



DEPARTMENT OF AGRICULTURE, SOUTH AUSTRALIA

## Agronomy Branch Report

OVERSEAS STUDY TOUR

May 19th to July 31st 1974

Ian D. Kaehne

A report of a study tour in Europe, the USSR and Iran which included an investigation of lucerne breeding in Europe, participation in the XIIth International Grasslands Congress and plant collection missions in the South of the USSR and North West Iran.

Report No. 59.

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1. LUCERNE BREEDING IN THE SOUTH AUSTRALIAN DEPARTMENT OF AGRICULTURE

The Lucerne Breeding Programme of the South Australian Department of Agriculture was commenced in 1969 with the objective of developing improved varieties of lucerne to meet special agronomic and environmental conditions, particularly in South Australia.

The major objectives of the programme are:

1. Selection for yield and persistence under irrigated and dryland conditions.
2. Selection for adaptation to poorly drained soils and adaptation to acid soil conditions.
3. Selection of a lucerne adapted to extensive and continuously grazed pasture conditions.
4. Incorporation of resistance to stem nematode into agronomically suitable varieties.
5. Selection for resistance to feeding by adult *Sitona* weevil.

This programme is based on a collection of over 1,000 introductions of cultivated and wild growing lucerne from 34 countries and representing all perennial species of lucerne.

The programme is based at the Northfield Laboratories of the South Australian Department of Agriculture.

2. OBJECTIVES OF THE STUDY TOUR

A study tour in western Europe and the USSR and Iran in conjunction with the XIIth International Grasslands Congress gave the opportunity to pursue the following objectives:

1. To visit the major lucerne breeding programmes in Europe, to study their objectives, the breeding methods which they used and the contribution these programmes have made to agriculture in their respective countries.
2. To visit the C.S.I.R.O. Biological Control Unit, Montpellier, France to study work on the biological control of *Sitona* weevil.
3. To participate in the XIIth International Grasslands Congress held in Moscow 11th to 20th June 1974.
4. To participate in an Australian Plant Collection delegation in the southern regions of the USSR to enlarge the Australian seed collection of species occurring in those areas.

5. To undertake plant collection in North-West Iran to enlarge the Australian collection of wild and cultivated lucerne, clovers, medics, sainfoin, grains and grain legumes which occur in that area.

### 3. INTRODUCTION

A detailed itinerary of the study tour is given in Section 11 of this report, together with a list of personnel with whom discussions were held, or who contributed to the planning and conduct of the successful plant collection missions in the USSR and Iran.

This report summarizes the major findings of my overseas tour together with major recommendations arising from it. If any reader wishes to pursue any particular subject in depth I would be please to assist them.

### 4. LUCERNE BREEDING PROGRAMMES IN EUROPE

In Western Europe I visited seven lucerne breeding programmes, three in France, one in Spain, one in England and two in Sweden. In the USSR lucerne breeding was discussed at the N.I. Vavilov All Union Institute of Plant Industry, Leningrad and the W.R. Williams Fodder Research Institute near Moscow.

At each location I studied as much as possible the following objectives of each programme:

1. The objectives of the breeding programme and their relationship to agriculture in that country or area.
2. The breeding and selection methods and the genetic base upon which the programme was developed.
3. The results of the programme and the contribution to agriculture.
4. The selection methods used in laboratory and glasshouse phases of the programmes.
5. The selection methods used in the field and the effects of field techniques upon the results of the programme.
6. The extent to which mechanization and computers were employed.

The headquarters of the private plant breeding firm Tourneur Freres is situated at Coulommiers, France on a 150 hectare property. The company employs 25 plant breeders and is mainly concerned with improvement of wheat, barley, lucerne and sugar beet. The lucerne breeding programme is based at Coulommiers and Toulouse in southern France. The objectives of the programme are to develop non lodging erect growing forms of lucerne which are higher yielding and are resistant to foliar pathogens, particularly Verticillium wilt and downy mildew.

Most of their breeding has been based on Flamande type lucerne although in recent years introduced varieties have been used as parents. Thirty five plants of introduced varieties are grown in the introduction nursery and individual clones are selected on their performance and appearance as spaced plants. These are selfed for disease resistance assessment and incorporated into paired crosses and top cross analyses of yield, using plots which are 4 metres long and contain five rows 20 cm apart. No experiments have been done on the optimum size and structure of individual field plots, although it was stressed that accurate assessment of yield can only be achieved by using sward plots sown at approximately 20 kg/ha seeding rate. From this programme six varieties have been released, Du Puits, Everest, Gemini, Cardinal, Atlas and Glacier which are all adapted to north-western Europe. The major improvements over the older Flamande types have been greater cold tolerance, less lodging and a slight yield increase.

Germ plasm from outside the Flamande type has been introduced to attempt to break a yield plateau which is reached by Europe, Verneuil and experimental lines from Tourneur Freres.

Of particular interest to Australia is a comparison of the latest Du Puit synthetic and the Australian variety Du Puits which has been found to be lower yielding and leafier than its French counterpart.

While I was visiting Tourneur Freres, Mr. M.J. Mathison, Senior Research Officer, Plant Breeding, visited the programme conducted by Vilmorins UCOPAC situated approximately 80 km south east of Paris. This company developed the variety 'Verneuil' which is one of the highest yielding French varieties.

Their present programme is similar to that conducted by Tourneur Freres. Approximately 250 introductions and elite lines are placed in a nursery each year and after 3 years of screening for height, disease resistance and lodging, and additional growth room selection for verticillium resistance approximately 120 clones are polycrossed each year and 25 of these selected for inclusion in a top cross programme, presumably using present parental clones as testers. The F1 matrix of hybrids is assessed in swards for general combining ability and the superior parental clones incorporated into synthetic experimental varieties.

Two lucerne breeding programmes conducted by the French Government Agency I.N.R.A. (Institut National de la Recherche Agronomique) were visited at Lusignan (near Poitiers) and Montpellier. The Lusignan Station d'Amelioration des Plantes Fourrageres is concerned with the agronomy, genetic, pathological and entomological problems associated with improvement in the utilization of lucerne, tall fescue, dactylis, ryegrass, trefoil, maize, sorghum and lupins. In addition the regulatory function of assessment of lucerne varieties for inclusion in the French catalogue of varieties is conducted at Lusignan.

The breeding programme is closely related to theoretical studies on the correlation of plant components (height, weight and number of stems, yield at first cut) with the yield at various densities. The height of inbred lines was considered to be sufficiently correlated with yield to base selection for yield on the height in successive inbred generations from S<sub>0</sub> to S<sub>7</sub> and to assess hybrids between inbreds as spaced plants using a diallel analysis. Genetic studies on the response to selection for disease resistance indicate that a few genes are involved in resistance to Colletotrichum whereas resistance to Verticillium albo-atrum is polygenic.

Two lines based upon the selection for tall space planted progeny from inbreds, selected for height and incorporating some resistance to foliar diseases and Colletotrichum have been included in the assessment for the French Catalogue. The best line is yielding approximately 95-98% of the standard variety Europe. Both lines are based on Flamande type lucernes and other germplasm has only recently been introduced into the Lusignan programme, where space planted F<sub>1</sub> crosses were extremely variable and generally frosting and Verticillium had decimated the populations.

Assessment for the French list is done in 2 metre x 6 metres plots replicated 4 times and cut 4 or 5 times per year by taking a 1 metre wide strip out of each plot. No entries in the current series are outyielding the controls Europe and Verneuil. A charge of 15000 francs (approximately \$2000A) is made for each line included in a three year assessment. At present 18 varieties are included in list A and the hay and seed yield, lodging, perenniality and resistance to Verticillium, sclerotinia and Colletotrichum are recorded.

The programme an INRA, Centre de Recherches Agronomiques de Montpellier contrasts markedly with that at Lusignan. Three varieties Magali, Mireille and Janine have been released from a programme based on Flemish, Provence and North African lines which have been selected through nine inbreeding generations as spaced plants and synthetics between these have been assessed in densely sown rows approximately 1 metre apart, using a diallel analysis to choose the inbred parent clones with highest genetic combining ability. The three released varieties have a higher yield than the old Flemish or Provence ecotypes in the southern Mediterranean region of France.

Other studies at Montpellier have shown that some introductions are higher yielding than all French varieties but tend to lack disease resistance. The presence of bacterial wilt affects lucerne yields in southern France but at present breeding is directed towards short lived frequently harvested types, but bacterial wilt affects yields of long term stands. A more serious mycoplasmic disease has become established at Montpellier in the last five years and has seriously disrupted the programme.

Strong interactions between the yield of successive generations of synthetics based on inbreds, the number of parents per synthetic and the plant density have led to the conclusion that experimental varieties be based on a minimum of 6 inbreds combined to the third synthetic generation and assessed for yield in densely sown rows.

The Association de Investigacion para la Mejora de la Alfalfa, Zaragoza is a private plant breeding organization funded by seed merchandizing companies in Spain. The first phase of their work was an assessment of local and introduced lucerne in southern, central and north eastern regions. In southern Spain the American variety Moapa was the highest yielding and in central Spain where only 2 or 3 cuts are taken the ecotype Tierra de Campos or introduced cold hardy North American types are considered adequate. In the valley of the Ebro river the local type 'Aragon' was higher yielding and more persistent than 150 lines and breeding is only currently directed to yield improvement in this region.

Two hundred ecotypes of Aragon were compared and the best line was commercialized as the variety Aragon 44, from this variety 5000 clones were selected and assessed as space plants for yield, seed, height, erectness and vigour and formed the basis of 'Ebro 7'. 200 from the 5000 clones were assessed in 10 polycrosses using sown plots and 10 clones combined to synthesize the variety Alma 1. The total yield advance over the original Aragon has been approximately 10%.

In studies of yield assessment rows of spaced plants have given higher variability than dense plots, but the yield under spaced or row conditions is not correlated with dense sward yield and in some cases spaced plants have given progeny differences of 70% but the yields in plots have not been significantly different.

Lucerne breeding at the Cambridge Plant Breeding Institute was commenced after the discovery of bacterial wilt in England in 1964 at the Cambridge Plant Breeding Institute and later in Norfolk. The area under lucerne fell from 40,000 acres and the decline was accentuated by the occurrence of Verticillium albo-atrum. Because all European varieties were susceptible to bacterial wilt and still are except for varieties developed at the Cambridge Plant Breeding Institute, it was necessary to base the bacterial wilt resistance programme on the varieties Saranac, Cayuga and Lahontan.

To select for high resistance stocks seedlings were incubated by painting a bacterial suspension onto a cut surface of a fully expanded cotyledon and enclosed under polythene to maintain high humidity. Every two weeks the seedlings were cut back and repainted, after twelve weeks the clones were lifted and if root staining was evident they were discarded. Approximately 10% of Saranac seedlings were given a score for high resistance, but at the conclusion of the programme 70% of the progeny of parent clones were resistant. The variety Maris Phoenix was developed from these clones after agronomic assessment.

Verticillium wilt resistance was developed using a backcrossing programme based on highly resistant artificial tetraploid Medicago hemicycla and Medicago sativa var. gaetula. Tolerant clones of Du Puits were used as the recurrent parent for four generations. Verticillium wilt resistance was determined by dipping two to three week old seedlings in a suspension of conidia and scored by comparing leaf curling, yellowing and shrivelling with a control line. Seedlings with no symptoms were redipped and planted in pots, rescreened and the healthy clones were used as parents for the next cycle of backcrossing. After incorporating resistance to bacterial wilt into this programme, the variety Maris Kabul has been released. It is



extremely resistant to *Verticillium* but has a yield 10% less than Du Puits in disease free conditions and a lower seed yield.

In Sweden the three major objectives of the programmes at the Swedish Seeds Association, Svalof and the Plant Breeding Institute, Weibullsholm, Landskrona are to increase cold tolerance and select for resistance to stem nematode (*Ditylenchus dipsaci*) and verticillium wilt (*Verticillium albo-atrum*).

The earliest selection in Sweden had been for winter hardiness within Flamande type varieties introduced from France. Mass selection for survival under field conditions resulted in the release of the varieties Tuna (Swedish Seeds Association) and Alfa (Weibulls). In the late 1950's verticillium wilt was first considered an economically serious disease. Svalof based a resistance programme on 200 plants selected after field infection. From these 30 plants were resistant after transplanting and one more years growth. Using a recurrent mass selection programme, 54% resistance was found in generation 7. In developing the variety Sverre, selections for stem nematode resistance was included between the 5th and 6th generation.

Weibulls Plant Breeding Institute also undertook recurrent mass selection for resistance to both stem nematode and verticillium wilt. By initially screening 25,000 to stem nematode 500 plants (i.e. 2%) were selected as highly resistant and after consideration of agronomic characteristics and recurrent selection, resistance was raised to 79%. After two cycles of seed multiplication the percentage resistance dropped 75%. From this programme the variety AlfaII was released. It is considered that stem nematode resistance is controlled by a small number of major genes because of the rapid response to selections and the low proportion of intermediate types between resistant and susceptible.

Resistance to *Verticillium albo-atrum* was commenced by Weibulls on 13,000 seedlings from generation 1 of the nematode programme. Eventually 33 clones were selected after repeated inoculation and polycrossed. After two more cycles of selection for nematode resistance, two tests for *Verticillium* resistance and agronomic assessment, 39 clones were selected as the basis for the variety Vertus which is highly resistant to both stem nematode and verticillium wilt.

A major limitation of lucerne utilization in Sweden is the poor seed yield of Flamande type varieties. Wild *Medicago falcata* along the east coast of Sweden sets seed and a programme was commenced at Svalof in 1942 to combine the seed yielding ability of this falcata type with the yield and necessary disease resistance characters of Flamande type lucernes. Seed yields of 300 to 500 kg/ha have been achieved compared with 25 to 100 kg/ha for the Flamande parent control varieties, and the better yielding families are approaching the production of the Flamande types. The poor seed yield in these types is due to embryo abortion if average daily temperature is less than approximately 22°C.

Weibullsholm have embarked on a yield improvement programme by using a crossing programme consisting of open pollination between F1 rows derived from known clone pair crosses. The F2 half sib families are assessed in plots and these yields will be related to the F1 rows and in turn the clones originally used in the paired crosses.

During a visit to the Administrative Head Office of the N.I. Vavilov All Union Institute of Plant Industry, Leningrad, a summary of lucerne breeding in the USSR was presented. There are many local ecotypes in the USSR which have been developed by domestication of wild growing forms, but the major advances, this century have been based on selection within hybrids between locally adapted varieties and exotic types collected by the Institute in its extensive world plant collection missions. Examples of varieties which have been developed using this technique are:

- 1) Tashkentskaya 3192 - Local Tashkent x introduction 3192 from Peru
- 2) Iolotanskaya - Tashkentskaya 3192 x Iraq
- 3) Tashkentskaya 721 - Uzbek x Iraq
- 4) Vashkaya 233 - Tadzhik x Iraq
- 5) Hersonskaya 7 - Ukrainian x Yemenite
- 6) Krasnadarskaya early - Local x Chinese.

A growing awareness of the adaptive features of wild growing lucernes within the USSR and the advantage of selection within hybrids of these varieties and species (some of these requiring chromosome doubling to the tetraploid level) with cultivated Medicago sativa have contributed to types which are agronomically useful and adapted to coldness and waterlogging.

The Williams All Union Fodder Research Institute near Moscow was the site for selection for winter hardiness using hybrids based on interspecific crosses between Medicago sativa and Medicago falcata.

Varieties developed at various stations in the USSR are included in State variety trials in the various regional Government districts of the country and the best varieties are recommended. Since the inception of these trials, varieties from broadly based programmes have generally replaced old ecotypes because of superior performance. No details of the breeding and selection methods was obtained, although general reference was made to the use of polycross testing.

#### 5. THE APPLICATION IN SOUTH AUSTRALIA OF OBSERVATIONS ON EUROPEAN LUCERNE BREEDING

The following conclusions relate to the overall balance and integration of lucerne breeding and not only to the narrow area of breeding methodology.

1. Selection for yield improvement is only successful under densely sown plot conditions, because spaced plant performance and plant components are not sufficiently highly correlated with sward yield to use correlations to select either parental clones or assess progeny performance.
2. Therefore the most important factor in efficient selection is to rapidly advance material from parental clone to progeny sward trials. This can be done by paired crosses, top cross matrices or open pollination between and within rows of F1, allowing assessment of half-sib families of known F1 crosses. The yields of plots derived from any of these crossing systems are related to clones which are used to synthesise experimental varieties. Because parental clones can be chosen from

any source variability can be maintained.

3. Inbreeding has not contributed to yield improvement, although genetical models may demonstrate the possibility of accumulating desirable genes. Because synthetics based on inbreds generally have Syn 1 vigour, Syn 2 depression and stability in and after Syn 3, one might consider that the population after Syn 2 is very similar to one based on heterogenous clones.
4. Programmes in which very high selection pressure has been applied to extremely large populations, have been the most successful in rapidly achieving new selection objectives.
5. Resistance to stem nematode is controlled by a few major genes and therefore it seems possible to select within a few generations for acceptable field tolerance in South Australia by crossing varieties adapted to South Australia with sources of high resistance.
6. High seed yielding is critical in the commercial acceptance of new varieties and therefore varieties having high yield performance or incorporating resistance to disease have only been accepted by farmers if they retain high seed yielding ability, resulting in competitive seed prices.
7. To adequately handle the plant populations which must be screened and processed, the experience of European lucerne breeders is to have one breeder, one technical officer and a minimum of two assistants fully employed with additional seasonal labour at peak periods.
8. Quarantine of lucerne should be maintained in South Australia to screen for bacterial and viral diseases and avoid the introduction of fungal and nematode pathogens.
9. Mechanization of as much as possible of a programme greatly increases efficiency.
10. The introduction of Leafcutter bees, if only for investigations of the pollinator and plant breeding research would be beneficial. Their use would require the construction of crossing rooms and provision of storage facilities.

#### 6. BIOLOGICAL CONTROL OF SITONA WEEVIL

During a visit to the C.S.I.R.O. Biological control unit, Montpellier, France the results of the study of parasites of Sitona species were summarised and the facilities being used to isolate parasites were inspected.

The main conclusions of the work at present are:

1. A wasp Microctonus aethiops is a common parasite of Sitona and in particular of Sitona humeralis in all sites studied in France, Spain and Italy. It is suspected in Greece. There are two forms of the wasp which cause a parasitism rate of approximately 10% in France. It has three to five generations per year with two to three weeks per generation in mid summer. Only eggs of the parasite are present in France during winter. One female lays between 30 and 40 eggs. Races of Microctonus aethiops were introduced into the U.S.A. to control Sitona cylindricollis but were not effective.
2. Other parasites which have occurred sporadically are a fly (Campobaster) and two wasps (Perilitus and Pygostylus) but these have a low parasitism rate (less than .5%).
3. The fungus Beauveria is found in 40-60% of larvae, but infection by this fungus does not occur in South Australia, therefore the strains of sitona and/or fungus must be different or the infection closely related to specific environments in France.
4. In sampling of parasites, 100-200 weevils are collected per site when Sitona humeralis is present. The common host of Microctonus are S. humeralis, S. lineata, S. hispida and S. delineata. The samples are kept in cages until all parasites have emerged or all weevils have died.

Because Microctonus has been found in a wide range of sites it is suggested it be released in Australia for testing. If it is not effective further field studies in North Africa should be done to study parasitism in environments more closely related to those in South Australia.

## 7. PLANT COLLECTION IN THE USSR

A plant collection mission was conducted in the southern regions of the USSR by an Australian delegation. The personnel were; Mr. M.J. Mathison, Senior Research Officer, Plant Breeding South Australian Department of Agriculture; Mr. P. Broue, C.S.I.R.O. Division of Plant Industry, Plant Introduction Section, Canberra; Mr. Peter Cornish, Agronomist, Condobolin Research Station, New South Wales; Department of Agriculture; and the author. The delegation made collections in the Tadzhik SSR, the Azerbaijan, SSR, and near Krasnodar, Novorossisk and Stavropol in the Russian Republic. The itinerary for the collection mission is included in Section 11 of this report.

A total of 700 samples were taken of the following species:

Medicago sativa  
Medicago coerulea  
Medicago falcata  
Medicago romanica  
Medicago hemicycla

Medicago polychroa  
 Medicago glutinosa  
 Medicago orbicularis  
 Medicago rigidula  
 Medicago polymorpha  
 Medicago arabica  
 Medicago lupulina

Trifolium subterraneum  
 Trifolium pratense  
 Trifolium fragiferum  
 Trifolium repens  
 Trifolium dubium

and the following genera -

Onobrychis	Lolium
Vicia	Bromus
Lotus	Triticum
Coronilla	Aegilops
Lens	Hordeum
Cicer	Brassica
Astragalus	Hymenocarpus
Hippocrepis	
Festuca	
Dactylis	

The details of the collection mission, including all species (as far as can be identified) the sites of collection and site descriptions will be published in the "Plant Introduction Review" C.S.I.R.O. Canberra.

My primary interest in undertaking plant collection in southern USSR was to increase the Australian collection of perennial Medicago species. A number of ripe samples were taken at lower altitudes, particularly of M. sativa, M. coerulea and M. romanica, but the collection tour was too early for collection at higher altitudes above 400 metres, because seed was not mature. Collection missions in August and early September would be able to obtain a much wider sampling of lucerne, ryegrass, cocksfoot, perennial clovers and fruits.

In addition to the lucerne material collected the team obtained potentially valuable accessions of annual medics, sub clover, chickpeas, wild wheat relatives and perennial clovers and grasses which have not been previously introduced into Australia.

The collection mission in the USSR would not have been as profitable without the assistance of the Ministry of Agriculture who made available to the party transport to allow field excursions, particularly in the two major collection sites in the area around Dushanbe, Tadshik SSR, and from Baku to the southern slopes of the Caucasus Mountains.

At each major centre of the collection mission the opportunity was taken by both Soviet and Australian workers to exchange technical and scientific information. Particular interest was shown by workers in pasture technology in southern Australia us:

medics, lucerne and perennial grasses. This information will undoubtedly be adapted for use in pasture development in the southern USSR.

Two of the hosts and organizers of our mission, Dr. Dzhamankulov (Director, Tadzhik Scientific Research Institute of Farming) and a Dr. Zaritovsky (The Director, All Union Institute of Sheep and Goat Breeding, Stavropol) had previously visited Australia in scientific delegations, and their personal appreciation of both Australian scientific work and hospitality was reflected in their valuable assistance in technical discussions and their cordiality. Indeed the friendship and co-operation of all our hosts should be recorded together with their desire to expand co-operation in agriculture between the USSR and Australia, particularly within the framework of the recent agreement on technical and scientific co-operation.

I wish to record my appreciation and thanks to Mrs. Valerie Sedova who was the interpreter and guide on our collection tour. Her ability to interpret detailed technical and scientific information, was invaluable in contributing to a successful visit. In addition, I wish to acknowledge the assistance of the Director and Staff of the USSR Ministry of Agriculture, Division for Co-operation in Agriculture with Foreign Countries.

#### 8. PLANT COLLECTION IN IRAN

I undertook a plant collection mission in north west Iran to enlarge the Australian collection of wild and cultivated lucerne, clovers, medics, sainfoin, wheat, barley and grain legumes which occur in that region.

The itinerary of the field trip was:

22/7/74	To visit the Amir Kabir Watershed Management Project
23/7/74	Teheran to Port Pahlavi
24/7/74	Pt. Pahlavi to Astara
25/7/74	Astara to Tabriz
26/7/74	North West of Tabriz
27/7/74	Tabriz to Zanjan
28/7/74	Zanjan to Teheran.

Because of the intense grazing pressure upon native and cultivated species by herds and flocks of grazing cattle sheep and goats, and the meticulous care of the villagers and farmers to harvest and glean the fields using manual labour almost universally for all tasks, the collection of seeds is extremely difficult. Nevertheless by searching in and around the margins of enclosures and protected farms, it was possible to obtain seeds of all species and plant types which were sought. In addition seeds of crops which had been harvested, particularly grain legumes, were purchased in shops and bazaars.

A total collection of 184 seed samples was obtained. The major groups of accessions were:-

Medicago sativa	57	accessions
Medicago rigidula	1	"
Trifolium (perennials)	12	"
Perennial grasses	11	"
Triticum aestivum	24	"
Aegilops squarrosa	1	"
Hordeum vulgare	2	"
Cicer arietinum	14	"
Lens esculentum	9	"
Onobrychis viciifolia	6	"
*Lupinus angustifolius	1	"
*Phaseolus spp.	30	"
*Lathyrus sativus	1	"
Vicia faba	1	"
*Vicia spp.	8	"

\* To be positively identified after growing.

A detailed list of all accessions will be published in the Plant Introduction Review C.S.I.R.O. Canberra, together with notes on the site of collection.

Because a number of accessions of wild lucerne were obtained from constantly and heavily grazed situations, they will be incorporated into a selection programme for persistence under continuous grazing. Although many searches were made for annual medics, only one accession from 20 km south of Mianeh was obtained. Medicago orbicularis was observed as seedlings near Heiran, 28km from Astara. The value of grain, legume and other pasture species accessions, will be assessed by various plant breeding programmes in Australia.

#### 9. SUMMARY OF THE XIITH INTERNATIONAL GRASSLANDS CONGRESS

The XIIth International Grasslands Congress was held in Moscow from the 11th to 20th June, 1974. It was convened in the modern October Cinema Hall, Kalinin Avenue, Moscow. The Conference was opened by the Minister of Agriculture of the USSR, followed by fourteen plenary papers describing the development of grassland farming in the centrally planned economies and highlighting grasslands research in the Netherlands, India, West Germany, England, Australia, Canada and Italy.

The Congress was convened into three halls for the following four days for concurrent sessions relating to seven sectional headings.

- 1) Biological and physiological aspects of the Intensification of grassland utilization.
- 2) Improvement of natural and production of seeded meadows and pastures.
- 3) Chemicalization of grassland farming.
- 4) Drainage and irrigation of grasslands.
- 5) Grassland utilization.

- 6) Techniques and Forage Conservation and Storage.
- 7) Plant Introduction Breeding and Seed Production.

I attended the session of Section 7 and presented a paper entitled "Breeding Lucerne (Medicago sativa L.) with higher tolerance to waterlogging", and contributed to discussion on a number of papers relating to lucerne breeding.

Through discussion with participants attending other sessions, it was apparent that no section generated wide interest in any particular aspect of grassland agriculture. This is partly a result of the extreme diversity of the papers presented in each section, although some individual papers were of a very high standard.

The Conference allowed me to meet three prominent lucerne breeders from the U.S.A. and Canada, namely Dr. R.P. Murphy, Cornell University, Ithaca, New York and Dr. I.J. Johnson, Cal West Seeds, Woodlands, California and Dr. D. Heinrichs, Swift Current Research Station, Saskatchewan, Canada, to discuss present research in lucerne breeding in their respective countries. The major lucerne breeding objectives which should be assessed for potential use in Australia are:-

- 1) Selection for low saponin concentration which is correlated with higher growth rates in animals fed concentrates incorporating that material.
- 2) Investigate the selection of a lucerne which does not have a high propensity to cause bloat.
- 3) Investigate the use of wet process protein extraction from green lucerne as an industrial enterprise.

#### 10. ACKNOWLEDGEMENTS

I wish to thank the A.W. Howard Memorial Trust Fund for granting financial assistance to me to attend the XIIth International Grasslands Congress. In addition I am grateful to those who encouraged and supported my application to undertake this study tour.

#### 11. ITINERARY OF THE STUDY TOUR

May 20th Etts. Tourneur Freres,  
64, Rue de Gal Leclere  
77- Coulommiers (S-&-M)  
France.

Mon. Raymond Pierre, Director  
Mon. Champs, Lucerne Breeder.

May 21st Institut National de la Recherche Agronomique  
22nd Station d'Amelioration des Plantes Fourrageres  
86- Lusignan  
France.

Dr. P. Guy  
Mon. M. Gillet  
Mon. R. Bournoville  
Mon. Tasei



- May 23rd C.S.I.R.O., Biological Control Unit,  
335 Ave Abbe Paul Parguel  
Montpellier (Herault)  
France 34000  
Dr. A. Wapshere  
Dr. J.P. Aeschlimann
- May 24th Institut National de la Recherche Agronomique  
Station d'Amelioration des Plantes de Montpellier  
Montpellier (Herault)  
France  
Mon. C. Clavier, Charge de Recherches  
Mon. M. Ferret, Ingenieur
- May 28th Asociacion de Investigacion para la  
Mejora de la Alfalfa  
B. de Movera, 165 dpdo  
Zaragoza  
Spain  
Fdo. Fernando Hidalgo Maynar, Research Director
- May 30th Cambridge Plant Breeding Institute  
Maris Lane,  
Trumpington  
Cambridge CB2 2LQ  
England.  
Mr. H.H. Rogers, Deputy Director  
Mr. R.G. Aubrey  
Dr. A.J. Thomson  
Mr. P.J. Webb  
Dr. D.A. Bond
- June 4th Swedish Seed Association  
Svalof  
Sweden  
Dr. G. Julen  
Dr. J. Sjodin  
Weibullsholm Plant Breeding Institute  
Landskrona  
Sweden  
Agr. H.A. Jonsson  
Agr. P. Lundin  
Agr. L. Nilsson  
Dr. Stig Blixt.
- June 6th- N.I. Vavilov All-Union Institute of Plant Industry  
7th 44 Herzen Street,  
Leningrad  
USSR  
Dr. K.Z. Budin  
Dr. P.A. Lubenets  
Mr. A.I. Ivanov

- June 11th-20th XIIth International Grasslands Congress  
Moscow  
USSR
- June 24th Tadzhik SSR (USSR)  
to (Plant Collection)  
based at Dushanbe
- July 2nd Dr. B.M. Kreiddik  
Dr. K.D. Dzhamankulov  
Dr. V.N. Litvinov  
Dr. G.T. Sidorenko  
Dr. Mansurov  
Dr. Pirmakhmadov
- July 3rd-7th Azerbaijan SSR (USSR)  
(Plant Collection)
- Prof. Igrabimov (Baku)  
Mr. Orudjev  
Mr. G.G. Nasibov  
Mr. M. Karderly (Shemahah)  
Mrs. Propova (Shemahah)  
Mr. Bullayev (Kutkashen)  
Mr. Karsumov (Vartashen)
- July 9th-10th Krasnodar and Novorossiisk (USSR)  
(Plant Collection)
- Mr. V.B. Ignatuahim  
Dr. I.P. Varenik
- July 11th-15th All Union Institute of Sheep and Goat Breeding  
Stavropol  
USSR
- Dr. V.S. Zaritovsky, Director  
Dr. G.I. Ribin, Deputy Director
- Stavropol Botanic Gardens  
Stavropol  
USSR
- Dr. V.V. Scripchinsky and staff.
- July 18th Ministry of Agriculture of the USSR  
1/11 Orlikov per.  
Moskow I-139  
USSR
- Mr. A.F. Kharchenko (Director, Foreign Relations)  
Mr. V. Tatulin  
Mr. E.I. Telitsin  
Mrs. V.M. Sedova (Interpreter)

July 21st- G.P. McGowan and Assoc. Pty. Ltd.,  
22nd 276 Roosevelt Ave.,  
Teheran  
Iran

Dr. N. Montieth (Technical Director)  
Mr. J. Edwards

July 23rd- Plant Collection in North East Iran.  
29th