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**Cover Page Footnote**

The trials are a joint project between regional advisers of the Wheat and Sheep Division and the author. The following farmers on whose properties the trials are located are thanked for their co-operation: Messrs. A. S. Ward, R. Charsley, P. Lloyd, I. Weiss, H. Perkins, E. Butcher, E. Richards and Sons, A. Rodgers, J. Rodgers, E. Jacobs and E. Gooch. Mr. G. Mason and Mr. R. Parrick are thanked for their assistance with the field work. The trials are financed by the State Wheat Research Committee.

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MAINTENANCE PHOSPHORUS AND SULPHUR FOR PASTURES

Progress report

By W. J. COX, B.Sc. (Agric.), Research Officer, Plant Research Division

PASTURE IMPROVEMENT has been based on topdressing with superphosphate, which supplies sulphur as well as phosphorus. In the past, all the benefit due to superphosphate was attributed to the phosphorus. It is only in recent years that the importance of the sulphur has been appreciated.

We have seen that where the phosphorus levels of the soil have been built up the rates of superphosphate applied can be reduced. The higher cost of farming in recent years has made many farmers wonder whether they need to continue to apply superphosphate at the present high rates. They have thought that perhaps the money they are spending on superphosphate could be better spent on other farm improvement programmes.

In reducing superphosphate dressings, a number of factors have to be considered. If levels are reduced too far then soil fertility will drop and pasture production will decline as well. On the other hand, if luxury amounts of superphosphate are applied, the farmer will be using his funds inefficiently and other farm programmes will suffer.

What is required is the lowest superphosphate dressing which will give the greatest economic return. This dressing is known as the maintenance superphosphate dressing, i.e., it replaces the natural losses of phosphorus due to leaching, erosion and removal in agricultural products, and maintains pasture production.

At these low rates of superphosphate the amount of sulphur applied may be inadequate, particularly as sulphur leaches much more readily than phosphorus.

With this in mind, a series of maintenance phosphorus and sulphur trials was established throughout the wheatbelt, on a range of soil types with high superphosphate histories. The trials use individually grazed plots and aim to find:

- The rates of phosphorus and sulphur needed to maintain pasture growth on old land.
- The best ratio of gypsum and phosphate fertiliser to maintain pasture growth.

Treatments

There are ten treatments; five rates of phosphorus with adequate sulphur as gypsum, and five rates of sulphur with adequate phosphorus as "double" superphosphate. There are two or three replications at each site.

The plots are topdressed in the middle of March each year and grazed by one sheep per plot or 7.1 sheep per acre from four weeks after germination till late spring when food and/or moisture become limiting. The plots are cropped one year in five.
Results

Effects on soil, pasture and animals are measured in trials at research stations. Trials on farms measure only the effects on soil and pasture.

Soil fertility changes

Results to date indicate that, on all soils, the no-phosphorus no-sulphur treatments lowered soil fertility while the highest phosphorus-sulphur rates increased soil fertility. Depending on soil type various intermediate rates maintained fertility.

Pasture changes

On old heavy land no change in pasture production was observed with the different treatments.

On old light and medium land the changes are quite remarkable, particularly in relation to the rate of sulphur applied as gypsum. In the presence of adequate phosphorus there was a response up to 35 lb. per acre of gypsum at Avondale Research Station. Cuts from the pasture cages indicated that the no-sulphur plots yielded 28.7 cwt. per acre while the 35 lb. per acre gypsum plots yielded 41.2 cwt. per acre.

The symptoms of sulphur deficiency are often confused with those of nitrogen or molybdenum deficiency. In the case of Dwalganup or Geraldton sub. clover the following symptoms of sulphur were seen:

Root nodules

Large branched and pinkish nodules were associated with plants receiving sulphur while untreated plants had small scattered unbranched nodules with greenish pigmentation near the base of the nodule.

Leaves

Leaf symptoms appeared eight to ten weeks after germination. The leaves of affected plants showed a pale yellow-green chlorosis in the early stages, which subsequently changed to lemon yellow. They were affected uniformly over their entire surface. Commonly associated with this symptom was a bright red anthocyanin coloration along the leaf veins. A few weeks after the initial change in leaf colour, necrosis set in, commencing at the margins, and rapidly enveloping the whole leaf. There was a distinct yellowness in sulphur deficient leaves but leaf size and leaf shape were apparently unaffected.

Petioles and stems

Petioles and stems were heavily pigmented and brownish red compared with the normal green which becomes only partly obscured by a light reddish brown pigmentation with age.

Animal changes

The four trials on Avondale, Chapman, Newdegate and Wongan Hills Research Stations are stocked with weighed shorn sheep in the first week of July each year. In late September the sheep are removed from the plots, weighed again, and shorn. This gives the body weight gain and wool production resulting from each treatment. The results from Avondale Research

Table 1.—Effect of sulphur as gypsum on body weight gain—1967

<table>
<thead>
<tr>
<th>Treatment (lb./acre)</th>
<th>July (lb./animal)</th>
<th>October (lb./animal)</th>
<th>Body wt. gain (lb./animal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gypsum Nil</td>
<td>59.7</td>
<td>60.0</td>
<td>12.9</td>
</tr>
<tr>
<td>Gypsum 15</td>
<td>60.0</td>
<td>75.6</td>
<td>15.6</td>
</tr>
<tr>
<td>Gypsum 35</td>
<td>60.0</td>
<td>81.0</td>
<td>21.0</td>
</tr>
<tr>
<td>Gypsum 55</td>
<td>59.0</td>
<td>81.0</td>
<td>22.0</td>
</tr>
<tr>
<td>Gypsum 75</td>
<td>58.7</td>
<td>81.0</td>
<td>21.9</td>
</tr>
</tbody>
</table>

To determine the maintenance requirements of pastures for phosphorus and sulphur, 16 trials have been begun throughout the wheat belt since 1966.

Early results point to soil type being important in determining maintenance requirements. Pastures on old light and medium soil types showed a response to sulphur (as gypsum) if superphosphate topdressing was missed more than one year, or if 'double' superphosphate was used. Pastures on old land with heavy textured soils showed no response to sulphur after two years without superphosphate application.
Station for 1967 are shown in Table 1. Over this short period there was no response in wool production to increasing rates of gypsum.

The gains in bodyweight could be due either to increased feed intake or to differences in feed quality.

Conclusions and recommendations
- On old light and medium land, annual topdressing of pastures with superphosphate is recommended.
- On old heavy land there was no effect on pasture production when the pasture was not topdressed for two consecutive years.
- "Double" superphosphate should not be used for topdressing pasture, except on old heavy land.
- Gypsum is no substitute for superphosphate where both phosphorus and sulphur are required.

ACKNOWLEDGMENTS

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