

DEPARTMENT OF AGRICULTURE AND FISHERIES, SOUTH AUSTRALIA

Agronomy Branch Report

AGRONOMY BRANCH WORKSHOP

REVIEW OF RESEARCH/EXTENSION NEEDS OF THE MIXED FARMING AREAS OF SOUTH
AUSTRALIA

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Waite Agricultural Research Institute
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Convenor: Murray V. Smith

Report No. 95

PIG PRODUCTION ON A MIXED FARM

Bob Tiller

Farmer, Balaklava

Pig raising until recently has been based on the family farm, owner operated concept, with little influence from companies. Today 75% of pig meat production is raised under intensive housing of some kind and 25% remain as always. 50% of pig meat is raised by big intensive piggeries solely producing pigs, 25% by intensive on the family farms and 25% in the open space type system.

One of the biggest fluctuating effects on profits in pig raising is the marketing system-namely "Cepps Cross Abattoirs". I think this market has much room for improvement and leaves a lot to be desired. South Australian pig numbers showed an increase of over 219% from 1960-1970 compared with only a 68% increase in Australian numbers. Pig numbers in South Australia peaked at 499,000 in 1973. At present numbers have stabilized at about 325,000 pigs (similar to numbers in 1970). Since 1970 South Australia has approximately 15% of total pigs in Australia.

Now to calculate our cost of production.

For a pig enterprise to be a worthwhile proposition I think we need to look at a minimum of approximately 15 sows. The estimated cost to set up sheds, storage, utensils would be approximately \$1000.00 per sow or in this case \$15,000.00. We purchase our mated sows at \$150.00 each and a boar at \$150.00. We price our barley at \$100.00 tonne; meat meal at \$265.00 tonne and lucerne hay at \$80.00 tonne.

To arrive at a cost for day old suckers using 8 pigs per litter and two litters per year - based on 15 sow + 1 boar unit.

	Per pig cost
Cost per pig for sow	\$ 3.75
" " " " " feed 1362kg @ 12.3¢	10.50
" " " " boar " 1000kg @ 12.3¢	.51
" " " " service for boar	.25
Depreciation cost of buildings etc. for housing sows and progeny (over 20 years)	2.92
Iron injection	.30
Power for heaters	.30
Erisyplus Injection	.10
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We have day old cost of	\$18.63

To feed a pig to a dressed weight of 66kg we would use 282 kg feed at 12.3¢/kg costing \$34.72 and taking approximately 30 weeks using a conversion rate of 4:1. The day old cost of \$18.63 and feed cost of \$34.72 give us a production cost of \$53.35 or 81¢/kg for our bacon pig.

At present we have a net selling price of \$1.15/kg. This gives us a profit of 34¢/kg. To maintain our profit the market price for our pig has to be \$80.00 plus.

Our feed mix would consist of using

1362 kg barley @ 10¢/kg	\$136.20
136 kg meatmeal @ 26.5¢/kg	\$ 36.00
100 kg lucerne @ 8¢/kg	\$ 8.00
Minerals and vitamins @\$3/tonne feedmix	\$ 5.00
Crushing, mixing etc.	\$ 10.00
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Total Cost of 1600kg feed mix	\$195.20
Cost per kg feed mix	0.123

This gives us 1.6 tonnes feed at 13.8% protein for \$195.20 or at 12.3¢/kg. Our labour would take approximately 1 hour per day or one full day per week involving 52 full days per year at \$25.00 per day our labour would cost us \$1300.00. During one full year's operation we should sell 240 pigs this equals 15.78 tonnes meat. Our total feed would cost us \$13022.00.

Summarising our operation we have -

Total sale value of	\$18,096.00
Total feed	\$13,022.00
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Gross profit	\$ 5,074.00
Less wages	\$ 1,300.00
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Net Profit	\$ 3,764.00
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Thus our project would return a net profit of \$3764.00 or \$72.38 per week. However the whole system must not go beyond 4:1 conversion and our markets must be at a stable level to maintain profit and barley at \$100.00 tonne must be considered the ceiling for what we pay for our grain! There is no room for mistakes!

PASTURES IN THE MIXED FARMING AREAS OF SOUTH AUSTRALIA

Murray V. Smith

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I. What are the roles of pastures

- 1) Crop production - long term fertility and structure values.
- 2) Livestock production - short term feed values.

II. What is desirable

- 1) From cropping viewpoint 80% or greater annual legume dominance - better nitrogen buildup - better disease control - these views are held by many research workers and a reasonable number of farmers.
- 2) From grazing viewpoint 50-75% annual legume with balance grasses such as cereal e.g. oats or annual ryegrass. Farmers claim that this gives a better mixed pasture for grazing than dominant annual legumes. They suggest improved earlier and later and dry feed is obtained.

III. What occurs

Survey results of annual pasture legume usage in the cereal belt of South Australia suggest that these areas can be divided into three major situations -

- 1) Problem areas - these include most areas suited to subterranean clover, where resowing following cropping is a problem e.g. many of the red brown earth soils. Additionally there are problem soils such as hard setting red brown earths, dark brown clay soils, sandy water repellent soils and the sand over clay soils for which there are no particularly well adapted annual legume cultivars. While the problem of annual pasture legumes are better recognised in these areas there appears to be no technology breakthrough allowing the maintenance of low cost annual pasture legumes in these areas.
- 2) Higher rainfall, better mallee soils - areas into which pasture legumes were readily introduced more than 20 years ago. Medics in particular initially grew well in these areas, but in recent years increasing problems (insects and weeds) have been experienced in maintaining these medic stands. Examples are Yorke Peninsula, Northern Adelaide Plains and Lower Eyre Peninsula.
- 3) Lower rainfall, less reliable mallee soils - areas in which annual pasture legumes particularly medics have also grown readily, but where there seems to have been less problem in maintaining dominant medic pastures. Rainfall seems to be the major factor limiting pasture growth in these areas. Typical of such areas are Upper Eyre Peninsula and the Murray Mallee. The attitude of farmers in some of these areas e.g. Upper Eyre Peninsula to medics are cause for concern - they appear to believe medics will always

continue to do well in these areas. The experience from the better rainfall areas suggests that they should be increasingly vigilant in their war against insects and weeds!

Results from the survey work indicate that the "problem pasture areas" e.g. Kapunda carry out more annual legume pasture sowing and are more aware of a pasture problem - Table 1. Further, these results suggest farmers of the "problem areas" think sowing of pasture legumes e.g. sub. clover is still profitable, while in the traditional medic areas pasture sowing is considered less profitable either because it is risky (Yorke Peninsula) or considered unnecessary (Upper Eyre Peninsula).

Table 1 - Pasture Legume Sowing in Three Annual Pasture Mixed Farming Areas of South Australia.

All figures indicate % respondent farmers.

Level of sowing	Kapunda	Yorke Peninsula	Upper Eyre Peninsula
<u>No</u> sowing last 10 years	16%	27%*	15%
Regular sowing last <u>few</u> years	47%	32%	18%
Occasional or periodic sowing	37%	41%	68%
STILL THINK PROFITABLE TO SOW	74%	44%	41% ⁺

*Note Dalkey (Owen-Balaklava) value 47%

⁺Most qualified by "if adequate seed not already present".

Instability is a feature of the pasture phase in the mixed farming belt of South Australia. While annual pasture legumes are generally seen by farmers as desirable components of the pasture only a few actively encourage annual legumes. As a result of this, farmer's expectations of the frequency of dominant annual legume pastures vary widely. If as has been suggested both farmers and scientists agree that 50% or more annual legumes in pastures are highly desirable, why have farmers not more actively encouraged the annual legume component of pastures?

VI. Factors limiting increased legume usage

- 1) Not convinced of benefits - in case of increased N and disease and insect control, benefits are in 1 or 2 seasons later than applied treatment. Such gains are difficult to measure in later periods, particularly due to seasonal and other confounding effects. Therefore unable to convincingly budget for benefits for improving annual legumes in pastures.
- 2) Benefits from increased grazing are often recognised but with current low livestock returns, investment for solely increasing animal production is seldom seen as profitable.
- 3) Sowing pasture legumes is seen as an increasingly risky and costly operation by many farmers. This is due not only to expected seasonal variation, but also to increasing vulnerability to insects (e.g. in addition to red legged earth mite and lucerne flea, in the last few years sitona weevil and now possibly aphids cause serious damage) and weeds (particularly annual

annual ryegrass and soursobs). Farmers in the better and the higher rainfall areas think insects are a major factor limiting pasture legume production (second only to seasonal factors) - Table 2. Weeds were also seen by many farmers as a major factor affecting pasture growth in these areas.

Contrast sowing or just encouragement of annual pasture legumes with the adoption by farmers over the last 3 or 4 years of herbicides such as Treflan for grassy weed control in the crop, where an obvious visual and profitable yield response is obtained in the year of application.

Table 2 - Factors Farmers Think Limit Legume Pasture Production on their Farms.

All figures indicate % of respondent farmers.

Limiting Factor	Kapunda	Yorke Peninsula	Upper Eyre Peninsula
Varieties	36%	12%	9%
Seed level	14%	22%	-
Seasonal	89%	93%	97%
Insects	83%	90%	12%
Weeds	58%	63%	29%
Others	6%	5%	6%

V. Predictions for the future of pastures in the mixed farming areas

- 1) Less legumes because of increasingly risky and hence costly regeneration and establishment due to increasing weed and insect problems as well as the usual seasonal problems. For these reasons the percentage of years of good annual legumes resulting from natural regeneration is likely to decline. This applies particularly to the annual medic areas where as a result of insects, weeds and closer cropping there will be an overall lower carry-over of medic seed from one pasture phase to the next. With sub. clover there has seldom been many farming areas where there has been good seed carry over from one pasture phase to the next.
- 2) More grasses, such as annual ryegrass and barley and brome grasses because of (1) above and despite increasing awareness of crop losses due to grassy weeds and improved weed control in crops (especially annual ryegrass). Another factor which could have a most interesting effect on pasture composition in the cereal belt would be the wide spread of annual ryegrass toxicity with associated severe animal husbandry problems. This may either result in the elimination of livestock from many farms or else the attempted elimination of ryegrass from farms. If an attempt was made to eliminate large areas of ryegrass the question is what species would replace it. This would seem an excellent chance for widespread annual legume sowing. If annual legumes were not encouraged in such a situation then it would seem likely that some less desirable species would establish. The most likely improvement in the grass component may be with improved oat varieties that have minimal disease host properties and excellent grazing potential.

- 3) More weeds because of (1) above and because of other continuing management and cultural changes. Soursobs for example are continuing to increase in area and low cost control methods have not been achieved. Numerous other weeds will continue to cause problems over most mixed farming areas. The particular weed problem may vary markedly between areas and between farms depending on soil, climate, cultural methods etc.

VI. What should be done?

What can be done about improving or maintaining the annual legume component of pastures in the mixed farming areas of South Australia. Again it may be easiest to consider the 3 categories of annual legume usage described earlier.

- 1) Problem areas - In these areas farmers are generally aware of the need to encourage annual legumes, particularly by sowing. The need is mainly to develop low cost-low risk methods of establishing annual legumes, and as with elsewhere this will particularly require evaluation and manipulation of weed and insect populations.

Close examination should also be made of alternative pasture species. The possible role of grasses plus nitrogen - particularly if the grass e.g. cereal for grazing is not an host for serious cereal diseases, must be further evaluated. It is also in these regions that the largest gains for better adapted pasture plants are possible and hence the gains from plant introduction and plant breeding are likely to be greatest in these areas.

- 2) Higher rainfall, better mallee soils - While not considered traditional problem pasture areas I believe there is cause for greatest concern and hence for far greater efforts to define the future role of annual legume pastures in these areas. These are the traditionally better mallee farming areas, in which annual medics in particular have established and produced well for 20 or more years with minimal active encouragement by farmers. On Yorke Peninsula and Lower Eyre Peninsula, it appears that medics are not performing as well as previously. While there is increasing awareness of these problems there are still areas in which farmers lack appreciation of the problem e.g. on the Northern Adelaide Plains. The major causes for the decline of medics in these areas would appear to be seasonal factors, insects and weeds (Table 2) and increased cropping frequency.
- 3) Lower rainfall, less reliable mallee soils - There appears to be minimal problems with annual legumes in these areas at present - if there is a reasonable season there are good annual legume pastures. The major problem is probably complacency on behalf of farmers. This attitude is typified in the Upper Eyre Peninsula area that was surveyed. "Medics will always do well in this area", "Once they are established they will always be there", and the like are the comments that abound. I would not be so sure! - particularly after hearing comments on Yorke Peninsula and the Northern Adelaide Plains, where medics used to grow very well naturally but where now there seems to be increasing problems in maintaining good medic stands. Weeds and insects seem to be the main potential problems, and the best strategy appears to be to ensure improved vigilance and control of both weeds and insects in these lower rainfall mallee areas. There are of course

some problem areas within these areas, particularly with sandy soils where there may be potential for better adapted plants.

In summary I believe the major problem is to focus effort more onto the apparently increasing problems with pastures on the higher rainfall, better mallee soils of South Australia, With the current crop:livestock price relationships, it is in these areas that we must question the traditional role of annual legume pastures. Is a pasture phase necessary? Are annual legumes necessary in the pasture? What are the medium-longer term benefits of having annual legume dominant pasture? We may know the short term benefits of annual legume pastures - they must be relatively low or else more activity would be evident by farmers to ensure good annual medic pastures. Alternatively the costs of obtaining good medic pastures are too high.

The longer term benefits of annual legume dominant pastures are certainly not well quantified either biologically or economically. While recognising that there are serious difficulties in measuring these effects, better information is required to allow reasonable budgeting of the benefits of annual legumes both on the individual farm and on a regional and state basis.

While plant breeders and evaluators may claim to be able to breed or introduce annual legumes cultivars which will have resistance to various insects and improved competitive ability, it seems to me that in the good arable farming areas of South Australia this is like a dog chasing its tail, or the treating of symptoms rather than causes. What I am suggesting is that there are increasing areas of South Australia to which our current annual legume cultivars, particularly medics are adapted, but which have dominant annual legume pasture less frequently. In these areas annual pasture legumes are seen as unreliable and costly components of pastures. There is an urgent need to develop low cost - low risk methods of establishing annual legumes. I do not believe that the possibilities of establishing under a crop and with the use of herbicides have been anywhere near adequately evaluated.

FLOOR DISCUSSION

E. CARTER - Generalizations can not be made over such a large topic and a range of options (e.g. legumes) is needed. There is a high correlation between crop yield and general standard of legume stands. Legumes in areas referred to in the paper are not as good as 20-30 years ago because of a buildup of pests and weeds. There appears a disproportionate emphasis on breeding and selection of cultivars and insufficient emphasis on cultural practices e.g. establishment. A run of bad seasons with cost price squeeze has not put legumes in good light but it is crazy to downgrade them. All research into annual grass improvement in the cereal belt should cease and all pasture research should be related to legumes. However work into specific problems such as annual ryegrass toxicity must continue.

M. SMITH - Impression that farmers have not considered that there is a problem in many areas - either because they do not see it as profitable or because they have not recognized the problem.

E. CARTER - Agreed - 30-40 years ago in some areas e.g. Mallala there was a very much better medic pasture than now. In a survey last year in the Mallala area we established that there was less than 1 kg/ha seed reserve in soil on some farms - ranged up to 300 kg/ha. Rule of thumb - need 100 kg/ha in a stubble paddock to ensure satisfactory regeneration.

P. KLOOT - I would like to comment on your statement that "There are increasing areas of S.A. to which current annual legume cultivars, particularly medics, are adapted, but which ...". This might have been true in the past but may now be a false assumption. They may have been adapted to these areas 20-30 years ago under poor soil structure, low fertility etc. As fertility and soil structure improved they have slowly reverted to their place in the Mediterranean flora and are now just being another plant without any special competitive ability unless specifically resown.

M. SMITH - I would expect increasing numbers of years where medics are not dominant. The way around it may be specific cultural practices such as seeding and herbicide techniques.

J. HARRIS - All these comments are relevant but perhaps we should ask - What is a pasture? Should we aim to replace all possible nutrients exported through the farm gate within the produce. Reg French's figures indicate the order of nutrient removal and many nutrients other than N and P may be involved. Perhaps we have never learnt how to handle medic pastures if we are going to build soil fertility. On the other hand, if we are feeding stock then a pasture is a different thing.

T. GREENSLADE - With advent of Avadex and Treflan we have seen a reduction in the grasses in pasture and we are at the stage where we are trying to get a medic pasture and this year there is nothing. There is a high degree of interest amongst farmers in reseeding medic. We can still see an N response in crops even following pasture.

J. McMAHON - There seems to be a misconception about my idea of a pasture - barley grass will not last unless there is a legume underneath. Such a legume could eventually be cluster clover in my situation. Why has superphosphate not been mentioned in the paper as a limiting factor.

M. SMITH - Superphosphate usage was one of the questions in the survey and although the analyses are far from complete superphosphate is not a factor that stands out like the others.

E. HIGGS - What was the farmers attitude to the phosphate issue.

M. SMITH - The feeling generally was that where cutbacks had occurred with superphosphate usage it had been solely on the pasture phase. However pasture legume problems appeared on properties with both high and low phosphate usage.

M. MATHISON - The key issue is what are we requiring from legumes. In the system where we rely on the relationship between pastures and crops the emphasis will vary according to what operators are gearing their system. In recent times farmers have been looking to legumes for an N input for the cropping phase. In due course there may be a swing back to legumes for animal feed. We do have a range of genetic variability to enable us to find or breed legumes to slot into these changed fertility situations.

THE ROLE OF GRAIN LEGUMES IN THE MIXED FARMING
AREAS

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Summary

Grain legumes have begun to play a vital role in South Australia's farming system.

In recent years spectacular cereal responses on grain legume stubbles have been achieved due to improved soil fertility and less disease.

Grain legumes fit readily into our farming systems and conventional farm machinery is adequate for their cultivation. Livestock perform well on stubbles and grain.

More and more grain legumes are promised. In the foreseeable future grain legumes will be commercially available for even the marginal cereal areas.

There is a developing local and overseas market for high protein grain for both human and stock consumption.

Introduction

South Australia's farming system has developed in a series of steps. She is just making her next step - a major step: one that may prove to be as significant as the introduction of superphosphate in the 1890's and the introduction of pasture legumes in the 1930's.

The development of grain legumes is exciting; they mark the end of one era and the beginning of a new one - one which promises greater flexibility and opens the door to continuous cropping, disease control and lower cost farming.

In the past, our only grain legume - field peas, had several shortcomings, particularly susceptibility to disease, weed competition and sharp finishes. Therefore South Australian farmers have relied almost exclusively on pasture legumes to increase or restore soil fertility.

Without pasture legumes our soils which are particularly low in fertility would either have been undevelopable or could not have been profitably farmed.

Recently our ley-farming system has begun to fragment, Sitona weevil has virtually destroyed medics in several areas. Pastures have not been fertilized or managed as carefully as in the 1960's because of high costs and low livestock returns. Grasses, hosts to several cereal diseases, now predominate.

We are fortunate that grain legumes have come to the rescue at such a time.

Benefits of Grain Legumes

1. General

Many of the following comments relate to lupins. It is because my

experience of lupins is greater and because lupins have performed so well and have fallen so neatly into our farming system. No doubt other legumes will soon be adapted equally well. There will be problems; there are with lupins but these are heavily outweighed by the advantages.

Most farmers in those areas lucky enough to be able to grow lupins can not speak too highly of them. Their benefit to cereal crops and livestock has created considerable excitement. The most important benefits as seen by farmers are:

- consistently higher yielding cereal crops; less root disease; less leaf disease
- excellent quality stubbles - high in protein on which large numbers of stock can be supported throughout the summer-autumn; fast growth rates in young stock; high lambing percentages.
- excellent pasture production following lupins
- an additional grain which adds security.

There are some disadvantages too, such as:

- wind erosion is a problem on sandy soils especially if establishment is poor.
- susceptibility to insect pests and sensitiveness to low levels of manganese.
- risk of failure is higher than with barley
- need to inoculate which is time consuming
- high costs of growing (operating costs are about \$60 per ha).

2. Profitability

High production costs relative to other cereals concern some farmers but many farmers don't look upon lupins simply as an alternative crop and therefore accept the high costs of production. They see lupins just as much a pasture as a crop, and often 'more a pasture than a pasture'. In essence grain legumes are soil fertility building cash crops - crops that don't exploit but restore soil fertility.

"Gross margins" of grain legumes have been less than barley in recent years. Barley yields and prices have been exceptionally good. But if a value is added to lupins for 'stock performances' and 'increased cereal yields', they are significantly more profitable.

Alternatively, compare the gross margin of a grain legume with a pasture, (for it's the pasture that lupins are replacing) and lupins will prove vastly superior.

To illustrate these claims:

2.1 Wheat (1974) sown on a 1973 lupin variety - pasture trial at Wanilla (1).

Wheat Yields: t/ha

Lupins 2.44

Sub clover 1.65

Gain 0.79

Profit(2) \$84.00

- (1) 1973 lupin variety trial incorporated a subterranean clover treatment. The trial was permanently marked; the whole area sown to wheat in 1974 and plots individually reaped.
- (2) Valued at \$106.00/t.

2.2 Cereal (1975) sown on 1974 lupin variety - pasture trial

	Barley	Wheat
Lupins	2.95	3.40
Sub clover	2.25	2.70
Gain	0.70	0.70

2.3 Farmer experiences almost invariably support these results. For example at Wanilla in 1973 half of a paddock which was sown to lupins yielded 2.0 t/ha and returned a gross margin of \$170.00/t.

2.3.1 1973 Lupins

	\$
Yield2.0 t/ha @ \$108.00/t	216.00
Total operating costs	46.00
Gross margin/ha	170.00

In the following year it was cropped -

1974 Wheat on Lupin Stubble

	\$
Yield1.8 t/ha @ \$107.43/t	193.00
Total operating costs	26.00
Gross margin/ha	167.00

- 2.3.2 The other half of this paddock was 'fenced off' and 'left out' to pasture.

1973 Pasture

	\$
Income 7.5 wethers @ 4.5 kg wool/head @ \$1.65/kg	
Sale of 20% of wethers @ \$2.50/ head	60.00
Total operating costs	14.00
Gross margin/ha	46.00

In the next year it was cropped -

1974 Wheat on Pasture

Yield.....0.8 t/ha \$102.53/t ⁽¹⁾	82.00
Total operating costs	25.00
Gross margin/ha	57.00

(1) \$3.90/t dock (lightweight wheat)

Thus in both years the 'lupin paddock' was superior to the pasture paddock.

The total gross margin from the 1973 and 1974 years was \$337.00 from the lupins-wheat rotation and \$103.00 from the pasture wheat rotation.

3. Disease and Soil fertility

Why are the differences so marked? Soil fertility and disease are the two most likely factors responsible.

Nitrogen is seriously deficient in South Australian soils. Nitrogen fertilizer costs have risen sharply in recent years and will continue to increase. Just how much nitrogen a grain legume fixes is difficult to establish. Some measurement of disease is possible as shown in the following trials.

In the trial (2.2 above) counts were made in the spring from six metres of row in each treatment.

	Heads		Dry Weight (gms)		Infection of Roots		Yield t/ha
	Total	Ave/Plant	Total	Ave/Plant	Primary	Secondary	
Control	122	3	150	4.5	87	60	(Not reaped)
Clover	156	3	210	4.3	85	55	2.25
Lupins	164	4.5	260	6.9	44	35	2.95

Root disease on the barley roots was almost halved on the lupin plots. And in the example quoted in '2.3.2' the wheat, which looked relatively healthy early in the season became severely diseased in the spring with glume blotch, leaf blotch and haydie. Little disease was evident on the wheat sown on the lupin stubble.

Cereal diseases have devastated yields in recent years. Dr. A. Rovira achieved yield responses of 175 to 600 per cent in soil fumigation trials on the Upper Eyre Peninsula. A suitable grain legume is desperately needed for these areas.

4. Freedom from weeds and crop density

4.1 Freedom from weeds

Cleaning crops need to be grass free to be fully effective. Results from a 1974-1975 trial illustrate this. In 1975 wheat was sown on a lupin trial which incorporated sprayed and unsprayed treatments.

Wheat Yields t/ha

	<u>Unicrop 1974</u>	<u>Uniharvest 1974</u>
Wheat on Sprayed ⁽¹⁾	3.44	3.55
Wheat on Unsprayed ⁽²⁾	3.11	3.39
Difference	0.33	0.16

(1) Lupin yields in 1974 were Unicrop 3.53; Uniharvest 3.20

(2) Lupin yields in 1974 were Unicrop 2.85; Uniharvest 2.86

At a field day in spring 1974, most farmers considered that there were insufficient weeds to justify spraying.

4.2 Crop density

Heavy seeding rates may not benefit yields, in fact it can be

detrimental. However a following crop is likely to benefit.

In the trial '4.1', seeding rate treatments were also incorporated. viz. 67 kg/ha and 100 kg/ha.

In 1975 the trial was oversown to wheat.

Wheat Yields t/ha

	Lupin Seeding rate (kg/ha)	
	67	100
Wheat 1975	3.25	3.73

5. Place in rotation

Grain legumes readily fit into cereal-pasture rotations. In fact continuous cropping becomes a reality.

An example of a traditional pea rotation is Wheat/Peas/Wheat or Barley/Pasture or Pasture-Pasture.

Lupin rotations are similar but many farmers, not wanting to sow three consecutive crops on poorly structured ironstone or sandy soils often adopt the following rotation.

Pasture or Pasture-Pasture/Lupins/Wheat or Barley

A rotation in which a cereal precedes a lupin crop is preferred for several reasons:

- Early seedbed preparation and weed control is facilitated.
- Insect pests which multiply in pasture can cause serious damage to lupins in the seedling stages.
- Several important fungus diseases - pythium, fusarium and sclerotinia stem rot which increase within pastures can also cause serious damage to lupins in the seedling stage.

A cereal crop sown prior to lupins acts as a cleaning crop for cereals.

Oil seed production is expected to increase in South Australia. Oilseed crops prefer high soil fertility and weed free conditions. Grain legumes should logically precede oil seed crops in the rotation.

6. Stock performance

Grain legume stubbles provide superior grazing to other stubbles in the summer-autumn because of their high protein. Farmers frequently emphasize this advantage.

In a trial at Wanilla conducted by Mr. S.W. Inglis ewes flushed and mated on a lupin stubble dropped 10 per cent more lambs than those on a cereal stubble. In two further trials to assess the value of lupin stubbles, yearling cattle performed better on lupin stubbles than cereal stubbles up until heavy autumn rains.

7. Grain legume species

7.1 Peas

Until recently peas were our only grain legume.

Disease, drought susceptibility and weed competition have been three major constraints to widespread production. These constraints may not be as important in the future.

Pennant, recently released, commences flowering two to four days earlier and has a shorter flowering period than White Brunswick. In the low to medium rainfall areas, Pennant yields (1972 to 1976 inc.) have been 12 per cent superior to White Brunswick.

Weed control has been improved with the advent of five 'pre' and 'early post-emergent' herbicides.

Black spot, which has devastated many pea crops in the past. A breeding programme to incorporate black spot resistance is in progress.

Future pea breeding aims to produce cultivars which are high yielding, resistant to frosting and to disease, earlier flowering and improved ability to stand upright.

7.2 Lupins

Currently the sweet narrow-leafed lupin cultivars, Unicrop, Uniharvest and Marri are well suited to the neutral to acid soils of above 400mm rainfall.

Ultra, a newly released cultivar of the white lupin species has extended lupin growing to the moderately alkaline soils.

7.3 Chick Peas

Research in Australia since 1971 show chick peas to have exciting prospects for the low rainfall areas of the Upper Eyre Peninsula and the Murray Mallee. They could do for these areas what lupins have done for the higher rainfall mixed farming areas.

Chick peas, first recorded 5450B.C. are a crop with enormous potential. Some are nearly ready for release and there is scope for considerable improvement from existing material which exists here and abroad.

Chick peas perform well on low fertility soils of pH 6.0 to 9.0. Their deep root system, earliness, and inherent ability to flower and set seed in low moisture, high temperature and solar radiation conditions make them ideally suited for the marginal cereal - sheep farming areas.

Their potential in these areas is greater than lupins and peas. In 1977 at Minnipa Research Centre, where 125mm of rain has fallen to mid-August, chick peas and lupins have commenced to flower with little visual moisture stress.

THE POTENTIAL OF OILSEEDS IN THE MIXED FARMING AREAS
OF SOUTH AUSTRALIA

P.J. Mowatt

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This paper is confined to the four most commonly mentioned oilseed crops - safflower, linseed, rapeseed and sunflower. Other crops could be mentioned, but either they have unrealistic needs (e.g. - irrigation) or are too new to even guess their potential for the mixed farming areas.

OILSEED MARKETS

Australian demand for vegetable oil, and for the protein meal by-product, has increased faster than production since 1970.

Production rose from 120,000 t oilseed in 1970/71 to peak at 315,000 t in 1974/75 and then fell to 210,000 t in 1976/77. Australian oilseed crushing capacity is around 500,000 t which suggests that industry is confident of a future demand which is only being half met by present production.

Demand has expanded more rapidly than was predicted. Higher butter prices, the availability of margarine as quotas were lifted, and the need to spend the household dollar carefully has favoured large increases in margarine use. Tastes and diets have changed such that vegetable oils are more widely used for cooking, as salad oils and dressings. The quickly expanding "take away" food industry is also preferring vegetable oils over the animal fat oils.

These trends, plus stronger promotion (Australia has a low per capita use of vegetable oils) should see markets strengthen into the 1980's. This is supported by an established and steadily growing market for the protein meal in stock feeds.

AGRONOMIC FACTORS

Promotion of these crops is also being made in the research field, attempting to clarify the needs and place of each crop for Australian conditions. However, experience has shown that two factors tend to have most effect on the success of this group of crops.

- Available soil moisture and mild temperatures are essential during the seed maturation period if these crops are to achieve useful seed yields, oil contents of 40-50%, and with good oil quality having high linoleic acid content. It is best to liken this need to that for producing malting quality barley, then lengthen the time. These crops have a longer ripening period, which is later in the season than barley.
- High soil fertility levels (particularly nitrogen and potassium) are needed to produce the desired oil quantity and quality, and to ensure a useful protein meal by-product. Thus the loam to clay soil types will most reliably supply those needs, as they have the capacity to build and maintain soil fertility.

The oil seed crops can be valuable in a rotation by using two of their attributes.

They have the capacity to use high soil fertility, and can provide greater income than cereals in these particular conditions. There may be a side benefit of lowering fertility to levels which produce better cereal grain quality.

As they are a different genetic crop type to the cereals, the oilseeds do not host the diseases common in cereals and so can provide variety in a crop rotation to break disease cycles and reduce their effect. Remember that the oilseed crops have their own diseases, and cannot be cropped continually without risk.

A mixed farming system usually places some stock grazing value on the after harvest crop "stubble". There is little such value from the oil crops, as they have been highly developed as seed producing crops.

THE OILSEED CROPS

Safflower

Has more sub-tropical than temperate climatic needs.

Young crop sensitive to frost and dry soils; develops a deep root system and then has some drought tolerance.

Up to four weeks later maturing than wheat; harvest in January or later.

Current varieties are too late; little source of "earliness" in Australian material.

Consider as competitor to wheat for soils - not suited to marginal areas or low fertility soils.

Trials indicate it has possibility at places like Georgetown and Turretfield; but was not successful at Arthurton, Witera and Bordertown.

Linseed

Has a market ceiling, as can only be used industrially. There is research into altering the fatty acid composition of the oil and so convert it to edible use, but an early commercial move is unlikely.

A true winter crop; past experience in South Australia as a fibre crop.

Slow early growth, thus poor weed competitor. Herbicides used satisfactorily on evenly emerging weeds.

Prefers firm loam to clay soils to support a weak root system.

Maturity similar to late wheat varieties.

Rapeseed

Winter crop, with varieties available of similar maturity to the early and mid-season wheats.

Small seed, requiring firm, moist seed bed.

Has grown more widely in South Australia with success than other oil crops.

- Restrictions - wide use in rotation to minimise effect of Black-leg disease
- seed pods shatter, thus pre-harvest windrowing is advised
 - some varietal changes to be made to meet the market demand of low erucic acid levels in the oil, and low glucosinolate levels in the meal.

Sunflower

Summer crop, growing from October to March/April.

Throughout the world, better yield and quality when grown in higher number latitude i.e. - milder growth conditions.

Can fit a rotation of winter fallow, sunflower, cereal. The crop has a penetrating root system; there is very little stubble to clean up; following cereal yields have been good.

Little effect on disease cycles unless there is a winter fallow of three months before sowing the sunflower crop.

Researching varieties that will germinate evenly in cold conditions, and thus suit earlier plantings and make better use of soil moisture. Will need to watch pollination (hybrid varieties could overcome this) and the effect of seed maturation at the temperatures of December/January.

SUMMARY

The oilseed crops are not as hardy as cereals, and are suited to the best of the cereal areas. Rapeseed has that potential for the Lower North, Yorke Peninsula, and in very limited areas of southern Eyre Peninsula, the southern Hills and the Upper South East.

Elsewhere, the crops will not be economical in their own right, but in a rotation, could be beneficial to the whole farm system.

POTENTIAL ALTERNATIVE SYSTEMS FOR MIXED FARMS UNDER
CURRENT PRICE TRENDS

E.D. Higgs

Senior Research Officer, Pastures

There could be many reasons for considering the possibility of constructing alternative farming systems. In a democratic country with a mixed economy, with farming almost entirely in the hands of relatively unfettered private enterprise, the prime reason for wishing to consider such an issue is that alternative systems might prove to be more profitable to the farmer adopting them over a reasonably long period. In determining profit the level of soil erosion and soil depletion, if any, should be properly accounted for.

Increasing profitability may be achieved by either or both reducing costs or increasing output without a proportional increase in costs.

While there may be possibilities for some cost reduction, South Australian mixed farming is not intensive, so there is little room to make major savings. I will therefore concentrate on issues which could lead to greater profitability through greater productivity, of products which can be readily marketed in increased quantities, and for which the increased supplies from South Australia will not greatly influence price. I will ignore those which have marketing difficulties now and are likely to continue to have them until fundamental changes in the pattern of world trade occur.

Wheat and barley are marketable, or storable at relatively small cost. Oil seeds and particularly grain legumes are also marketable or will be with proper market development. For instance, soya beans are the dominant grain legume in a very large world trade in grain legumes. Their major use is in blended feeding stuffs. Other grain legumes and protein sources can be substituted to varying degrees. The necessary work has been done on *Vicia faba* for rational substitution to be made. In the case of lupins, further work will be needed to establish the extent to which they can substitute for soya beans, to ensure that the price received is commensurate with their true feeding value for particular kinds of livestock.

Most livestock products offer relatively much poorer prospects for expanded production and will remain so as much of Australia's production is on country for which no alternative use is feasible without heavy capital expenditure, and on which production will continue in the absence of better prices. The current production from these areas is likely to hold livestock products at a low price level until a fundamental change in world trade occurs. The Middle East livestock market is perhaps an harbinger of such a fundamental change. Our options to service such a market must be kept open. It is however, one which is largely dominated by absolute rulers who could quite arbitrarily deny access to any or all potential suppliers.

There is a considerable scope for increasing total crop production in our mixed farming system as current levels of production are based on half or less than half the farm being in crop each year. Compare this with three heavy crops a year in parts of South China, two crops a year in North China and much of India, one heavy crop every year in Western Europe and much of U.S.A., and at least two crops in three years in much of the cereal belt of Canada. Should we be fearful of being able to devise stable cropping systems based on more frequent or indeed, continuous cropping when much of the world's agricultural produce comes from such intensive cropping systems? Our fear is based on what happened in the past when no proper corrective actions were taken to cope with intensive culturing of our soils.

When South Australia was first settled continuous cropping without any fertilizer dominated for the first decades. It led to declining yields in a short time. It was then found by farmers that more wheat could be grown on the fallow wheat system without fertilizer, than with continuous cropping. Since then phosphorus fertilizer has been injected into the system, later grazed cereal and annual ryegrass and still later grazed annual legumes have been added. Machinery, tillage and sowing operations have been progressively modified towards greater size and speed of operation.

There has not at any stage of the development of the present system been sufficient experimental investigation and manipulation of the current and a radical range of alternative systems, to be confident that current practice is logical and produces maximum profits. That is not to say that no worthwhile investigations have been made. Many have been. The significance of the results of these investigations needs to be considered more fully than they have been, in the current and envisaged future context.

This conference is designed to crystallise the increasing concern by professional agriculturalist that the current practices of our mixed farming system are not leading to continuing growth in productivity, but indeed suggestions of declining productivity are becoming apparent in areas where 20-40 years ago the adoption of the alternate crop, legume based pasture sequence led to a dramatic increase in productivity and profitability, and simultaneously largely solved the then pressing technical agricultural problem soil erosion.

There is at present, as there has been at many stages in the past in South Australia, a very small minority of farmers who have recognised impending productivity declines and have already developed novel and effective solutions. Unfortunately the majority of farmers do not seem to be aware that they could be moving into a situation, to escape from which there will be difficulties encountered as great as those following the erosion and soil fertility disasters of the 1930's and early 40's.

Sustained increases in farm productivity and profitability can only be achieved by -

1. Increased nutrient inputs, particularly nitrogen inputs into the system
2. Reduction of disease losses by better disease control, and
3. Reduction in the number of years in which no crop is produced.

The Research and Development (R & D) which needs to be done can be categorised into R & D which requires an extended period of time, but leading to the potential for a drastic increase in productivity, but beyond the ambitions of most present day farmers, and R & D which can rapidly lead to some modest gains by a reasonable portion of the present farming population. We must not be overwhelmed by the catch as catch can attitude of our current farmers in planning for the longer term. If farmer motivation is practised effectively as part of the overall plan, then by the time the results of the R & D are available there will be a large receptive group of farmers. Short-term work must of course proceed with useful outputs in the short-term, but longer term work will be needed for the big leap forward. In the short term it should be possible to increase productivity of the cereal farming system without radical modification of crops grown, cropping intensity or cropping sequences. The weak links in the system are the inadequate nitrogen input and an inadequate attention to root disease control which follow from the incorrect catch as catch can approach to farm enterprise rather than a steady purposeful approach.

Apart from fertilizer nitrogen which will have an increasing role more nitrogen input can undoubtedly be achieved in many areas by a greater effort towards increasing legume dry matter production. Either or both more legume plants and less non legume competing plants will achieve this. The proportion of years in legume pastures need not increase and in many areas the number of pasture years with little legume should be reduced.

Reduction in unwanted plants must be pursued relentlessly whenever the opportunity presents itself, irrespective of the situation. A weed of crops may be reduced by manipulating pastures, a weed of pastures (i.e. a plant which competes with and reduces nitrogen fixation by pasture legumes) may be reduced by cropping or by treatments applied to a crop as well as direct treatments when present in crop or pasture.

In this short term general development will not be substantially different from what is currently done on a few avante garde farms. Much more could be achieved if more farmers were motivated to better effort by better conception of the possibilities they are ignoring now. Farmers in general do not spend enough of the day thinking! Too much of their time is spent on routine manual or labouring work and too little of their time on "farm management". Research workers spend far more of their time thinking, and are possibly frowned upon (wrongly) by many farmers for this.

In the longer term the envisaged systems would rely on the knowledgeable manipulation of the crop environment, particularly the soil environment based on a much deeper understanding of plant nutrition (for maximum crop yield) and the ways and means by which plant's nutritional gathering and supply system can be manipulated to ensure that nutrition is close to optimum irrespective of the prevailing relatively non-manipulatable moisture supply situation. The use of the nitrogen fixing legume is not ruled out but there can be no doubt that the envisaged system will involve the use of some nitrogen fertilizer. Although the system can be envisaged from existing knowledge of soils and plant physiology much R & D must be done to demonstrate feasibility.

It is most likely that the systems will vary widely according to soil type and landscape in that the capacity for soil to take up and release moisture will be a vital issue and the capacity of soils to withstand cultivation will vary widely. The extent to which land will be largely

or entirely withdrawn from cultivation because of soil and topographical difficulties is hard to predict but some may well be. These areas may be completely abandoned for agriculture or may specialise in livestock production.

The key issue will be how much crop production can be increased per unit of nitrogen fertilizer and at what price. Under European conditions 20 units of cereal can often be produced per unit of nitrogen contained in fertilizer. Such figures are not unheard of in fertilizer experiments in Australia but are rare. At least in part this is due to the low level of sustained demand placed on our soils which means that crops in the absence of N fertilizer are not seriously short of nitrogen. More intensive cropping will undoubtedly increase crop responsiveness to nitrogen.

Another key issue is organic matter oxidation which leads to production of mineral nitrogen available for plant uptake. A sub facet of this is the macro organic matter, fresh animal droppings and the roots, stems and leaves of crop and pastures. Although of variable composition these residues often have wide to extremely wide C:N ratios. Their total weight can be considerable and the degree to which these restrict the supply of mineral nitrogen for crops can be highly significant. Some of these materials however are a very desirable slow release nitrogen fertilizer. A deeper understanding of the mineralization of nitrogen in crop and pasture residues and animal excreta is an urgent need.

The control of soil borne disease should not be substantially more difficult than the control of weeds. Chemical control possibilities will increase. Constant attention to detail by farmers to ensure that the disease organism load is attacked whenever an opportunity presents itself is vital. The cropping sequence and tillage practices must be the most appropriate to minimize the effects of the major diseases.

Apart from the need for an expanded properly oriented and co-ordinated research and development programme to develop the technology required the farming population must be motivated to wish to increase production and the necessary skills imparted to them in a planned way.

Major agricultural revolutions have occurred in China, Western Europe and North America in the past 30 years with vast increases in productivity. Too many mixed farming areas of South Australia have made relatively much less or no progress in this time. Without government agricultural and general policies consistent with the objective of increased profitability through increased productivity of marketable agricultural products, the next 30 years will not be revolutionary, but with proper agricultural policies a programme to motivate farmers and an R & D programme to develop sophisticated production technology, the future productivity and profitability of the mixed farming areas can be increased dramatically.

Perhaps the greatest danger to long term success is unwarranted premature optimism about particular new crops and management practices leading to an over-reaction by farmers to their disappointment.

We must be sure that what we think is the cause for particular crop responses really is the cause.

At the moment lupins and treflan have been seen as wonderful promotion of productivity and profitability without really knowing why they are having their dramatic effect and what this will lead to if their use is continued for long periods. To construct new sophisticated farming systems deep understanding both by scientists and farmers cause and effect must be a prerequisite before the system can be publically advocated.

FLOOR DISCUSSION

- P. BIRKS - Present farming systems are extremely simple in relation to the few species used for production. The introduction of new species will reduce our dependence on these few species and the near monocultures and therefore reduce our vulnerability to new pests. It is hoped that new introductions will be free of their pests and diseases through careful quarantine.
- K. BICKNELLS - New crops mentioned only cover a limited area of the cereal growing areas. What new crops could take the place of existing legumes in the low rainfall areas?
- E. HIGGS - There is no ready made system at present to hand on to farmers. All present farming systems have been developed by farmers with science tinkering with them in the way of genetic adaptability, fertilizers, insecticides, herbicides etc. Science must become less analytical and more synthetic and fit potential systems together. There is no particular legume available for the lower rainfall areas other than annual medic which may have to be resown if aphid problems occur with it.

SECTION III

DISCUSSION OF RESEARCH/EXTENSION NEEDS FOR MIXED FARMING SYSTEMS

GUIDELINES FOR GROUP DISCUSSIONS AT AGRONOMY BRANCH WORKSHOP

Thursday 25th August, 1977

TITLE: REVIEW OF RESEARCH AND EXTENSION NEEDS OF THE MIXED FARMING
AREAS OF SOUTH AUSTRALIA

1. The aim of the workshop is to review the Research and Extension needs and it is important that all group members consider the whole farm system which includes the social (people) implications.

2. The objective of this discussion will be to bring together the relevant technical, economic, social and management aspects raised on the first day of the workshop to define priorities for research, extension and training (farmer/extension/research) in relation to:-

2.1 improving present farming systems especially for higher farming profits.

2.2 emerging systems of farming.

It is proposed that these issues be discussed as they apply to each of the five land use or land class regions.

3. Format of group discussion - to maximise individual contribution to discussions, 10 groups, each of 6 people, will discuss aspects of the previous day's programme as they relate to the five land use or land class categories viz:

- A. High rainfall red brown earth and other higher rainfall.
- B. Lower rainfall red brown earth
- C. Sand over clay
- D. Higher rainfall mallee (loamy mallee)
- E. Lower rainfall mallee

The accompanying map defines the approximate boundaries of these land use categories.

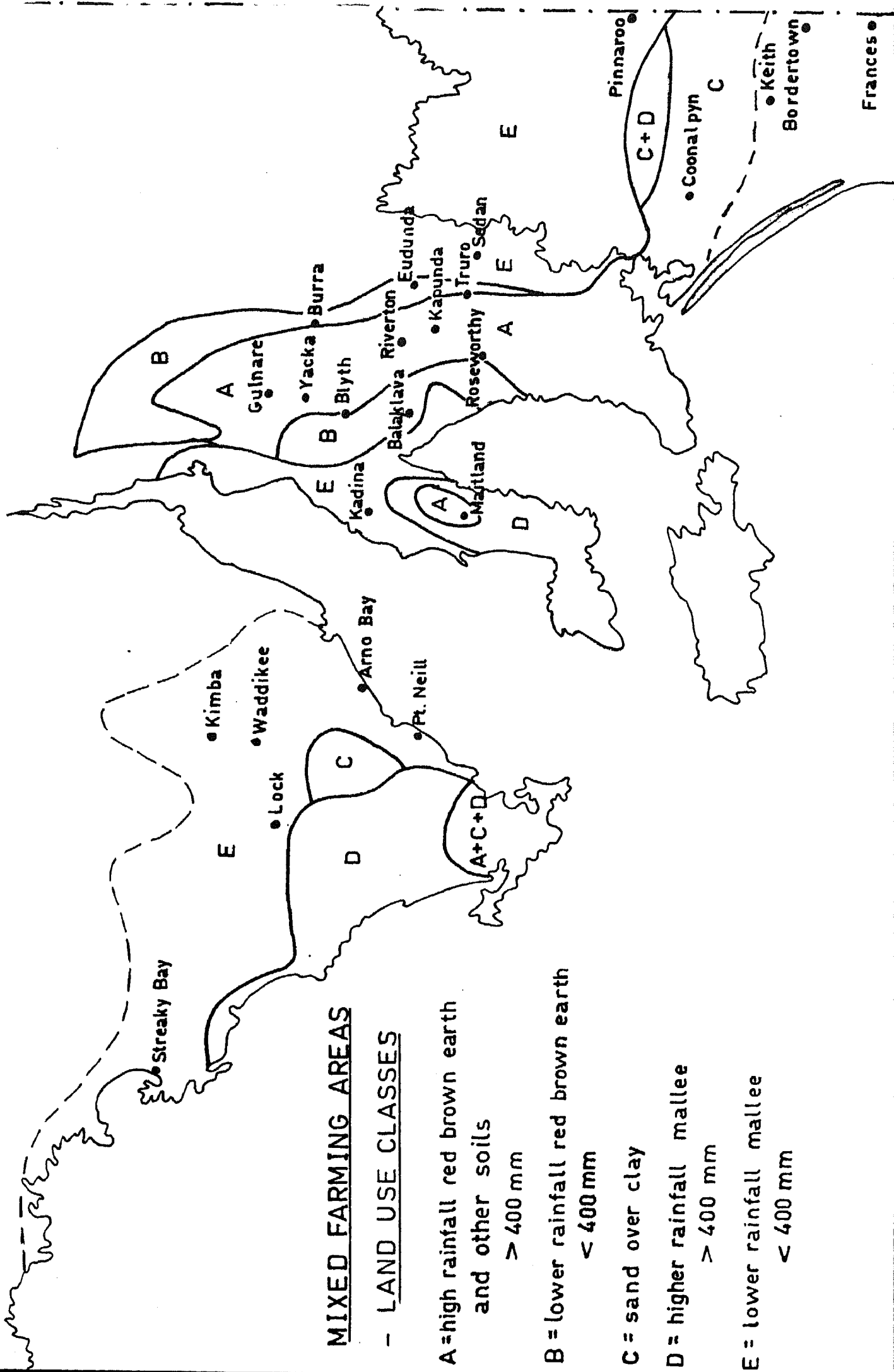
Two groups, each of 6 people, will discuss ONE LAND CLASS CATEGORY for 1½ hours. Each group will be assigned a leader to help structure the discussion - it is suggested that a recorder be selected to help 'keep track' of the points raised. The two groups for each land class will then join together to pool their findings and reach consensus on findings, recommendations etc. The two group leaders in each land class will be required to prepare a composite report on their proposals for presentation later to the whole group.

In addition the two group leaders for each land class category will be responsible for providing a written composite report for publishing in the workshop proceedings.

4. Guidelines to assist discussion -

- . Scope for improving profits, reducing work etc.
- . define limiting factors
 - social factors e.g.: attitudes (be specific)
 - technology - economics - marketing.

- . technical information and manpower training required by extension officers and farmers.
- . resources required to achieve proposals
 - finances
 - manpower
 - machinery
- . recommendations
 - research needs
 - extension needs
 - farmer training
 - officer training.



MIXED FARMING AREAS

- LAND USE CLASSES

- A = high rainfall red brown earth and other soils > 400 mm**
- B = lower rainfall red brown earth < 400 mm**
- C = sand over clay**
- D = higher rainfall mallee > 400 mm**
- E = lower rainfall mallee < 400 mm**

SUMMARIES OF GROUP DISCUSSIONSGROUP A

Higher Rainfall (Two separate reports
from groups)

Leader - P. Mowatt

Recommendations arising from discussion included the following:

1. There is a need to examine the overall production under different rotational systems.

It was considered that alternate year crop/legume pasture system led to pasture deterioration and consequent lower stock carrying capacity.

Extended cropping and pasture phases were suggested as an alternative e.g. 5 years pasture - 5 years crop.

2. There is a need to quantify annual legume pasture contribution to:
 - (a) nitrogen input and crop response
 - (b) disease control in following crop
 - (c) animal production
3. Similarly there is need to quantify inputs provided to the system from other legume crops e.g. nitrogen, disease control, animal production from stubble grazing.
4. Cereal diseases-septoria and take-all need studying and control measures.
5. Cultural practices generally require re-assessing to ensure that they are not limiting potential field capabilities of new cereal varieties.
6. Stubble handling (cereal) requires studying.
7. Minimum tillage - continue to investigate (e.g. is moisture loss as great as under conventional tillage).
8. Markets for grain legumes lack stability. Requires research.

Leader - H.R. Day

Considered that there was opportunity for improving farm profits within the technology that already exists.

There was a reluctance by some farmers to make changes.

Those willing to make change were not always able to get the required service - Banks, Stock Agents, Departmental Officers.

S.A.D.A.F. should concentrate efforts on servicing few farmers rather than large numbers.

The major research need is to develop better methods of servicing the farmer - more effective extension. The setting up of demonstration units operating on practices as recommended by the D.A.F. and operated as commercial units was suggested as a possible area of investigation.

SUMMARIES OF GROUP DISCUSSIONSGROUP B

Lower Rainfall Red-brown Earths

Leaders - C.L. Rudd and E.D. Carter

1. General Comments

The low rainfall red-brown earth soils have always had a lower potential for production than other well structured soils in the same rainfall zone (<400mm annually). At present yield of cereals is limited to approximately 85% and pasture yield to about 30% of that possible on more friable soils. This occurs with a probability of 8 years in 10. Much of the area occurs on sloping land and the combination of poor soil structure, texture and slope has caused severe soil erosion in the past and the effects are still evident today. These soils require soil conservation structures to prevent erosion of cropping land situated on slopes greater than 3-4%. In addition to the hard-setting nature of the surface, tight clay subsoils often present a barrier to water movement and root development. Hence water use efficiency is critical to successful crop and pasture growth and this can be influenced by soil conservation procedures and tillage practice.

Naturalized medics have never done well on these soils and soil fertility is generally low. This situation has not changed significantly as introduced medics have not persisted any better. There is also approximately 160,000 ha of stony hill country within this zone which has never been significantly improved. However, a relatively few individual farmers have greatly lifted the potential of this country by making a determined effort to ensure the success of the pasture phase. This has not been done without an increase in inputs and at some risk.

Farming systems generally are severely restricted by two most important factors completely outside the control of the farmer:-

1.1 Great variability in seasonal conditions

Overall, 62% of variability in cereal yield in S.A. is due to rainfall. This figure would be much higher for the specific soil group under discussion. This makes the planning of inputs to the system extremely difficult when yield may vary 7-10 fold. (The decision on whether to use bag N is a typical example).

1.2 Fluctuations in the availability of overseas markets and their effect on prices paid for farm products

The low rainfall red-brown earths are a high risk farming proposition and there seems little hope of changing from present systems currently used. The recent trend and interest in oilseeds and grain legume crops is not available to farmers in these areas as an alternative source of cash cropping due to inadequate rainfall and soil fertility. For these farmers there is much to be said for not rushing in and changing farming systems quickly and this resistance to change has probably ensured their survival so far. The low indebtedness of many farmers on this soil group (particularly at the lower extremities of the area) is also a most important factor in survival.

2. Scope for Improving Profits, Reducing Workload

Productivity is essentially the ratio of outputs to inputs in a given farming system. Increased productivity does not necessarily mean an increase in profit. Many farmers may be satisfied with sufficient cash surplus for their needs. Farmers looking for a significant return to investment remain unsatisfied in most cases.

2.1 Basic production systems of cereals (wheat, barley, oats) and livestock (sheep) will remain until a better system is available. There is none at present.

2.2 Limited scope for sidelines such as poultry, pigs, Angora goats, tourism etc. This very much depends on the attitudes and interest of individual farmers as the capital cost of setting up sidelines may be prohibitive (cf. R.W. Tiller's pig enterprise).

2.3 Reducing costs of inputs seems to be the short term answer. These may be achieved through:-

- syndication
- sharefarming
- reducing tillage (zero tillage practices not possible)
- increased cropping intensity and a reduction in fallowing
- critical appraisal of fertilizer needs (particularly superphosphate).

2.4 Re-appraisal of the role of the pasture phase and a determined effort to ensure its success. (Better annual legumes than the currently available medics and clovers are desirable).

3. Limiting Factors

3.1 Social factors related to the norms of the area in relation to:-

- fallowing
- pasture improvement
- heavy stocking rates

Attitudes generally tend to be rather fixed.

3.2 The lack of a productive annual medic for these soils.

3.3 Crop losses due to cereal root diseases.

3.4 Physical isolation of the northern areas in relation to stock markets and processing facilities.

3.5 The high cost of all inputs (A. Glover) and heavy tariff burden on farmers.

3.6 The high risk associated with the use of bag N to boost nitrogen supply in a more intensive cropping situation.

4. Technical Information and Manpower Training Needed

4.1 Much technical information already available is apparently not reaching farmers:-

- in relation to superphosphate use
- in relation to bag N
- in relation to the importance of climatic variables

4.2 More use could be made of the Agricultural Bureau system to disseminate information.

4.3 Farmer apprentice schemes aimed at young farmers and the further training of extension officers to ensure that alternatives given to farmers fit their existing or potential farming systems.

5. Recommendations

5.1 Continuing research on -

- insect pests and cereal root diseases
- annual legumes for dry red-brown earths
- reduced tillage and the handling of stubbles
- the quantification of soil N transformations and inputs from annual legumes is indicated.

Of these areas the control of cereal root diseases is likely to produce large benefits in an area with poor legume pastures.

5.2 The place of oats as -

- standing crops
- cleaning crops in rotations
- grain for feed
- improvement for stony hill country needs further investigation.

5.3 Monitoring of the effects of the widespread use of pre-emergent herbicides in relation to -

- the effect on soil structure and erosion potential
- the effect on the annual ryegrass component of pastures.

5.4 An investigation of alternative drought strategies.

5.5 Farm management economics training for Departmental personnel and farmers alike. Short courses were suggested in the areas of -

- marketing
- financial management
- record keeping and problem definition
- estate planning and legal matters
- taxation.

Whilst some are specialised fields, both farmers and Departmental staff should be aware of problems and the agencies providing specialist services.

5.6 Some effort should be made to predict likely problems when the farming system is changed. A modelling approach may be possible even with limited data currently available e.g. a relatively simple model could have indicated -

- nitrogen deficiency
- increased disease problems
- increased erosion potential - as a result of greater cropping intensity.

Whilst these facts were recognised by individual officers and farmers alike a more organised approach is suggested. Trends determined by district staff could be tested against the model and followed up by appropriate extension activity.

SUMMARIES OF GROUP DISCUSSIONSGROUP C

Sand over Clay

Leaders - K.J. Holden and W. Hawthorne

1. Extension1.1 Alternative enterprises

- Farmers need to know all the alternatives available.
- Implications of any advice has to be considered - capital and operating costs, risks, increased labour, new skills and effects on subsystems.

We need to recognise that new ventures require the farmer to learn new techniques and skills. Greater demands will therefore be thrust on research and extension services.

As farming systems are becoming more complex, more dependent on technology and are changing at an ever increasing rate, an increased extension effort is necessary in the future.

- Farmers need more explicit information for borrowing.
- Price variation and production of grain proteins is greater than with cereals.

Increased production may help guarantee firm markets and may stabilise prices.

- Local markets for grain legumes should be developed.

1.2 Farmer Groups

Future extension efforts will need to be focussed more towards groups as:

- resources can be used more efficiently
- adults learn more readily when involved in groups.

1.3 Social systems

A knowledge of the people within the rural community is essential, otherwise considerable research and extension effort is wasted.

1.4 Drought situation

The drought years of 1975, 1976 and 1977 have seriously affected the viability of farms in the low rainfall sand/clay districts. The drought conditions have been aggravated on these soil types because of water repellence, drift and root diseases.

Farmers with little prospects of return until late 1978 have insufficient cash flow to purchase seed or to meet other operating costs. Carry-on finance and advice on drought management strategies is required.

1.5 Increasing costs

Should more emphasis be given to 'most profitable production' rather than 'maximum production'?

Minimum tillage and a more intensive cropping system was cited as one way to achieve this objective.

Increased machinery costs have been a significant factor in high production costs in recent years. Potential exists for more contractors and sharefarmers who own plant to spread capital costs of machines, thereby reducing production costs.

Costs and returns information provided by the Department should be kept up to date and needs to be more specific.

1.6 Increased returns

Potential exists for improved profits in low rainfall areas by decreasing cropping and increasing livestock numbers as:

- there are less risks in a dry season
- less variability in returns
- lower costs of production

Insufficient attention has been focussed on improving livestock profits by increasing lambing percentages.

2. Research

2.1 Alternative crops

A wider choice of alternative crops (especially grain legumes) is needed for the less than 375 mm rainfall areas. An objective for research should be to discover new grain legumes.

2.2 Pastures

- Better suited pasture legumes are required for acid sands and water repellent soils. Deep rooted perennials are desirable.

More pasture legumes are desirable as there is too much reliance on a few species of crops and pastures - more species would provide greater flexibility in event of introduction of serious insect pests. Pastures are too vulnerable when only a few varieties are available e.g. 'if lucerne is annihilated, what is left?'

- A wider range of herbicides is needed for grassy weed control, especially brome grass - hosts to root rotting fungus diseases.
- Biological control of red-legged earth mite is needed.

2.3 Minimum tillage

Minimum tillage and stubble retention has potential for crop establishment on water repellent sands and should assist to overcome water repellance and drift.

Greater co-ordination is needed between farmers, industry and Department of Agriculture and Fisheries. In addition more liaison within the department is necessary. The minimum tillage techniques committee should be revived.

Improvements in machinery design is essential. Current machinery has been designed for overseas conditions. Resources within the Department are required to liaise with farmers and industry, to act as resource personnel for machinery manufacturers and to provide an extension service for farmers.

- Long term effects on soil fertility, disease, insects and yields and other factors need to be researched.

2.4 Crop rotations

Introduction of lupins into the farming system has highlighted the yield increases possible by disease control and fertility build up.

Research is necessary to determine how lupins and other grain legumes fit into the rotation, the frequency of cropping grain legumes, utilization of stubbles, emergence problems, seed quality, disease control, nodulation and weed control.

2.5 Fertilizer trials

Longer term trials should receive more emphasis. Single year trials do not provide sufficient information. Need to know how fertilizer influences other sub-systems. Discontinuity of personnel has created problems with long-term trials in past.

SUMMARIES OF GROUP DISCUSSIONS

GROUP D

Higher Rainfall Mallee (Two separate reports from groups)

Leader - T. Dillon

1. Possible new System

Under the present market conditions, i.e. returns from grains much better than livestock, any change in farming systems will, logically, be towards more intensive cropping.

This may only mean more cereal crops. Where a suitable grain legume or other crop (e.g. oil seed rape) is available then it may mean continuous cropping with no pasture phase in the rotation.

Problems with increased cropping:

- 1.1 Larger equipment may need to be purchased to handle larger hectares.
- 1.2 Soil structure could be a most serious problem.
 - A farmer will have larger areas to work so he works implements faster.
 - Operations may not be timed as well.
 - Large areas will be cultivated and in years such as this year drift problems may be worse. The ability to resow affected areas will be limited by the area that must be resown in a limited time.
 - Soils which have particular structure problems e.g. sands and sandy red brown earths must be watched very carefully.
- 1.3 Minimum tillage could be very valuable to allow a larger acreage to be sown with present machinery and labour.

There were some questions about minimum tillage that we thought were not well enough answered.

- weed control - particularly ryegrass - Work on Eyre Peninsula indicated that a shallow cultivation before opening rains gave a better germination. Subsequent cultivation would kill these weeds and would perhaps give adequate control.
- The behaviour of cereal root disease with minimum cultivation e.g. would cereal cyst nematode hatchings be delayed and prolonged?
- Insect pests of germinating cereals. Cereal curculio apparently have created some serious problems in trials at Turretfield. How will wireworms and white curl grubs be affected?
- Fertilizer requirement - Would more nitrogen fertilizer be needed? Early cultivation gives some build up of available N at seeding.
- Soil moisture - In areas where moisture, for the crop, may be

limiting what is the effect of allowing weeds to grow for two months? In traditional situations these weeds would be killed by cultivation but this may dry out the soil anyway.

- 1.4 More intensive cropping is possible now where suitable grain legumes are available, e.g. where peas are reliable or on the neutral to acid soils where lupins grow well.

Some of the factors requiring more work are:-

- Grain legumes for lower rainfall districts and for alkaline soils in higher rainfall districts.
- Market information for increased production of grain legumes.
- Disease resistance of peas. Diseases is one of the major factors holding the pea area down.
- How much nitrogen do the grain legumes actually fix?
- The effect on soil structure of a cereal-grain legume (continuous cropping) rotation.

The two farmers (both from Yorke Peninsula) were queried regarding the farmers attitude to continuous cropping, using a grain legume. Their answer was "If you can provide us with a satisfactory and reliable grain legume we will all go for continuous cropping and there will be no social problem".

One of the serious problems with more intensive cropping is handling the stubble residues. Burning is, of course, a very effective way of removing them but is very wasteful. Should header tailings be put into a big roll and fed back with some grain or urea and molasses. The rolling or baling of these tailings is becoming more practical with the use of windrowers for barley crops; all the stubble and heads go through the header.

Are there better methods of incorporating this straw back into the soil before the following crop is sown? There is a great deal of farmer experience on this subject, of handling stubble, that should be collated and disseminated.

2. Present System

2.1 Root diseases - Cereals

The first problem that we discussed was that of the root diseases of cereals.

From information already available, and the table presented by Grant Baldwin, it is obvious to us that root disease is costing farmers dearly. Farmers generally have insufficient information on these diseases and their control. There is at least some information available that many extension officers are not aware of; e.g. some oat varieties suppress cereal root eel-worm. This fact has been established by Mathison and later O'Brien but some district agronomists have not heard of it.

Farmers are aware of some practical methods of controlling some root diseases, their practices should be assessed carefully. Maybe, practical control methods could be developed.

2.2 Legume pastures are a weak link in the system at present.

The main reasons for the medic's poor performance are somewhat uncertain but the following are contributing:

- Sitona weevil have certainly damaged medic stands. The possibility of further damage by spotted alfalfa aphid is causing further uneasiness.
- Weeds, e.g. ryegrass and broad leaved weeds, are competing much more successfully than they were 15 years ago. One possible reason for this is that the fertility status of the soil is much higher now. While the present cultivars performed well then there may be a need for cultivars which can compete vigorously with grasses at higher levels of fertility.

The fact still remains that some farmers still have good medic pastures in most years. Good management is more important now than it was 15-20 years ago. Our farmer commented that many farmers in his district have decided to sow more medic in an attempt to improve medic pastures. We felt that unsatisfactory sowing methods (too deep, under heavy crop, into heavy stubble) will cause many failures. It is important that extension officers promote the most suitable sowing and management methods

2.3 Bag nitrogen is being used increasingly to overcome the effect of poor medic pastures and root disease. One farmer uses 16 kg/hectare of N because it works but suspects that a higher rate might be better. He will stay with this level until somebody convinces him differently. Generally farmer and extension officers are unsure of the level of nitrogen usage needed in most situations. The information, a parently is available but certainly not readily or in an easily disseminated form. Methods of application are not well understood by farmers.

2.4 The monitoring of disease, insects and weeds need far more input than at present.

A cereal breeder in our group, said that an accurate table, such that presented by Grant Baldwin, would be the basis of determining the direction of his breeding programme.

Huge sums have been spent on breeding rust resistant wheats and nothing on attempting to breed for resistance to root disease. This is natural because it was easy to guess at the losses for rust. In a bad rust year the losses are dramatic but does it compare with regular losses from cereal-root eelworm?

Weeds such as mignonette and Lincoln weed are increasing in importance but nobody has assessed the loss in production caused by them.

This monitoring should not be an extra load on present staff. Extra staff should be employed and stationed in country areas to work with present staff to carry out this monitoring role.

GROUP D (Contd.)

Leader - M McKay

1. Farmer and his family MUST accept change.
2. Changes are inevitable because the farmers are such a small proportion of the community they cannot realistically expect any special treatment.
3. People in the cities have had to accept changes (even if unwillingly in many cases).
4. Farmers are not going to like making any changes very rapidly.
5. Farmers need to consider (and be helped to consider) the effects of the inevitable changes which lie ahead.
6. There are many significant social changes taking place in the Western World.
7. Technological changes are easier for a farmer and his family to accept than social changes for which he is ill-prepared - by his Industry leaders and by planning and executing authorities.
8. There appears to be some definite needs:
 - 8.1 Overcoming current problems which limit low input production.
 - 8.2 Australian farmers have the ability to work in an agricultural system based on relatively low inputs.
 - 8.3 The opportunity for Australian farmers to diversify their production is probably greater than almost any other farmers.
 - 8.4 We do not need short term recipes to "plug up the odd hole or two in our systems".

We probably require some quite basic changes to either our current system, or else; a system based on the long term needs of -

- Each farmer and his family
- Each farm as an increasingly more efficient production unit
- Each farm as a store house of readily available fertility,
- The total rural production based on market requirements - not on production without thought of the customer's needs.

9. It was felt by this group that:-
 - 9.1 S.A. farmers must accept drought as a part of the farming scene. Farmers need to manage properties to reduce the effects of drought - not from the old time point of view of conserving hay or grain, only. Perhaps it will be more useful to conserve cash than fodder.
 - 9.2 There is a need for farmers to be guided how to build up a bank of soil fertility, when farm incomes are high. This would enable farmers to make the very best use of above average seasonal conditions.

- 9.3 It was believed by this group that the overwhelming majority of farmers are operating on such a low level of soil fertility (and also on such a high level of crop pests and diseases) that it is not possible to make full use of a "bumper" season.
- 9.4 It seemed to this group that no-one knows what is happening in the States' legume pastures as far as nitrogen building is concerned (or as far as pests, diseases and weeds are concerned).
- 9.5 It seems most likely that we need to have a fresh look at bagged nitrogen under the conditions that exist on the average farm TODAY. We doubted validity of work done on "A typical" farm or some years ago when we suspect legume pastures produced a nitrogen build up between crops (i.e. before weeds in pastures were the problem they are today).
- 9.6 There is a need to look at rotations in a new light altogether. How do we work out a crop rotation system which enables us to maximise cash flow by getting the best possible returns from the cash crop phase?
- 9.7 We need to be more critical of the importance of the pasture phase in relation to the needs of the cash crop. What has gone wrong with the "between the cash crop phase:?"
- 9.8 We believed there is a need for an accurate soil fertility and crop pathogen MONITORING service.
10. The very brief time we could spend on the MARKETING ASPECT led us to only a couple of points:
- 10.1 We felt that in the U.S.A. there was a more clearly defined and accepted rural policy of linking production with marketing.
- 10.2 This we felt was a reason behind the U.S.A. appearing to be prepared to store produce until "glut" conditions were overcome by the natural downturn of production in subsequent seasons (refer to the grain gluts and subsequent poor world wide harvests).
11. Two other factors were felt to be worthy of greater consideration - perhaps by the Economics Branch:
- 11.1 What is the actual effect on the cost of production on an average farm by the current high capital cost of plant and machinery?
- 11.2 Are land prices so high that they will cripple farming - especially "family - farming"?

SUMMARIES OF GROUP DISCUSSIONSGROUP E

Lower Rainfall Mallee (< 400mm)

Leaders - K.G. Bicknell and J.R. Cawthorne

1. Limiting Factors1.1 Social1.1.1 Decreasing Rural Population

1.1.1.1 Farms getting larger

1.1.1.2 Larger farm machinery (one man is now able to crop more land).

1.1.1.3 Small towns disappearing (modern transport allows farming community to travel to larger centres).

1.1.1.4 Less casual labour (seasonal workers).

1.1.2 Image of "Expert"

General acceptance of the "public servant" is not good in the farming community.

The "expert" must be able to sell himself to gain acceptance.

1.1.3 Rural Community is very conservative1.2 TechnologicalFragmented Information

Technical information available on many specific problems is not getting to Extension Officers or farmers. Much of the technical information available is not related to the whole system.

1.3 Economics

1.3.1 A farmer may accept new information, but is unable to implement because of lack of finance.

1.3.2 Finance limits availability of training for farmers.

2. Technical information for Extension Officers and Farmers

2.1 New information and findings from trials need to be further demonstrated on larger areas (on farm) to gain better and quicker acceptance.

2.2 The adviser must be able to present information in relation to the whole farm management programme or system.

3. Resources required to achieve proposals3.1 Finances

3.1.1 Income equalization deposits.

Purchase of deposits in the years of high income (1 in 3) may reduce income tax in that year and provide a more even cash flow to enable the farmer to survive, year in year out.

They should provide stability of income in the drier areas.

- 3.1.2 Off farm investments
Could be used to spread income and to provide a source of regular income.

3.2 Manpower

- 3.2.1 Information officer necessary for each Research Group to collect and present research findings to Extension Officers.

- 3.2.2 Personnel required for monitoring yield losses from diseases, insects and weeds - maybe some existing personnel could be reallocated for this work.

4. Recommendations

4.1 Research Needs

4.1.1 Examine the whole Ley Farming System

4.1.1.1 How well are legumes fixing nitrogen

4.1.1.2 Critically examine pasture

- (a) Assessing seed reserves
- (b) Reseeding methods
- (c) Economics of reseeded

4.1.1.3 Use of fertilizers on crops and pastures.

4.1.1.4 Assess the role of alternative crops.

4.1.2 Examine all alternative (potential) crops e.g. grain legumes, Triticale, cereal rye.

4.1.3 Disease control in crops

4.1.3.1 Varietal resistance

4.1.3.2 Role of non host crops

4.1.4 Examine minimum tillage methods and stubble mulching.

4.1.5 Suitable grasses to replace existing barley grass and brome grass.

4.1.6 New oat varieties for grain and grazing (perhaps the oats could replace the grass component in pastures).

4.1.7 Monitoring of crop losses from diseases, insects and weeds. (This additional work load should not be added to existing Extension Officers duties).

4.1.8 Marketing information

4.1.8.1 For new crops (information required on potential markets prior to testing new crops).

4.1.8.2 Forward information regarding existing crops to avoid over-production.

4.1.9 Collection and dissemination of information (e.g. suitability etc.) on farming equipment. This information is not available from the Department at present - may be a new section needs to be formed.

4.1.10 Information on low cost fencing (electric fences are not the answer in dry areas during summer).

4.1.11 Alternative animals to sheep (not cattle) - may be goats.

4.2 Extension Needs

Information officers - to collect all new and relative information from Research Organisations, Research Centres and Research Officers and pass onto Extension Officers.

4.3 Farmer Training

4.3.1 Short courses on specific subjects.

4.3.2 Workshops of 1 or 2 days

4.3.3 Field Excursions - to examine existing problems (e.g. diseases)
- inspect trials and demonstrations.

4.4 Officer Training

4.4.1 More extensive basic training for Extension Officers.

4.4.2 Apprenticeship type training for Extension Officers (e.g. Assistant Advisers).

OVERVIEW OF GROUP DISCUSSIONS FROM RESEARCH POINT OF
VIEW

E.D. Higgs

Research workers must realize -

- (1) All the most desirable equipment will never be available to do a complete job. We must do the best with our limited resources.
- (2) Farmers should be encouraged to be productive to help increase State revenue, and hence the overall wealth of South Australia. S.A.D.A.F. officers must also have a conservation role to ensure that the basic land resource is maintained or improved.

Farmers should be maximising profit in the long term to ensure survival.

Government is also in the business of survival and the S.A.D.A.F. is involved in preserving the State's resources in the long term. In the short term the S.A.D.A.F. must also be involved to maximize State revenue from taxes.

How does the research officer and/or extension officer go about achieving these objectives? Research officers are in the business of INVENTION - i.e. better ways of farming and development of better systems. Development is a very important part of research in S.A.D.A.F. e.g. research officer working with farmer - too little of this has occurred previously. A major problem exists in dissipating the research effort of the S.A.D.A.F. too widely - I am suggesting that greater returns will be obtained if concentrated efforts with fewer key farmers!

I cannot overemphasize the importance of summing up existing knowledge before racing off to do research - or before even thinking there is a need to do research! There is a vast amount of information relevant to the farming systems we are discussing. The problem is finding, sifting and collating the information into a relevant form.

Examples of subject areas requiring major research effort are -

- (1) Nitrogen response and understanding of N cycle is the top priority - much work is required to improve knowledge of rise and fall of N levels in both crops and pastures - need this information to go into the developmental stage.
- (2) Disease situation in relation to crops and pastures is similarly very poorly understood and work is required on a similar basis to that for N.
- (3) Weed and insect pests.
- (4) Factors influencing levels of annual legume seed reserves.

As a general comment I believe too much work has been going on in the glasshouse without knowing what is going on in the field e.g. competition in sub. clover - variance between field and glasshouse experiments.

OVERVIEW OF GROUP DISCUSSIONS FROM EXTENSION POINT OF
VIEW

G.D. Webber

The workshop groups have tried to look at the mixed farming system and have found it difficult to tackle the overall system - farm easier to attack various components of the system in isolation.

Must always remember that people are the most important component of the system.

Extension problems

- i) Much technical information is available on the components of the system - problem of achieving more effective collation and distribution.
- ii) Develop better methods of servicing farmers - criticisms of fragmented methods at present.
- iii) Need better adapted information in relation to the system in any given region or district.

Comments

- 1) Extension workers are mostly involved in communications - sender and receiver with equal responsibilities. If we are not sending information required then we hope we get rapid feedback from the farm level i.e. we will find out what farmers want. This means that farmers must define the information they require.

Our current extension methods are based on -

- i) Service role
- ii) Develop programmes

Are better methods required?

- 2) System needs better monitoring

Major pressures exist from Government and Agricultural Industry to monitor from the production end. However major problems may be with monitoring basic inputs of the system e.g.

nitrogen levels
seed reserves
fodder reserves
crop losses
pest plant and insect levels

These are the basic foundation blocks of the system!

How do we mount a better monitoring system?

"Think tanks" are used to look at industry problems but why no use of think tanks to look at mixed farming on an "integrated system" basis?

These are the basic foundation blocks of the system and it has been suggested many times that we have little quantified information in these areas.

How do we provide a better monitoring system? -

"Think tanks" are used to look at industry problems but there has been little of this approach to look at mixed farming on an "integrated system" basis.

3) Training

Training has been discussed for the farmer, extension officers and specialists. We seem to have a major problem in integrating formal training at the various levels. There are certainly moves to have a programme of in-service training in the "Whole Farm Approach" for field extension officers over the next couple of years.

4) Critical review

In the words of Max McKay we "need to get outside the square". We need to look at the system from the point of view of an outsider. We do have a reasonable amount of flexibility in the system. We should explore it. Have we looked at all the possibilities?

5) Drought management

We must manage for drought - drought has more important effect on some components of the system than others.

The mixed farming system has survived in semi-arid areas because it has been a low-cost production system. We must remember that the goal of most farmers in many of these areas may be one of long term survival rather than maximization of short term profits. Our extension methods need to be adjusted accordingly, to have full consideration of all factors (technical, economic and social) involved.

DISCUSSION OF GROUP SUMMARIES

- A. RATHJEN: Nitrogen is the single most important factor in S.A. farming and has been for 80 years. Since the advent of superphosphate, the neglect of nitrogen is almost criminal. The reason for fallowing in the early decades of this century was, I believe, almost entirely for nitrogen release. Early research at the Waite Institute demonstrated the interaction between nitrogen and phosphorus on crop yield. Large increases in crop yields were recorded when fallowing and super application were combined. In the 1930's research at the Waite described nitrogen movements in the soil - there has been little follow up work. Farmers and researchers are forced to make management decisions on crops without a sound understanding of nitrogen dynamics. This information should be freely available considering the large number of soil scientists in this State.
- New cereal varieties are released after approximately 50 trial results have been analysed. In contrast, I believe that there is not a single trial result for nitrogen fixation by medic pastures. There are more results available for sub clover. We need to know when nitrogen becomes available and when deficiencies occur. At present we are forced to rely on two research efforts - one 15 years old and the other 40-50 years old. As a rule of thumb, no/little available nitrogen is present in August in normal seasons.
- C. RUDD: Soil nitrogen status is highly variable and is difficult to quantify especially with the limited "tools" available to the Soils Branch. Much information is available on bag nitrogen use and response.
- A. RATHJEN: The nitrogen analyses performed 30-40 years ago were much more laborious than present day techniques.
- C. RUDD: Rovira (C.S.I.R.O.) has recently obtained some information on the nitrogen cycle using radio-active tracer techniques. I agree that not enough information is available on the dynamics of nitrogen in the system.
- A. RATHJEN: I believe that bagged nitrogen is about to be used on a wide scale. Not enough information is available to provide recommendations.
- K. HOLDEN: We have been working with Wanilla and Karkoo bureaux on the response to nitrogen of Clipper, Weeah and Prior barley. These trials have been particularly useful - those farmers involved have increased their nitrogen applications significantly.
- A. RATHJEN: That's what I thought was the case but more accurate information is necessary.
- E. CARTER: We are dealing with a dynamic system. We don't know how much nitrogen to apply as the rainfall is unpredictable. This is true for all zones with a mediterranean climate.

- A. GLOVER: I have decided on 20 kg per ha of nitrogen in the Yeelanna environment (400mm rainfall, sand over clay and red brown earth soils). Application rates would be higher if spring conditions predictable. Below 20 kg there is not an economic response and above 20 kg problems are encountered with crops which are too vigorous.
- D. CORRELL: There is an important difference between bagged nitrogen and that which becomes available through the season. At Winulta, nitrogen is in short supply in August-September.
- C. RUDD: The Soils Branch has conducted over 200 experiments with fertilizer nitrogen since Russell's era. However knowledge of the dynamics of nitrogen in the soil have improved very little since the early days. The sophisticated equipment needed to follow nitrogen in the soil (i.e. tracer equipment) is too expensive for the S.A.D.A.F. Therefore this problem will remain a basic research programme suitable for Universities or C.S.I.R.O.

The reason for no available nitrogen during periods of active growth is that plants take up this nitrogen as rapidly as it is released.

- J. HARRIS: I would like to make 3 points pertaining to take-all.

1. I refer to a paper published in Victoria titled "Dead Heads in Wheat - a field study". The researchers involved isolated fungi associated with dead heads. The highest involvement of take-all *Gaeumannomyces graminis* was 5%. There are a number of other fungi involved including *Cochiobolus*, *Fusaria* spp and *Pythium*. Thus we are dealing with a disease complex.
2. The above should be considered in plant breeding programmes especially with regards to Mexican wheat.
3. Varietal evaluation trials should be scored for incidence of dead-heads and take-all.

Root diseases are much more severe when plant nutrition is inadequate. The use of infra-red false colour techniques to indicate disease patches was described.

GENERAL FLOOR DISCUSSION

CHAIRMAN: M.R. KRAUSE

M. KRAUSE: Summarized extension needs as -

1. Better collation and dissemination of information
2. Better service to farmers e.g. (i) closer liaison with bureaux
(ii) use of demonstration farms.
3. Monitoring services for the following components of the system.
 - a) diseases
 - b) nitrogen
 - c) crop losses
 - d) markets
 - e) pasture seed reserves
4. Training programmes for farmers and extension workers
5. Think-tank concept.

I am pleased to see there were no radical changes proposed although there are some problem areas.

The place of new crops was questioned as well as the efficacy of one year pasture.

J. HARRIS: Emphasized the importance of extension and research workers liaison.

M. SMITH: There should be more feedback from farmers and rural people on the effects of the cost:price squeeze and rural survival. What do farmers expect? - is it still rural adjustment in the form of becoming more efficient i.e. "get big or get out". Alternatively has this movement from rural areas already gone too far, and more subsidies, protection e.g. carry on finance should be allocated to farmers with the overall aim of keeping more people in rural areas.

More emphasis should be made of South Australia becoming too urbanized and the effect of high protection of most of the urban jobs compared with most rural jobs.

Should farmers and their advisers be more actively trying to influence the policies of the State Planning Authority? This authority will increasingly become the agent of change affecting what may happen to marginal farms as the cost:price squeeze continues. In particular they are likely to have most effect on areas within reasonable distance of Adelaide where there will be a ready market for marginal farms from hobby farmers and others wanting to escape suburbia.

- R. BEACH: Made the observation that farmer numbers are decreasing while their debts are increasing. Most cures proposed were of a temporary "band-aid" type. It was difficult to reduce costs while the Arbitration Courts increase wages. In answer to Murray Smith's questions regarding Rural Adjustment, in my opinion it is only a temporary measure. If any industry needed carry on finance it is past the point of no return.
- Australian farmers were operating from behind a "tariff wall" over which they had no control.
- Tariffs costs each Australian farmer \$4,000p.a. Taxpayers subsidise the car industry \$4,000/employee and over \$20,000/employee in the ship building industry. Farmers are price takers and should be price makers - for example have some control over the price of a loaf of bread. In America the price was 80¢ a loaf several years ago while in Australia it is still only 50¢ with present Australian wages 20% higher than American wages.
- E. CARTER: We need information on the inter-relationships between N and disease and the crops ability to get ahead of disease. That is, we need to be able to distinguish between the effect of N on disease and nutrition.
- J. POTTER: We need an integrated workshop in the future between livestock, crop agronomy and soil branches.
- A. GLOVER: The average age of farmers is 54-55. A pilot training scheme has been initiated at Yeelanna involving 23 young farmers aged between 15-17 yrs. Little co-operation has been received from any level of the Department. There should be more emphasis placed on training the young farmer. Extension services should be aimed primarily at the 16-22 year old age group. Youth today has the very difficult choice to make between a weekly paid job and having to raise \$150,000 in assets before the basic wage level can be reached in a farming enterprise.
- M. KRAUSE: Summarized the Research needs as follows:
1. The dynamics of nitrogen in our ley farming systems especially
 - a) the role of bagged nitrogen
 - b) factors affecting the inputs of nitrogen from pasture and grain legumes and the subsequent effects on cereal yields
 - c) the seasonal fluctuation in soil nitrogen levels
 2. Plant protection research
 3. Tillage systems especially minimum and reduced tillage and their effect on soil structure and water economies. This would include examination of machinery needs.
 4. The place of new crops in the system
 5. Marketing research especially involving the newer crops
 6. Water repellance

7. Improved legumes for the red brown earth soils

8. More reliable oat varieties.

P. KLOOT: Farmers have developed our farming systems and we as agricultural scientists have and still are only tinkering with parts of that system. I question Mr. Krause's statement that no radical changes are required. In my opinion this was not the tone of the conference.

M. McKAY: We are trying to put new ideas into an old system whereas greater gains may be made by developing an entirely new system.

M. KRAUSE: It is paradoxical that our system is working well in the Middle East and yet here it is beset by problems.

G. HOLLAMBY: I believe that the transition of information to the farmer has been slowed down by the over conservatism of the research worker. New ideas should be passed on to farmers more rapidly, provided that they are warned of possible risk. The innovative farmer will critically evaluate these ideas. In this way new ideas would be disseminated and evaluated more rapidly than if confined to the research centre.

W. HAWTHORNE: Six of the eight points listed by Mr. Krause are already being investigated by officers of the department. Does this indicate that this conference has confirmed that the Department is "on the right track"?

P. BIRKS: We have looked at the "pieces" now we need to look at the whole system. The demonstration farm approach would facilitate this. In this way research could be integrated across a number of disciplines.

J. HARRIS: Are the agronomy branch's research resources diminishing and if so, should more co-operative research be done? We started examining the system: the further the conference has progressed the more we have reduced the system to spare parts.

E. CARTER: One can obtain systems information from the good farmers and we should support them if necessary.

M. McKAY: You must use the whole farm approach and not a plot-paddock approach if information on whole systems is to be obtained.

E. MILNE: I believe that many farmers would be happy to look at nitrogen responses on a half paddock scale. Necessary research projects from a farmers point of view are -

1. fertilizer usage - especially nitrogen
2. yield improvements in wheat and oats
3. increased lambing percentages
4. increased stocking rates and their effects on pasture
5. new and improved cultivars of crop plants, Can ryecorn be improved for the sand over clay areas?
6. low cost fencing
7. disease and insect control
8. reduced crop losses due to wind - especially oats

9. reduced harvesting losses in oilseeds. It is estimated that twenty percent of rape and sunflower crops are lost annually due to poor harvest techniques.

10. tillage practices

11. herbicide use.

D. CORRELL: The answers to the nitrogen cycles will not be found in one year. I believe that present day observations may be influenced by events of up to five years previously.

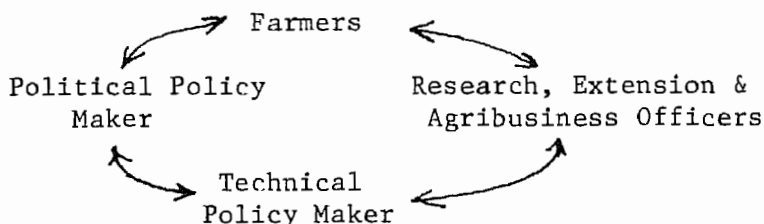
M. CATT: A rotation trial has been initiated on Lower Eyre Peninsula which aims to continuously crop lupins with cereal/oilseeds. This trial also includes minimum tillage techniques. It is hoped to integrate the "bits" into a complete farming system in this way.

SUMMARY - A POLICY MAKER'S VIEWPOINT

A.F. TIDEMAN

Assistant Director, Department of Agriculture
and Fisheries

As Acting Assistant Director, I would like to emphasize my role as a technical policy maker and contrast it with the political policy maker and others involved in a continuum which can be illustrated as follows:



The day to day tasks of the farmer are practical and often require considerable manipulative skills. The extension, research and agri-business officers can work with a fair degree of scientific precision. The political policy makers on the other hand, are guided largely by their ideologies and are sensitive to the needs of the electorate. At times the technical policy maker has to work in a different field, one in which, although of a technical nature, there is often little precise data. Technical policy makers have to try and be one jump ahead. They can not wait for the research or extension programmes to run their course before a new direction is decided. The technical policy maker therefore often finds himself 'flying-by-the-seat-of-his-pants'.

To contrast the role of the political policy maker compared to the technical policy maker and to highlight the interfaces, the current rural political policy for South Australia was outlined and your attention is drawn to the philosophies expressed by Arnold and Chatterton in the journal, "Politics", Volume 12 of May, 1977.

Very often when statistics are available to help the technical policy maker, they are "broad brush" in nature and have to be used with care. This point is illustrated in the following table which compares the graduate research time spent on field crop research in the various states with the gross value of the field crops produced in those states.

Field Crop Research in Australia

State	% Graduate Research Time (All institutions)	% of Gross Australian Value
New South Wales	32.4	25.7
Queensland	30.4	28.1
Victoria	18.4	15.4
Western Australia	12.2	15.5
South Australia	2.4	13.8
Tasmania	1.6	1.2
Northern Territory	1.6	0.1

1974 figures compiled by the Australian Plant Production Committee.

New data is due November, 1977.

These figures indicate that South Australia in 1974 was using only one-tenth of the research force available to New South Wales, while the gross income from field crops in that State was only double that of South Australia. Obviously there are more crops in N.S.W. but these figures were useful to support a "fly-by-the-seat-of-ones-pants" decision made in 1970 to increase the strength of the Crop Agronomy Research Section.

I have summarised the issues arising from the conference which need further attention by the policy maker as follows:

1. How to Help Farmers Understand Changes and Cope With It

The strengthening of the Extension Branch has already been initiated. This includes the appointment of rural sociologists which will help this issue so often raised during the Conference.

I feel that the human problems behind such issues as machinery syndication need further attention.

Farmer training was not emphasised enough during the conference. The technical policy makers in the Department should concentrate on providing formal education (certainly if possible through the DFE) in basic practical skills such as tractor driving and maintenance and less emphasis on 'biology' subjects than in the past. Neither Departments are equipped to carry out such teaching programmes and they may best be handled by co-opting skilled farmers themselves and encouraging 'day release' schemes such as used in the United Kingdom.

2. Farm Systems Modelling

While the Department has successfully undertaken some crop modelling studies, much of that information is still in filing cabinets or not used by extension officers. I agree that there is a need to direct some more of the Department's resources into crop modelling and expand this work into farm systems. While there is possibly a case for some research resources to be re-directed into farm systems modelling, the first thing that might help would be a review of the activities of the Biometrics Section to see that they are adequately integrated into the research programmes. Farm systems modelling is limited in that it can never design new farming systems as farmers have been able to evolve them over the years, but modelling can sharpen our understanding of the efficiency or lack of efficiency of particular systems.

3. Lack of Statistics & Monitoring

I believe there is a case for Departmental policy makers to give more support to crop loss assessment investigations, such as those projects currently being carried out by Mr. Peter Allen and Mr. Allan Mayfield in the Entomology and Plant Pathology Sections, respectively.

The LACIE satellite programme cannot be ignored and serious projects will have to be shortly developed to use these systems of monitoring.

I would like to express my concern that the work of the Australian Bureau of Statistics is being curtailed because of a lack of funds and I feel the policy maker should continue to put pressure on that organisation to maintain continuing information on such things as crop yields to support research and extension planning.

4. Better Understanding of Biological Inter-relationships

This point, emphasised by Mr. Baldwin in his paper, has received general acceptance by the Conference but to carry it out requires considerable flexibility by research officers. I believe that there is still too much emphasis on "branch thinking" when it comes to planning research and there is a need for policy makers to help break down these barriers even further. Task force operations were being encouraged and the Research Management Report about to be released should give valuable leads.

5. Research on the Genetic Control of Crop Diseases

This point stressed by Mr. Krause in his papers, received strong support from the Conference. The current pea breeding programme was a good example. These developments begun already in a small way by the Plant Pathology Section of the Agronomy Branch, should be expanded and given support by the policy maker.

6. Marketing Needs of Lupins and Other Special Crops

A start towards fulfilling this need stressed by the Conference had been made by the strengthening of the economic and marketing services within the Department. A complete new branch had recently been formed and it should now be possible to give better attention to such matters as the marketing of lupins. The policy maker should ensure that those involved in these studies work very closely with the industries themselves and in turn with our front line advisers such as Messrs. Holden and Prance who now have considerable field expertise with lupins.

7. Machinery Expertise

The policy makers should support this need as emphasized during the conference and provide a machinery expert who could advise field staff and maintain close liaison with the engineers of the various machinery companies. However I do not see a need for elaborate testing of machinery or engineering research.

8. How to Deal with Stubbles

This is an important need highlighted by the Conference. To facilitate progress the policy maker will need to cement closer ties with other organizations such as the Emergency Fire Service and the Department of the Environment. Policy makers in the Department are making progress at working with other Government Departments.

Other matters raised by the Conference which I feel could be given more attention by the Department include nitrogen fertiliser research, the accumulation of nitrogen by medics, insects, weeds and minimum tillage.

APPENDIX: RESEARCH PROJECTS CURRENTLY UNDERWAY OF RELEVANCE TO THIS WORKSHOP

Many of the subjects requiring research as listed by Messrs. Krause and Milne are currently being tackled by one or more of the four agricultural institutions in S.A. A list of these projects follows:

SOUTH AUSTRALIAN DEPARTMENT OF AGRICULTURE & FISHERIES

NAME:	P.M. King
TITLE:	MEASUREMENT OF WATER REPELLENCE
COMMENCEMENT DATE:	1975
EST. COMPLETION DATE:	-
NAME:	D.C. Hopkins
TITLE:	BIOLOGY OF SITONAHUMERALIS
COMMENCEMENT DATE:	1975
EST. COMPLETION DATE:	-
NAME:	M.V. Smith, W.A. Michelmore, A.E. Hincks, E.J. Crawford and G.D. Webber
TITLE:	SURVEY OF ANNUAL LEGUME ADOPTION IN MIXED FARMING AREAS
COMMENCEMENT DATE:	1975
EST. COMPLETION DATE:	-
NAME:	E.J. Crawford
TITLE:	EVALUATION OF MEDICAGO RUGOSA LINES
COMMENCEMENT DATE:	1975
EST. COMPLETION DATE:	-
NAME:	E.J. Crawford
TITLE:	EVALUATION OF THREE TRIFOLIUM SUBTERRANEAN SSP. BRACHYCALYGINUM
COMMENCEMENT DATE:	1975
EST. COMPLETION DATE:	-
NAME:	E.J. Crawford
TITLE:	EVALUATION OF ANNUAL LEGUMINOUS SPECIES FOR RED BROWN EARTHS
COMMENCEMENT DATE:	1975
EST. COMPLETION DATE:	-
NAME:	W.G. Wootton and P.S. Cocks
TITLE:	THE COMPETITIVE ABILITY, YIELD AND SEASONAL FIXATION OF NITROGEN OF THREE CULTIVARS OF SUBTERRANEAN CLOVER
COMMENCEMENT DATE:	1975
EST. COMPLETION DATE:	-
NAME:	D.E. Elliott
TITLE:	NITROGEN RESPONSE ON PASTURE AND OATS
COMMENCEMENT DATE:	1975
EST. COMPLETION DATE:	-
NAME:	E.J. Crawford
TITLE:	THE INITIAL ASSESSMENT OF NEW HERBAGE PLANT INTRODUCTIONS AND SELECTIONS
COMMENCEMENT DATE:	1974
EST. COMPLETION DATE:	-

NAME: P.M. King
 TITLE: N x TILLAGE
 COMMENCEMENT DATE: 1975
 EST. COMPLETION DATE: -

NAME: I.T. Grierson, H.C. Nourse and W. Davies
 TITLE: ALTERNATIVE PRESOWING TECHNIQUES
 COMMENCEMENT DATE: 1973
 EST. COMPLETION DATE: -

NAME: D.W. Armstrong
 TITLE: LAND COVER ASSESSMENT USING SATELLITE IMAGERY
 COMMENCEMENT DATE: 1975
 EST. COMPLETION DATE: -

NAME: J.E. Schultz, P.M. King, R.G. Fawcett, W. Hawthorne
 T. Potter and A. Pullman
 TITLE: ECOLOGICAL STUDIES WITH WHEAT, BARLEY, OATS, LUPINS,
 BEANS, PEAS AND PASTURES.
 COMMENCEMENT DATE: 1976
 EST. COMPLETION DATE: -

NAME: W.A. Hawthorne, D.C. Lewis, T.D. Potter and
 R.G. Fawcett
 TITLE: LEGUME CROPS AND THEIR EFFECTS ON SOIL FERTILITY
 COMMENCEMENT DATE: 1976
 EST. COMPLETION DATE: -

NAME: J.E. Schultz, P.M. King, R.G. Fawcett and W.J. Davies
 TITLE: RESPONSE TO MANGANESE BY CEREAL AND LEGUME CROPS
 COMMENCEMENT DATE: 1976
 EST. COMPLETION DATE: -

NAME: J.E. Schultz, P.M. King, R.G. Fawcett, R.J. French,
 W.J. Davies, M.T. Seeliger, R.M. Wood, C.L. Rudd,
 G.R. MacPhie, J. Hannay
 TITLE: EFFECT OF SUPERPHOSPHATE ON CEREAL AND PASTURE YIELDS
 COMMENCEMENT DATE: 1976
 EST. COMPLETION DATE: -

NAME: W.J. Davies, G.R. MacPhie
 TITLE: SOIL BORNE DISEASES AND WHEAT PRODUCTION ON
 WHARMINDA SANDS
 COMMENCEMENT DATE: 1976
 EST. COMPLETION DATE: -

NAME: W.J. Davies, G.R. MacPhie
 TITLE: EFFECT OF CULTURAL TECHNIQUES ON BARLEY PRODUCTION
 ON WHARMINDA WATER REPELLENT SANDS
 COMMENCEMENT DATE: 1976
 EST. COMPLETION DATE: -

NAME: T.G. Heard, R.J. Puckridge, S.G. Cornish,
 N.D. Steinborner
 TITLE: WHEAT CULTIVAR EVALUATION IN SECONDARY TRIALS
 COMMENCEMENT DATE: 1972
 EST. COMPLETION DATE: -

NAME: T.G. Heard
 TITLE: OAT CULTIVAR EVALUATION
 COMMENCEMENT DATE: 1972
 EST. COMPLETION DATE: -

NAME: W.A. Hawthorne, T. Potter and R.G. Fawcett
 TITLE: ASSESSMENT OF NEW LUPIN CULTIVARS IN THE SOUTH EAST
 COMMENCEMENT DATE: 1976
 EST. COMPLETION DATE: -

NAME: H.C. Nourse, R.E. Holloway, L.E. Dahlenburg,
 M.R. Krause
 TITLE: TURRETFIELD ALTERNATIVE CROPS TRIAL
 COMMENCEMENT DATE: 1972
 EST. COMPLETION DATE: -

NAME: T.G. Heard
 TITLE: OIL SEED RAPE CULTIVAR EVALUATION
 COMMENCEMENT DATE: Pre 1972
 EST. COMPLETION DATE: -

NAME: T.G. Heard
 TITLE: ASSESSMENT OF A RANGE OF TRITICALE LINES IN SOUTH
 AUSTRALIA
 COMMENCEMENT DATE: 1976
 EST. COMPLETION DATE: -

NAME: T.G. Heard, R.J. Puckridge, N.D. Steinborner
 TITLE: INTERSTATE WHEAT CULTIVAR EVALUATION
 COMMENCEMENT DATE: Pre 1972
 EST. COMPLETION DATE: -

NAME: A.H. Mayfield and B.G. Clare
 TITLE: THE EFFECT OF LEAF SCALD ON THE YIELD AND QUALITY
 OF BARLEY
 COMMENCEMENT DATE: 1976
 EST. COMPLETION DATE: -

NAME: A.H. Mayfield and R.A. Short
 TITLE: SURVEYS OF WHEAT STEW RUST STRAINS IN SOUTH AUSTRALIA
 COMMENCEMENT DATE: 1976
 EST. COMPLETION DATE: -

NAME: A.H. Mayfield
 TITLE: CONTROL OF POWDERY MILDEW OF BARLEY WITH FUNGICIDES
 COMMENCEMENT DATE: 1976
 EST. COMPLETION DATE: -

NAME: H.C. Nourse, R.E. Holloway, L.E. Dahlenburg, M.R. Krause
 TITLE: LUPIN- TIME AND RATE OF SEEDING TRIALS (cv. UNICROP)
 COMMENCEMENT DATE: 1974
 EST. COMPLETION DATE: -

NAME: H.C. Nourse, L.E. Dahlenburg, R.E. Holloway, M.R. Krause
 TITLE: METHOD OF INCOULATION OF LUPINS (cv. UNICROP)
 COMMENCEMENT DATE: 1976
 EST. COMPLETION DATE: -

NAME: H.C. Nourse, R.E. Hollway, L.E. Dahlenburg, M.R. Krause
 TITLE: METHOD OF PHOSPHATE APPLICATION OF INOCULATED LUPINS
 (cv. UNICROP)
 COMMENCEMENT DATE: 1975
 EST. COMPLETION DATE: -

NAME: S.M. Ali, A.J. Dube, L. Nitschke, H.C. Nourse,
 R.E. Holloway
 TITLE: DEVELOPMENT OF ASCOCHYTA COMPLEX RESISTANT PEA
 CULTIVARS WITH OTHER COMMERCIALY DESIRABLE
 CHARACTERS.
 COMMENCEMENT DATE: June 1976
 EST. COMPLETION DATE: 1978

NAME: J.E. Schultz, R.G. Fawcett
 TITLE: EFFECT OF CLOSE ROTATIONS AND STUBBLE HANDLING
 TECHNIQUES ON SOIL FERTILITY AND CROP YIELDS.
 COMMENCEMENT DATE: May 1977
 EST. COMPLETION DATE: Field work - 1980
 Publication - 1982

NAME: B.L. Ashton, R.G. Fawcett
 TITLE: THE EFFECT OF LEGUMES, CEREAL CROPS AND PASTURES,
 IN VARIOUS ROTATIONS, ON SOIL NITROGEN, SOIL BORNE
 DISEASES AND POTENTIAL FARM PRODUCTION
 COMMENCEMENT DATE: May 1977
 EST. COMPLETION DATE: Field work - 1981
 Publication - 1982

NAME: P.M. King, R.K. Beare
 TITLE: GROWTH OF LUCERNE, LUPINS AND BARLEY ON WATER
 REPELLENT SANDS.
 COMMENCEMENT DATE: February 1977
 EST. COMPLETION DATE: June 1979

NAME: L. Nitschke
 TITLE: GRAIN LEGUME EVALUATION
 COMMENCEMENT DATE: 1977
 EST. COMPLETION DATE: -

NAME: A.R. Barr
 TITLE: BREEDING OF OAT CULTIVARS FOR SOUTH AUSTRALIA
 COMMENCEMENT DATE: 1977
 EST. COMPLETION DATE: -

NAME: M.J. Catt
 TITLE: HERBICIDE CONTROL OF ANNUAL RYEGRASS IN WHEAT
 COMMENCEMENT DATE: May 1977
 EST. COMPLETION DATE: December 1979

NAME: M.J. Catt
 TITLE: CONTROL OF SOURSOB (OXALIS PES CAPRAE) IN A CEREAL PASTURE ROTATION
 COMMENCEMENT DATE: May 1977
 EST. COMPLETION DATE: December 1979

NAME: M.J. Catt
 TITLE: MINIMUM TILLAGE METHODS FOR WHEAT CROP ESTABLISHMENT
 COMMENCEMENT DATE: April 1977
 EST. COMPLETION DATE: December 1979

NAME: M.J. Catt
 TITLE: CONTINUOUS CROPPING ROTATIONS WITH LUPINS ON LOWER EYRE PENINSULA
 COMMENCEMENT DATE: 1977
 EST. COMPLETION DATE: -

NAME: M.J. Mathison, B.C. Bull and D.W. Parker
 TITLE: BREEDING NEW CULTIVARS OF ANNUAL MEDICS
 COMMENCEMENT DATE: 1966
 EST. COMPLETION DATE: -

NAME: M.J. Mathison and B.C. Bull
 TITLE: SELECTING ANNUAL MEDICAGOS RESISTANT TO SITONA HUMERALIS
 COMMENCEMENT DATE: 1971
 EST. COMPLETION DATE: -

NAME: M.J. Mathison B.C. Bull and D.W. Parker
 TITLE: SWARD TESTING OF ANNUAL MEDIC HYBRIDS AND INTRODUCTIONS
 COMMENCEMENT DATE: 1971
 EST. COMPLETION DATE: -

NAME: I.D. Kaehne
 TITLE: BREEDING OF LUCERNE RESISTANT TO THE SPOTTED ALFALFA APHID (SAA), THE BLUE GREEN APHID (BGA), THE PEA APHID (PA) AND OTHER BIOTIC AND ABIOTIC FACTORS
 COMMENCEMENT DATE: 1977
 EST. COMPLETION DATE: -

NAME: M.J. Mathison
 TITLE: BREEDING OF ANNUAL MEDICS RESISTANT TO SAA, BGA, PA AND SITONA WEEVIL
 COMMENCEMENT DATE: 1977
 EST. COMPLETION DATE: -

NAME: D. Swincer and K.G. Boyce
 TITLE: DEVELOPING SEEDLING INSECTICIDE PROTECTANT TECHNIQUES FOR APHID SUSCEPTIBLE LUCERNE AND MEDIC CULTIVARS
 COMMENCEMENT DATE: 1977
 EST. COMPLETION DATE: -

NAME: P. Allen
 TITLE: DEVELOPING INTEGRATED APHID (SAA AND BGA) CONTROL
 IN DRYLAND LUCERNE
 COMMENCEMENT DATE: 1977
 EST. COMPLETION DATE: -

NAME: M.J. Mathison and I.D. Kaehne
 TITLE: DEVELOPING APHID RESISTANT PASTURE LEGUME CULTIVARS
 FROM SPECIES OTHER THAN AUSTRALIA'S WIDELY
 CULTIVATED SPECIES
 COMMENCEMENT DATE: 1977
 EST. COMPLETION DATE: -

ROSEWORTHY AGRICULTURAL COLLEGE

NAME: G.J. Hollamby and R.E. Wilson
 TITLE: WHEAT BREEDING WITH SPECIAL EMPHASIS ON SEPTORIA
NODORUM, S. TRITICI, CEREAL CYST NEMATODE AND STEM
 RUST RESISTANCE.

NAME: I.T. Grierson
 TITLE: COMPARISON OF STANDARD AND INNOVATIVE (e.g. ZERO
 TILLAGE) TILLAGE SYSTEMS. ALSO, WORK ON
 ALTERNATIVE FERTILIZERS SUCH AS ANIMAL MANURES.

NAME: B.J. Baldwin
 TITLE: EVALUATION OF THE GRAIN LEGUMES LENTILS AND TIC BEANS

NAME: B.D. Williams and N.L. Richardson
 TITLE: STUDY OF HELIOTHIS PHEROMONES

NAME: G.G. Collins
 TITLE: DEVELOPMENT OF EARLY SOWING TECHNIQUES

NAME: R.L. Brengman
 TITLE: TRITICALE BREEDING

C.S.I.R.O. DIVISION OF SOILS

NAME: J. Ladd
 TITLE: THE DYNAMICS OF "RHIZOBIAL NITROGEN" IN CEREAL-PASTURE
 ROTATIONS ON THE CALCAREOUS WHEAT BELT SOILS OF S.A.

NAME: A. Rovira
 TITLE: THE EFFECTS AND CULTURAL CONTROL OF SOIL-BORNE ROOT
 DISEASES ON CEREAL, ESPECIALLY WHEAT, PRODUCTION

WAITE AGRICULTURAL RESEARCH INSTITUTE

NAME: A.J. Rathjen
TITLE: BREEDING OF WHEAT VARIETIES FOR S.A.

NAME: D.H.B. Sparrow
TITLE: BREEDING OF BARLEY VARIETIES FOR S.A.

NAME: C.J. Driscoll
TITLE: BREEDING OF TRITICALE VARIETIES FOR S.A.

NAME: K.W. Shepherd
TITLE: BREEDING OF HIGH PROTEIN WHEAT VARIETIES FOR S.A.

NAME: R. Knight
TITLE: BREEDING OF PASTURE GRASS VARIETIES FOR S.A.

NAME: J.H. Silsbury
TITLE: PASTURE AND ANIMAL PRODUCTION FROM NON-HEADING RYEGRASS

NAME: E.D. Carter
TITLE: AGRONOMIC WORK WITH ANNUAL MEDICS

NAME: W.G. ALLDEN
TITLE: FEEDING VALUE OF TIC BEAN, VICIA FABA

NAME: D.J. Cooper and T.O. Browning
TITLE: STUDIES ON HELIOTHIS

NAME: R. Laughlin
TITLE: STUDIES ON STORED GRAIN BEETLE

NAME: R. Laughlin
TITLE: MONITORING OF THE RATE OF MIGRATION OF APHIDS ACROSS SOUTH AUSTRALIA