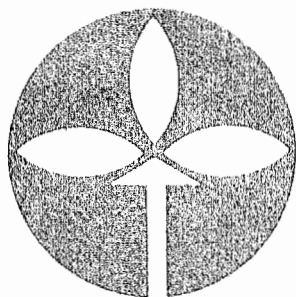


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DEPARTMENT OF AGRICULTURE, SOUTH AUSTRALIA

Agronomy Branch Report

Report No.

DEPARTMENT OF AGRICULTURE

SOUTH AUSTRALIA

AGRONOMY BRANCH

PASTURE RESEARCH SECTION

RESEARCH PROJECTS

AND PERSONNEL

September, 1970

PASTURE RESEARCH SECTION

This section, responsible to the Chief Agronomist (Mr. P.M. Barrow) through the Principal Research Officer, (Agronomy) (Mr. J.B. Doolette) is led by the Senior Research Officer, (Agronomy) (Mr. E.D. Higgs).

The section's research function is oriented towards increased production from pastures via the PLANT.

It is arbitrarily grouped into disciplines with group or discipline leaders.

These groups have been so chosen to give an integrated approach to plant improvement through both genetic and cultural means to the point of evaluation in terms of animal product.

Projects undertaken by individual members of the section may cover one or more of the disciplines and in the latter case co-operative research is encouraged wherever practicable.

The projects and personnel are listed below in their groups.

1. Genetics, Plant Breeding, Plant Introduction - Leader, M.J. Mathison, Senior Research Officer, (Plant Breeding).
 - A. Annual Medic Breeding - M.J. Mathison.
 - B. Perennial Medic Breeding - Mr. I.D. Kaehne, Research Officer, (Plant Breeding).
 - C. Plant Introduction - Mr. E.J. Crawford, Plant Introduction Officer.
 - D. Variety Testing - E.J. Crawford, E.D. Higgs.
 - E. Other Plant Improvement - I.D. Kaehne.
2. Pasture Plant Physiology, Seed Physiology, Seed Crop Physiology - Leader, Mr. K.G. Boyce*, Senior Research Officer, (Agronomy)
 - A. Growth and development of perennial grasses - K.G. Boyce
 - B. Flowering behaviour in annual medics - M.J. Mathison
 - C. Time of harvest studies with perennial grasses - K.G. Boyce
 - D. Physiology of hard seededness in annual medics - Cooperative.

*At present overseas undertaking Ph.D. studies.

3. Seed Crop Agronomy - Leader, Mr. E.D. Higgs, Senior Research Officer, (Agronomy)
4. Pasture Establishment Agronomy - Leader, Mr. D.A. Saunders, Research Officer, (Agronomy).
5. Weed Control - Mr. P.M. Kloot**, Research Officer, Weeds
 - A. Weed Control in Pastures
 - B. Weed Control in Pasture Seed Crops.
6. Pasture Management - Leader, Mr. M.V. Smith, Senior Research Officer, (Agronomy).
 - A. Utilisation of Dryland Lucerne Pastures Project - M.V. Smith
 - B. Research and Extension Programme for Lucerne in other Areas of South Australia - M.V. Smith
 - C. Testing of Perennial Grasses Under Grazing - Mr. P.R. Gibson, Research Officer, (Agronomy).
7. Pasture Production Potential Re-Assessment in the Lower South East - Leader, Dr. P.S. Cocks, Senior Research Officer, (Agronomy)
8. Other Pasture Investigations - Mr. P. Beale, Research Officer, (Agronomy).

** Member of Weeds Section

1. Plant Breeding, Genetics, and Plant Introduction

A. Annual Medic Breeding - (M.J. Mathison)

This programme has as its broad objectives, increased yield and protein levels in wheat grain and increased livestock production in the ley phases of the wheat, sheep, annual pasture legume interaction.

The objectives are being sought through breeding improved cultivars of annual Medicago particularly M. truncatula (barrel medic) and its close relatives M. littoralis (strand medic) and M. tornata (disc medic). This species group is of major importance in southern Australia, especially in this state where it is "the" ley legume for some two thirds of the wheatbelt.

The main attributes in which improvements are sought are:-

1. winter dry matter production,
2. seed and pod yields,
3. adaptability to a wide range of environments,
4. natural regeneration in the year following the setting of seed.

Since its inception in 1965/66 the programme has been concentrated in the following areas:-

- a. Developing mechanised field plot techniques for evaluation of yield and adaptability in swards of large numbers of entries of accessions and breeding progeny.
- b. Selection, on a biological basis, of test sites for adaptability evaluation for the major regions of importance of annual medics within South Australia,
- c. Acquiring adequate genetic variability in conjunction with the Plant Introduction Programme for setting performance standards and ensuring faster progress through breeding.
- d. Screening introductions for desirable seed coat permeability attributes.
- e. Making intraspecific and interspecific crosses with material in the following categories; outstanding selections from earlier plant introduction studies, adapted lines (mainly cultivars), morphological variants (both for identification and possible new forms of pasture management), material of geographically isolated origin (for superior transgressive segregates).

The present stage in the programme involves the following activities:-

- a. Sward trials at two localities of 64 entries comprised mainly of pre 1969/70 breeding parents, and including all Australian cultivars of annual Medicago.
- b. Seed production in glasshouse and field for sward testing to commence in 1971, of several hundred pre 1969/70 accessions of M. truncatula (almost the entire collection) and approx. fifty F2 populations of pre 1969/70 M. truncatula and M. truncatula x M. littoralis crosses.
- c. Glasshouse seed production of 1969/70 F1's and accessions of limited seed stocks.
- d. Making further F1, backcross and 3 and 4 way crosses both within the M. truncatula species complex and other closely related diploids and also among the tetraploids M. scutellata (snail medic) and M. rugosa (gama medic), This will involve cytological studies and further development of crossing techniques to achieve certain combinations.
- e. Cooperative seed physiology and anatomy studies aimed at improved screening techniques for seed coat permeability studies.
- f. Further acquisition of medic material for screening for seed coat permeability attributes.
- g. Flowering behaviour and genetic studies.

Financing of this project is from State Funds, and State Wheat and Wheat Industry Research Council funds.

B. The Breeding of Improved Lucerne Cultivars Primarily for use in South Australia - (I.D. Kaehne)

Within the perennial species of Medicago, i.e. the lucerne family of plants, there exists genetic potential to improve upon the present cultivars currently commercialised.

It is proposed to develop populations which will be assessed for their potential to contribute improvement in the following features:

- (1) Yield of herbage and seed, especially in the more favourable areas and under irrigation.
- (2) Adaptation to a wider range of soil conditions, especially winter waterlogged soils.
- (3) The persistence of lucerne under continuous grazing, and improve the tolerance under grazing of winter active lucernes.
- (4) Incorporating higher resistance to disease and insect attack.

Financing of this project is from State funds and recently approved Wool Research Trust funds.

C. Plant Introduction Programme

General Herbage Plant Introduction - (E.J. Crawford)

A continuing programme of evaluation of a wide variety of herbage plant introductions is maintained. Material is received regularly from C.S.I.R.O. Division of Plant Industry. Most promising material is included in trials described under section dealing with plant variety testing.

Maintenance of herbage plant seed collection (E.J. Crawford, M.J. Mathison, I.D. Kaehne)

A seed store is being planned to house seed stocks in a manner which should allow effective long term storage. Stocks will be turned over every decade or so as necessary to maintain viability.

1970 Plant Introduction Observation Rows (E.J. Crawford)

Approximately 580 rows of 25 plants at six inch spacing. Main groups are - M. truncatula, M. littoralis, M. rugosa, M. tornata, M. turbinata and M. orbicularis lines, from an extensive collection made in Mediterranean countries during 1967 and subsequent introductions. Detailed morphological and performance details are being scored.

D. Variety Testing

Annual Legume Trial (E.J. Crawford)

Seasonal production and persistence of two strains of T. cherleri, T. purpureum, T. globosum and T. xerocephalum is being compared with two commercially available strains of T. subterraneum viz. Yarloop and Woogenellup at Hundred Ritchie, Kangaroo Island.

Establishment determined by actual plant counts, production by quadrat cuts.

Annual Medic Sward Trials (E.J. Crawford)

Twenty three strains of Medicago truncatula, Medicago littoralis (Harbinger), Medicago rugosa (Paragosa) selected on outstanding performance at Parafield are under test in the upper north in an endeavour to find an adapted annual legume for soils at present lacking one. Three sites of mainly hard setting red brown earths were selected at Appilla, Caltowie and Gulnare.

Establishment counts, production cuts and burr harvests are taken.

Sowings for three consecutive years have been made in the same general areas.

Lucerne Variety Trials (E.J. Crawford)

- a. Persistence and seasonal and total production of African, African selection (breeder's seed), Nomad, Canberra Creeping rooted and Rhizoma strains is being compared with Hunter River. Trial was established with seedlings at two plants per square link. Sampled at six weekly intervals when growth permits. Survival determined by actual plant counts after opening rains in each season.
- b. Two African selections are being compared with Hunter River for persistence and seasonal and total production, Latin square with each strain appearing twice in each row. Sampled for dry matter production at six weekly intervals. Survival from actual plant counts after opening rains.
- c. Persistence and seasonal and total production of two African selections is being compared with African and Hunter River. Production samples taken and whole trial grazed at regrowth stage of African.

Lucerne Variety Trials (E.D. Higgs)

Lucerne variety research is currently being redeveloped after a period of little work which followed fairly extensive work by E.J. Crawford. While some work is being undertaken in regions previously studied, the emphasis is being placed on variety performance in higher rainfall regions of the state where little

previous variety testing work has been undertaken. A range of previously untested varieties from the Mediterranean basin selected from Dr. G. Leach's introduction program is being compared with the range of commercially available varieties.

The most recently established trials have included a wide range of densities. Trials are harvested on a regular basis throughout the year using a flail harvester. Undeveloped areas are subsequently crash grazed.

Sub clover variety trial (E.J. Crawford)

Five (Howard x [Clare x Wenijup]) hybrids produced by the Genetics Section of C.S.I.R.O. are being compared in a latin square design with the cultivar Clare for season herbage production. The hybrids are reputed to:-

- a. be low in formononetin
- b. be higher seed yielding
- c. have easier threshed burrs
- d. be more frost tolerant than Clare
- e. be virus stunt resistant
- f. have greater seedling vigour and total production,

Other Plant Improvement, An Assessment of the Seed Production of Creeping Rooted Lucerne Clones (I.D. Kaehne)

[A joint project with C.S.I.R.O., Division of Tropical Pastures]

A breeding programme at C.S.I.R.O., Tropical Pastures, has developed populations in which high all-season production is combined with creeping and rhizomatous growth habit.

To ensure that the seed production of any cultivar derived from clones having high vegetative yield is adequate for commercial production, forty four clones having high vegetative yield are being grown under irrigation, and their seed production under random pollination using honey bees is being assessed.

It is proposed that those clones having both high seed yield and desirable vegetative characteristics will be combined to form a synthetic variety.

The seed yield assessments are being done in South Australia because the climatic conditions are most suitable,

2. Pasture Seed Production and Physiology

A. Pasture Plant Physiology (K.G. Boyce)

1. Influence of CCC on height of Sirocco Phalaris

A series of studies to determine whether application of the growth hormone CCC will reduce the height of seed crops of Phalaris tuberosa cv. Sirocco and so facilitate harvest operations.

2. Growth and development of perennial grass species in S.A.

Studies being undertaken to determine the seasonal timing of growth stages (particularly floral initiation) of perennial pasture grasses grown for seed in S.A. Plant material growing in the field at three sites, Mt. Gambier, Naracoorte and Northfield is being sampled during winter and early spring. The influence of temperature on the seasonal timing of growth stages is being determined by glasshouse experiments.

3. Time of Application of Nitrogen to seed crops

Glasshouse experiments to determine the time to apply Nitrogen fertilizer for optimum yield of perennial pasture grass seed crops.

4. Evaluation of Reproductive rhythm of European Grasses

Photoperiod and vernalization responses are studied of a number of European grasses which may possibly be grown under contract by S.A. seed growers.

B. Flowering behaviour study in annual Medicago species (M.J. Mathison)

Knowledge of the operation of the factors, temperature and photoperiod and their interactions influencing the flowering process is particularly important for the practical considerations including:-

- a. Manipulation of flowering of parental lines in the medic breeding programme, particularly synchronisation in the actual crossing procedure.
- b. Seed production in artificial environments - qualitative and quantitative aspects.

- c. Studying the genetics of response of the stages of flowering to the factors.
- d. Adapting exotic material to our own natural environments through a knowledge of c.

Controlled environment studies are planned, using material from distinctly different climatic source regions. Initially growth cabinet facilities nearing completion at Northfield will be used for preparatory studies.

C. Time of Harvest studies with Perennial Grasses (K.G. Boyce)

A series of experiments are being conducted to determine the time of maximum viable seed yield in relation to seed moisture percentage, seed growth and development and seed shattering. All current perennial grasses grown for commercial seed produced in S.A. are being investigated. Aspects involved in this program are:-

1. Seed growth and development in relation to temperature, relative humidity and nutrition - in controlled environment.
2. Evaluation of threshing damage to seed caused by harvest at high moisture levels.
3. Seed drying and influence on seed viability.
4. Development of commercial harvest techniques for more efficient seed production.
5. Determination of harvest time from seed moisture content in the field and application to grower practice.

Mr. Boyce's programme is financed from State funds and Wool Research Trust funds.

D. Seed Physiology

Several cooperative projects are being conducted by members of the research group concentrating on the physiology of hard-seededness and water relations of the seed for germination in the annual Medicago species.

Projects being undertaken at present are:-

1. Comparison of various laboratory methods for assessing Hard-seed status of annual legume seed - Northfield (K.G. Boyce, E.J. Crawford, M.J. Mathison, D.A. Saunders)

To assess a range of laboratory methods causing hard-seed breakdown of annual Medics in an endeavour to devise a rapid method of assessing hard seed status of a large number of lines of Medicago species from the Medic Breeding and Plant Introduction Programs.

2. Comparison of Field and Laboratory methods for Hard-seed breakdown - Northfield and Parafield (K.G. Boyce, E.J. Crawford, M.J. Mathison, D.A. Saunders)

A comparison of the alternating temperature technique (Laboratory) and successive harvest technique (Field) for measuring the rate of breakdown of hardseededness (seed coat impermeability to water entry) in annual Medicago species from the Plant Introduction Program will be made. The aim is to reduce the time and labour necessary to assess breakdown in the field. The method of successive harvest at present used is to take samples at three-weekly intervals from the time of plant maturity and determine germination percentage (soft seeds). This method takes about 6 months to complete and is applicable only to the site and year of testing. By submitting samples to alternating temperatures of 15°C to 65°C at several cycles per day, the rate of hardseed breakdown may be increased, resulting in shorter test periods, may involve less seed material and be repeatable. Tests made so far in which seeds of 3 cultivars have had exposure analagous to 8 months in the field have failed to reduce seed coat impermeability. Further studies are in progress.

3. Determination of water balance of medic seeds during germination in relation to rainfall, evaporation and rate of increase of suction pressure (Boyce and Saunders).
4. Comparative anatomy of the seed coat and particularly the strophiole region of species of annual medics (Boyce and Mathison).
5. Evaluation of the possibility of long term storage of annual medic gene material associated with the breeding and evaluation programs (Boyce, Mathison and Crawford). Using low temperature storage in comparison with standard seed-store conditions.

3. Seed Crop Agronomy (E.D. Higgs)

Seed Production

A continuing interest is being maintained in research aimed at providing reliable technology for obtaining maximum economic yields in the year of establishment of perennial grass seed crops. This work is confined to the higher rainfall regions of the South East of South Australia. Currently herbicides and nitrogen fertilizers at various times and rates of application are being examined on Demeter fescue.

4. Pasture Establishment Agronomy (D.A. Saunders)

In South Australia, there have been no serious investigations into pasture seeding techniques. Hitherto, trials have either been seeded by hand or by a standard machine. From these trials, however, much useful information has been gained, mainly relating to choice of plant species and to fertilizer technology.

With the many recent advances in herbicide technology, it is obvious that there is a multitude of techniques now available to sow, resow or upgrade a pasture. Some of these techniques will be economic to implement, others will prove highly uneconomic.

The broad spectrum of factors (soil type, weeds present, herbicide type and rate, seeding rate of particular pasture species, machinery types, fertilizer types and rates) will be covered by the Pasture Establishment Group.

The aims of the group are:

1. To develop simple, low cost methods which will ensure more efficient and more reliable results.
2. To develop systems by which the time of lost grazing will be substantially reduced.
3. To compare commercial machinery performance and to provide an advisory service for farmers when considering the purchase of new seeding machinery.

The equipment for this project, comprising a glasshouse and a full range of mobile field trial machinery has been financed by funds granted by the Australian Meat Research Committee.

5. Weed Control (P.M. Kloot)A. Pasture Weed Control

This officer is a member of the Weeds Section, but his projects are related to those of the Pasture Group.

The work is in two sections:-

a) Specific Pasture Weeds

1. Salvation Jane - Work over a number of years has led to a satisfactory recommendation for the control of this weed in pastures with low rates of hormone type herbicides applied early in the season.
2. Pheasant's Eye - Intensive studies of the ecology and control of this weed are in progress. This is a serious weed of the pasture years of the cereal belt particularly on the heavier calcareous soils.
3. Woolly Salvia - This troublesome weed of the Mallee is also being studied with a view to finding a satisfactory, but cheap control measure in pastures.

b) Weed Control in Pasture Seed Crops

A comprehensive programme is in progress. Crops involved at present are medics (Jemalong, Harbinger, Tornafield), subterranean clover, seedling and established lucerne, seedling and established perennial grasses. The work is mainly routine herbicide screening to establish or to improve recommendations. Studies of the effects of hormone herbicides on the yield of grass and subterranean clover crops are also being made.

6. Pasture ManagementA. Utilization of Dryland Lucerne Pastures Project (M.V. Smith)

Initially, this programme has been concerned with defining the animal production potential of dryland lucerne pastures on the deep sands of the Upper South East of South Australia. The main work aimed at defining stocking rate effects, grazing management requirements and potential erosion hazards was attempted by a relatively large stocking rate x grazing management trial on an established dryland lucerne pasture.

Subsidiary work in this area has been aimed at determining the best methods of fertilizing and establishing dryland lucerne pastures, and defining maintenance nutrient requirements of dryland lucerne pastures.

Considerable work has also been carried out to determine the most suitable companion species, both grasses and legumes to be sown with the lucerne component.

This project has been financed from Wool Research Trust funds, and a suitable area of land was provided on a private property.

B. Research and Extension programme for lucerne in other areas of South Australia

It is considered that the potential of increased animal production from the sowing of dryland lucerne pastures also extends to other areas of South Australia.

1. In the cereal areas for example, lucerne might well be profitably incorporated especially on soil types marginally suited to cereal growing. However, there is great need to define how best to utilize dryland lucerne when it is incorporated into these cereal-sheep farming situations.
2. In the higher rainfall areas, the main attribute of lucerne to the grazing situation is still valid, i.e. response to out of season rainfall, and ability to exploit moisture deep down the soil profile to provide nutritious, out of season feed for growing and fattening stock. Again there is little evidence on the optimum utilisation by livestock. Lucerne cultivar evaluation studies with companion annual and perennial species are also needed.

It is planned that future work in the Dryland Lucerne Pastures Project will extend into these other areas of the State.

C. Testing of Perennial Grasses Under Grazing (P.R. Gibson)

One of the limited number of changes a farmer can make to his farming system is to add one or more new plant cultivars.

For many years the addition of cultivars to particular farming systems has been made on the basis of information other than animal production data. The aim of this project is to place the recommendations for pasture changes on animal production data.

The trial on Kangaroo Island is concerned with the production and persistence of three perennial grasses: Victorian perennial rye grass, Medea perennial rye grass, siro 1146 hybrid phalaris; each forming the basic component of a renovated pasture in the 23" rainfall zone of Kangaroo Island.

The design allows comparisons between perennial and annual renovated pastures both in relation to an unrenovated control.

The pastures are to be evaluated in terms of animal production, particularly wool production, at different stocking rates, particular attention being paid to the stability of the perennial grasses and their economic contribution to wool production in this environment both in the short and long term.

Finance for this project have been provided from Wool Research Trust Funds.

7. Pasture Production Potential Re-Assessment in the Lower South East (P.S. Cocks)

This is a long term investigation aimed at developing means of substantially increasing herbage production in the South Eastern district.

Initially field and growth cabinet studies are being undertaken to determine the interaction between plant variety and species, (all annuals) density, nitrogen application, temperature and light.

It is hoped to more accurately define the upper limit of herbage productivity by these investigations.

A trial including a range of perennial grass cultivar hitherto untested in this region is being established under irrigation at Struan in an attempt to get some indication of the impact of irrigation on the herbage producing potential of the region.

8. Other Pasture Investigations

Replacement of the highly oestrogenic Yarloop cultivar of subterranean clover by less oestrogenically potent material on Kangaroo Island (P. Beale)

A series of studies are being undertaken using the following approaches.

1. Examination of the ability of low oestrogen cultivars of the subspecies group Yanninicum to invade a hitherto Yarloop dominant pasture at various grazing pressures.
2. Examination of the ability of low oestrogen cultivars of other types of subclover to yanninicum to invade a hitherto yarloop dominant pasture at various grazing pressures.
3. Examination of the potential of a number of Trifolium species of low oestrogen status to invade a hitherto yarloop dominant pasture.
4. Examination of mechanical and chemical treatments to reduce seed populations of Yarloop as a precursor to reseeding with less potent material.