DEPARTMENT OF AGRICULTURE, SOUTH AUSTRALIA

# Agronomy Branch Report

## FIELD DAY ON UTILISATION OF DRYLAND LUCERNE PASTURES

KYNOCH STATION, VIA KEITH

SOUTH AUSTRALIA

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Report No. 21

# FOREWORD

Over the past 20 years, large areas of deep sandy soils of the Upper South East of South Australia have been cleared and pastured. Research work indicated that lucerne was the most productive species, and in fact it now forms the basis of pastures in the area.

While experience also showed that dryland lucerne based pastures required a management far different from that of an annual based pasture, there was little precise information on the optimum stocking rate and grazing management policies.

As a result of this, a co-operative research programme between the Australian Wool Research Trust Fund which provided funds, the South Australian Department of Agriculture which provided technical know how and the Scottish Australian Company which provided pasture areas and animals, was set up in 1966.

The project aimed to define the potential of dryland lucerne pastures on deep sands in this area in terms of:-

a. Potential stocking rate

b. Grazing management requirements

c. Risk of erosion.

## EXPERIMENTAL WORK

The main work of the experimental programme has consisted of a relatively large stocking rate x grazing management experiment on a typical deep sand area. Subsidiary experiments on establishment and fertiliser requirements of dryland lucerne pastures have also been carried out.

The design of the main trial allowed grazing management and stocking rate to be varied as follows:-

1. 6 paddock system (6P)

   Five acre paddocks were subdivided into six equal sub-paddocks; wethers rotated throughout the year on a 6 weekly cycle, i.e. 1 week on and 5 weeks off; stocking rates 0.8, 1.2, 1.6 and 2.0 wethers/acre.

2. Continuous system (C)

   Five acre paddocks continuously stocked at 0.8, 1.2, 1.6 and 2.0 wethers/acre.

3. 3 paddocks system (3P)

   Five acre paddocks subdivided into three equal sub-paddocks; wethers rotated throughout the year on a 6 weekly cycle, i.e. 2 weeks on and 4 weeks off; stocking rates 1.2 and 1.6 wethers/acre.

4. Set stocked winter - 6 paddock summer system (SW)

   Five acre paddocks were treated as for (1) in late spring, summer and autumn; subdivision fences removed and treated as for (2) in winter and early spring; stocking rates 1.2 and 1.6 wethers/acre.

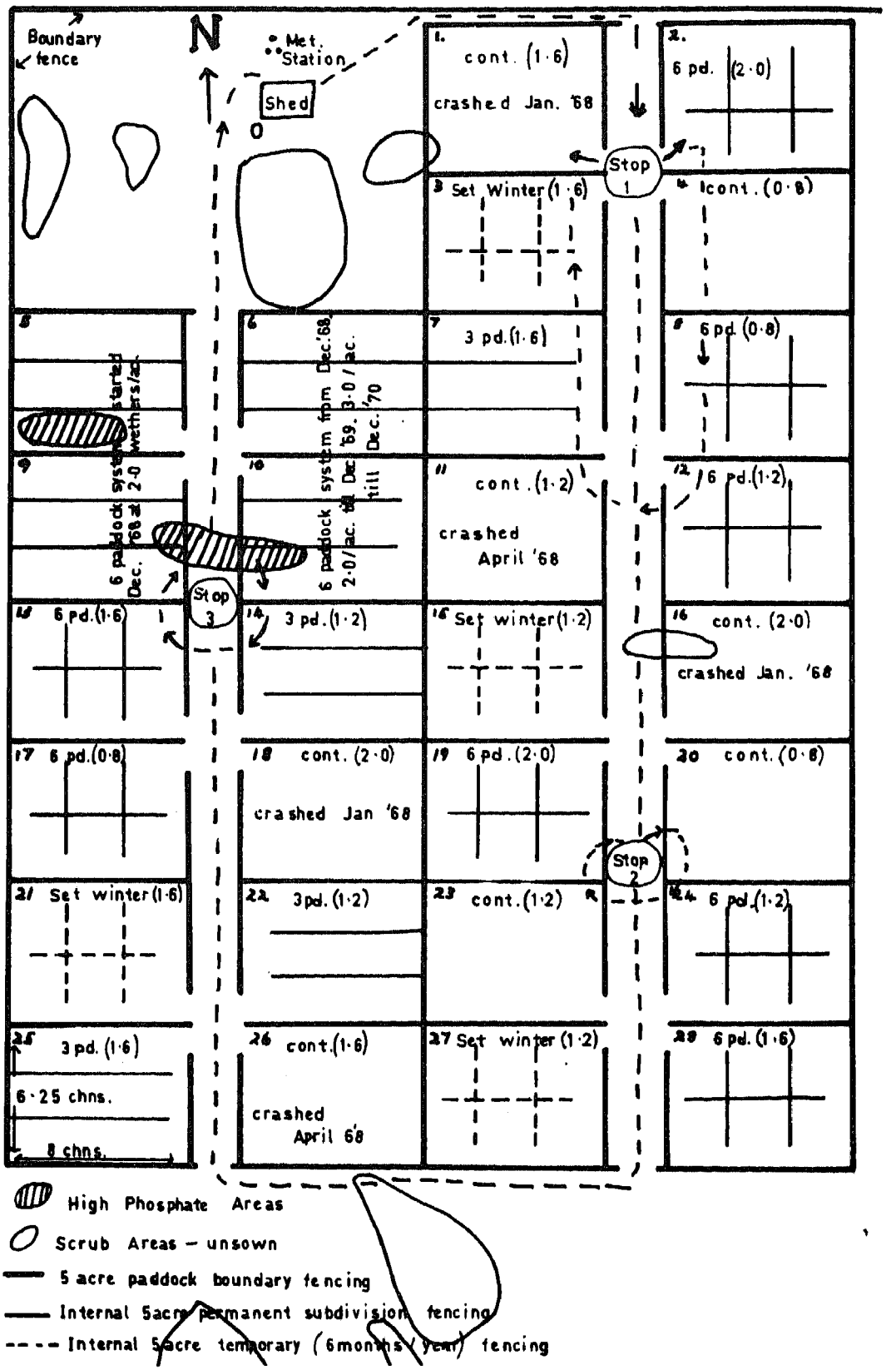
   This system was included to allow a period of set stocking when lucerne growth was expected to be relatively slow due to lower temperatures, but when growth of annual species was favoured by adequate moisture. During late spring and the summer-autumn period when lucerne was the most responsive species, management reverted to the 6P system. Evidence from elsewhere has indicated that growth rates of lamb are often increased by set stocking.

The trial was first stocked in December, 1966 on new land sown to dryland lucerne pastures in autumn, 1964. Hunter River was the lucerne cultivar used.

KYNOCH STATION – UTILIZATION OF DRYLAND LUCERNE PASTURES

Plan of Trial Area  Sec. 16, Hundred of McCallum

Scale: 1" represents 5 chains



## RESULTS

1. General:

1967 was a drought (rainfall of 8" compared with average 16-17"). Subsequent seasons have been average or above average.

The range of stocking rates used, i.e. up to 2.0 wethers/acre was the correct range during the drought period of 1967 and following the poorer years of 1965 and 1966. In the subsequent better seasons, however, up to 3.0 wethers/acre have been carried easily.

The main trial results are reported for the initial stocking rate range (up to 2.0 wethers/acre) and I believe would have been similar but at 50% higher stocking rate levels if a normal run of seasons had been encountered.

2. Liveweights:

When vigorous lucerne is retained in the pasture, liveweights during the summer-autumn period are dependent on rainfall in this period - if this is considerable then a minimum decline in liveweight occurs. However, if the lucerne component is removed by mismanagement then the normal seasonal liveweight decline will occur regardless of summer rainfall. Bodyweights tend to equalise again under all management systems by the end of spring. Some of the liveweight data is recorded in Figure 1.

3. Wool Production:

In the first year the 3P system performed well but subsequently fell well behind the 6P system at the higher stocking rate. The C treatment resulted in decline of wool production even at the lowest stocking rate. The performance of the SW treatment at the higher stocking rate was disappointing, but emphasised the dangers of this practice, especially in unfavourable years.

With the 6P system no increase in production between 1.6 and 2.0 wethers/acre occurred due to the severe overgrazing following the 1967 drought and failure to allow for adequate recovery after this period.

In treatments started since 1968 yields of up to 40 lbs. of wool/acre are expected.

Some of this data is included in Figure 2.

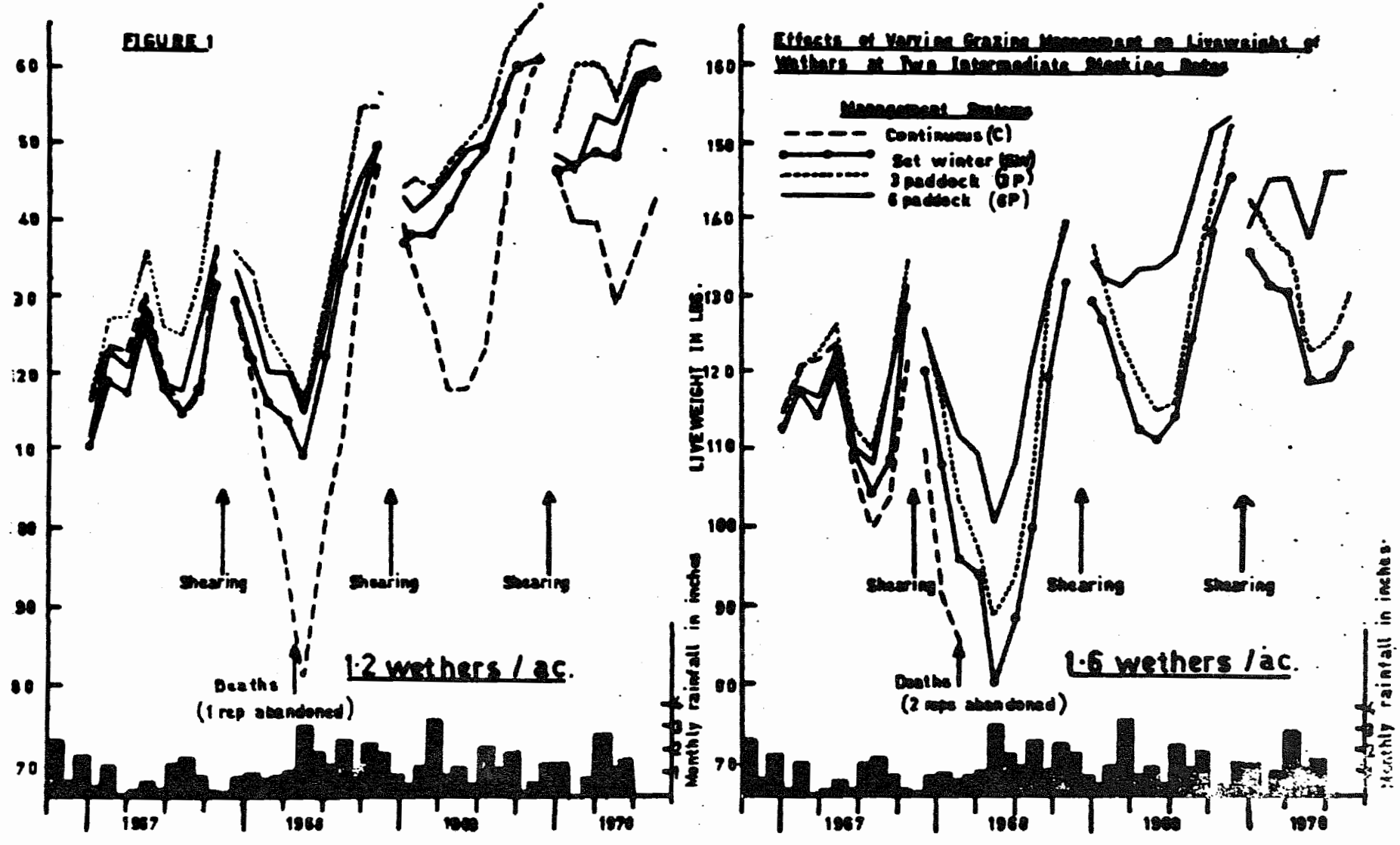
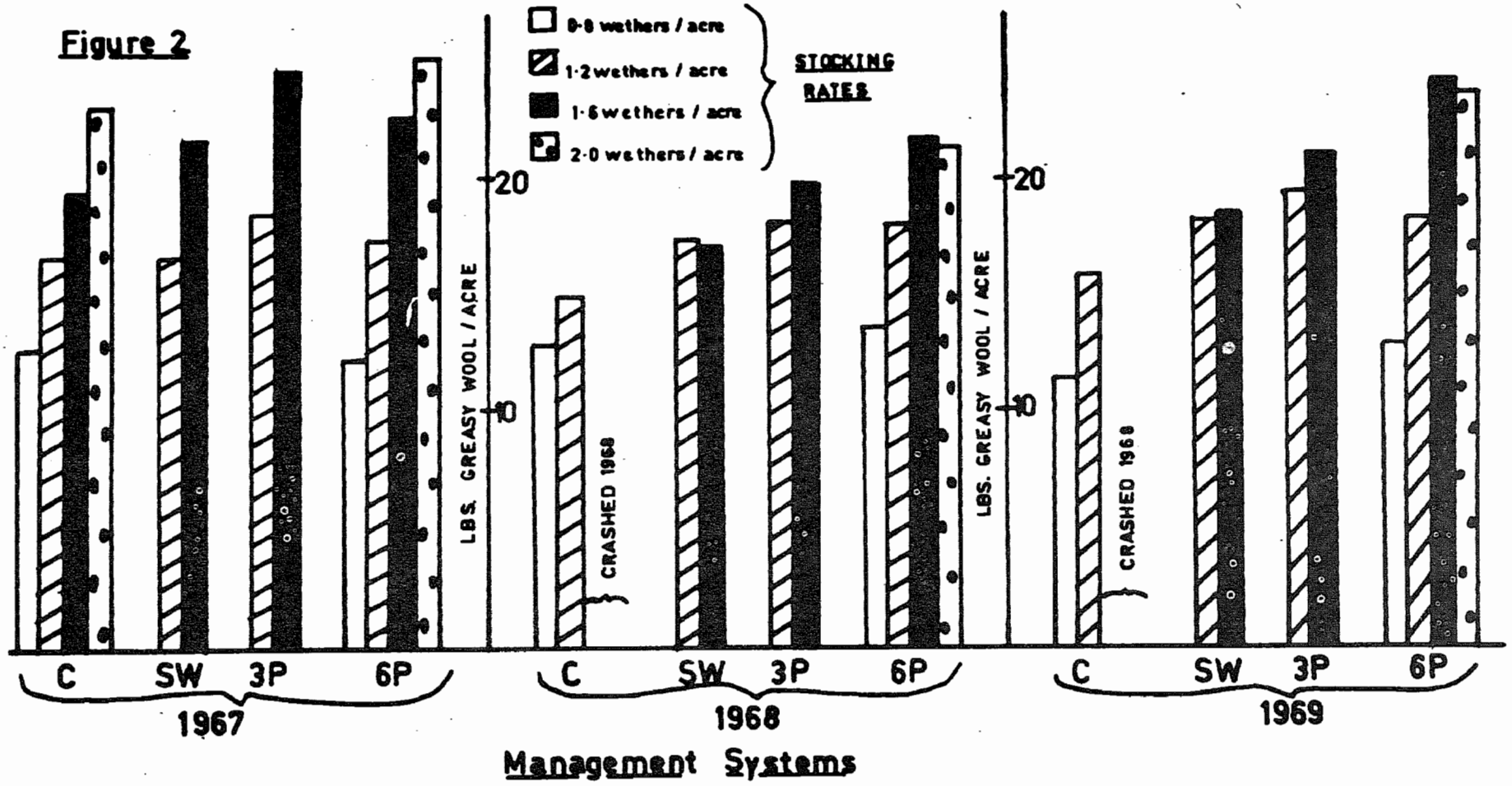


FIGURE 1
Effects of Varying Grazing Management on Liveweight of Wethers at Two Intermediate Stocking Rates
Management Systems
Continuous (C)
Set winter (SW)
3 paddock (3P)
6 paddock (6P)
LIVEWEIGHT IN LBS.
Shearing
Shearing
Shearing
Deaths
(1 rep abandoned)
1·2 wethers / ac.
Monthly rainfall in inches
1967
1968
1969
1970
Shearing
Shearing
Shearing
Deaths
(2 reps abandoned)
1·6 wethers /ac.
Monthly rainfall in inches
1967
1968
1969
1970

## EFFECTS OF STOCKING RATES AND GRAZING MANAGEMENT ON PRODUCTION OF GREASY WOOL PER ACRE OVER THREE SEASONS.

Figure 2



4. Lucerne Production & Persistence:

a. Lucerne production increased total seasonal pasture production in this environment due to the ability of lucerne to exploit moisture out of season and at depth, and its non-susceptibility to nitrogen and potassium deficiencies. Total growth from other species may have equalled that when lucerne was included if adequate nitrogen (for grass) and potassium (for sub. clover) were applied at the correct time of the year - such fertiliser applications are unlikely to be economic.

b. Density of the lucerne component has declined with all stocking rates and grazing managements. Deaths of plants occurred during the summer-autumn periods, but not necessarily as a result of management during those periods. This decline was particularly severe after the 1967 drought.

With an adequate combination of grazing management and stocking rate, however, the population has tended to stabilise at approximately 10-15 plants/square yard and no further reduction in population has occurred over the past two summers. At this level the plant population appears to be in equilibrium with the environment, and that only severe stress due to severe drought or mismanagement will cause a further decline in plant numbers.

Figures 3 and 4 indicate the changes in lucerne plant populations which have occurred.

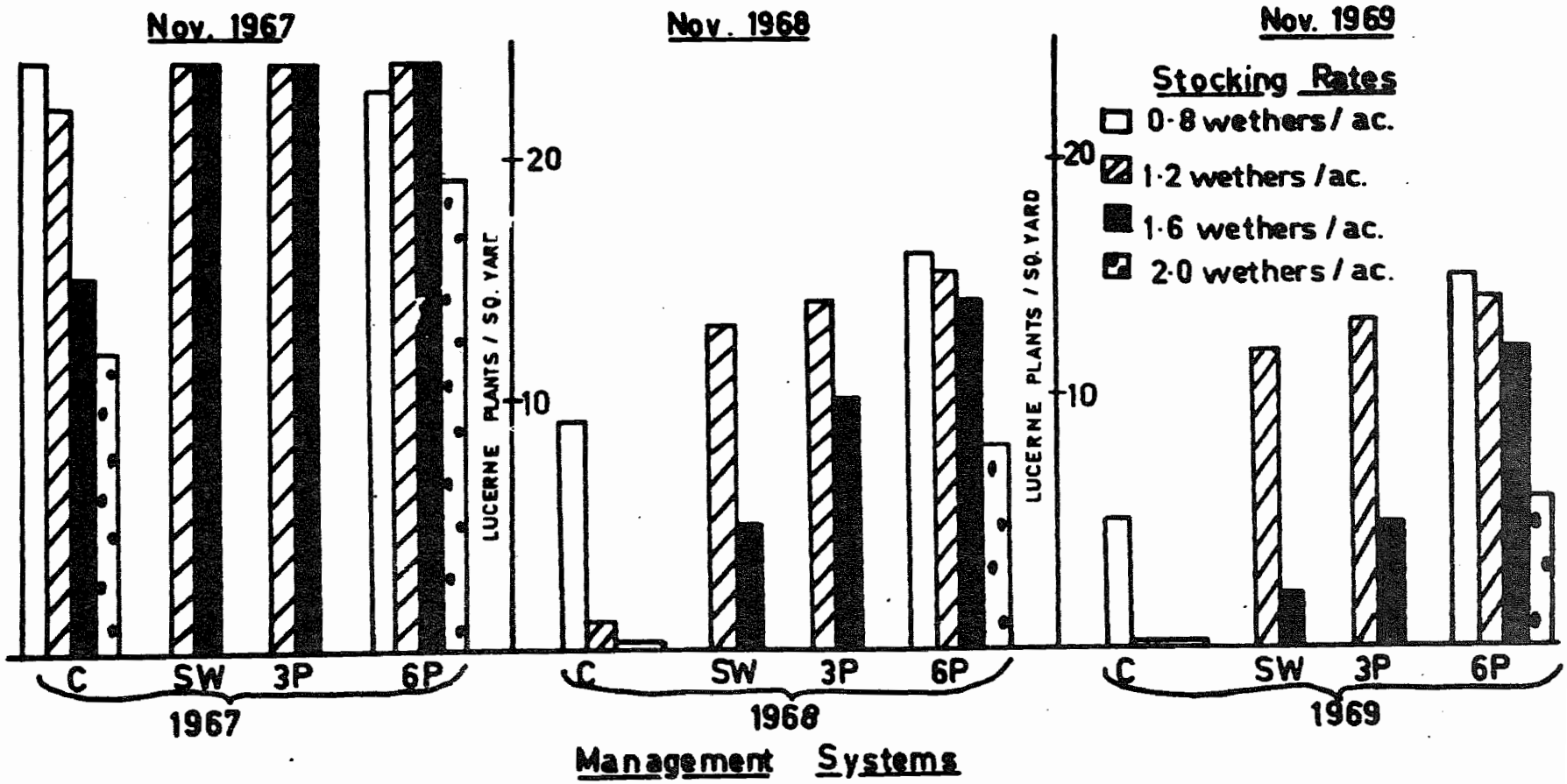
5. Botanical Composition:

Under the 6P system the changes in botanical composition depend on stocking rate. At the lowest stocking rate there may be 60% lucerne, with the remaining production coming from annual ryegrass and sub. clover. Dandelion, silver grass and phalaris are largely eliminated, and capeweed and other grasses are no problem. But as stocking rate increases the contribution of species other than lucerne also increases until at the highest stocking rate lucerne may contribute only 20% of total production. Sub. clover and phalaris content increase, but so does dandelion, and with likely invasion by capeweed, brome and barley grasses a relatively unproductive pasture may result.

These changes are emphasised of course when the lucerne component is eliminated from the pasture.

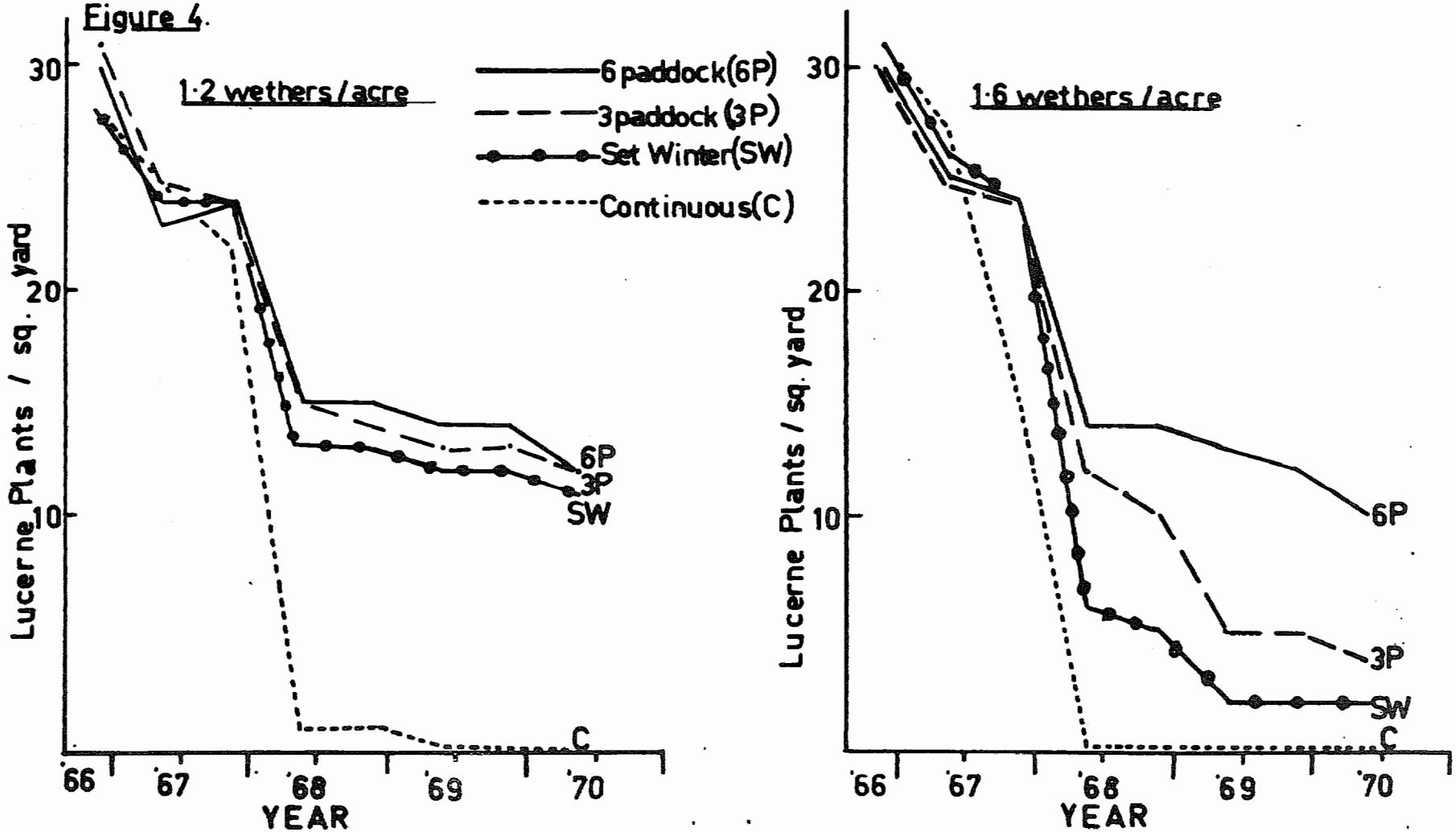
EFFECT OF STOCKING RATE AND GRAZING MANAGEMENT ON LUCERNE PLANT DENSITY OVER THREE SEASONS.

Figure 3



# THE CHANGES IN LUCERNE PLANT DENSITY AT INTERMEDIATE STOCKING RATES.

Figure 4.



These changes in pasture production and botanical composition are summarised in Figures 5 and 6.

The elimination of the lucerne component from the pasture may also allow such undesirable weeds as skeleton weed to establish readily. This has happened in several of the trial paddocks from which lucerne has been eliminated.

6. Moisture Changes:

The moisture content of the deep sand profile has been followed under various treatments from access tubes mostly down to 7 feet, but down to 15 feet in two instances.

Results indicate the soil type has a very low water holding capacity. Thus 1 inch of rain will wet approximately 2 feet of the soil from wilting point to field capacity. Without a vigorous lucerne component, water is only drawn from the top 3-4 feet, and thus in a wet season much water can drain beyond the root zone. With a vigorous lucerne component, however, water below 3-4 feet may be used later in the season. In fact with a vigorous lucerne component it is doubtful whether much water is unused due to drainage beyond the root zone. Obviously this is also important in the re-cycling of soil nutrients.

## DISCUSSION

1. Application to Other Enterprises:

The trial demonstrates the advantages of maintaining a vigorous lucerne component even with wethers and wool production. The advantages of out of season production of lucerne are likely to be even greater when reproductive sheep are involved. Lucerne then provides the means for growing out young animals or fattening them and the chance to flush ewes at mating, to mate ewes earlier, and to provide excellent feed prior to and after lambing (especially if deferment is practised).

Similarly experience with beef cattle indicates that dryland lucerne pastures are excellent for growing out young animals and for fattening sale stock. The pasture are also likely to be suitable for making high quality hay.

From grazier experience, it appears that beef cattle may be run solely, or in any ratio with sheep on dryland lucerne pastures.

The other often highly profitable enterprise on dryland lucerne pastures is the harvesting of lucerne seed. This, however is very dependent on seasonal conditions and is unreliable.

Figure 5

Production of Lucerne and Other Species for 1967 and 1968 at Varying Stocking Rates, with Extreme Management Systems.

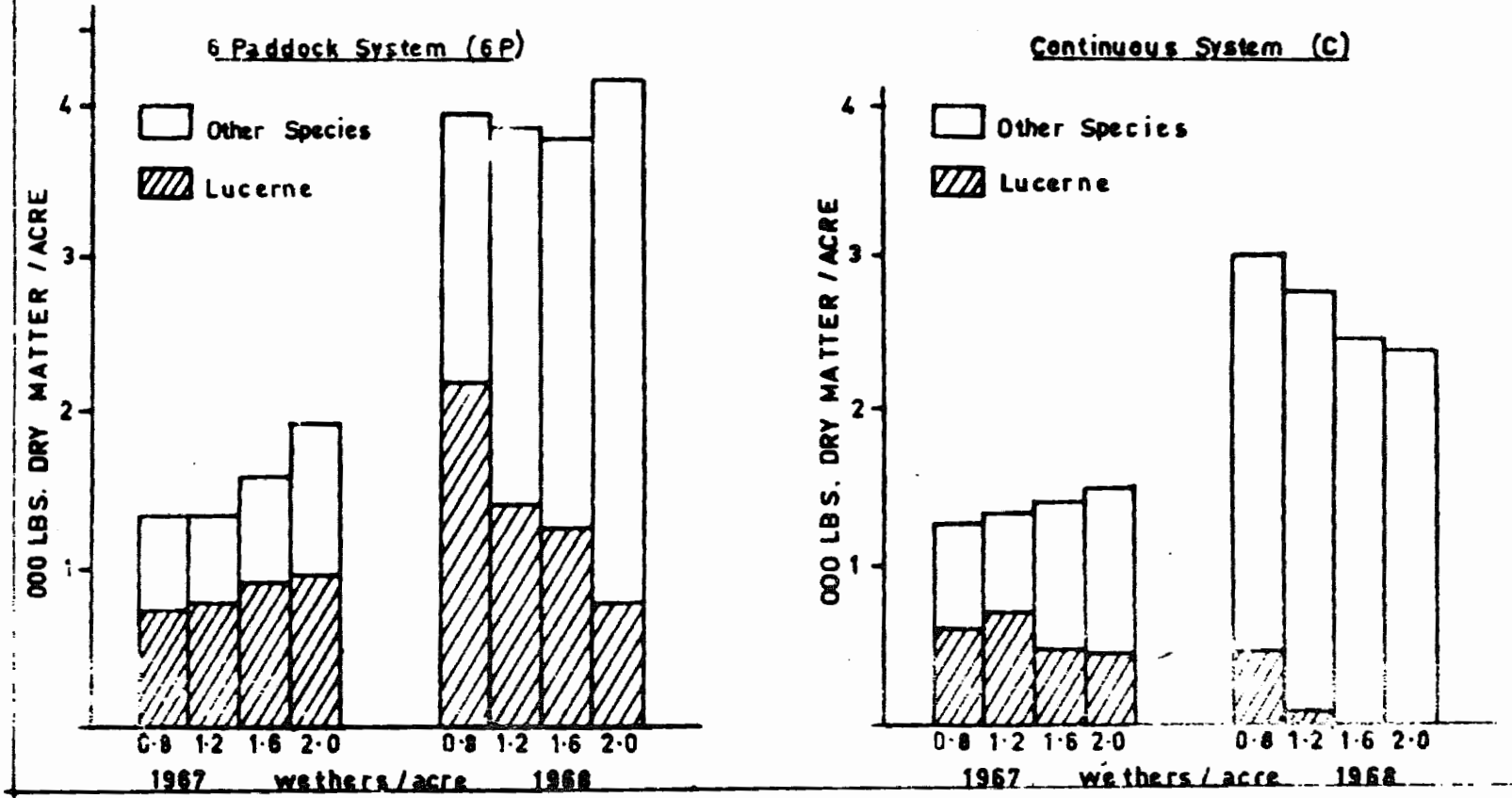
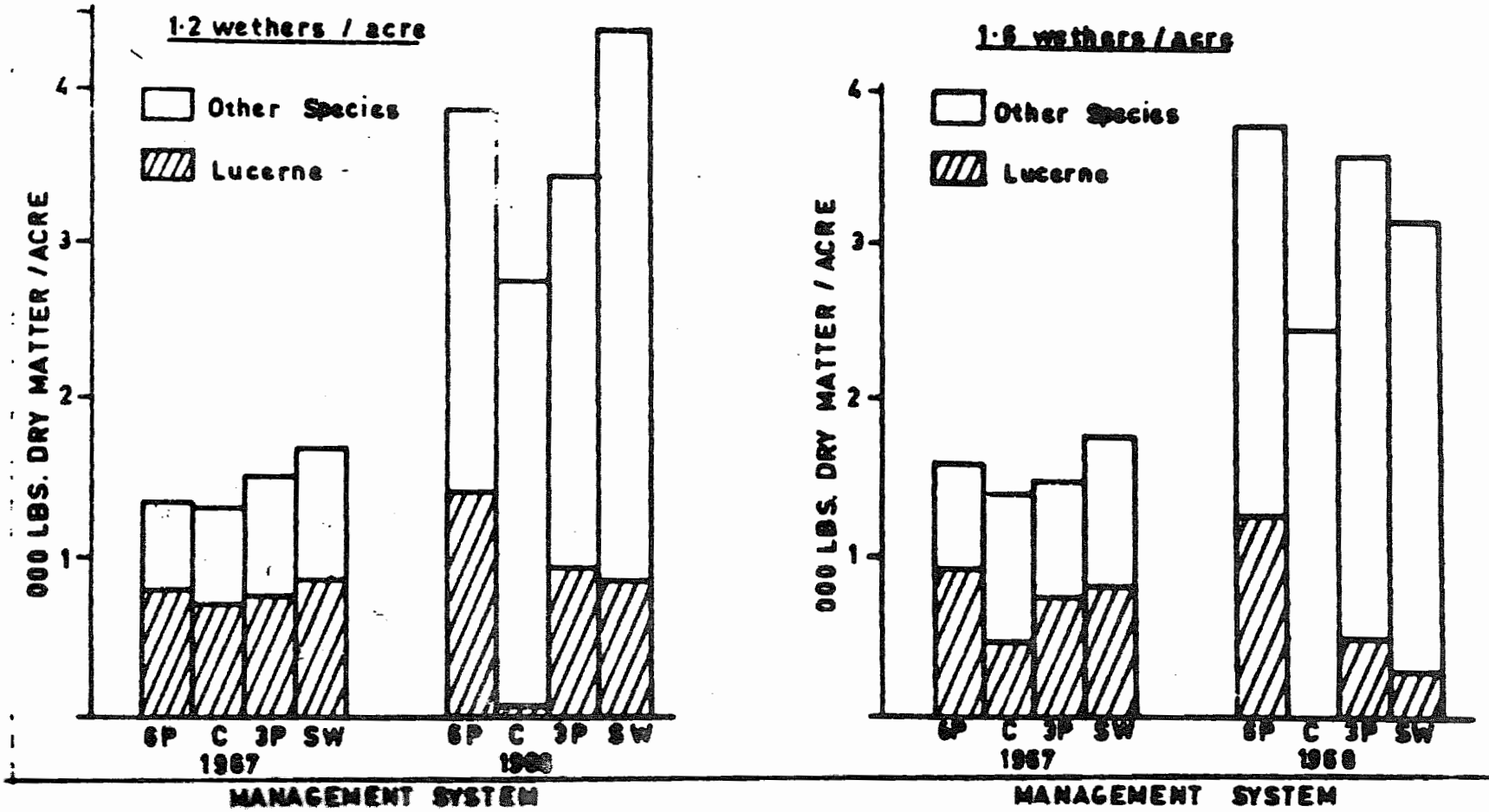


Figure 6

Production of Lucerne and Other Species for 1967 and 1968 with Varying Management Systems at Intermediate Stocking Rates.



2. Paddock Numbers & Sizes:

If high level, long term productivity of dryland lucerne pastures is to be maintained, rotational grazing on a 6 paddock system for at least part of the year is essential.

Periods of slower rotations through fewer paddocks and periods of set stocking during the winter months may be possible but the hazards of such practices are obvious from the trial results. One of the problems of course, is that the hazards are not immediately obvious, and may show up 6 months later, or accumulate from year to year.

Are the costs for providing watering and fencing for a 6 paddock system recouped by increased production? Might it not be better to accept lower production/acre, or the need for re-establishment every 3-4 years! Some very interesting answers to these questions are given in the appendix, in which a theoretical area of 1,500 acres of dryland lucerne pasture is subdivided and stocked to varying levels.

3. Use of Several Classes of Livestock over the Same Rotational System:

The mature lucerne plant varies in digestibility from one part to another, i.e. from greatest digestibility with new leaf → flowers → old leaves → new stems → old stems with lowest digestibility. Thus near mature lucerne plants contain material of a wide range of digestibility. Young animals tend to select the younger and more digestible material, and this results in good bodyweight gains. However, if these animals are forced to eat all the lucerne then growth rates will suffer.

There is a good case for allowing young animals or animals being fattened for market first entry into the spelled paddocks, followed by animals which are only being maintained, or for which high growth rates are not essential. Thus at times of the year when growth is largely lucerne, groups may have access to the pasture with the following preference - weaners and/or calves → ewes and cattle → wethers. I see no real problems in implementing this. Instead of having say two separate 6 paddock rotations for weaners and ewes and each group being shifted once weekly, both groups are shifted twice weekly, so that each individual paddock is still grazed for only one week and rested for five weeks.

4. Problem Periods of the Year:

One of the greatest difficulties during dry summer-autumn periods is to protect the lucerne crowns from "digging",

especially by sheep. This may be difficult once adult sheep have learnt the art. Ideally with a 6 paddock system, access should be restricted to say only days 1 and 4 of the week, and during the other periods held in yards. Alternatively they may be held on an area of scrub, different soil type or area of lucerne due for resowing. Whether hand feeding is carried out when the animals are not allowed access to the lucerne will depend on the circumstances. The digging problem is likely to be minimised with cattle.

The other problem period of the year may be June-July, when low temperatures may restrict lucerne growth, and production of annual species is minimised by nitrogen and potassium deficiencies. The correction of these deficiencies is unlikely to be economic, and it would appear better to have an adequate lucerne density, or ideally, to have a lucerne cultivar with better winter production. The over-sowing of oats plus nitrogen is another possibility.

5. Insect Control:

This is essential with lucerne. The growth of lucerne and sub. clover after "the break of the season" is often hampered by red legged earth mite. If no control is taken, infestations may preferentially feed on lucerne during the winter months and seriously weaken or kill the plants, i.e. the same effect as continuous grazing.

With newly established lucerne, control of red legged earth mite is even more critical, and in some cases lucerne flea may also need control. Pink cutworm control during October-November is also essential.

6. Associated Species & Cultivars:

a. Other research indicates that Hunter River is still the most suitable lucerne cultivar. African has increased winter production, but is less persistent and probably more susceptible to mismanagement. It would seem that a more winter vigorous type of Hunter River is required.

b. Annual clovers, e.g. Geraldton sub. clover and under higher rainfall conditions with Woogenellup and/or Seaton Park, sub. clovers are recommended for dryland lucerne mixtures. Rose and cupped clovers may also be tried. Annual medics, Harbinger and Jemalong, have also been successful, particularly on more alkaline sites. Harbinger especially has proved widely adapted to deep sands, and being deeper rooting seems better able to survive dry periods.

c. Merredin or Wimmera annual ryegrass is usually included in the pasture mixture.

d. Perennial grasses. The requirement is a winter active, summer dormant, highly persistent grass. The chief advantage of such a grass would be to prevent the invasion by capeweed (which while nutritious has severe problems with high water content) and other inferior grasses and weeds.

At present in the 15-20" rainfall area on deep sands there is no perennial grass fitting these requirements. Australian phalaris is of doubtful value, although it is useful on clay flats. A small amount of perennial veldt grass may be useful on deep sands. Competition for moisture during spring with phalaris, and in the summer-autumn period as well with perennial veldt grass detracts from the value of these grasses.

Medea perennial ryegrass may be suitable in slightly higher rainfall areas, while Currie cocksfoot may be suited to even higher rainfall areas.

7. Fertiliser Requirements:

a. The recommendations of Powrie with regard to superphosphate application to dryland lucerne pastures on deep sands are still good guidelines. He suggested that after establishment on new land, applications to ½ ton/acre should be achieved as soon as possible, and thereafter a topdressing of 60-90 lbs./annum of superphosphate either annually or biennially is adequate for dryland lucerne pastures under grazing in 15-20" rainfall areas.

b. Trials with other forms of phosphorus have indicated that superphosphate is still the best source of this element. Prices of high analysis phosphate fertilisers may become more competitive but then sulphur (S) deficiencies in the sub. clover component will occur and need correction.

c. Deficiencies of calcium (Ca) and magnesium (Mg) are unlikely on established dryland lucerne pastures.

d. Nitrogen deficiencies in the grass component and potassium deficiencies in the sub. clover component are likely to occur during winter, because of ready leaching of these nutrients. Correction of these deficiencies is unlikely to be economic, and may be at the expense of subsequent spring-summer lucerne

growth in any case. Initial potassium applications may be necessary when establishing lucerne, especially on deep sands in higher rainfall areas. In subsequent years under grazing, lucerne seems able to "mine" adequate potassium.

e. Guidelines for trace element applications after initial correction are difficult to obtain. Both copper (Cu) and molybdenum (Mo) are expensive to apply. A close watch on animal health, including steely wool and the running of an odd black sheep are probably the best methods for copper requirement indications. Molybdenum deficiency is likely to take longer to show up. Copper must be applied when molybdenum is applied to prevent imbalance of these elements in the animal. High levels of copper alone must not be applied or copper toxicity may occur. As a suggestion maintenance copper should be applied at the rate of $\frac{1}{2}$-$\frac{3}{4}$ lb./acre/annum, with molybdenum at the rate of 1 oz. every 9-10 years, i.e. Cu $3\frac{1}{2}$ applied every 5 years and Cu $3\frac{1}{2}$ Mo$_1$ applied every 10 years unless earlier symptoms in animals or pasturesshow up.

ACKNOWLEDGMENTS:

I wish to thank the Australian Wool Board for financing this project; the Scottish Australian Company and Kynoch Station for providing land, animals and other facilities; Messrs. M.R. Lewis and J.A. Wurfel for willing field assistance; other property owners and managers in the district and many fellow Departmental officers for their encouragement, guidance and helpful criticism.

(Murray V. Smith)

14/9/70. SENIOR RESEARCH OFFICER (AGRONOMY).

# APPENDIX

## Exercise on the economics of the subdivision and stocking requirements of dryland lucerne pastures

(Compiled in conjunction with Mr. G.R. Trengove, Agricultural Economicst).

TABLE 1 (Contd. page 2)

Subdivision costs of a 1,500 acre paddock of dryland lucerne pasture, boundary fenced and with adequate water supply at trough

Additional Watering Points Required (See next page)
Sheep troughs at $60.00 each
Cattle troughs at $100.00 each

| Additional fences* | | Total Cost | Cost per Acre | 2 Sheep | 2 Cattle | 5 Sheep | 5 Cattle | 14 Sheep | 14 Cattle | 29 Sheep | 29 Cattle |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | $120 | $200 | $300 | $500 | $840 | $1400 | $1740 | $2900 |
| | | | | 4¢ | 13¢ | 20¢ | 33¢ | 56¢ | 93¢ | $1.16 | $1.93 |
| 2 | SH | $1225 | 82¢ | 86¢ | | | | | | | |
| | CA | $1837 | $1.22 | | $1.35 | | | | | | |
| 3 | SH | $1837 | $1.22 | | | $1.42 | | | | | |
| | CA | $2755 | $1.84 | | | | $2.17 | | | | |
| 6 | SH | $3675 | $2.45 | | | | | $3.01 | | | |
| | CH | $5512 | $3.67 | | | | | | $4.60 | | |
| 9 | SH | $5512 | $3.67 | | | | | | | $4.83 | |
| | CA | $8218 | $5.48 | | | | | | | | $7.41 |

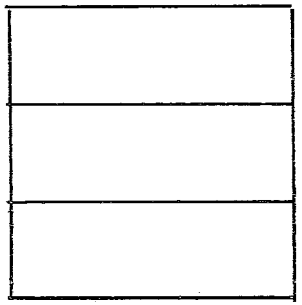
*No. of Additional Fences Required (see next page)

Each 122.5 chains long, Sheep fences at $400/mile
Cattle fences at $600/mile

Table 1 (Contd.) Extra fencing & watering facilities required.

3 PDK. ROTATIONS

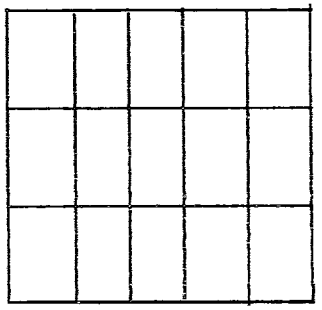
1500 Ac's



3 x 500

2 fences required
2 troughs required

1500 Ac's

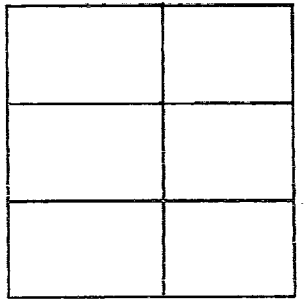


15 x 100

6 fences required
14 troughs required

6 PDK. ROTATIONS

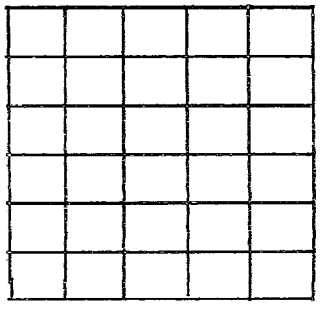
1500 Ac's



6 x 250

3 fences required
5 troughs required

1500 Ac's



30 x 50

9 fences required
29 troughs required

ASSUME: Annual charge on fencing and watering facilities

Depreciation = 4% (i.e. 25 year life)

Interest = 4% (8% of $\frac{1}{2}$ Capital value)

Repairs & Maintenance = 2%

i.e. ANNUAL CHARGE = 10% OF CAPITAL VALUE**

Gross Margins Used in the Exercise:

1. Sheep - 1 breeding Merino ewe = 1.5 dse

| | | | |
|---|---|---|---|
| Income: | 12 lbs. wool at 32¢ | $3.84 | |
| | 3 lbs. wool at 30¢ | 90 | |
| | 80% lambs at $4.00 | 3.20 | |
| | 20% CFA ewes sold at $3.00 | 60 | $8.54 |
| Costs: | Shearing 1.8 at 40¢ | 72 | |
| | Crutching | 14 | |
| | Animal health | 23 | |
| | Mating | 25 | |
| | 25% replacement 2 tooths at $7.00 | 1.75 | |
| | Supp. feed (1 bale of hay or bushel of oats) | 50 | $3.59 |
| | Gross Margin/Ewe | | $4.95 |

G.M./D.S.E. = $3.30

Capital/D.S.E. = $4.67 = $7.00/1.5

2. Cattle - 1 breeding cow = 14 dse

| | | | |
|---|---|---|---|
| Income: | 80% calving sold at $85.00 | $68.00 | |
| | 10% CFA cows sold at $100.00 | 10.00 | $78.00 |
| Costs: | 15% replacement at $120.00 | $18.00 | |
| | Bull cost at $1/cow | 1.00 | |
| | Supp. feed ½ ton hay | 8.00 | |
| | Animal health | 1.00 | $28.00 |
| | Gross Margin/Cow | | $50.00 |

G.M./D.S.E. = $3.57

Capital invested D.S.E. = $8.57

Costs of Pasture Re-establishment:

| | |
|---|---|
| 1 hour tractor work in ground preparation at $1.50/hour | $1.50 |
| Seed: 3 lbs. lucerne at 30¢lb) | |
| 2 lbs. sub. at 20¢lb. ) | 1.70 |
| 2 lb. medic at 20¢ lb. ) | |
| Additional super 100 lbs. at $1.00 | 1.00 |
| Bag lime 187 lbs. at $10/ton | 80 |
| Loss of grazing 1 D.S.E. at $3.00 | 3.00 |
| | $8.00 |
| + 25% contingency in case of poor establishment | 2.00 |
| | $10.00 |

i.e. If lucerne is grazed out every 4 years, pasture re-establishment will cost $2.50/year.

If we assume average life of normal stand is 10 years,

i.e. annual cost is $1.00/year

This figure doesn't include maintenance fertiliser dressing of 60-90 lbs/year or any insect control. We assume this money will be spent anyway, irrespective of age of the pasture.

Therefore excessive grazing causing the lucerne stand to be eaten out every 4 years will represent an additional cost of $2.50 - $1.00 = $1.50/year.

TABLE 2

| Development Stages | Continuous Grazing | 3 Paddock Rotation (1) | 3 Paddock Rotation (3) | 3 Paddock Rotation (2) | 3 Paddock Rotation (4) | 6 Paddock Rotation (1) | 6 Paddock Rotation (3) | 6 Paddock Rotation (2) | 6 Paddock Rotation (4) |
|---|---|---|---|---|---|---|---|---|---|
| Paddock size | 1500 | 500 | 100 | 500 | 100 | 250 | 50 | 250 | 50 |
| D.S.E's. per acre | 1.2 | 1.8 | 1.8 | 2.4 | 2.4 | 1.8 | 1.8 | 2.4 | 2.4 |
| Costs & returns over & above the continuous grazing system | | | | | | | | | |
| (1) Sheep | | | | | | | | | |
| Cost of additional fences & water (i.e. maintenance/ac./ year)** | - | .09 | .30 | .09 | .30 | .14 | .48 | .14 | .48 |
| Cost of pasture re-establishment | - | - | - | 1.50x | 1.50x | - | - | - | - |
| Gross margin from additional stock | - | 1.98 | 1.98 | 3.17* | 3.96 | 1.99 | 1.98 | 3.17* | 3.96 |
| Annual increase in net profit/ac. | - | 1.89 | 1.68 | 1.58 | 2.16 | 1.84 | 1.50 | 3.03 | 3.48 |
| (2) Cattle | | | | | | | | | |
| Cost of additional fences & water (i.e. maintenance/ac./ year)** | - | .14 | .46 | .14 | .46 | .22 | .74 | .22 | .74 |
| Cost of pasture re-establishment | - | - | - | 1.50x | 1.50x | - | - | - | - |
| Gross margin from additional stock | - | 2.14 | 2.14 | 3.42 | 4.28 | 2.14 | 2.14 | 3.42 | 4.28 |
| Annual increase in net profit/ac. | - | 2.00 | 1.68 | 1.78 | 2.32 | 1.92 | 1.40 | 3.20 | 3.54 |

** From Table 1

x With heavy stocking rate on 3 paddock rotation lucerne is assumed to require re-establishment every 4 years (page 3).

* Have assumed 20% reduction in profitability on stock in large paddocks at high stocking rates.

Title: Annual increases in net profit/acre resulting from increased stocking and subdivision of dryland lucerne pastures over continuous grazing for both sheep and cattle

TABLE 3

| Development Stages | Continuous Grazing | 3 Paddock Rotation (1) | (3) | (2) | (4) | 6 Paddock Rotation (1) | (3) | (2) | (4) |
|---|---|---|---|---|---|---|---|---|---|
| Paddock size | 1500 | 500 | 100 | 500 | 100 | 250 | 50 | 250 | 50 |
| D.S.E's./acre | 1.2 | 1.8 | 1.8 | 2.4 | 2.4 | 1.8 | 1.8 | 2.4 | 2.4 |
| Costs & Returns over & above the continuous grazing system | | | | | | | | | |
| (1) Sheep | | | | | | | | | |
| Additional capital/ac. in fences and water | - | .86 | 3.01 | .86 | 3.01 | 1.42 | 4.83 | 1.42 | 4.83 |
| Additional capital in pasture re-establishment | - | - | - | 1.50 | 1.50 | - | - | - | - |
| Additional capital invested in stock | - | 2.80 | 2.80 | 5.60 | 5.60 | 2.80 | 2.80 | 5.60 | 5.60 |
| Total additional capital invested | | 3.66 | 5.81 | 7.96 | 10.11 | 4.22 | 7.63 | 7.02 | 10.43 |
| Additional net profit/acre/year | | 1.89 | 1.68 | 1.58 | 2.16 | 1.84 | 1.50 | 3.03 | 3.48 |
| % Return on Capital | | 51.7% | 28.9% | 19.8% | 21.4% | 43.6% | 19.7% | 43.2% | 33.4% |
| (2) Cattle | | | | | | | | | |
| Additional capital invested in fences & water | - | 1.35 | 4.60 | 1.35 | 4.60 | 2.17 | 7.41 | 2.17 | 7.41 |
| Additional capital invested in pasture re-establishment | | | | 1.50 | 1.50 | | | | |
| Additional capital invested in stock | | 5.14 | 5.14 | 10.28 | 10.28 | 5.14 | 5.14 | 10.28 | 10.28 |
| Total additional capital invested | - | 6.49 | 9.74 | 13.13 | 16.38 | 7.31 | 12.55 | 12.45 | 17.69 |
| Annual increase in net profit/acre | - | 2.00 | 1.68 | 1.78 | 2.32 | 1.92 | 1.40 | 3.20 | 3.54 |
| % Return on Capital | | 30.8% | 17.2% | 13.6% | 14.2% | 26.3% | 11.2% | 25.7% | 20.0% |

Title: The returns to additional capital invested in increased stocking and subdivision of dryland lucerne pastures over continuous grazing for both sheep and cattle

## SUMMARY OF ECONOMICS OF SUBDIVISION

3 Paddock Rotation:

The return on capital invested with 2.4 D.S.E's./acre under the 3 paddock rotation is 21.4% and 14.2% for sheep and cattle respectively. This would appear profitable. However if we consider situation (1) with sheep (1.8 D.S.E./acre and 3 x 500 acre paddock) the capital invested per acre is $3.66 and the return is $1.89. To advance to stage (4) requires an extra $10.11 - $3.66 = $6.45 investment per acre for an additional return of only $2.16 - $1.89 or 27¢.

i.e. The marginal return on capital is:- $\frac{.27}{6.45} = 4.1\%$

This is not sufficient to pay the interest and so investment should not be extended beyond stage (1) with the 3 paddock system.

Likewise with cattle the marginal return is:-

$$\frac{.32}{9.89} = 3.2\%$$

6 Paddock Rotation:

However with a 6 paddock rotation the high stocking rate does not result in lucerne having to be re-established every 4 years. Hence the higher stocking rate is more profitable.

Sheep: Marginal return $= \frac{3.48 - 1.84}{10.43 - 4.22} = 26.4\%$

Cattle: Marginal return $= \frac{3.54 - 1.92}{17.69 - 7.31} = 15.6\%$

i.e. although the rate of return on capital is reduced with added fences, etc., the return is still sufficient to justify this cost (for sheep).

Under the 6 paddock rotation stage (2) (6 x 250 acre paddock and 2.4 D.S.E./acre) has almost as high a return on capital as stage (1) despite an assumed 20% decrease in gross margin.

For cattle the marginal return on capital from (2) to (4) is 34/5.24 is only 6.5% and so it is pointless going past this 2nd stage.

For sheep the marginal return on capital from stages (2) to (4) is .45/3.41 = 13.2% which is a borderline return to capital and is anyway dependent on the assumption that gross margin/D.S.E. will be reduced by 20% in the larger paddocks. It thus appears that even with sheep alone, the development from stages (2) to (4), i.e. decreasing paddock size from 250 to 50 acres is only of borderline profitability, and certainly not a high priority developmental stage.