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H G. Neil

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A Survey of the
INCIDENCE OF "LUPINOSIS" IN SHEEP
in the
Dandaragan District in 1959

By H. G. NEIL, W. J. TOMS and C. M. RALPH

FOLLOWING widespread losses of sheep grazing on dry lupins, a survey of flockowners' experience with the disease was made by the Department of Agriculture in one of the districts most affected.

The idea of a survey originated from discussions with the President, Mr. K. E. Jones, and several other members of the Dandaragan Pasture Improvement Group.

The information obtained from the survey has provided a valuable factual basis for the design of laboratory and field experiments.

Lupinosis has been described by Bennetts (1). It is a chronic disease characterised by a rapid loss of condition, dullness, loss of appetite, jaundice and a degree of sensitivity to light, accompanied by a rapid breakdown in liver tissue. The liver is usually pale in colour, very firm in texture, much smaller than normal, and with thin edges.

Deaths may occur within a week after sheep are placed on lupins, but usually do not occur for four to five weeks. Affected

Fig. 1—An area of lupins at the green stage

565
The shaded area shows roughly the extent of the survey.

The rectangular area is the portion shown in Map 1.

Fig. 2—Map showing area in which the survey was conducted
sheep often recover, but do so over a period of some weeks.

Lupinosis must not be confused with lupin alkaloid poisoning. The latter is characterised by an excitement, especially if the sheep are disturbed, followed by a convulsive fit. This condition is rarely fatal, and the sheep usually recover in ten minutes or so, if undisturbed.

HISTORY OF SHEEP GRAZING PRACTICE IN THE DANDARAGAN DISTRICT

Three changes in grazing practice have occurred in the district since sheep were first grazed on lupins.

(1) In the early 1920s to the late 1930s sheep were purchased for fattening but were held for only short periods. Lupins were grown solely for summer grazing. Sheep fattened rapidly on the shed lupin seed. After the lupin pods had shed their seed in November there was a rapid turnover of stock on most farms in the district. Sheep were generally not kept longer than a month and were carried on lupin land at the rate of four to five sheep per acre.

(2) In the late 1930s the practice of rapid turnover of stock largely disappeared. This change was probably brought about by the reduced supply of suitable sheep from the outer wheat belt during the summer months. Sheep for grazing in the Dandaragan district were now purchased in spring and often were held until autumn before being sold.

(3) Recently, commencing in the early 1950s, many sheep owners in the district have sown subterranean clover and thereby have been able to carry a permanent flock of breeding stock as well as sheep bought for fattening over the summer period. The breeding sheep generally graze lupins for at least part of both the summer and winter periods. Because sheep are grazed among the lupins in winter there is possibly less non-lupin roughages available to the sheep bought for fattening over summer.

There were no reported cases of lupinosis prior to 1950 except for one case in the wheatbelt in 1948. Since 1950 there have been numerous reports of sheep affected by lupinosis. The fact that sheep are now able to graze on lupins over a longer period of the year may be a contributing factor to the occurrence of the disease.

THE SURVEY

Forty-one farms were visited in the Dandaragan district. The area covered is
roughly enclosed within the line joining Badgingarra, Watheroo, Regan's Ford and Koojan. (Maps 1 and 2).

The total acreage of properties visited amounted to 262,090, carrying 134,800 sheep and 4,398 head of cattle.

For the purpose of selecting properties for the survey, the holdings in the district were divided into two categories conveniently described as "new" and "old" properties. "New" properties were those that had been developed over the last few years. The "old" properties had been farmed for many years. They comprised the better soils of the Dandaragan area.

Fig. 4—A lupinoise-affected sheep. Such sheep tend to wander aimlessly until they encounter obstacles such as this fallen tree where they remain in a semi-comatose condition.

Fifteen properties of the "new" category that grew lupins were selected at random. As many as possible of the "old" properties were also included. Because of their longer records "old" properties were considered more important. All properties included in the survey were visited by one or other of the authors and a questionnaire was filled in for each.

The number of properties reporting lupinosis was 22. Nineteen owners were confident that they had never experienced the disease. Two properties which had lupinosis while under different ownership in the early 1950's are now free of the disease. On one of these properties sheep now have access to other feed when grazing lupins. This is not a common practice in the district.

As almost half of the properties in the survey were not affected by lupinosis it suggested management methods might play a part in avoiding the disease.

SHEEP LOSSES

In the summer of 1958/59 deaths from lupinosis amounted to 3,707 sheep, or 3.5 per cent. of the sheep carried on affected properties. As a percentage of total stock carried on all properties in the survey, losses amounted to 2.5 per cent. Sheep deaths since 1950 totalled 7,370, or 0.7 per cent. of the total sheep carried during that period. These figures show that over half the losses since 1950 occurred during the 1958/59 summer. Records were often scanty and probably many owners could not identify lupinosis as the cause of deaths during the early occurrences of the disease.

Lupinosis was found to be a much more serious disease than was indicated by the numbers of deaths. Many owners either sold affected sheep as soon as they were aware of them losing condition, or retained them on the property but kept them off lupins, in the expectation that they would recover. Affected sheep sold for lower prices than did healthy animals.

PERCENTAGE RANGE OF DEATHS IN THE INDIVIDUAL FLOCKS

The incidence of losses in individual flocks further emphasises the seriousness of the disease and the financial strain that some owners have experienced.

Table 1

<table>
<thead>
<tr>
<th>Number of flocks</th>
<th>Percentage of the flock that died</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>0-5</td>
</tr>
<tr>
<td>7</td>
<td>6-10</td>
</tr>
<tr>
<td>5</td>
<td>11-20</td>
</tr>
<tr>
<td>2</td>
<td>21-50</td>
</tr>
<tr>
<td>1</td>
<td>51-100</td>
</tr>
</tbody>
</table>

One owner lost 70 per cent. of his flock, two lost between 20 per cent. and 50 per cent., while five lost between 10 per cent. and 20 per cent. of the sheep in their individual flocks (see Table 1.)

In these flocks there was a high percentage of sheep that lost condition and were...
unthrifty and unprofitable. In some cases all sheep were affected.

Low lambing percentages are another source of financial loss believed to be due to lupinosis. One affected property raised only 120 lambs from 1,000 ewes mated.

BREEDS, SEXES AND AGES OF SHEEP

Although sheep of all ages and breeds were affected, weaners and young sheep are evidently more susceptible to the disease than older animals and did not do well on lupins. Weaners are difficult to manage at any time and when grazing on dry lupins may not eat the seed as readily as older sheep do. Wethers and ewes are apparently affected alike.

TIME OF OCCURRENCE OF DEATHS

It was found that major losses occurred in the various flocks at different times during the summer period. This suggested that factors other than climate may be involved.

Table 2

<table>
<thead>
<tr>
<th>Date of first major losses</th>
<th>Number of properties reporting start of major losses</th>
</tr>
</thead>
<tbody>
<tr>
<td>December</td>
<td>5</td>
</tr>
<tr>
<td>January</td>
<td>2</td>
</tr>
<tr>
<td>February</td>
<td>4</td>
</tr>
<tr>
<td>March</td>
<td>4</td>
</tr>
<tr>
<td>April</td>
<td>4</td>
</tr>
<tr>
<td>May</td>
<td>3</td>
</tr>
</tbody>
</table>

It was not possible to determine whether climatic or environmental conditions in winter could affect the occurrence of the disease.

TIME ELAPSING BEFORE FIRST DEATHS OCCUR

The time elapsing before deaths occurred after placing sheep on lupins, varied from one week to more than 16 weeks. Sixteen owners reported deaths within two months after placing sheep on lupins. The two owners reporting deaths within ten days had both kept the sheep in paddocks where there was no roughage other than lupins.

Table 3

<table>
<thead>
<tr>
<th>Number of Properties</th>
<th>Time elapsing before deaths occurred (in weeks)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>1-3</td>
</tr>
<tr>
<td>7</td>
<td>3-8</td>
</tr>
<tr>
<td>4</td>
<td>9-16</td>
</tr>
<tr>
<td>2</td>
<td>16</td>
</tr>
</tbody>
</table>

EFFECT OF BURNING DRY LUPIN ROUGHAGE

On one property, sheep which had been affected by lupinosis previously, were put into a paddock that had been poorly burnt. The fire had removed all the ground cover—pods, leaves and small stems—and had left standing the large stalks with some small stems attached. On another property a paddock was completely burnt out except for 10 acres of a very dense stand of lupins. In both cases stock introduced after burning the paddocks showed symptoms of the disease within ten days. This suggests that the disease can be caused by eating either the stalks and small stems, or the scorched seed.

Summer rains, dews, hot weather and other climatic factors could not be identified as factors in the cause or onset of the disease during the summer months. No connection between lupinosis and good or poor lupin years or years of higher winter rainfall was evident.

It is unlikely that scorching of the seed would cause the disease as it is known that it occurs in unburnt paddocks. Bennetts (private communication) has reported that he was unable to induce the disease by feeding lupin seed. However, he has induced it by feeding lupin roughage. Dr. Gardiner (private communication) also reports that he has induced lupinosis by the feeding of lupin roughage. Therefore it seems likely that either the stalks or the small stems can cause lupinosis.

During October-November, 1959, sheep were observed grazing on lupin stands. In each paddock the sheep ate the small stems of the lupin plant in preference to mature brome grass roughage that was also present. There is no doubt that sheep find the small stems of the lupin plant palatable. From the evidence it appears very unlikely that sheep will contract lupinosis when grazing burnt paddocks containing only lupin seed.
PREVIOUS GRAZING EXPERIENCE ON LUPINS

Sheep are susceptible to the disease whether they have had previous grazing on lupins or not. No direct comparisons could be made on all affected properties because the owners were uncertain of the identity of the sheep that died. However, on four occasions, losses occurred with new sheep introduced to lupins, and on seven occasions with sheep that had access to lupins previously.

CUMULATIVE EFFECT OF GRAZING LUPINS

From the survey there was no direct evidence that sheep that had once recovered from the disease were then more susceptible to it. Sheep have been affected one year and the following year have been grazed on lupins without ill-effects. Both new sheep or sheep with previous experience with lupins may either die quickly or deaths may be spread over a lengthy period.

RESISTANCE TO LUPINOSIS

Two owners reported that only some sheep in each flock were affected while other owners were unable to make any comment as sheep were either sold or taken off lupins before deaths occurred. If there are some unaffected sheep in each flock, it could be because those sheep do not eat that part of the pasture causing the disease, or do so only sparingly. There was no direct evidence indicating that some sheep have an inherent resistance to the disease.

THE EFFECT OF FEED OTHER THAN LUPIN ROUGHA

Evidence from the survey suggests that sheep became affected when the only palatable roughage present is the lupin plant itself. If the lupin roughage is the cause of lupinosis, other palatable roughage may help to reduce the severity of the disease and provide a means whereby lupin paddocks can be used without danger or, alternatively, lupin plants could be removed completely by chaining and burning.

There are several sets of conditions which could lead to a large intake of lupin roughage, e.g.:

(1) Dense stands of lupins with very little else growing among them.
(2) High stocking rates.
(3) Stocking for long periods.
(4) Sparse stands of lupins with a dense cover of unpalatable mature brome grass.

No connection could be recognised between the onset of the disease and any single one of these factors. The disease occurred on thin and dense stands of lupins; in paddocks with high and low stocking intensity; and in paddocks where sheep had been left for short and long periods.

With high stocking rates, even if only for short periods, there is a grazing pressure on the sheep which may force them to eat lupin roughage. Mature brome grass (Bromus species) is particularly unpalatable in the early summer and is not consumed until the seeds are shed or removed by mechanical means. This grass occurs in dense and thin stands of lupins and can be dominant to such a degree that the only palatable roughage in the paddock is parts of the lupin plant. In general, it was found that at the time lupinosis occurred, one or more of the above factors had caused a shortage of palatable roughage other than lupins in the paddock.

PERCENTAGE OF SHEEP THAT RECOVER

The percentage recovery apparently depends on how badly the sheep are affected and the type of feed affected sheep are given.

When sheep are very sick there appears little chance of recovery. If sheep are moderately affected recovery should take place when removed to good feed other than lupins.

Grain feeding, even in liberal amounts, was reported to have little effect upon recovery. Sheep on a grain diet apparently still seek roughage and, if not removed from lupins, may be still prone to the disease.

DRENCHING

Sheep which are grazing on lupins or showing signs of lupinosis should not be drenched with either phenothiazine or bluestone-nicotine sulphate drenches. Many farmers reported rapid death of lupinosis affected sheep after drenching.
If sheep must be drenched it should be done before they have access to lupins.

**ACREAGE OF LUPINS**

In comparison with unaffected properties, those where lupinosis occurred had a greater:

1. percentage of used land under lupins;
2. acreage of lupins;
3. increase of lupins over the last 9 years (43,000 acres compared with only 7,000 acres);
4. carrying capacity.

**Table 4.**

<table>
<thead>
<tr>
<th>Lupinosis Farms</th>
<th>Lupinosis Farms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lupins as percentage of used land</td>
<td>53</td>
</tr>
<tr>
<td>Lupins as percentage of cleared land</td>
<td>66</td>
</tr>
<tr>
<td>Lupins as percentage of total area</td>
<td>47</td>
</tr>
<tr>
<td>Bush grazing as percentage of land used</td>
<td>21</td>
</tr>
<tr>
<td>Sheep per acre in summer on cleared land basis</td>
<td>1.0</td>
</tr>
<tr>
<td>Sheep per acre in summer on used land basis (includes bush grazing)</td>
<td>0.8</td>
</tr>
</tbody>
</table>

The great increase in acreage of lupins on lupinosis affected properties over the last nine years may be related to the incidence of the disease.

**VARIETY OF LUPINS AND AGE OF THE LUPIN STAND**

Lupinosis occurs on both varieties, the W.A. Blue (Lupinus digitatus Forsk) and N.Z. Blue (L. angustifolius Linn) lupins, and on mixed sowings of the two varieties. The W.A. Blue was by far the most widely used variety.

Age of the lupin stand evidently has no bearing on the incidence of the disease. Lupinosis occurred on three occasions on new stands and on several occasions on old stands ranging in age from three to ten years or more.

**FERTILISER APPLICATION**

Fertiliser application appears to have no direct bearing on the disease. Properties where lupins have had no superphosphate reported lupinosis as did properties where superphosphate was used. Sheep on properties where copper and zinc had not been used were no less prone to lupinosis than sheep grazing land that had received these elements.

The average application of superphosphate to lupins on “lupinosis” properties (68 lb./ac.) was higher than on the unaffected properties (50 lb./ac.).
Fig. 6—The liver of a lupinosis-affected sheep. It is small, hard and fibrous. The enlarged gall-bladder is another common feature of this disease.

GREEN LUPINS

It appears unlikely that young green lupins could cause "lupinosis" as it has been a practice for years to eat out lupin paddocks soon after germination. Thirteen of the properties reported lupinosis when grazing only on dry lupins, and two when the plants were not quite mature. Five properties reported lupinosis when the young plants were very small. Sheep on these latter could have eaten left-over lupin roughage from the previous summer.

CAN THE DISEASE BE CORRECTED BY MANAGEMENT

The survey indicated that sheep owners in the Dandaragan district thought the disease could be avoided to some extent by reducing the amount of lupin roughage eaten by the sheep. This could be brought about by:

1. Sowing cereals in the lupin stand.
2. Allowing stock access to lupin-free areas when grazing lupin paddocks.
3. Burning lupin paddocks before grazing.
4. Rotational grazing of "lupin" and "non lupin" paddocks (sheep to be shifted every seven days).
5. Chaining pastures to cause grass seeds to shed, thereby making the mature grasses more palatable.

Owners considered that "set stocking" of lupin paddocks should be avoided.

REFERENCES

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