 1964, and ¾ lb. per head in 1965 and 1966.

This experiment is on the property of the Twitcham Farm Co., 18 miles west of Mt. Barker. Annual average rainfall is 30 in. and the winter growing season is about eight months. The soils are gravelly and sandy soils overlying clay and are typical of big areas of jarrah/red-gum country in the South-West. The pasture is based on Mr. Barker and Yarloop subterranean clovers and Wimmera ryegrass, and was sown in 1958.

Six wethers an acre have been carried without hand feeding, producing up to 80 lb. of wool an acre. At high stocking rates, production has increased with increased annual rates of superphosphate application.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Wool per head (lb. greasy)</th>
<th>Wool per acre (lb. greasy)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4/acre : 1 cwt. super</td>
<td>11.9</td>
<td>11.7</td>
</tr>
<tr>
<td>4/acre : 2 cwt. super</td>
<td>11.6</td>
<td>11.7</td>
</tr>
<tr>
<td>4/acre : 3 cwt. super</td>
<td>12.6</td>
<td>13.1</td>
</tr>
<tr>
<td>5/acre : 1 cwt. super</td>
<td>11.1</td>
<td>11.3</td>
</tr>
<tr>
<td>5/acre : 2 cwt. super</td>
<td>12.4</td>
<td>12.8</td>
</tr>
<tr>
<td>5/acre : 3 cwt. super</td>
<td>12.4</td>
<td>12.1</td>
</tr>
<tr>
<td>6/acre : 1 cwt. super</td>
<td>11.1</td>
<td>11.0</td>
</tr>
<tr>
<td>6/acre : 2 cwt. super</td>
<td>12.2</td>
<td>12.9</td>
</tr>
<tr>
<td>6/acre : 3 cwt. super</td>
<td>12.1</td>
<td>12.3</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>11.9</strong></td>
<td><strong>12.1</strong></td>
</tr>
</tbody>
</table>
Pasture Production

In winter, pastures have been very short and growth of pasture at 6 sheep per acre has not been sufficient to maintain or increase sheep body weights, even at higher rates of superphosphate; wethers at 4 and 5 per acre have gained weight rapidly during winter, with greater gains at each rate of superphosphate.

Early spring pasture outgrows sheep needs at all stocking rates and body weight gains are rapid, narrowing the winter differences due to both stocking rate and superphosphate rate.

Large pasture growth increases result from all increases in rate of superphosphate during early spring under grazed or ungrazed conditions.

Late spring feed has been even more abundant. Differences due to superphosphate are smaller and the effect of stocking rate is less, so that under these conditions, there is little difference in pasture production between rates of stocking and superphosphate in late spring. However, the feed available at the end of the growing season, for about a four month summer period, ranged from 3,000 to 5,000 lb. per acre.

Pastures were understocked, and at germination in the following seasons, 1,600 to 3,300 lb. per acre of dead material remained.

Pasture Composition

Dramatic changes in pasture composition have taken place. The position after three seasons is summarised in Table 2.

The results in Table 2 indicate that grass-clover balance of a pasture can be altered by different combinations of superphosphate rate and stocking rate until such time as an adequate soil phosphate bank has been built up. The total bank of superphosphate applied will determine how quickly these changes can be induced. As the superphosphate bank increases beyond 20 cwt, stocking rate becomes more important than rate of phosphate in determining pasture composition.

Pasture Quality

Feed quantity and quality are both important in pasture utilisation. The amount of feed produced and accessible in winter months is very important to animal growth, whereas in late spring and summer quality becomes more significant for animal nutrition.

The graph compares the body weights of sheep stocked at 4 and 6 per acre on plots topdressed with 2 cwt. of superphosphate annually over three seasons. In 1963 the sheep at 4 per acre were heavier throughout the first year. Pasture composition differences do not show up until 1964. At the 1964 shearing the sheep stocked at 4 per acre cut 12.2 lb. of wool per head. At 6 per acre production was 12.6 lb. per head.

The autumn of 1964 was affected by a "false break"—when the true opening rains did not arrive until June. The lower stocking rates withstood this period well, whereas at 6 per acre the sheep lost weight until July. The lowest average weight of this group was 110 lb. In this instance feed quantity limited sheep growth.

<table>
<thead>
<tr>
<th>Rate of Superphosphate cwt./acre</th>
<th>Stocking Rate (sheep/acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4</td>
</tr>
<tr>
<td>1</td>
<td>Balanced</td>
</tr>
<tr>
<td>2</td>
<td>Grass dominant</td>
</tr>
<tr>
<td>3</td>
<td>Very grassy pasture</td>
</tr>
</tbody>
</table>

Ripgut brome and silver grass are the main grasses present.

Table 2.—Pasture composition, spring, 1965

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No supplementary feed was given during this period. However, once the pasture got away the sheep at 6 per acre made a compensatory gain, and caught up with those stocked at 4 per acre in November.

During this period pasture composition differences began to exert a strong influence upon the relative weight changes. By October, 1964, the 4 per acre plot had become very grassy and the sheep started to lose weight as soon as this pasture matured. The 6 per acre sheep continued to gain weight into December, and remained in much better condition throughout the summer, presumably because of their clover-dominant dry feed. This is more easily digested and better in quality than the grass dominant feed available at low stocking rates.

At the 1965 shearing the wool from the grassy 4 per acre plot showed seed fault. Wool weights per head were 12.3 lb. at 4 per acre and 12.6 lb. at 6 per acre.

The autumn of 1965 was excellent, with early opening rains, and both groups gained weight until late August. The body weights of all sheep followed an erratic pattern in the spring flush of 1965. All sheep were affected. The 4 sheep per acre group actually lost weight during the second half of October (a very wet month) on what was, by this time, a rank grass-dominant pasture. The sheep at 6 per acre continued to gain weight, but they also suffered a slight check in late October. Neither worms nor cobalt deficiency were implicated in this check to growth, which occurred in varying degrees on all plots.

Once again the sheep at 6 per acre maintained their condition better during the summer months because of the better quality feed available to them.

At the 1966 shearing wool cut per head was 12.3 lb. at 4 per acre and 13.9 lb. at 6 per acre.

Superphosphate

The gravelly soils of this area have the ability to "fix" phosphate in a form unavailable to pasture plants, and this has retarded the development of considerable areas in the high rainfall timber zone.

These soils require heavy rates of superphosphate in the virgin state, and, if stock are available to eat the feed produced, half a ton of super should be applied over as short a period as possible.

The trial has confirmed that if less than 20 cwt. have been applied, topdressing at the rate of less than 1 bag (180 lb.) per acre will severely reduce pasture production. Low superphosphate rates can also
cause severe shortages of winter feed, especially in years with a false break of season, when many seedlings die.

In this experiment pasture production and sheep body weights generally increased with increasing rates per superphosphate up to 3 cwt. per acre, although there were variations with season of the year and stocking intensity. Wool production did not increase when superphosphate application was increased beyond 2 cwt. per acre.

Obviously, pasture and animal responses to increased superphosphate under continuous grazing are very complex. However, from the results of this trial it is safe to say that if pasture is not fully utilised, superphosphate rates on old land can be lowered.

The total available phosphate—the total of the phosphate supplied from soil reserves plus the annual rate of application—has also been shown to influence pasture composition on these soils, so that the balance of these pastures is determined...
by both available phosphate and stocking rate.

The total superphosphate "bank" on the experimental plots, after the 1966 top-dressing is:

<table>
<thead>
<tr>
<th>Annual application</th>
<th>total &quot;bank&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 cwt. per acre</td>
<td>14 cwt. per acre</td>
</tr>
<tr>
<td>2 cwt. per acre</td>
<td>18 cwt. per acre</td>
</tr>
<tr>
<td>3 cwt. per acre</td>
<td>22 cwt. per acre</td>
</tr>
</tbody>
</table>

SUMMARY and DISCUSSION

This trial has contributed much to our knowledge of stock and pasture management in the higher rainfall areas.

- The high potential carrying capacity of pastures in this area has been confirmed. It will be necessary to continue this trial at still higher stocking rates to determine the best economic carrying capacity, and to define the "crash-point" for these pastures.

- Wool quality and quantity per head have been maintained with wethers set-stocked at above district average rates.

- The importance of plentiful superphosphate for both pasture and stock production has been emphasised. This can be summarised as follows:

VIRGIN SOILS: Pastures on these soils become clover-dominant because of their naturally low levels of phosphate and nitrogen. Under these conditions, grasses cannot become a major pasture component and until both phosphate and nitrogen are freely available the pastures will remain clover-dominant.

We therefore recommend that 10 cwt. of superphosphate be applied as quickly as possible, consistent with stock availability and requirements.

WHERE "SUPER-BANK" is 10-20 CWT. PER ACRE: Superphosphate should be applied at not less than one bag (180 lb.) per acre per year. Higher rates of application will not be profitable in terms of animal production at the stocking rates used in this trial. However, if a property has been sown to an oestrogenically potent strain of subterranean clover and breeding is a problem, the use of higher rates will be desirable to increase the grass component of the ewe pastures, and dilute their clover content. In this situation, the dry sheep and cattle can be grazed on the clover-dominant parts of the property which can be topdressed at a lower rate of super. During the summer, ewes and weaners can be grazed on the "safe" high quality dry clover.

In this manner, capital outlay on superphosphate remains constant, but its distribution over the farm is changed to obtain control over pasture composition.

WHERE "SUPER-BANK" EXCEEDS 20 CWT. PER ACRE: In this case, it is most unlikely that a pure clover pasture will be maintained, irrespective of stocking rate. However, on the heavy gravels, where high stocking rates are used, grass may not become the dominant species until about 25 cwt. of superphosphate has been applied. More information is needed on the residual value of superphosphate on these soils. The evidence we have suggests that, even on very old pastures, pasture growth is depressed if the annual dressing is below 180 lb. per acre. It is therefore advisable to maintain this rate of application wherever pastures are being stocked to capacity. At lower stocking rates, the rate of superphosphate application can be reduced to avoid grass dominance.

- The trial has defined the periods of feed shortage and excess as reflected in the body weight changes of wethers. The critical period of feed shortage occurs after the break of season. If there is a false start to the season, or the opening rains are delayed, this period can extend until the end of July.

- Peak body weights are reached at the end of spring on good quality pastures, but earlier on poor quality grass dominant pastures.

- As the trial has defined the pattern of seasonal feed availability over a range of stocking rates, the results should help farmers to plan management procedures such as times of mating, lambing, weaning and shearing.
ACKNOWLEDGMENTS

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