DEPARTMENT OF AGRICULTURE, SOUTH AUSTRALIA

Agronomy Branch Report

PART I

DRYLAND LUCERNE RESEARCH AND EXTENSION

IN N.S.W. AND A.C.T. - 1970

PART II

TECHNIQUES OF ANIMAL EVALUATION OF PASTURES

IN N.S.W. AND A.C.T. - 1970

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FOREWORD

The Australian Wool Research Trust Fund has financed a research programme in South Australia since 1966 under the general title, Utilization of Dryland Lucerne Pastures, which has initially looked at dryland lucerne of deep sandy soils of the Upper South East of South Australia.

This programme has been relatively successful, and the valuable role of lucerne in that area has been defined. In addition the requirements for maintaining dryland lucerne in that environment have been outlined, and methods of meeting these requirements have been suggested.

It has been realized however, that certain of the advantages of lucerne would also apply to other areas of this State, especially the higher rainfall areas of the South East and certain cereal growing areas in which increasing areas of land are being returned to pasture. Most other research work on dryland lucerne pastures in Australia is being carried out in N.S.W. and A.C.T., and it was considered worthwhile to visit the centres carrying out such research prior to any further expansion in South Australia.

While the visit was largely aimed at getting further information on the usage of dryland lucerne pastures, other important aspects examined during the trip were concerned with methods of animal evaluation of various species and pasture mixtures. Animal evaluation, although more difficult and costly is now considered essential in evaluation of species, fertilizer and other management treatments.

The trip was combined with a visit to Brisbane to attend the 8th Biennial Conference of the Australian Society of Animal Production, at which a paper from initial dryland lucerne experimentation in South Australia was presented.

PART I

DRYLAND LUCERNE IN N.S.W. AND A.C.T.

Introduction:

Interest in dryland lucerne pastures has of course been boosted by wheat quotas having the effect of increasing the proportion of land on individual properties under pastures. On the other hand decreased prices for sheep products have made even more critical the need to establish highly productive pastures at minimum cost.

The ability of dryland lucerne based pastures to survive drought (1965 and 1967 in N.S.W. for example) and to produce valuable "out of season" pasture well suited to growth of young animals and fattening of older ones has been adequately demonstrated, but techniques for establishing, and methods of optimally using dryland lucerne pastures are far from clearly defined.

Centres visited which were actively engaged in lucerne research were C.S.I.R.O., Deniliquin and Canberra, New South Wales Department of Agriculture at Tamworth, and University of New England at Armidale. Current research and extension findings from these of most likely interest are as follows:-

1. Establishment

a. Deniliquin - the work of Noble has been aimed at defining the requirements for pasture establishment with or following a cereal crop. Lucerne can be established reasonably only in most favourable seasons under a crop (on loam and clay soil types). A far more productive pasture will be obtained in most seasons if the lucerne is sown solely in a pasture mixture in the year following the crop, but this must of course be balanced against the increased establishment costs - obviously requirement for minimum cost establishment research. Another particularly interesting aspect of this work on loamy soils has been the control of heliotrope (Heliotropium europaeum) when lucerne was sown at rates greater than 0.5 lb./acre without a cover crop.

b. Canberra - Considerable work is being carried out in this environment, largely by Hutchings. The aim is to introduce improved pasture species at minimal cost onto arable and semi-arable land. Herbicides and/or minimal tillage are the chief tools being used in the hope of reducing the costs of normal seedbed preparation and the dangers of erosion. These

techniques are being looked at both on areas which have received considerable fertilisation and on unfertilised areas of native vegetation. Sod seeding of lucerne has been most successful for example when Dalapon + Amitrol (rather than Reglone(R) + Gramoxone(R)) have been used at sowing after heavy grazing or burning of the dry pasture residue.

It is crucial that the results of this work should be closely followed, so that any possible adaptation to South Australian conditions can be tested.

2. Row spacing, plant density & companion species of lucerne

a. Deniliquin - In this semi-arid environment evidence is accumulating that Jemalong or Harbinger barrel medic and/or Geraldton subterranean clover are the most suitable companion species with lucerne. However, on drier sites, loss of lucenre stands occurred during the 1967 drought. In most other environments, although populations may have been reduced during the drought, lucerne generally survived these stress periods remarkably well. The reasons for the loss at Deniliquin are not clear.

b. Canberra - A considerable amount of work is in progress in the Canberra environment, attempting to define the interactions between width of row spacing, plant density, cultivar of lucerne and companion species.

The Canberra environment may bear considerable resemblance to areas of South Australia with say greater than 22" annual rainfall. In the Canberra environment, phalaris plus subterranean clover is a highly successful improved pasture mixture and gains from lucerne based pasture over this are only marginal. These gains are in the form of better out-of-season-growth suitable for growing young animals and for fattening stock for market.

Preliminary investigations on the effect of combining lucerne and other species has indicated that with a range of five row spacings of lucerne (6", 12", 18", 24" and infinity), it appears that 12" and 18" rows maintain best the advantages of lucerne, while allowing winter production from the other species component to be similar to that of subterranean clover plus "other species" or subterranean clover-phalaris. at 6" row spacing, it appeared that total annual production may be lowered, and this reflected in animal performance during the winter. 24" rows caused depression of animal production because of inadequate lucerne to respond to out of season rainfall. Number of lucerne plants/unit row length were kept constant in this experiment.

The range of cultivars tested in this trial indicated that Hunter River is still the most adaptable cultivar. The design of this experiment was very interesting - originally cross strips of perennial grasses were included as well, but these failed to compete with the lucerne. The layout consisted of two Latin squares, 5 x 5 incorporating a 5 paddock rotation. Stocking rate was constant, 10 weaners/acre overall, but was in fact varied by leaving the animals in the various paddocks from periods of 5 to 9 days.

The ramifications of this experiment to higher rainfall areas of South Australia are important, and the testing of these tentative conclusions in these areas are of high priority.

The information from these and other row spacing and companion species with lucerne are going to be put to the test under full scale grazing trials on land recently acquired at Gianninderra. Through the use of a capital re-development fund, C.S.I.R.O. will be able to set up two relatively large scale grazing trials with both sheep and cattle which should better define the place of lucerne and the best species combination with lucerne in the southern tablelands environment of New South Wales. These experiments have been sown in 1970 and are as follows:-

(i) The grasses, Siro 1146, Sirocco, Special Select, General Select (from C.S.I.R.O. phalaris breeding programme) and Australian phalaris, Victorian PRG, Gundaroo PRG, Medea PRG, Wimmera ARG, Bromus unioloides and Avena strigosa will be sown alone and in combination in alternate 7" rows with Hunter River lucerne. Standard grazing management will be around 4 paddocks each of 1/8 acre, with two stocking rates in the ranges 4-6 and 6-8 breeding ewes/acre. Merino and crossbred ewes will be included in each group in an attempt to gain breed information as well.

(ii) Breeding cattle (20/treatment) will be used in another experiment in which Wimmera annual ryegrass and Australian phalaris will be sown alone and in alternate 7" rows with Hunter River lucerne. Two stocking rates will be compared with constant 4 paddock systems (4 x 6 acres and 4 x 8 acres).

The two trials are large and expensive, but I consider by far the most relevant way of estimating the economies of including lucerne in the grazing situation. The experiment using cattle was the only one I saw either in planning or in practice involving the assessment of lucerne in terms of beef cattle production. Obviously there is a great need for work

with lucerne and beef cattle, but the high capital costs of establishing worthwhile trials seems to be the limiting factor. Alternative methods of financing and running such experiments need close examination.

c. Tamworth - Traditionally lucerne has been established under a cereal crop in this environment, and the pasture has consisted largely of lucerne. However the winter feed gap is not helped by lucerne alone and it is realised that one or more alternative winter growing species are desirable. Natural annual Medicago species grow reasonably in some seasons but have some undesirable characteristics. Cultivars such as Jemalong would appear suitable but problems with re-establishment have been met, and research is being conducted to define these problems.

3. Utilisation

a. Canberra - Considerable work is being carried out at Ginninderra with relevance to the Southern Tablelands environment (some of this work has been summarised in the previous section).

(i) The work of the McKinney indicates that grazing time is immaterial, but that spelling time is all important in lucerne plant loss. He suggests that the critical spelling times (below which plant loss accelerates markedly) is 30 days in summer and 45 days in winter. His work also indicated that wool production was greater under systems of moderate (2 and 3 paddock) than intense (6 and 12 paddock) subdivision. Thus as spelling time increases the lucerne component increases and the barley grass and sub. clover components decrease. The general feeling from this and other Canberra work is that a 3 paddock system with long rotation is the most economical utilisation of dryland lucerne pastures on Southern Tablelands. Unfortunately this work was carried out only at one stocking rate. In addition the Canberra soil types do not allow stock to damage the lucerne crowns by "digging" around them and high lucerne plant densities can be maintained for a few years at least. The application of such results to the sandier soil types in South Australia on which lucerne is generally grown must be done with extreme caution.

(ii) Work on grazing lucerne with weaners has indicated the importance of allowing these animals first access. When a group of "leader" weaners preceding a group of "follower" weaners, the former grew far more rapidly and produced more wool. Thus obtaining maximum growth rates of weaners and maximum utilisation of the lucerne are mutually exclusive.

By leaving weaners in a paddock for only half the normal time, and using twice the number of paddocks, and following the weaners by animals only requiring maintenance, e.g. cattle, ewes or wethers, then maximum growth rates of the weaners and maximum utilisation of the lucerne can be achieved.

b. Tamworth & Armidale - Bloat problems with cattle on lucerne may be considerable even under dryland conditions at certain times of the year. At present there are two lines of work which seem they may minimise the problems of bloat.

(i) The development of an anti-bloat capsule and the closer definition of bloat promoting conditions of pasture, give considerable hope for commercial control of bloat in beef cattle. The anti-bloat capsule still needs developing, however, both in its effectiveness and its cost. Under closely subdivided conditions bloat control by additions to drinking water are receiving attention and could be of commercial importance.

(ii) There is some evidence that cattle with Bos indicus blood are less susceptible to bloat. If further work on this subject indicates this to be the case, then the potential for introducing Bos indicus blood into beef cattle enterprises on "bloating" pasture must be considered.

4. Physiological work

Glasshouse and pot work was being carried out on lucerne at both Deniliquin and Tamworth. This is a certain method of obtaining results, but the relevance of the results to the grazing situation are doubtful. Problems include the use of plants under 1 year old for experimental treatments and which have not developed a root system at all comparable to that developed under field conditions. Field problems of drought and disease further complicate the interpretation of the results obtained under glasshouse conditions.

Difficulty was being found at Tamworth in interpretation of results from field trials where differences occurred between comparable treatments according to whether cutting or grazing occurred.

In effect I am saying that there is still a large and interesting field of lucerne physiology which can be worked on in the glasshouse, but that many of the results obtained are unlikely to be of relevance under the grazing situation and thus if one is worried about cost benefit relationships in pasture research, then pot and glasshouse research is not of high priority. If glasshouse facilities are available however,

then such work may be relatively low cost and provide positive results, compared with the difficulties and frustrations of experimenting under the grazing situation.

5. Breeding work

a. Deniliquin - Miss Veronica Rogers' work in this environment is aimed largely at production of more suitable cultivars of lucerne for the dryland environment. Major emphasis is being placed on increased persistence and drought resistance. Several reputedly drought resistant and long lived lines, Medicago agropyretorum and M. tianschianica have been obtained from southern Russia. Both species readily cross with Hunter River lucerne and F1's are being examined. Other species of perennial Medicago will be examined when they have been freed from quarantine.

Other work has been selection for increased "creep" in the Deniliquin environment. An interaction between expression of "creep" and soil type meant that "creep" was poorly expressed in Deniliquin compared with Canberra. Some selected lines show four times the "creep" of cultivar "Cancreep" after 12 months in dense soil with vigour comparable to Hunter River. Parental material in such programmes also includes Hunter River residual plants which have grown for some years at Deniliquin as a non-irrigated sward exposed to long grazing periods.

b. Canberra - Work in this environment has aimed at production of a creeping rooted cultivar of lucerne. However, the conditions required to maximise "creep", i.e. planting on a 2' x 2' grid with weed free conditions for the first 18 months is uneconomical. This has been one of the reasons for the poor acceptance of the cultivar "Cancreep". It is desirable that future creeping rooted lucernes should be able to express "creep" under conditions of competition with annual plants at least and not only under weed free conditions.

I implore that in any lucerne breeding, selection and testing programmes, promising plants should be tested at an early stage under competitive conditions, rather than all testing being done under weed free conditions up to the point of release.

c. Tamworth - In this environment, improvement in lucerne is considered most desirable in terms of insect and disease resistance, and increased winter production. There is no active lucerne breeding work at Tamworth at present. One of the interesting points raised in discussion at Tamworth was that some recent work indicated that death of lucerne plants under waterlogging was due to ethylene toxicity. Further there appeared to be, under the conditions tested, a wide range of ethylene

concentrations causing toxicity. If such a mechanism is the chief one involved in the waterlogging effect, then selection for resistance to waterlogging may not be as difficult as had been previously thought.

6. Research techniques particularly applicable to lucerne

a. Canberra

(i) Precision seeding of lucerne and grass seeds with accurate metering along rows, and ability to vary row width has been achieved with an imported Dutch precision vegetable seed seeder. Such equipment has allowed the relatively rapid sowing of large scale trials comparing for example row spacings and seeding rates of lucerne and grasses.

(ii) Counting of lucerne plants within a quadrat had not been found practical in the Canberra soil type due to difficulties in distinguishing individual crowns. The method now used estimates number of plants/unit row length. For example the soil is ripped or dug up for 2 feet along the row, so that the tap roots are exposed, and can be easily counted. Soil is then replaced around the exposed tap roots. Attempts are being made to mechanise this process by attaching small ripper blades onto a tractor tool bar.

(iii) Electronic pasture probes were used widely at Canberra and Tamworth for estimating availability of pasture in lucerne grazing experiments. At Canberra it was claimed that the same regression could be used for all treatments at any given sampling time. The pasture at Tamworth was almost pure lucerne. Complications will arise with this method however, when estimations of lucerne and one or more other components are required.

PART II

TECHNIQUES OF ANIMAL EVALUATION OF PASTURES

a. Pasture availability - The core dissection technique of Hutchinson was being used on several experiments both in the Canberra and New England areas. This method was considered particularly useful on levels of low availability. 40 x 3" cores/acre were considered adequate sampling. Yields of these cores could then be determined accurately in the laboratory. Definiton of ground level was the greatest difficulty with this technique.

b. Use of lambs for measuring performance of pure swards - Growth rates of lambs was considered the most meaningful and most easily obtained method of assessing animal performance of various pasture mixtures or components. In Canberra growth rates were being compared on lucerne, subterranean clover and phalaris. In this situation lambs in pens ate 31% more of the legumes and gained 85% more carcase weight over 50 days than lambs on phalaris when fed ad lib. When legume intake was restricted to that of the grass, all the lambs grew at the same rate.

At Chiswick, Hamilton and Hutchinson were comparing growth rates of lambs on four perennial grasses. In this trial, lambs were being placed on the trial at 5 months of age, and replaced after 12 months with lambs of similar age. By this method they considered that maximum economic differences of the various treatments would be estimated.

Other work at Chiswick by Wheeler had compared Demeter fescue with phalaris. He found that Demeter fescue was better in the first two seasons. In the third season there was no difference, and subsequently phalaris was better. This was considered due to the slowness of phalaris to establish and later failure of Demeter to persist.

Workers at Chiswick used net energy change techniques in assessing lamb growth. They considered that the increased information obtained out-weighed the extra time and expense of greater numbers of animals required, and the need to obtain slaughter data, etc.

The objections to the use of young animals being replaced every 12 months are the lack of lifetime productivity data, and the difficulty of obtaining adequate data for initial stratification of the trial animals.

c. Modelling in the pasture system - Work by Hutchinson at Chiswick was aimed at applying energy flow concepts to the pasture conservation system. In one experiment involving three stocking rates with wethers the entire ecosystem was being studied in detail - even down to the energy flow via

decomposition of dry material by arthropods. A less complex trial was being carried out with ewes. Definition of areas requiring further research and other problem areas were considered the main benefits of this modelling systems approach.

d. Changing agricultural systems - The effects of droughts and low prices for wool have at this stage caused a major rethink of direction of research in the Northern Tablelands of New South Wales. This change of attitude at the University of New England for example suggests that phalaris and lucerne which survived the droughts are the only worthwhile sown perennial species, while white clover, and other improved perennial grasses are now in disrepute. Lowering of fertiliser applications have resulted in many pastures being invaded by native grasses. It seems that there could be increased emphasis on specific fodder crops, both summer and winter.

An example of an attempt to experiment with a real farm problem is provided by a co-operative experiment on defining the best method of utilising oats + N in the winter by the University of New England, Departments of Agronomy and Agricultural Economics, farm club advisers and fertiliser companies. The aim of the experiment was to assess oats + N in the fattening of beef cattle. Levels of nitrogen x stocking rate designs were used for several farms in various areas as selected by the farm club advisers. After much discussion it was decided that "a put and take system" for the cattle would be the most useful method of determining the economics of the various treatments. Thus stocking rates were defined by pre-determined liveweight gains, and "putting" and "taking" was carried out according to the liveweight of test animals in each treatment. In this way, the treatments would most closely approach the real farm situation, where as many animals as possible are fattened, for sale in winter months and the rest are held over for later fattening and sale.

This type of experimentation could be useful in many situations, for example in defining the economics of a portion of a property under lucerne both in cereal and in the high rainfall areas of South Australia. The use of such experimentation is certainly worth following up.