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APPENDIX I

WHEAT, OATS, BARLEY, RYE AND TRITICALE CERTIFICATION STANDARDS

1. APPLICATION OF GENETIC CERTIFICATION STANDARDS.

The Genetic Certification Standards, pages 1 through 12, are basic.

2. LAND REQUIREMENTS.

A cereal grain crop shall be planted on land with a time interval of at least 2 years between crops of different varieties or certified crops and uncertified crops.

A crop will not be eligible for certification if planted on land on which the same kind of crop was grown the previous year unless the previous crop was grown from certified seed of the same variety and freedom from disease is maintained.

3. FIELD STANDARDS

3.1 General

3.1.1 Isolation - Wheat, Oats, Barley, Triticale.

A field shall be separated by a strip of ground at least 5 metres wide adequate to prevent mechanical mixtures. The strip may be either mowed or uncropped.

3.1.2 Isolation - Rye.

A field producing any class of certified seed must be isolated by at least 210 metres from rye fields of any other variety or fields of the same variety that do not meet the varietal purity requirements of the class of seed inspected.

3.2 Specific

Factor	Basic	Certified
Other varieties (maximum)	1:3000	1:2000
*Inseparable other crops (maximum)	1:10 000	1:10 000
Rye in other crops (maximum)	none	none
**Objectionable weeds (maximum)	none	none

* Inseparable other crops shall not include crop plants, the seed of which cannot be thoroughly removed by the usual methods of cleaning.

** Objectionable weeds are those prohibited.

APPENDIX I (Cont.)

4. SEED STANDARDS.

Factor	Standards for each class	
	Basic	Certified
Varietal purity (minimum)	99.9%	99.7%
Pure seed (minimum/weight)		
Wheat, Barley, Oats, Triticale,	99.0%	98.0%
Rye	98.0%	98.0%
Inert matter (maximum)		
Wheat, Barley, Oats, Triticale	1.0%	2.0%
Rye	2.0%	2.0%
*Objectionable weeds (maximum)	none	none
Other weeds (maximum)	1 seed/500g	2seeds/500g
Total other crop seeds (maximum)	0.1 seed/500g	0.1seed/500g
Germination (minimum/pure seed)		
Wheat, Oats, Barley	85.0%	85.0%
Rye, Triticale	80.0%	80.0%
**Diseases (maximum)		
Ergot (Claviceps purpurea)	none	none

*Objectionable weeds are those prohibited.

**Diseases shall be of the lowest possible level, and chemically controlled seed-borne disease seed treatment is required, where applicable. (Covered Smut and Loose Smut are well known examples). Protection against grain insect pests must also be included in this treatment.

APPENDIX II

FIELD PEA, BEAN AND LUPIN CERTIFICATION STANDARDS

1. APPLICATION OF GENETIC CERTIFICATION STANDARDS.

The Genetic Certification Standards, pages 1 through 12, are basic.

2. LAND REQUIREMENTS.

Field peas, beans and lupins shall be planted on land on which the preceding crop was of another kind, or the same variety of a certified class, equal or superior to that of the crop seeded, provided that freedom from diseases is maintained. A 4 year rotation may be necessary for disease control.

3. FIELD STANDARDS

3.1 General

3.1.1 Isolation

Fields shall be separated from any other variety or fields of the same variety a distance of at least 100 metres wide.

3.1.2 Management

Poor stands, poor vigor, lack of uniformity, excess weeds or conditions which are apt to make inspection inaccurate or bring certified seed into disfavor shall be cause for rejection.

3.2 Specific

Factor	Basic	Certified
Other varieties (maximum)	1:2000	1:1000
*Other kinds (inseparable) (maximum)	none	1:2000
Diseases (maximum)		
Black and brown leaf spot	1:400	1:200
Mosaic (common)	none	1:200
Sclerotinia	1:400	1:200
Anthracnose	none	1:10 000
Bacterial blights	none	none
Wilt	none	1:10 000
**Objectionable weeds (maximum)	none	none

*Inseparable other crops shall not include crop plants, the seed of which cannot be thoroughly removed by the usual methods of cleaning.

**Objectionable weeds are those prohibited.

APPENDIX II (Cont.)

4. SEED STANDARDS

Factor	Standards for each class: Basic	Certified
Varietal purity (minimum)	99.9%	99.8%
Pure seed (minimum/weight)	98.0%	98.0%
Inert Matter (maximum)	2.0%	2.0%
Split and cracked seeds (maximum)	1.0%	1.0%
*Objectionable weeds (maximum)	none	none
Other weeds (maximum)	1seed/500g	2seeds/500g
Total other crop seeds (maximum)	0.1seed/500g	0.1seed/500g
Germination (minimum/pure seed)	85.0%	85.0%
**Diseases (maximum)	-	-

*Objectionable weeds are those prohibited.

**Diseases shall be of the lowest possible level.

APPENDIX III

RAPESEED AND MUSTARD CERTIFICATION STANDARDS

1. APPLICATION OF GENETIC CERTIFICATION STANDARDS.

The Genetic Certification Standards, pages 1 through 12, are basic.

2. LAND REQUIREMENTS.

Basic and Certified seed of rapeseed and mustard must be planted on land which did not produce rapeseed and/or mustard seed during the previous three years, and where freedom from disease is maintained.

3. FIELD STANDARDS.

3.1 General

3.1.1 Isolation.

A field producing Basic or Certified seed must have the minimum isolation distance from fields of any other variety of the same kind or from a noncertified crop of the same variety as follows:

Rapeseed and Mustard - 210 metres

(Required isolation between classes of the same variety - 5 metres).

3.2 Specific.

Factor	Basic	Certified
Other varieties (maximum)	1:2000	1:1000
Other kinds (inseparable) (maximum)	none	none
*Objectionable weeds (maximum)	none	none

*Objectionable weeds are those prohibited.

APPENDIX III (Cont.)

4. SEED STANDARDS.

Factor	Standards for each class Basic	Certified
Varietal purity (minimum)	99.9%	99.8%
Pure seed (minimum/weight)	99.0%	99.0%
Inert Matter (maximum)	1.0%	1.0%
*Objectionable weeds (maximum)	none	none
Other weeds (maximum)	5seeds/500g	10seeds/500g
**Total other crop seeds (maximum)	1seed/500g	1seed/500g
Mustard in Rapeseed (maximum)	none	none
Germination (minimum/pure seed)	90.0%	90.0%
***Diseases (maximum)	-	-

*Objectionable weeds are those prohibited.

**Other crop seeds shall not include those which cannot be thoroughly removed by the usual methods of cleaning.

***Diseases shall be of the lowest possible level.

APPENDIX IV

LINSEED CERTIFICATION STANDARDS

1. APPLICATION OF GENETIC CERTIFICATION STANDARDS.

The Genetic Certification Standards, pages 1 through 12, are basic.

2. LAND REQUIREMENTS.

A linseed crop shall be planted on land which the previous crop was of another kind or was planted with certified seed of the same variety.

3. FIELD STANDARDS

3.1. General.

3.1.1 Isolation.

A distance of at least 5 metres wide adequate to prevent mechanical mixture is necessary.

3.2 Specific

Factor	Basic	Certified
Other varieties (maximum)	1:5000	1:2000
*Other kinds (inseparable) (maximum)	none	1:3000
**Objectionable weeds (maximum)	none	none

*Inseparable other crops shall not include crop plants, the seed of which cannot be thoroughly removed by the usual methods of cleaning.

**Objectionable weeds are those prohibited.

4. SEED STANDARDS

Factor	Standards for each class Basic	Certified
Varietal purity (minimum)	99.7%	99.0%
Pure seed (minimum/weight)	99.0%	99.0%
Inert matter (maximum)	1.0%	1.0%
*Objectionable weeds (maximum)	none	none
Other weeds (maximum)	1seed/500g	2seeds/500g
Total other crop seeds (maximum)	0.2seed/500g	0.2seed/500g
Germination (minimum/pure seed)	85.0%	85.0%
**Diseases (maximum)	-	-

*Objectionable weeds are those prohibited

**Diseases shall be of the lowest possible level.

RECENT TRENDS IN ROTATIONS, TILLAGE, AND SOIL FERTILITY

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Introduction

Farming was once a simple process where the inputs were small (in money terms), the level of production was low, and the risks were also correspondingly small.

For the modern farmer the situation is vastly different due to:-

1. The high cost of land and machines.
2. The need to continually lift the minimum economic level of production to make a return on capital invested.
3. The complex decisions that need to be made in relation to many farm operations where the climatic variables are never known.
4. The high level of risk e.g. A total crop failure now means a large financial loss in terms of fuel, fertilizers, seed, weed and disease control.

Advising farmers was also once a simple task where large responses to fertilizers, legume pastures, and different varieties were possible and "blanket" recommendations were in order. Now that S.A. appears to be on a fairly stable yield (per unit area) plateau, differences in yield due to various treatments are relatively small and advice must be given on a farm or even on a paddock basis. Even so it is often not recognised that many farmers have not even adopted practices which would take them to the first step i.e. Adequate fertilizer and legume pastures! A great deal of potential still exists in this area as indicated by the fact that visitors are still taken to Y.P. to see the "medic system" in operation even though "individual farmers" have shown that it can be made to work on all soil types. This situation is unlikely to change as less than 10% of farmers can be regarded as innovators. It is this small group that most readily adopt new practices and often they "lead the way" in new farming techniques.

Farmers themselves have developed and used different farming systems long before research organisations "proved" them, e.g.

1. Removal of fallowing from rotations on all but black soils and clay-loam red brown earth.
2. Specialisation in either cropping or livestock.
3. Continuous cropping.

Hence the following systems have emerged as alternatives to the traditional cereals-sheep-pasture system.

Alternative Farming Systems

1. Continuous Cropping

Three variations of the continuous cropping system are possible.

(a) Cereals + bag nitrogen

This system is only possible on well structured soils such as the better loamy mallee soils, clay loam red brown earths and black cracking clays. Even though these soils are not completely dependent on organic matter for their structural properties the system involves the return of stubbles to the soil and/or trash retention methods. These soils are deep enough and are sufficiently well structured to allow the use of implements specifically designed for stubble retention on the surface. Bag nitrogen is essential with every crop as removals are high and there is a need for additional N to assist in the breakdown of stubbles in some seasons.

Land used for continuous cropping must necessarily be fairly flat - contoured cereal lands are unsuitable. A high degree of mechanisation and specialisation in machinery is essential.

All inputs to this system are therefore high.

- machinery
- fertilizers
- weed control
- disease control

Hence the risks associated with this system are also high but consistent with the likely returns.

The problems are:-

- limited area of suitable land
- the effects of cereal root diseases are currently being investigated and could be expected to cause problems.

(b) Cereals + grain legumes + bag N

This system could be considered for the sand over clay soils in higher rainfall districts such as the Upper South East and Lower Eyre Peninsula. Grain legumes such as lupins are not sufficiently reliable and suitable varieties not available for the drier cereal areas.

The same specialisation and investment in machinery is necessary as for system (a). However, the main differences appear to be:-

- less need for bag N
- disease control should not be necessary because of the legume.
- more need for trash retention methods to prevent erosion.

The nett quantity of N input by the legume in relation to removals in grain is not fully known and therefore the use of bag N must be considered as a necessary part of the system. Some of these soils display undesirable hard-setting problems which could prevent the use of stubble retention machinery. The fact that during the legume year there is a 100% stand (instead of the poor clover pastures normally present) overcomes cereal root disease problems. The longer term effects of a build-up in insect pest populations may cause problems.

(c) Cereals + annual medic or clover seed + bag N

This third alternative is suitable for the drier cereal areas where suitable soils can be found. It applies to some of the red-brown earths on relatively flat land in the mid and upper north. Extra investment in clover harvesting machinery is necessary but syndication overcomes this problem.

Sitona weevil and aphids are likely to be the biggest potential problems.

The use of bag N must be considered depending on the extent of cereal cropping as it seems that wherever any continuous cropping is practiced (even using legumes), the nett nitrogen input must be supplemented. There is also a need to return all stubbles to the soil to maintain soil structure which tends to deteriorate on red-brown earth soils with the rather harsh treatment necessary for clover seed production. Stubbles would not, however, be retained on the surface in this case.

2. Livestock only

This system can and has worked in some situations. However, it is relatively inflexible and the risk factors are high. Implicit in this system is a high level of management ability on the part of the operator. Fluctuations in seasons and markets could greatly influence the profibability. Suitable pastures and feed reserves are essential. Also, because pastures must necessarily be medic based, the effect of pests like sitona weevil and aphid could be drastic.

3. Modifications to the Cereal - Pasture - Livestock System

Variations of the present cereal - pasture - livestock system are the most likely course of action for the majority of farmers, and is in fact, what has been going on for the past decade. The system has the great advantage of being flexible. This is lost once specialisation occurs. Flexibility is essential in our environment as we are dealing with a highly variable situation in regard to soils, seasonal conditions, pests and diseases. The mixed farmer usually has one enterprise which is profitable at any given time. He also has the machinery and basic facilities to form the nucleus of some specialisation in a profitable enterprise when the market opportunity occurs.

Hence we have seen:-

(a) An intensifcation of cereal cropping in recent years in response to poor livestock markets and drought. This is now rapidly changing

(b) Production of small seeds has been a profitable enterprise for some farmers.

(c) Small intensive pig units are profitable for cereal farmers producing their own feed.

(d) Grain legume production can be considered as part of the system on farms in more favoured areas.

(e) Yet others have fitted poultry into their particular system.

There is little doubt that the many variations of our basic cereal-pasture-livestock system will continue. A swing in any particular direction is likely at any time according to markets, seasonal conditions and the cost of machinery and fuel. S.A. farmers do not have opportunity to specialise to the same extent as others in more favoured areas with reliable rainfall and uniform soils. Specialisation inevitably involves high capital inputs and the acceptance of a high risk factor which is both unlikely and impractical for the bulk of farmers in S.A.

Farming is a Compromise

Most farm practices are a compromise.

e.g.
- cultivation
- removal of farm products
- hay cutting
- seed production - are all processes which deplete soil structure, and fertility.

Pastures, the use of fertilizers, and soil conservation practices tend to balance the system and restore it. Grazing animals are far less damaging unless carried to the point of overstocking and subsequent erosion

- a large portion of nutrients are recycled.
- removals in terms of animal products are much smaller compared with grain growing.

The Maintenance Concept

Production can only be maintained at a particular level if nutrients removed in farm products are replaced. In the long term, production is determined by the level of inputs up to the limit imposed by growing season rainfall.

The table gives average values for the removal of the two major elements (N&P) in farm products.

Nutrient Removal

grain (1 tonne)	kg N	kg P
Wheat	24	2.5
Barley	24	2.4
Oats	20	3.0
Lupins	57	3.9
Peas	41	4.0
Rape	40	6.2
Linseed	35	6.4
Safflower	25	3.4
clover hay (1 tonne)	20	2.3
livestock		
1 fleece	0.68	0.02
1 fat lamb	2.05	0.18
1 steer	8.18	2.50
1000 litres milk	5.91	1.00

The figures emphasize the heavy removal of nutrients in grain as opposed to livestock. The legume system typically replaces approximately 80 kg N/ha in a single year or "pasture". This is normally sufficient to sustain one or two cereal crops depending on the soil type. Any additional cropping must be supplemented by bag N.

With phosphorus, the only possible input to the system is from the bag. Once the "maintenance" level has been achieved (i.e. responses no longer obtained) then the following rule of thumb gives an easy method of working out maintenance rates based on average production figures.

25 kg superphosphate/tonne of average cereal grain yield.

10 kg superphosphate/D.S.E. carried/ha.

e.g. 1 rotation (typical farm)	super required
wheat (2 tonnes/ha average)	50
barley (2 tonnes/ha average)	50
"legume" pasture carrying 4 D.S.E.'s/ha	40
	140

A total of 140 kg super must be applied/ha sometime in each 3 year period to maintain this level of production. Where good records are kept it is possible to be more precise. From the table it is also obvious that additional P must be applied for grain legumes and "new" crops where removals are higher.

Tillage

Preparing a suitable seedbed in which to sow crops and pastures is both an art and a science which together compound into skill. A considerable knowledge of local conditions and experience is necessary to do an effective job.

Preparation varies considerably according to soil differences, moisture conditions and the requirements of a particular crop.

e.g. Intensive preparation - many workings
Minimum tillage - "Spray - seed" techniques
Zero preparation - broadcasting seed and super direct

One must also consider the soil conditions necessary for the success of pre-emergent herbicides.

Usually it is necessary to strike a balance between the biological requirements of the crop and economic efficiency.

(a) biological requirements
- firm moist seedbed
- finer aggregates around the seed (increase available moisture)
- course aggregates on top (act as a mulch)

(b) economic requirements

e.g. where time is critical it may be more economical to sow a greater area with less preparation (and lower establishment) than less acres with say 90-100% establishment.

Soil preparation can therefore have a major influence on the percentage of viable seeds that germinate and live to maturity.

Some of the most important factors which determine the type of soil preparation are:-

(a) Soil type
- course textured or sandy soils require minimum preparation; it is normally preferrable to maintain cover for as long as possible to prevent erosion.
- heavy textured soil (clay loams, clays) require more workings to produce a suitable seedbed; soils must be broken down into aggregates of suitable size.

(b) Weeds - generally a prime factor influencing the number of cultivations. Stock (sheep in particular) play an important role here.

(c) Soil Moisture - heavy soils require much more moisture before working up. Soil structure may be damaged if heavy soils are worked when they are too wet and light soils when they are too dry.

1. Normal working

When soil is worked in the correct moisture condition many processes result.

- soil permeability is improved
- runoff is reduced
- evaporation losses are reduced (mulching effect)
- soil aeration is increased (essential for germination)
- mineralisation of nutrients from organic matter
- re-distribution of immobile nutrients e.g. phosphorus
- germinated or growing weeds destroyed and reduced seed population
- microbial population is changed.

(a) bacteria initially increase during breakdown of organic matter.

(b) fungi generally decrease due to mechanical damage (Rhizoctonia and Hay die reduced both by mechanical damage and removal of food source).

(c) eelworm population reduced for same reasons.

Hence normal cultivation techniques constitute a "cleanup" operation in addition to providing a suitable physical environment for the seed. However, they must be balanced against the need to maintain a minimum amount structure in the soil.

2. Fallowing

Moisture is by far the most important factor influencing crop growth. Since most of the cereal growing areas in S.A. receive less than 450 mm (18 in) annual rainfall, fallowing is likely to remain an important feature of cropping on the heavy soils.

However, for fallowing to be an advantage, certain conditions must be satisfied.

(a) the subsoil must contain clay and/or fine lime. From experimental work an extra 60 mm of moisture can be stored under a fallow on heavy soils whilst sands store less than 12 mm.

(b) July - August rainfall must exceed 100 mm.

(c) The first working must be completed before mid-September otherwise pasture growth will rapidly use subsoil moisture.

On soils suitable for fallowing the extra nitrogen available at seeding is generally very small (only 2-5% higher than no fallow). With recent trends to higher yielding varieties and more intensive cropping it is very doubtful whether this is significant. The effect of long fallows in reducing cereal root disease is probably much more important.

3. Minimum cultivation and zero tillage

Advantages
- lower cost claimed - only if they work!
- preserve soil structure.
- reduce the risk of erosion.
- more grazing time (stock management most important part of min. tillage).
- on low fertility soils (hard-setting red-brown earths and some sands) soil in a better physical condition and more N available at seeding.

Disadvantages
- difficult soils (hard setting or stony) are a problem.
- disease more prevalent (eelworm, hay-die).
- may not get sufficient weed kill.
- compacted soils (poor aeration, infiltration).
- seed often not covered properly (birds, mice).

Minimum cultivation techniques vary from reduced tillage to the "once over" 'Spray-seed' method.

e.g.
- work up, work back seed.
- graze, spray, work, seed.
- graze, spray, seed.
- Howard Seedavator.

Minimum cultivation techniques are not rapidly adopted in most districts. Experiments have demonstrated that some of the disadvantages are very real - many of our wheatgrowing soils need more than a "once-over" preparation. Yields about equal to normal preparation are possible but in wet years yields may be well down due to weed competition.

It is suggested that "Spray-seed" can be considered as:-

- an alternative sowing technique on better structured soils if time is limiting.
- if extra grazing is necessary
- if sufficient stock are available to "clean-up"
- on soils prone to waterlogging (e.g. sand-over-clay soils)
- on sandy soil prone to drift.

However, the general principal of 'minimum tillage necessary to do the job' applies to all cultivation practices and the aim should be to prepare a suitable seedbed with the minimum number of workings.

4. Rotavation

Rotary tillage equipment for broad acres has become available. Whilst rotary tillage may never compete economically with other forms of tillage on most farms, it has a place in certain situations.

e.g. (a) Intensive cropping where large amounts of trash or stubble must be handled in the first working.

(b) Problems in handling trash from prolific growth of pastures in alternate cropping systems (few farmers could claim this problem!)

(c) As a time saver in land preparation on farms carrying a high stocking rate and where feed is retained as long as possible.

(d) The handling of difficult or unpalatable stubbles left by some of the alternate crops now being sown.

This simply boils down to farms where the handling of large quantities of trash is a regular problem. There is no point in working bare land with rotary equipment as this can be done much more economically with conventional equipment.

Rotary tillage equipment, although capable of cultivating soil in just about any condition, should not be used when:-

(a) the soil is too dry
(b) the soil is too wet
(c) it is not incorporating trash or stubble (i.e. first working only)

5. Speed of working

Speed of working has greatly increased with the use of large tractors. Frequently it is due to miss-match of tractor and implement. Whilst there is no documented local evidence on the effect of speed on soil structure or weed kill, observations over a long period confirm the following points.

(a) Speed and soil structure

- All soils which depend on organic matter for their structural properties will be damaged if worked too fast. e.g. sands, sand-over-clay soils, many of the poorer red-brown earths.

- Moisture content is important. Speed will damage sandy soils if worked too dry and heavy soil if worked too wet.

- Soils high in lime or clay are less prone to damage, because they tend to be 'self-mulching' due to their chemical composition.

- Less damage will be caused in the initial workings when compared with subsequent workings because the organic matter content is still high.

- Where heavy trash is present a faster initial working may even be of some benefit by producing better incorporation and break down, provided soil moisture is adequate.

(b) Speed and weed kill

- Tillage is a compromise - high speed and dry soil gives the best weed control but the worst effect on soil structure.

- All tyned implements can be expected to kill more weeds with higher speed. However, the choice of shares is of greater importance than speed.

- Experimental work in W.A. has shown that the order of effectiveness for weedkill with various implements was as follows:-

scarifier or chisel plough	50%
disc plough	75%
mouldboard (seldom used)	100%

(Wheat yields were only slightly improved by subsequent workings after breaking up with a mouldboard but were essential to control weeds in ground broken with tyned implements).

- Other effects of excessive speed are increased fuel consumption and greater wear on machinery.

- Soil compaction from large tractors is most unlikely to be a problem in S.A. as it has been in European countries where soil is often worked in a very wet condition.

(c) Speed and soil erosion

- potential for wind erosion on sandy soils is markedly increased by fast workings.

- fast working of poorly structured soils on sloping land increases the probability of water erosion.

SUMMARY

With higher levels of production/unit area we will need to keep the following points in mind.

1. The fertility level of our soils (in terms of N&OM) is only approximately half that of cropping soils in other countries. (U.K. & U.S.A.) where intense cropping is practised. Structural properties and moisture regime are also considerably less favourable - hence alternative systems are limited.

2. Production potential of different soils vary considerably even in the same rainfall zone. e.g. At best, the hard setting R.B.E. soils can only produce from 85% (nil bag N) to 96% (30 kg N/ha) of the cereal yields obtained on well structured soils. Pasture yield potential is worse at 30% (nil N) to 75% (30 kg N/ha) of those obtained on friable soils.

3. With more cropping, tillage operations must be kept to a minimum in order to maintain soil structure. Speed of working should also be controlled to suit the soil type and moisture content - not by tractor H.P.!

4. The fine tilth required for incorporating of pre-emergent weedicides has led to an increased erosion potential on red soils in hilly districts.

5. More frequent cropping of sandy ground will considerably increase erosion potential unless minimum or zero tillage techniques are adopted.

6. The nutrient requirements of "new crops", their effect in reducing the incidence of cereal root diseases, and their proper place in rotations needs further investigation.

7. More intense cropping will inevitably lead to the use of more bag N.

LEGUMINOUS PASTURES FOR CEREAL AREAS

E.D. HIGGS, SENIOR RESEARCH OFFICER, PASTURES

The advent of the spotted alfalfa aphid (SAA) and the blue green aphid (BGA) requires a re-assessment of the medic and subclover pasture recommendations for the arable land in cereal areas. Most of the medic species and cultivars are susceptible to attack by one or both aphids. Damage is direct and obvious in terms of loss of herbage production but the amount of nitrogen fixed may be reduced by a disproportionately greater degree than herbage production.

The relative importance in cereal areas of subterranean clover must increase. It is not generally seriously damaged by either aphid, although SAA and BGA are sometimes found on it. All subclover can be regarded as tolerant to highly tolerant to both aphids. The area of soil and climate equally suitable to either subclover or medics is limited. However this area is by no means fully utilized by first class leguminous pastures and there still remains large areas on which Geraldton, Nungarin, Northam and Daliak can all find increasing roles. In the better rainfall cereal areas, where subclover is clearly the best annual legume, the situation has not been materially changed. Clare is the number one choice for alkaline soils in these areas. Woogenellup, Seaton Park, Esperance and Daliak can all be used without any qualms. Geraldton will be relatively trouble free but it does have higher oestrogen levels than many alternative cultivars. Esperance and Daliak are highly tolerant of Kabatiella and would be preferred in areas where this disease is frequently troublesome.

In most areas the only reliable method available for ensuring that good subclover pastures are established is to re-sow after every cropping phase. At least in some of the areas, Geraldton and possibly other of the early maturing varieties, will have sufficient seed production and sufficient degree of hard seed to enable a worthwhile density of regeneration to occur after a cereal crop. However, if several successive cereal crops and fallows are taken, it is unlikely any subclover will regenerate well following the last crop.

Our widely grown medics are all susceptible to SAA or BGA or both. Jemalong has some tolerance to SAA as a seedling. This increases as it becomes well established. It is quite susceptible to BGA at all stages of growth.

Harbinger, Hannaford, Borung and Tornafield are susceptible to both SAA and BGA at all stages of growth.

Burr medic and woolly burr medic are both susceptible to SAA but in South Australia generally have some tolerance to BGA. Cyprus is tolerant to very tolerant to SAA but susceptible to BGA.

Some of the less widely grown medics, the new gama medic cultivars Sapo and Paraponto and commercial snail medic have substantial levels of tolerance to both aphids. However, there are only very limited quantities of seed of Sapo and Paraponto and the older gama medic variety Paragosa which also has dual aphid resistance. Substantial quantities of seed of commercial snail medic is available. It is unlikely that any of these dual aphid tolerant medics would be damaged by either SAA or BGA under normal conditions of field infestations, whereas the aphids seriously retard growth and often kill the susceptible medic species and cultivars.

More aphid tolerant medics can be bred and vigorous efforts are being made to do this as quickly as possible at Northfield Research Laboratories. At the moment there is no commercial quantities of seed available of barrel medics with tolerance to both SAA and BGA. Breeders have identified barrel medic lines with dual aphid tolerance and are building up stocks of seed as rapidly as possible. These lines need testing for their suitability for South Australia and even for those which are suitable, it will be at least four years before seed can be available in substantial quantities.

While widespread and serious damage was done to South Australian medic pastures by both the SAA and the BGA in 1979, it is not possible to predict the severity of aphid attacks on medics in 1980. The pattern may be quite different. In 1979 SAA did its damage mainly in the autumn and winter and BGA in the winter and spring. As the majority of medics in South Australia in 1980 will be the self re-generating medics, it is most essential that the best possible management is applied to these to minimise damage by aphids.

Grazing and insecticides are the principal management tools available to farmers for aphid control in the immediate future.

Aphids are more likely to build up and cause severe plant damage when grazing is relatively light. A heavy grazing following aphid build up usually results in a substantial drop in aphid numbers. This drop can be as great or greater than the drop following the application of a recommended insecticide. Grazing should be exploited as far as possible but this is unlikely by itself to keep aphids in check on all medic pastures throughout the full season.

Both SAA and BGA can be killed by relatively inexpensive and readily available insecticide. However, there is little knowledge available on winter spraying and how often they may have to be sprayed throughout a season. Aphid numbers particularly BGA, sometimes drop suddenly following the development of damage symptoms on medics. Spraying at this time may prove to be a complete waste of time and money. Regular inspection of medic stands from germination onwards is essential to detect the presence of aphids as early as possible. The beneficial effects of spraying are likely to be greatest, when heavy infestations occur on small seedlings but before symptoms of damage can be seen.

A factor of greatest uncertainty at the moment, is the pea aphid (PA). This pest is now well established in Victoria on lucerne and is expected to spread across Australia quite rapidly. It could attack some, or possibly all of our medics and most of our grain legumes as well. As worthwhile information on PA becomes available, it will be promptly circulated.

While subs and medics will be the main pasture legumes in cereal areas for the foreseeable future, Sainfoin has interesting possibilities. It is a large seeded perennial legume which is drought tolerant probably to a greater degree than lucerne. It is however most susceptible to waterlogging. It requires special Rhizobium to do any good at all and even when nodulated may not be able to fix its full requirements of Nitrogen. Its insect resistance (SAA, BGA, lucerne flea, red legged earth mite, alfalfa weevil and Egyptian alfalfa weevil) and its inability to cause bloat in ruminants and its acceptibilities to grazing animal which do particularly well on it, indicate that work should be done to develop it as a new pasture plant. Seed supplies of the SAGRIC selected cultivar "Othello" are very limited. Release will not be before autumn 1981 but could be further delayed if unexpected weaknesses are detected.

It cannot be over emphasized that high sustained cereal yields in most parts of the South Australian cereal belt are dependent on prolific nitrogen fixing annual legume pastures. There can be little doubt that in the past two years, the heavy cereal crops have taken more nitrogen out of South Australian farms overall than has been put back by all the legumes grown. The success of future cereal crops will be increasingly impaired if medic pastures are not maintained in a highly productive state. The amount of nitrogen fixed by legumes is closely related to total growth made.

<u>FURTHER REFERENCE MATERIAL</u>

Fact Sheet 28/78, Agdex $\frac{130}{622}$

'A Guide to Cultivars Medic and Sub-Clover Susceptibilities to SAA and BGA'.

Technote 2/78 Agdez $\frac{130}{622}$

'A Guide to the Susceptibilities of some pasture and crop legumes to Spotted Alfalfa Aphid, Blue-green Aphid, Pea Aphid and Sitona Weevil'.

<u>Note</u> revised versions are currently being processed.

ROTATIONS & TILLAGE

K.J. HOLDEN, SENIOR DISTRICT AGRONOMIST

TILLAGE

One of the most dramatic developments in field crop production in recent years has been the change in tillage techniques and the move towards minimum tillage. In fact a growing number of farmers no longer till their soil but sow direct.

Many factors are influencing this development, of which a few are:

1. Economics - The high capital and operating costs of traditional equipment. P. Finlayson of McGown and Associates, Victoria, recently claimed that in the northern mallee of Victoria, ownership and operating costs account for 75% of production costs.

2. Herbicides - Chemicals can now largely replace cultivation in weed control.

3. Flexibility in management - Minimum tillage saves time and enables more precise sowing in a wide range of situations.

4. Extra grazing - Farmers are able to carry more stock in early winter.

5. Reduced erosion risk - Both water and wind erosion is reduced. In 1977 large areas of sandy soils in Eastern Eyre Peninsula were drifting. Direct drilled crops hardly suffered. One Property on which the crop was established by direct drilling, looked like an oasis in a desert from the air. Unless our current techniques are modified erosion is likely to increase because of machine size, speed of working and intensity of cropping.

We now know that in most situation cultivations are unnecessary. In the past one of the most important benefits of cultivation has been due to weed control. It is interesting to note that in most spray seed trials conducted by I.C.I. and our Department, the yields from spray - sow are consistently better than yields from spray-cultivate - sow.

For the above reasons farmers are critically analysing their traditional practices and are showing keen interest in new crop establishment techniques and machinery - and it is our job to keep abreast of these new developments so that we can assist farmers to make changes.

Yields are often lower when minimum tillage techniques are compared with conventional techniques but the new techniques should not be thrown out on the results from one to two years - many skills have to be aquired in mastering a new system. And it is invalid to use yields as the only criteria for comparison since direct drilling alters many factors within the farming system.

Therefore when comparing alternative techniques for establishing a crop we must look at the whole farm system. The most significant variable in most cases is <u>income</u>. Too often sprayseed has been compared with conventional cultivation only on a cost basis per hectare. Cost differences are usually only small.

As an example of the need to look at the whole farm, Mr. Gardiner, a farmer of Karkoo direct drilled the whole of his farm (500 ha) in 1978. In a continuous trial established by our Department on his property to compare conventional with direct drilling techniques he gained the equivalent grazing of 0.5 extra sheep per hectare per year on the direct drilled area.

If a grain legume is included into the system direct drilling may enable continuous cropping.

Other benefits may only become apparent in the long-term. For example soil fertility levels may increase as the following trial suggests.

Soil Nitrogen levels after five consecutive wheat crops.

(expressed as kg of N2 per hectare)

Conventional	1 300
Minimum tillage	1 430
Direct Drilling	1 510
Triple Disc*	1 720

* Yields only 60% of conventional which could explain (at least in part) the higher soil nitrogen levels.

Limited trial work indicates less soil campaction, less surface sealing and crusting and higher organic matter levels following direct drilling.

Soil Physical conditions following four successive wheat crops at Wagga.

	Resistance to Ploughing (Drawbar pull - kg)	Aggregate Stability (%)	Penetrability (kg/C^2)
Undisturbed Soil	76	13	4.1
Conventional	60	6	3.5
Direct drilling	45	12	2.9

The effect of direct drilling on leaf and root diseases of crops is unknown. Some diseases may increase due to the greater carry-over of infectious residues. In Europe insect and disease problems increased initially but eventually declined.

Blade ploughs, chisel ploughs, rod weeders are implements which will increase in popularity. Several questions need to be answered. Will crop yields increase? Will they cost more or less to own and operate? If they are dearer, will the benefits be worth the extra costs?

The tables below briefly describe the functions of conventional and more recent tillage implements.

Implements used in Stubble Retention

Wide share implements for primary or secondary tillage, and which are designed for weed control whilst leaving maximum cover on surface with minimum soil disturbance and breakdown of structure.

<u>Sweep Plough</u> Shares 40 to 180 cm	Excellent trash clearance. Minimum residue incorporation (15%) Minimal disturbance of surface soil Low draft.
<u>Blade Plough</u> (Heavy duty type of sweep plough with shares wider than 180 cm)	Incorporates 10% trash. Limited weed control. Handles more trash because less shanks. Low draft.

Rod Weeder (live square rod best)	Works under trash. Often attached to plough for weed control. Incorporates 5-10% trash Low draft.

NOTE: Sweep assemblies can be replaced by chisel tynes or scarifier tynes. Therefore the sweep plough is a versatile implement.

Implements used for Weed Control

Implement	Increasing:- (↓)
Blade Plough	Aggressiveness for weed control
Chisel Plough	
Rod weeder	stubble burried
Blade plough plus rod weeder	soil inversion
Chisel plough plus sweep points	structure breakdown
Scarifier	pulverisation
Spring tyne cultivator	
Combine	
Disc harrows	
One way disc plough	

Tyned Implements

Primary Tillage	Function	Progressive Reduction in:- (↓)
Ripper (no inversion)	Reduces soil strength and arranges aggregates. Shatters soil 20 cm.	Implement strength. tyne strength. tyne spacing. working depth.
Chisel plough	Shatters soil to 20 cm. Incorporates 20% trash.	machine draft.
Scarifier	Shatters soil to 15 cm re-arranged particles burries 25% stubble. Trash handling is better than ripper and chisel plough.	Ability to handle trash.

AND

Secondary Tillage		Progressive Increase in:-
Cultivator	Prepares tilth. controls weeds. improves aeration. improves infiltration	Breakdown of O.M. Breakdown structure. wind and water erosion. loss of nutrients in winter wet soils.
Harrows (also used for "early tickle" or after seeding weed control or post seeding soil compaction - especially direct drilling).	Pulverises. smoothes. packs. controls weeds.	

Disc Implements

Primary tillage	Function	Reducing
Disc plough ('one way') discs individually mounted on stump jump mechanisms single or twin disc ploughs.	Inverts soil and incorporates trash. (30-70%) buries well established weeds prepares for subsequent tillage	Machine weight. strength. disc size.
Disc plough ('off set')	chops trash but leaves more on surface.	

AND

Primary or Secondary Tillage		Increasing
Disc cultivator 'off set' or wheeled	Prepares seedbed	Soil structure breakdown
'off set' (two gangs of discs)	Chaps trash - leaves more on surface. weed control	

Secondary Tillage

Disc harrows (two gangs of discs which may be arranged in tandem).	Light tillage for control of small weeds and for advanced seedbed preparation.

Price Comparison of Various Tillage equipment

(Source Australian Country Magazine, November, 1979)

Implement	Width (metres)	Price per metre ($)
Disc plough	6.0 - 2.0	2 000 - 2 200
Scarifier	11.0 - 7.0	1 100 - 1 400
Chisel plough	14.2 - 5.6	1 150 - 1 500
Chisel sweep	11.5 - 6.8	1 150 - 1 400
Blade plough - standard	5.5 - 13.5	1 000 - 1 700
Blade plough - stump jump	5.5 - 20.0	1 700 - 1 950