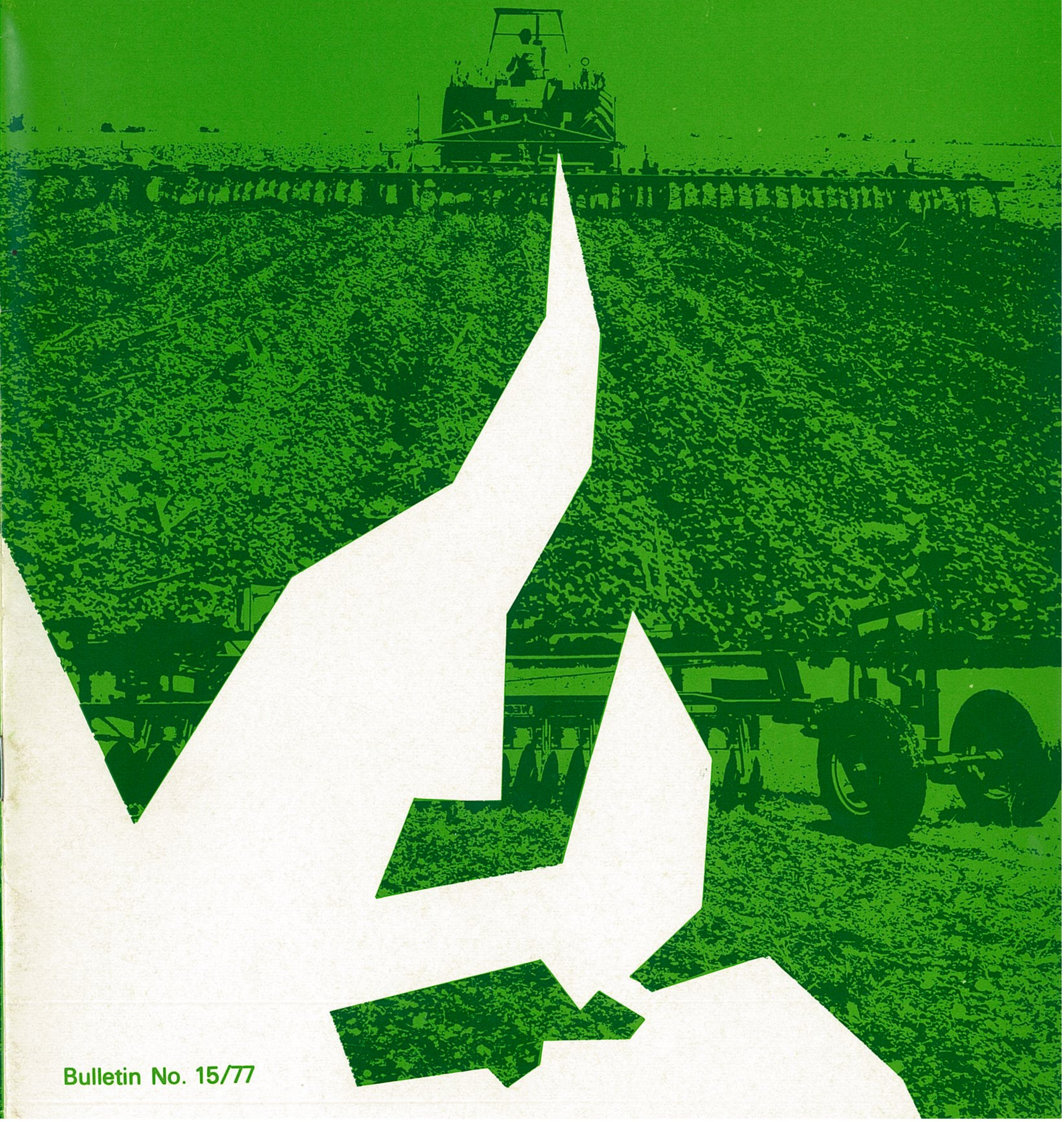
Department of Agriculture and Fisheries, South Australia AGDEX 100/18

LEY FARMING in South Australia



Bulletin No. 15/77

Contents

LEY FARMING in South Australia*

Ley farming, a legume pasture-cereal crop rotation, has revolutionized agricultural production in the cereal zone of South Australia since the late 1930s.
The principle of ley farming is now widely acknowledged in Australia and interest in the system is growing in other parts of the world that have a Mediterranean climate.

Historical background

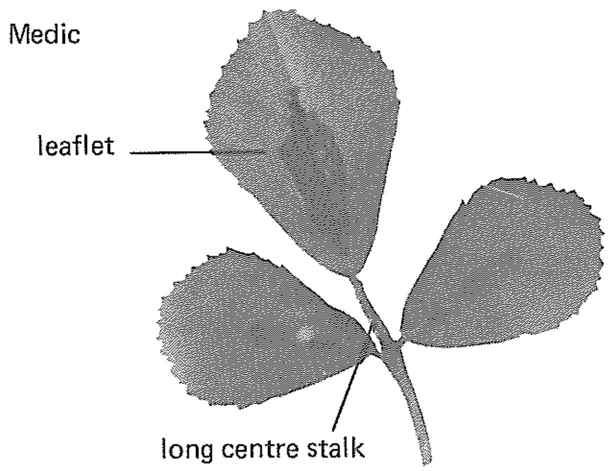
Up to the late 1930s, S.A.'s cereal zone had been exploited by extensive cropping on fallow. Under the fallow-wheat system, much of the soil's natural fertility was exhausted, soil erosion was acute in many areas, soils were difficult to work because their structure had been broken down, and there was insufficient forage to feed the increasing numbers of livestock.

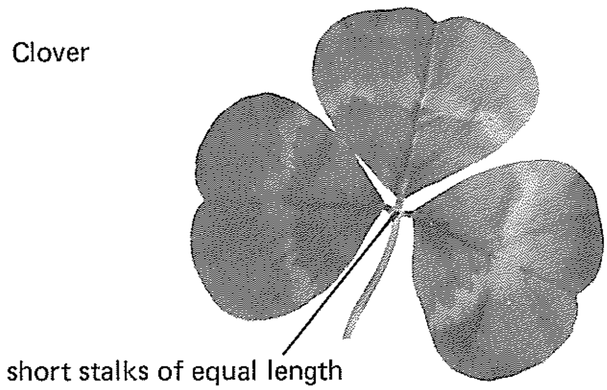
Ley farming, the farming system now used in S.A., was developed in the State mainly between 1940 and 1960. The system is based on growing annual legume pastures, i.e. cultivars of *Medicago* species or *Trifolium subterraneum,* between cereal crops. An integrated system of cereal and livestock production, ley farming has reduced fallow markedly, improved soil structure, and increased soil nitrogen levels and forage production. The net result within the cereal zone has been increased crop production and yields per hectare and the achievement of considerably higher stock numbers with increased wool and meat production.

Specific advantages

The specific advantages that have accrued from the ley farming system are:

- increased soil fertility and farming stability.
- improved soil structure.
- increased forage production, resulting in higher, better quality and more stable livestock output.
- a lengthened grazing season because of the provision of excellent quality dry pasture capable of carrying larger numbers of stock through the drier months of the year.





In medics (top), the central leaflet has a longer stalk than the leaflets at each side. In most clovers (bottom), all three leaflets have very short stalks of equal length.

*This Bulletin was prepared by: Glyn Webber, Principal Agronomist, Noel Matz, Senior Special Agronomist and Gill Williams, Acting Senior Agronomist.

- increased cereal crop yields, often with improved protein levels and greater cropping flexibility.
- better soil erosion control, particularly when combined with contour banking in areas susceptible to water erosion.
- improved weed control when the system is correctly managed.

The impact of ley farming

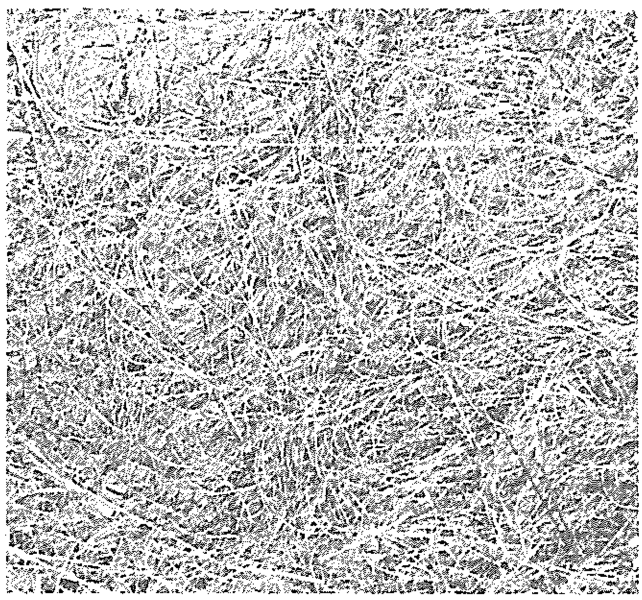
The introduction of the annual legume pasture-cereal crop rotations in the cereal zone had a rapid impact on production. By 1950, annual pasture legumes, mainly medics (*Medicago* spp.), were sown or had volunteered over a wide area under suitable management techniques. They grew prolifically in many areas and were stimulated by higher phosphate applications. As well as supporting more sheep, the legume-based pastures replenished depleted organic matter reserves and raised soil nitrogen levels. The increase in soil fertility was reflected in increased cereal crop yields and higher stocking capacities (see Table 1 showing production statistics for the whole State over this period, and Table 2 showing production from three counties in the heart of the cereal zone).

Attempts to establish and maintain legume pastures were not uniformly successful throughout the cereal areas. The most impressive results were achieved on alkaline soils, i.e. the grey, sandy and loamy mallee soils and black earths. Here, the medics – barrel *(M. truncatula)* and burr *(M. polymorpha)* – established readily. Rotations were adapted and an alternate year cropping system was widely established with barley areas increasing. To some extent, the short rotation system was developed out of necessity in regions such as Yorke Peninsula where livestock water supplies were limited. Because medics could set a high percentage of hard seeds, with a relatively small percentage softening each summer to germinate with opening rains, they regenerated readily after one or even two cereal crops.

Similar gains to those on the alkaline soils have followed in almost all the soil zones in the cereal areas where *Medicago* species grew well. Progress has not been as rapid on the heavier red-brown earths of the northern region and on the transitional solonetz soils (the neutral to acid sandy soils) where volunteer pastures contained only sparse legume growth. Here, it was necessary to sow early strains of subterranean clover *(Trifolium subterraneum)*. The pastures were more difficult to establish and needed resowing after each period of cropping. The lack of legume pasture development in the red-brown earth zone was reflected in the lower rate of soil fertility build-up and subsequent effects on cereal yields as compared with the mallee soil areas.

In the red-brown earth zone, there are many examples of individual properties where subterranean clovers have brought about increases in soil fertility and production at least equal to the gains made in the medic areas. The development of the ley farming system based on subterranean clover pastures has met with some setbacks over the years: unsuitable varieties in the early stages, problems with establishment methods, and dry conditions in critical pasture resowing years. The red-brown earth zone still offers considerable scope for further developments.

It is now well established that with correct management and use of newer, more suitable clovers, the ley farming system in the subterranean clover areas can provide the same degree of success as the system in the annual medic areas, i.e. the mallee (alkaline) soil areas.



Ley farming provides excellent quality dry pasture to carry large numbers of stock through the drier months.

A prolific growth of annual medic will support more sheep, replenish depleted organic matter reserves and raise soil nitrogen levels.

Figure 1: Southern area of South Australia showing mean annual rainfall (mm) and Counties Gawler, Stanley and Daly.

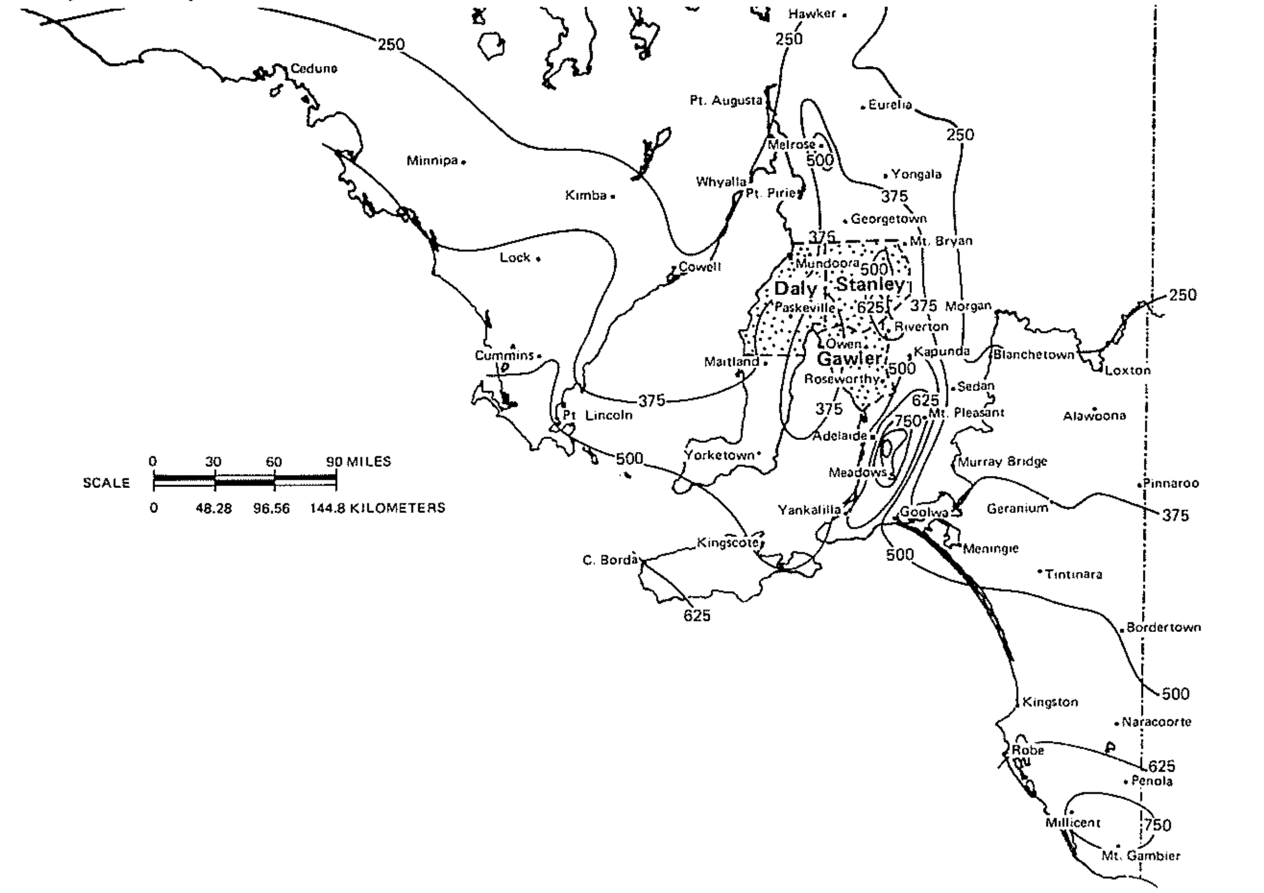


Figure 2: The cereal zone of South Australia showing the main medic and subterranean clover areas.

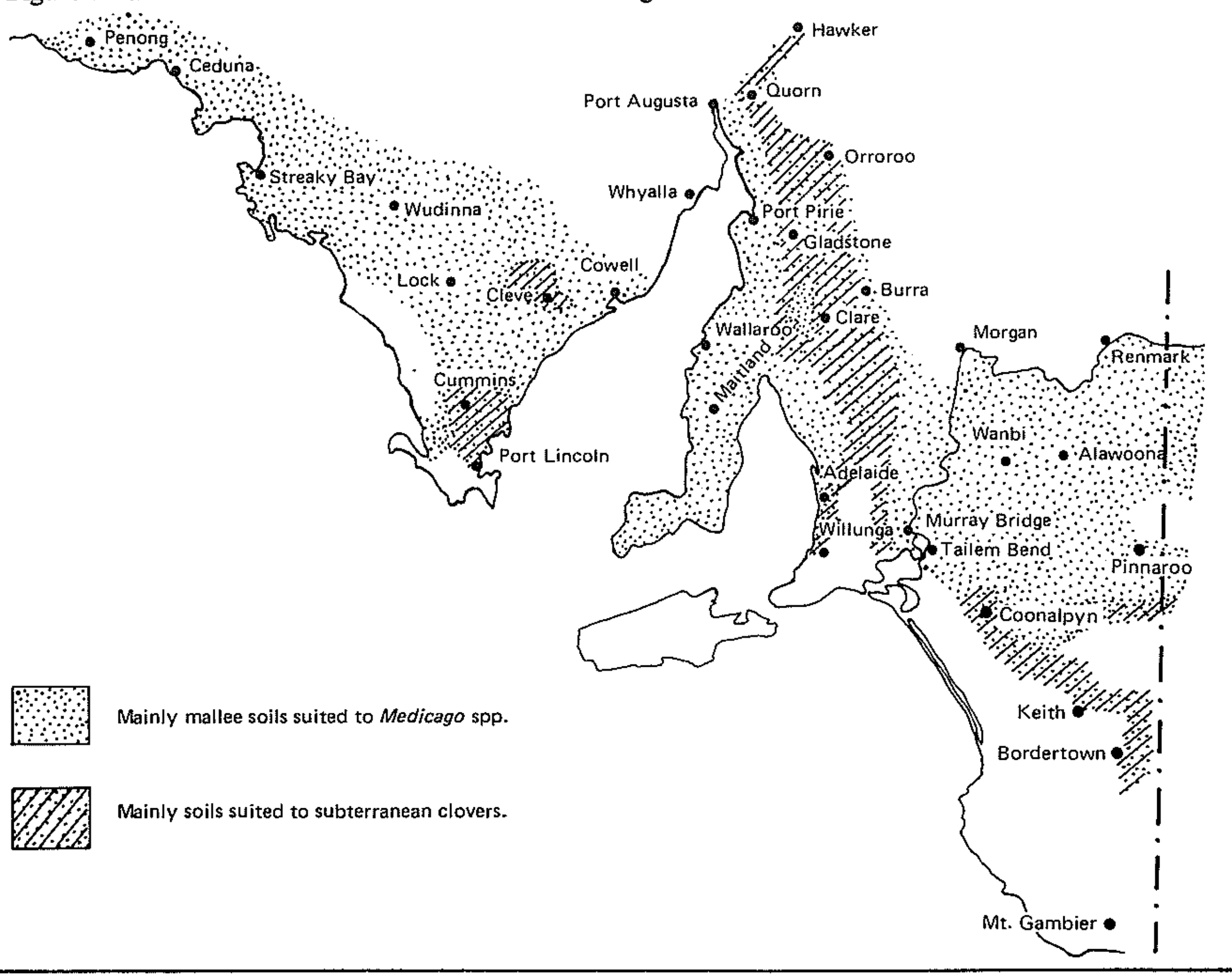


Table 1: Cereal and livestock production, South Australia – average of ten-year periods.

Period	Wheat			Barley			Total cereal production	Sheep and wool		Cattle
	Area sown '000s ha	Production '000s tonnes	Yield t/ha	Area sown '000s ha	Production '000s tonnes	Yield t/ha	Wheat, oats and barley '000s tonnes	Numbers '000s	Wool production '000s kg	Total nos.
1931 40	1 326	939	0.71	151	142.3	0.95	1 125.5	8 504	33 731	331 156
1941-50	824	712	0.87	205	222.5	1.09	990.6	9 226	42 842	422 034
1951-60	633	779	1.25	468	579.4	1.24	1 477.0	13 658	70 703	522 797
1961-70	1 128	1 272	1.14	503	537.5	1.07	1 943.5	17 120	100 574	725 323

Table 2: Cereal and livestock production, South Australian cereal zone. Counties Daly, Gawler, Stanley.

Period	Wheat			Barley			Total cereal production	Sheep and wool		Cattle
	Area sown '000 ha	Production '000s tonnes	Yield t/ha	Area sown '000 ha	Production '000s tonnes	Yield t/ha	Wheat, barley, oats '000s tonnes	Numbers '000s	Wool production '000s kg	Total nos.
1931-40	263	274	1.04	42	36	0.86	315	543	2 792	30 392
1941-50	192	224	1.17	55	56	1.02	310	667	4 386	29 810
1951-60	157	251	1.60	96	137	1.43	412	938	7 521	30 101
1961-70	213	314	1.47	91	114	1.25	451	1 050	8 744	34 580

A good first year subterranean clover pasture in the red-brown earth zone.

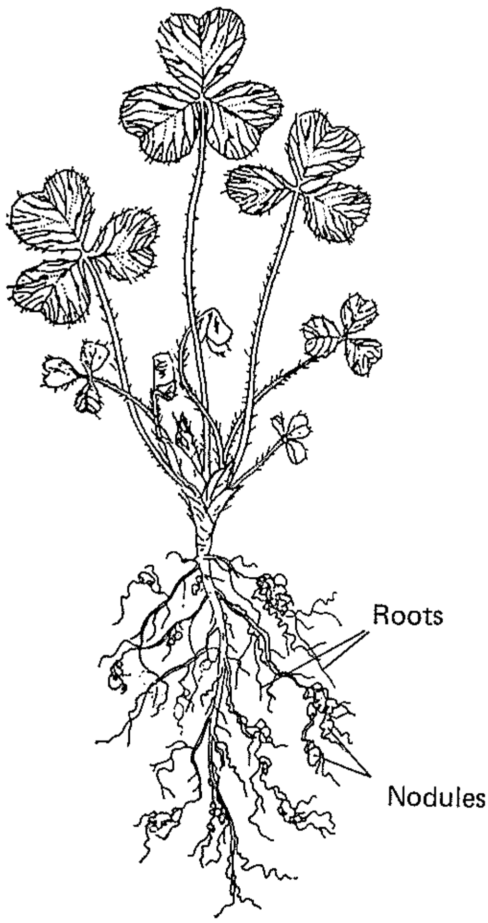
Key features of the ley farming system

Legumes and their nitrogen fixing properties

Nitrogen and phosphorus are the most serious major element deficiencies of soils in the cereal zone. Nitrogenous fertilizers are expensive and yield responses measured under S.A.'s semi-arid and variable climate are variable and often not profitable in many areas. Also, nitrogenous fertilizers do not improve the structure of worn, over-cropped soils.

Legume-dominant pastures, on the other hand, improve soil structure and hence water intake and rapidly build up soil nitrogen levels. This in turn provides adequate nitrogen in a form available to crops when required.

Figure 3: Legumes rebuild farm soil.



Some important questions about the system are:

How do legumes fix nitrogen?

Nitrogen is fixed by bacteria in nodules that form on the roots of legume plants. The bacteria are able to trap the nitrogen from the air and convert it into a form that the plant can use. Consequently, most legumes are rich in nitrogenous compounds. As the compounds are returned to the soil, whether through the grazing animal or by decaying plant residues, the soil nitrogen content increases.

How much nitrogen is fixed?

The amount of nitrogen fixed by a legume varies with soil type, the vigour of the legume pasture stand, the existing level of soil nitrogen, and the efficiency of nodule-forming bacteria.

Measurements taken in the wheat belt indicate that an average *Medicago* stand increases soil nitrogen by at least 60 to 70 kg/ha in one season, i.e. the equivalent of about 300 kg of sulphate of ammonia. Measurement of up to 200 kg/ha of soil nitrogen fixed on sandy soils has been recorded with vigorous stands of Harbinger medic on the low fertility, sandy soils in the Murray Mallee.

Where to grow medics and clovers?

Medics

In general, medics are suited to the alkaline soils in the 250 mm to 450 mm rainfall zone of the cereal zone, which include the mallee soils of the Murray Plains, Yorke Peninsula and Upper Eyre Peninsula, and some of the limey soils and black earths of the northern region.

What variety to use?

The wide variety of soils and climatic conditions in the cereal zone influence the choice of medic best suited to the particular locality. In recent years the development of new medic cultivars has extended the area over which highly productive medic stands can be grown.

In the past, burr medic has predominated in some areas, but problems of burrs in wool and the availability of newer medics with more desirable features have brought about its replacement.

The main medics grown in S.A. are:

Barrel medic *(Medicago truncatula).* Jemalong, Hannaford, Cyprus, and Borung. The latter is a newer cultivar that shows promise on loam and clay loam soils.

Strand medic *(Medicago littoralis).* Harbinger.

Gama medic *(Medicago rugosa).* Paragosa.

Snail medic *(Medicago scutellata)* is grown in some areas.

Disc medic *(Medicago tornata).* Tornafield is showing some potential on solonetz soils but will possibly be replaced by more productive disc medics currently under test.

Subterranean clovers

Although the *Medicago* species are suited to the majority of soils in the cereal zone, there are some areas where they do not flourish, e.g. the red-brown, neutral to slightly acid soils and the light-coloured, sandier, transitional solonetz soils. Subterranean clovers have proved more suitable on these soils.

The newer earlier maturing strains have extended the lower rainfall zone limits for subterranean clovers, but, in general, 350 mm to 400 mm average annual rainfall seems to be the lower limit for successful stands.

What variety to use?

A number of varieties have been tried over the past 20 years with variable degrees of success. Some of the initial varieties used were found unsuitable because of late maturity, failure to regenerate effectively under the climatic conditions, and high oestrogen content which causes ewe infertility problems. The range of varieties now available provides suitable characteristics to cover most of the non-medic areas of the State.

The main cultivars now sown are **Clare, Geraldton, Woogenellup** and **Daliak**.

Factors determining rotations

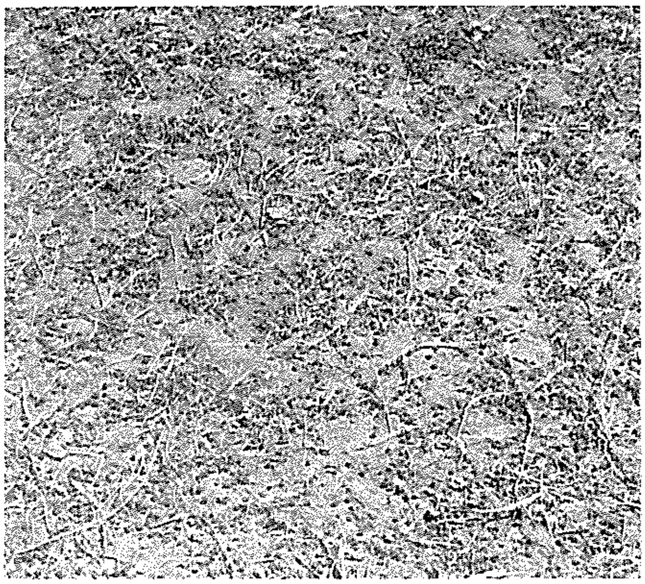
The medic and subterranean clover areas vary in the use of cropping systems, or rotations.

Rotations for medic areas

Because of the hard-seeded nature of medics, optimum regeneration is achieved where an alternate year cropping programme is practised. The basic crop-pasture-crop-pasture rotation has been used for many years in areas such as Yorke Peninsula. Better germination occurs after the crop year because:

- more hard seeds are broken down by two summers of exposure to temperature extremes at or near the soil surface.
- seed incorporated in the top few centimetres of soil is in a better environment for germination and establishment.

Whatever the cropping system used, it is important that seed reserves be maintained at a high level to promote vigorous medic stands in future years.



A good seed reserve will promote vigorous medic stands in future years.

The concept of fixed rotations has tended to change in recent years. The build-up in soil fertility under legume-dominant pastures has allowed greater flexibility in the management of crops and pastures to maximize profits. Rotations in medic areas, although based on alternate year cropping, vary in relation to soil type, inherent soil fertility levels, seasons, density and vigour of pastures, and the relative prices of crop and livestock products.

As a general principle, the objective is to grow one or two cereal crops for every moderate to good medic crop. Less intensive cropping is wasteful because it allows poor types of annual grasses to become dominant on the increased fertility.

Some of the rotations used in conjunction with medic pastures:

- barley-pasture-barley-pasture in the good medic areas suited to barley production.
- wheat-pasture-wheat-pasture where medic growth is regular on good loam soils of 350 mm to 475 mm rainfall. A modification would be wheat-pasture-barley-pasture, or fallow-wheat-pasture-barley-pasture.
- on lighter soils where rainfall is not so reliable, the crop year is followed by two or three seasons of pasture, depending on the medic growth.
- on heavier soils, particularly in the more favoured rainfall areas, where fallowing is likely to be necessary for maximum returns, a rotation of fallow-wheat-pasture-barley-pasture or fallow-wheat-pasture is practised (see "Fallowing" page 11).

Whatever rotation is used, it is necessary to assess soil fertility and seed reserves carefully. Seed reserves can reach low levels after poor pasture years, or when paddocks are cropped for two years or more in succession. Operations such as hay cutting can also reduce the quantity of seed set. If seed reserves are in doubt, resowing with medic seed should be undertaken.

Rotations with subterranean clovers

Unlike medics, subterranean clovers have fewer hard seeds and regenerate best in the year following seed set. They are therefore not as well suited to close rotations and tend to fit best into a system where there is a pasture phase followed by a cropping phase. That is, where subterranean clover is the basic legume in the ley farming system, the policy should be to build soil nitrogen levels and soil fertility over two, three or more years, and then crop for two or more successive years before going back to a clover pasture.

As a rule, subterranean clover seldom survives a cropping programme well. Geraldton and Clare are

Figure 4: A typical rotation used on heavier soils in more favoured rainfall areas.

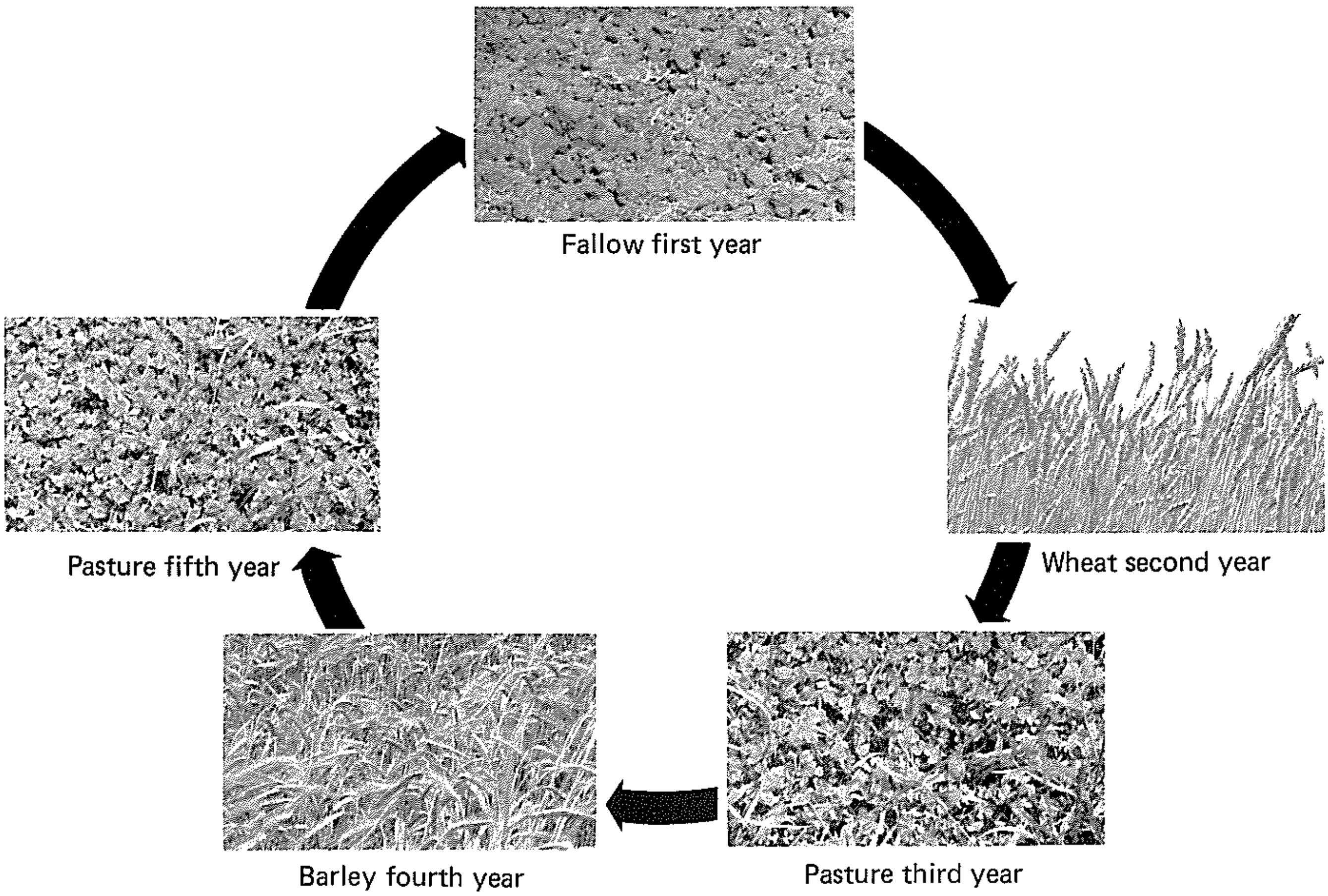
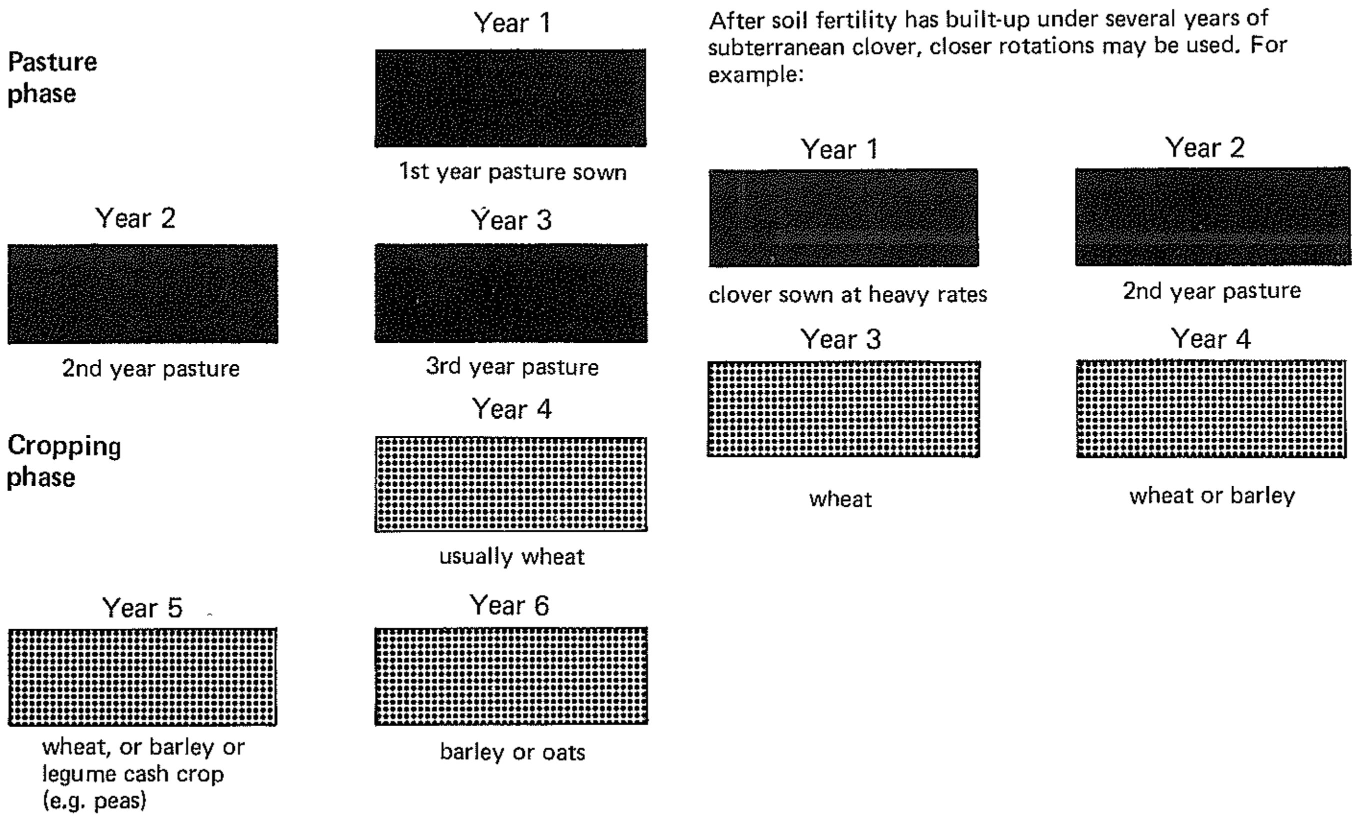


Figure 5: Some examples of rotations used in subterranean clover areas.



A young second year stand of subterranean clover.

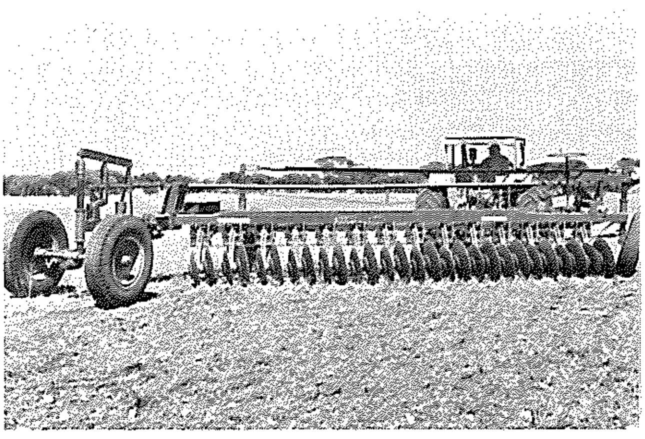
the most reliable in this respect but even their regeneration after cropping cannot be taken for granted. This means subterranean clovers need to be resown after each cropping phase and it is vitally important that they establish well and rapidly in the first year.

The system with subterranean clovers is also flexible when soil fertility is high enabling farmers to capitalize on opportunities to increase areas either for cereals or livestock production as prices fluctuate.

There is little doubt that more rapid progress could have been made in the subterranean clover areas with the use of higher seeding rates.

Fallowing

Although the amount of land fallowed for wheat has been considerably reduced, there is still a significant amount of fallowing carried out in some areas. Fallowing is considered most effective in storing water in soils that have a moderate to high clay content at 15 cm to 30 cm depth.



Fallowing with a disc plough.
By courtesy of Horwood Bagshaw.

In general, fallowing is carried out under conditions where:

- soils have relatively poor legume history and nitrogen build up, and where mineralization under fallow would help make soil nitrogen available.
- soils have a good pasture legume history. Fallowing is then recommended only where:
  - clay subsoil is present.
  - July to August (winter) rains exceed 100 mm.
  - average seasonal rainfall is below 450 mm.

Fallowing is normally carried out in August to September when pastures are flowering.

Sowing legume pastures

The system of ley farming depends on the quick establishment of good productive stands of medics or clovers and their maintenance.

Once medics have been established, they are normally highly persistent under a suitable rotation and management system. Subterranean clovers usually need reseeding after each cropping phase and more attention is necessary to obtain optimum establishment in each sowing year.

Sowing methods — medics

Three main methods are used for sowing medics in the S.A. cereal zone:

- drilling into cereal stubbles before the opening rains.
- undersowing with the cereal crop.
- sowing on a prepared seedbed – to ensure a heavy stand for seed production or establishment on new land.

Stubble sowing dry

Stubble sowing dry before the opening rains of the season is the most popular method for sowing medics because it is cheap and effective. Normally, a disc drill is used, although a combine is satisfactory if the stubble is removed by heavy grazing or burnt before sowing. The implement used should be set so that the seed is just scratched into the soil and lightly covered.

With sowing dry, the medic seed germinates after the first rains and grows vigorously enough to compete with the annual grasses and weeds in the paddock.

Sowing too early is risky because of the possibility of one or more false breaks. Late March to April is a satisfactory time in most seasons. Moderate stands have been obtained with 4 to 5 kg/ha of seed, but twice this quantity of seed has a greater

A good establishment of medic drilled into a cereal stubble before the opening rains.

chance of establishing a productive stand. Heavier seeding rates increase the density of germinating plants and thereby increase the amount of early pasture production when it is needed most. This practice allows earlier grazing and less loss of production while the pasture is establishing and more rapid build-up of soil nitrogen.

A light crop of grazing oats or barley of around 33 kg/ha is sometimes sown with the medic to boost early feed. Early feed is important in many seasons to provide adequate stock feed and to control wind erosion.

Undersowing with the crop

Undersowing medic with the cereal crop is a convenient method that has sometimes given good results. It is risky because:

- intense competition is offered by a dense cereal crop.
- insect spraying is rarely carried out.
- most herbicides used in crop spraying can give young medic plants a severe set-back.
- late sowing of the crop may not suit the medic.

The shortening of the growing season brought about by late sowing can seriously limit the amount of medic seed set.

When undersowing medic with the crop, use a small seed box on the combine. The medic seed can then be topsown and lightly covered by trailing harrows. Generally, 2 to 3 kg/ha of seed is used with this method.

Sowing methods — subterranean clovers

It is critical for a subterranean clover pasture to establish well in the first year. Although medic sowing methods can be used, the most reliable method has proved to be sowing on a well-prepared seedbed. This is particularly important on the heavier red-brown earth soils where experience has shown that short cut methods have resulted in many of the establishment failures throughout the years.

In some cases, subterranean clovers are sown on a prepared seedbed with a grazing oat crop. The advantages are:

- it gives better grazing in the first year. In the past, an objection to sowing on a prepared seedbed has been that little early grazing is available in the first year.
- by closing the paddock at the end of August after being grazed:
  - the young clover is protected during flowering and seed setting.
  - if late spring conditions are good, a valuable regrowth of oats gives a light standing crop for grazing in late summer and early autumn.

Oats are usually sown at 30 kg/ha, but in some cases higher rates have been used. The only disadvantage of this method is that the oats may compete with the clover for moisture and light. It is therefore important to adequately graze the oats to reduce competition with the young clover.

Other important factors in sowing legumes

Seeding rates

In the past, many medic stands have been established in the cereal zone at rates of 4 to 5 kg/ha, but rates of 8 to 12 kg/ha or more have produced productive stands much more rapidly. The lower rate can be satisfactory for thickening existing stands but higher rates are favoured. The need to establish a good stand of subterranean clover in the first year cannot be overemphasized and rates of 10 to 12 kg/ha or more have been shown to produce a much more satisfactory pasture than lower rates.

Time of seeding

The growing season is relatively short in most of the agricultural areas of S.A. and conditions for germination and establishment are best early in the season. It is therefore preferable to sow medics and subterranean clovers as early as possible.

Depth of seeding

Medics and clovers are relatively small seeded and should not be sown too deep. On light soils, small seeds can be sown up to 3 cm to 4 cm deep, but shallower seeding is necessary on heavier loams and clay soils.

Generally, the most satisfactory results are obtained when seed is dropped on the surface of cultivated soil from seed boxes and then covered by light trailing harrows. When discing seed into stubbles before opening rains, seed is best sown about 1.5 cm deep.

Seedbed conditions

Whether seeding into a stubble dry or into a prepared seedbed, care should be taken to provide the best possible conditions for maximum germination.

On prepared land, a shallow, fine seedbed free from weeds is important. Deeper working causes a fluffy seedbed that, in many cases, can result in a poor and variable germination.

On rough and non-arable land, every attempt should be made to scratch up or disturb the soil surface. Limited germination and considerable seed loss can result from just dropping seed on hard soil surfaces.

With sowing dry, dense stubbles can restrict germination. Heavy grazing, slashing or burning of stubbles may be necessary to provide suitable conditions for accurate seed placement by the disc drill.

Management of legume pasture stands

The main objectives in grazing management in the ley farming system are to obtain the maximum grazing potential for livestock throughout the year, and to achieve a high level seed set to enable a continuous high level of regeneration and production from the pasture.

To achieve the objectives, farmers must be aware of the following points:

- new stands need careful grazing management early in the season.
- stands should become well established; for example, six to eight leaf stage before grazing, then grazing levels should be aimed to keep weed and volunteer grass growth under control.

A medic pasture being grazed relatively short as flowering begins.

- once the stand is established, grazing management should be aimed at keeping the stand relatively short until flowering approaches. Maximum seed set is achieved in this way provided grazing is carefully controlled during flowering and podding.
- the dry residue of medics is valuable stock feed as well as a builder of soil organic matter. To ensure that good seed reserves remain, care should be taken to prevent overgrazing of medic pastures during summer and autumn.
- heavy grazing soon after germination can be detrimental. Seedlings of some medics are easily pulled up by sheep and seedling losses result from trampling.
- relatively heavy grazing of established stands up to the time of flowering often increases seed yields of the subterranean clovers but heavy grazing after flowering begins can reduce seed yields.
- seed reserves of new stands of subterranean clover can be depleted by overgrazing during summer and autumn.

Other important management factors are:

Stubble density

Medic pastures often regenerate poorly in dense stubbles. Straw walker tracks left by headers are particularly troublesome because the dense cover keeps summer ground temperatures low and reduces hard seed breakdown. Straw residues also blanket germinating medics from available light.

Dense stubbles often prevent good regeneration of medic pastures.

Topping pastures

Topping is carried out in medic pastures to remove the top growth of inferior annuals, mainly the barley and brome grasses. It produces better quality feed and reduces weed competition and build-up of weed seed.

Cutting too low may reduce medic seed set, particularly where it is too late for regrowth to occur.

Hay cutting

The extent to which hay cutting affects the seed set of medic stands depends on:

- time of cutting. If cut at the early flowering stage, there is more chance of regrowth.
- seasonal conditions for regrowth.
- height of cutting.

Even under favourable conditions hay cutting reduces seed set to about 30 per cent of normal. But seed reserve after cutting could still be as much as 220 kg/ha. In general, the effect of cutting should be watched carefully and if little seed is set, resowing could be required in the next pasture year.

Hay cutting reduces seed set to about 30 per cent of normal.

Fertilizer application

Legume pastures have a high requirement for phosphate, and under S.A. conditions it is important that adequate superphosphate be applied for maximum growth and seed set in the pasture year.

Superphosphate can be applied as a top dressing or at resowing. Experience has shown that at least 65 to 100 kg/ha should be applied. Amounts required will depend on average rainfall of the district and available residual phosphate, i.e. the superphosphate history. Where possible, phosphate should be applied as close as possible to the break of the season. When resowing, maximum benefit is achieved by sowing phosphate with the seed.

Table 3: A guide to superphosphate application rates for different rainfall districts.

Average annual rainfall (mm)	Superphosphate rate (kg/ha)
325 or less	66
350	72
375	77
400	83
425	88
450	94

Control of insect pests

Many of the failures to get legume pastures established or to obtain full production from stands have been caused by insect pests.

The main insect pest problems in S.A. are red-legged earthmite, *(Halotydeus destructor),* lucerne flea, *(Sminthurus viridis),* pasture cockchafer *(Aphodius tasmaniae)* and, in recent years, sitona weevil *(Sitona humeralis).* Heavy infestations of any of these pests can seriously reduce winter production and subsequent spring growth and seed set. For control, early spraying with insecticides is important.

The recommended treatments for all insect pests are published annually by the Department of Agriculture and Fisheries.

The feed year — under a ley farming system

One of the great benefits that ley farming has brought is its stability of production. It has provided a system where individual farms and the majority of the cereal zone can crop a stable crop area and carry a regular number of livestock. This has been a major breakthrough for farming in semi-arid conditions compared with previous unstable exploitive systems.

The greenfeed period in a normal season is short (five to seven months) through most of the cereal zone and volunteer grass species rapidly lose their feed value after maturity. This leaves a considerable gap in the feed year. Annual legume pastures retain feed quality in their dry residues and extend the quality feed season significantly.

Figure 6: A typical feed year of a farm in the cereal zone cropping about 50 per cent of its area.

winter: June, July, August.

With a normal seasonal opening in May, legume pastures support stock numbers through winter.

spring: September, October, November.

The spring flush of growth is normally well ahead of stock needs and provides valuable reserves for carry-over dry feed and/or paddocks for hay cutting.

early summer: December, January.

Carry-over dry pastures are utilized during this period with stubbles also becoming available after the cereal harvest. It is usual to graze fresh stubbles with young stock, making sure they are fully fed on hay or some other feed before entering cereal stubbles with grain on the ground to prevent grain poisoning.

late summer: January, February.

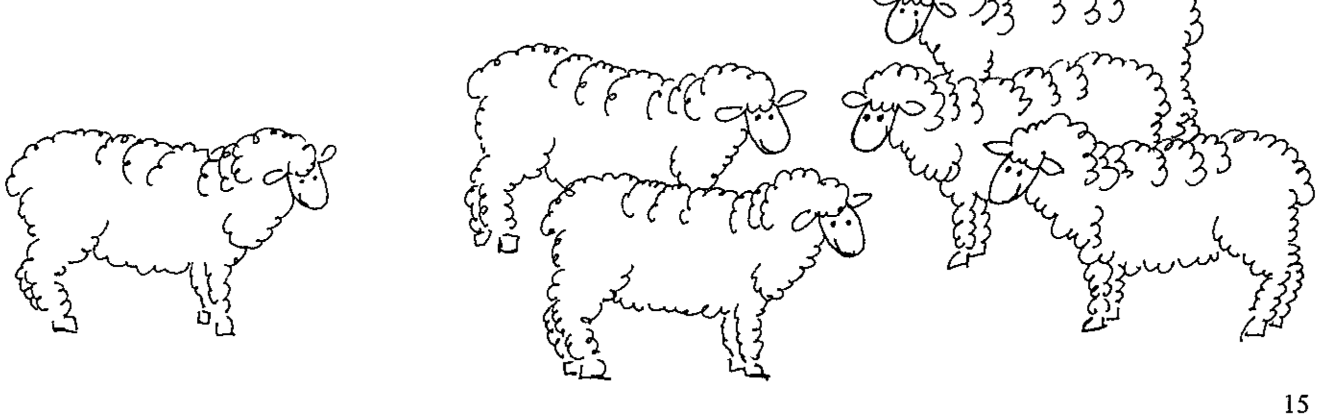
Normally, pasture residues and stubbles last well into early autumn. Sometimes, hay or grain supplement is required for some stock when they must be left in a stubble to dispose of bulky straw residues or if body condition is declining. Body condition scoring can be learned quickly as a guide to sheep management.

early autumn: March, April.

During this period the last of the paddock feed is eaten. Increased hand-feeding may be necessary in less productive years. Weaners should be followed by pregnant ewes and dry adult sheep because stubbles deteriorate in feed value. Weaners and ewes in late pregnancy may need a supplement of grain.

late autumn: April, May.

Opening rains normally come in late April to May. Pastures then germinate. Supplementary feeding is even more necessary immediately after the opening rains because dry feed is unpalatable and of low feed value and the fresh green shoots contain over 90 per cent water and could cause sheep to scour. It is often sound practice to confine sheep to a small area and feed up to 0.4 kg of wheat or barley, 0.5 kg of oats or 0.7 kg of hay each day for two weeks after the opening rains, until greenfeed is 5 cm to 8 cm high and hardens up.



Tillage methods

The tillage system that has evolved in conjunction with, or as part of, the ley farming system is by overseas standards a shallow tillage system. In general, there are no advantages in deep ploughing in semi-arid areas, but there are considerable disadvantages in terms of costs, timing, deep placement of some weed seeds that remain dormant for long periods, and the resultant rough and uneven conditions of the seedbed.

Tillage implements used in South Australia are almost all equipped with a stump-jump mechanism to enable them to ride over stones, stumps and uneven areas. The original bridle mechanism on ploughs and scarifiers has been superseded by spring loading of individual tynes.

The majority of tillage equipment used in the cereal zone is haulage equipment and is fitted with hydraulics for depth control.

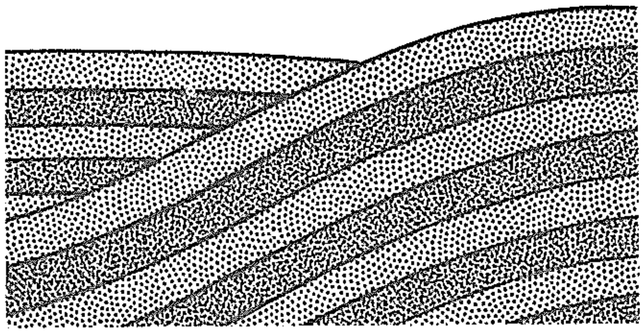
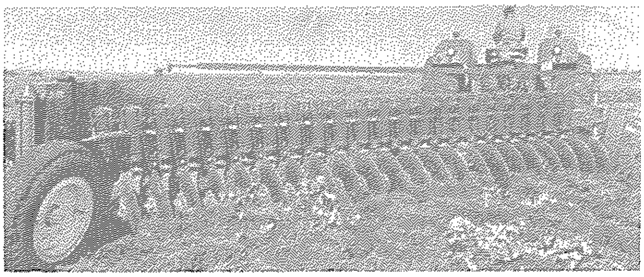


Figure 7: A typical programme of cultivation of pasture land in preparation for seeding of the cereal crop.

1. Initial breaking up of land

Usually carried out with a disc plough or scarifier. Disc ploughs are especially useful when significant amounts of herbage or trash are to be handled.

Scarifier type of implements are now widely used for initial breaking up of land.

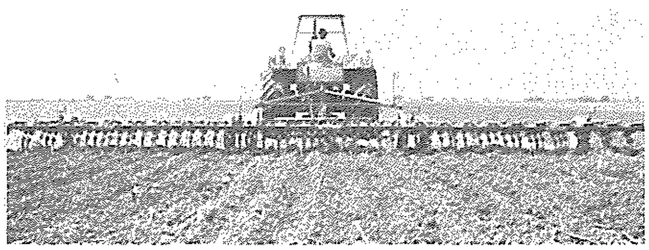


Initial breaking up of land with disc plough.
By courtesy of John Shearer.

Scarifier working grassland paddock.
By courtesy of Horwood Bagshaw.

2. Subsequent workings

Follow up cultivations are usually carried out with a scarifier and even a combine drill to achieve weed control and good seedbed tilth. In recent years, a wide range of wide-line cultivators or scarifiers has been produced that enable farmers to cultivate large areas in a short time.



Cultivating a wheat stubble in preparation for sowing barley.
By courtesy of John Shearer.

3. Harrowing

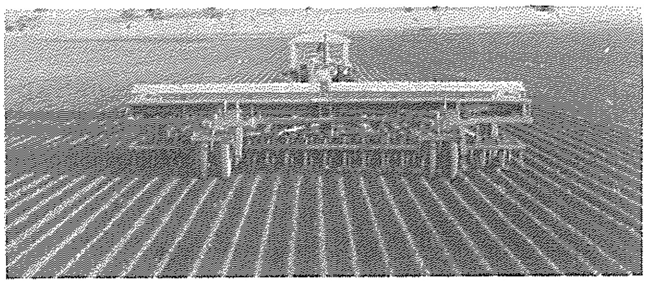
Heavy harrows are used to control young germinating weeds and to break down clods to a finer tilth before seeding.

Heavy harrows being used to break down clods.

4. Seeding implements

Seeding on prepared land is almost exclusively carried out with the combine (a combined drill and cultivator). Where there is a large amount of straw and trash in the seedbed, a disc drill can be used.

Most combine drills can be converted to disc drills by removing tyne floats and replacing them with disc attachments.



Sowing a cereal crop with a combine drill.
By courtesy of John Shearer.

Disc drill.

Seed production

The development of the ley farming system has been dependent on sufficient quantities of good quality annual legume seed being available. The early seed production methods were carried out mainly with sheep skin rollers and rotary brooms, and the pods were put through various types of thrashers to separate the seed.

More sophisticated harvesting machines have now been developed and today almost all seed is reaped using the Horwood Bagshaw suction-type machine.

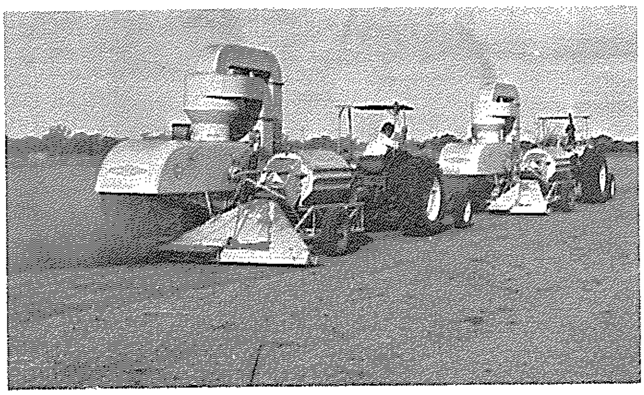
Important points in seed production

- High yields of seed can only be harvested from well-prepared, level paddocks.
- Before harvesting, the paddock should be rolled to give a firm, level surface that facilitates easier harvesting and better seed recovery. Rolling is best carried out when soils are moist after plants are well established.
- Paddocks should be well grazed until flowering begins.
- Top growth should be removed with a side delivery rake or harrows and medic pods loosened by dragging chain wire or similar equipment.
- An average well-managed medic stand in the cereal zone will yield 300 to 400 kg/ha of seed in a normal season. Experienced seed producers produce 50 to 100 per cent above this quantity. Subterranean clover stands in the wheat belt average about 20 per cent less in seed yields than the medics.
- In most cereal districts, the newer suction-type harvesters reap about 0.5 ha an hour.

The medics

Barrel medic

Hannaford barrel medic, which was formerly known as Commercial barrel medic, is well suited to the grey and rubbly limestone mallee soils. It matures relatively early and its seed reserves provide valuable feed in summer.



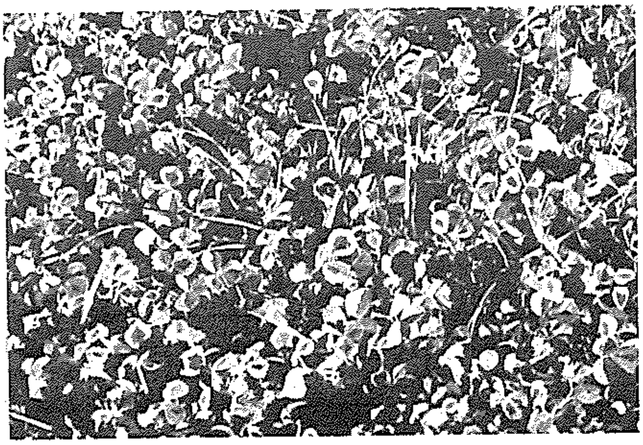
Harvesting medic seed.

The ability of Hannaford medic to produce a high percentage of hard seed has helped it to carry large quantities of seed through the cropping year to germinate in the next pasture year. The spirals of the seed pods have a clockwise formation.

Seed of Hannaford barrel medic was first harvested and sold commercially in 1939.

Jemalong is a more recent cultivar of barrel medic and has proved superior in production to Hannaford in many parts of the mallee wheat belts. It is well suited to most of the mallee soils and tolerates harsh conditions.

Jemalong matures a few days later than Hannaford and can be distinguished from it by the irregular purple blotch on the leaflets during its early growth. A further difference is the anti-clockwise direction of the pod spirals.



Jemalong medic showing irregular purple blotch on leaflets.

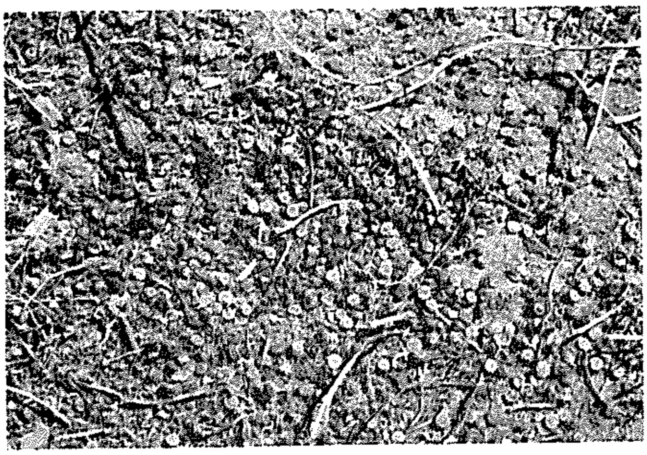
Borung is a more recent cultivar of the annual medics that has performed well on a range of mallee soils, particularly the clay and clay loam soils. It makes prolific growth during winter, flowering at about the same time as Hannaford and Jemalong. Seed and pod yields are generally high in moderate rainfall seasons.

The burrs are small, 6 mm to 7 mm wide and 4 mm to 6 mm long, with 2.0 to 3.5 anti-clockwise coils. They are about two-thirds the weight of Jemalong burrs.

Cyprus matures about two weeks earlier than Hannaford. It is best suited to the heavy mallee soils in the lower rainfall areas where it gives a more assured seed set and makes a better contribution to early winter feed than other cultivars. Pod spirals twist in a clockwise direction, similar to Hannaford.

Strand medic

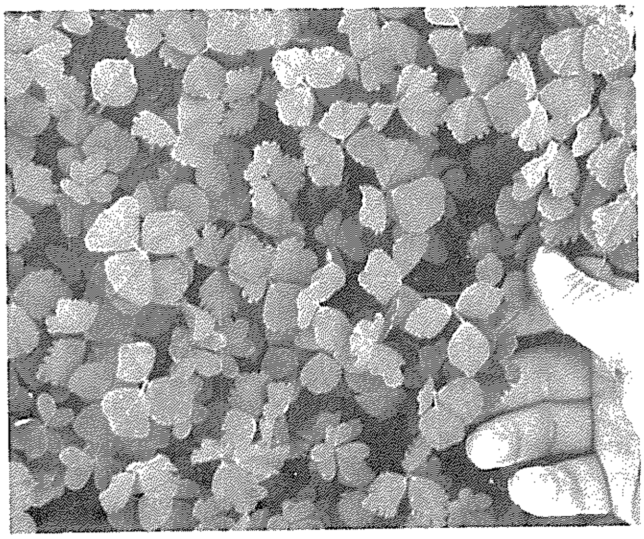
Harbinger is another of the more recent cultivars that have shown their superiority on sandy mallee soils in the lower rainfall areas. It matures up to two weeks earlier than Hannaford and produces a large bulk of feed early in the season. It is a prolific seeder and because of its early maturity is able to seed well in an adverse spring. Early growth appears similar to Hannaford, but the variety is more vigorous, has paler green early growth, brighter yellow flowers, smaller pods only half the size of barrel pods, and smaller seeds. Its pod spirals twist in an anti-clockwise direction.



Harbinger medic seed pods.

Gama medic

Paragosa is well suited to the heavily structured alkaline clay and clay loam soils and the heavier phases of the mallee soils. It gives extremely good winter and early spring production and sets seed a little earlier than Hannaford. The pods are spineless, papery, flat and disc-shaped with 2.5 to 4.0 anti-clockwise coils that rarely have more than two seeds. Paragosa has a different rhizobial strain requirement to other annual medics.



Paragosa gama medic.

The subterranean clovers

Geraldton has proved a valuable variety replacing Dwalganup. It is an early maturity variety that sets seeds prolifically under most conditions.

Geraldton has a low habit of growth but normally establishes as a high density stand because of the large seed reserves.

Clare has proved the most reliable cultivar in the mid-season areas and is well suited to higher rainfall cereal districts. It has outstanding early vigour and is a good competitor against weeds. It also produces a large bulk of growth in spring.

It is suited to a wider range of soil types than other commercial cultivars because it grows **on acid and alkaline soils,** and is particularly suited to the heavier, black, self-mulching soils.

Woogenellup is an early mid-season strain suited to the higher rainfall red-brown earth soils of the wheat belt. It is noted for good winter and early spring production, and is generally best suited to the acid soils.

Daliak is one of the many Western Australian cultivars that are finding a place in S.A. It has a similar habit to Geraldton but is not as prostrate or compact. It is early mid-season in maturity and maintains a relatively high level of hard seeds and persistence in suitable rainfall areas.

Because Daliak has a lower oestrogen level than Geraldton, it can replace Geraldton and other cultivars in regions where ewe infertility is a problem.

Dense stands of subterranean clover compete well with weeds.

Printed by D.J. Woolman, Government Printer, South Australia.