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NSW Agriculture

## Phalaris Pastures

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Phalaris (*Phalaris aquatica*) is the most persistent and productive temperate perennial pasture grass which can be sown in the Tablelands and Slopes regions of New South Wales; hence it is the basis for much of the pasture development programs in these regions.

Phalaris is a native of southern Europe, north west Africa and the Mediterranean region. It was first introduced into Australia from the United States in 1884 under the name *Phalaris commutata* by Mr R. Harding, later the curator at Toowoomba Botanic Gardens, where it became known as Toowoomba Canary Grass for some time.

Phalaris may also have arrived in a collection of 21 packets of grass seeds received in 1883 from Italy. Harding reported that the seeds were planted in the nursery and germinated well. However, frosts killed all plants except those of *Phalaris commutata*. Within two years it overran the whole plot in the nursery, the grass having grown from self sown seed. The grass had to be moved, and although the clumps were dumped in a corner on hard ground, they continued to grow despite dry conditions and frost.

In the United States, the standard common name for phalaris is Harding Grass in recognition of Mr Harding's efforts in evaluating and distributing phalaris.

The New South Wales Department of Agriculture (now NSW Agriculture), through the interest displayed in this grass by Mr R. H. Genny, Glen Innes Agricultural Research Station Manager, obtained seed early in 1905 from Toowoomba for trial. This seed was sown at Hawkesbury Agricultural College, Richmond, and at Glen Innes, Bathurst, Wollongbar (Lismore), Grafton, Cowra and Wagga Agricultural Research Stations. In September 1908, the Department distributed 6,000 roots of this grass to farmers.

Two New England graziers, Mr F. J. White, 'Saumarez', Armidale, and Mr G.M. Simpson, 'Stonehenge Station', Stonehenge, obtained seed from Toowoomba in about 1908, and after raising a large number of plants put them out into paddock areas. Most of the seed initially used in establishing phalaris pastures in this and other states originated from these sources—the Glen Innes Agricultural Research Station, and from a few New England graziers.

Australia was the first country to recognise and demonstrate the usefulness of phalaris as a permanent pasture species.

Phalaris was formerly recognised botanically as *P. commutata*, *P. bulbosa*, *P. stenoptera* and *P. tuberosa* but botanists have now accepted its naming as *Phalaris aquatica*.

## DISTRIBUTION OF PHALARIS

There are more than 1.6m hectares of pasture containing phalaris in NSW. A survey by District Agronomists in 1990 indicated that the potential area of phalaris based pastures in NSW was 3m hectares.

Phalaris is largely confined to the Tablelands, Slopes and some coastal districts of NSW.

Major plantings of phalaris exist in the New England and Central and Southern Tablelands districts where phalaris has been traditionally sown since the early 1900's. Following the development of Siroso and Sirolan in the mid 1970s, the area sown to phalaris increased significantly in the Tablelands districts as well as in the low to medium rainfall Northern, Central and Southern Slopes areas where phalaris was not traditionally sown.

In New South Wales, very little phalaris is sown beyond the 550–600 mm average annual rainfall isohyet.

At present Siroso is the predominant variety in most districts of the state. It accounts for more than half of the total phalaris pasture area. Since its release in 1974, it has been widely sown and successfully established in a range of environments throughout New South Wales.

The more recently released variety Holdfast is increasing in area and gradually replacing Siroso in some districts, especially in southern NSW.

Australian was the only variety of phalaris available in Australia for 60 years and hence accounts for about 320,000 hectares or 40 per cent of the phalaris pasture area.

Although Australian is sown over a significant area, its relative importance and sowing is declining in most districts. Australian is now mainly sown as a mixture with Siroso or Sirolan phalaris and is rarely sown on its own or as the main grass in the pasture mixture. Australian will be increasingly replaced by Uneta and newer semi-winter dormant varieties. Sirolan is sown in most districts of New South Wales but is the minor variety. However, it tends to be the dominant variety in the hotter and drier slopes districts towards the western edge of the phalaris belt or lower rainfall sections of districts. Sirolan continues to be sown at a relatively stable rate with a trend towards slight increase in usage.

## ADVANTAGES AND DISADVANTAGES OF PHALARIS

The **advantages** of phalaris are:

- most persistent and drought tolerant temperate perennial grass species commercially available in Australia;

- productive perennial species providing good quality grazing for all types of grazing livestock (cattle, sheep, horses and goats) for 8–12 months of the year, depending on the environment and management;
- competitive robust plant recognised as one of the best pasture species for controlling and excluding many serious weeds of pastures such as serrated tussock, thistles, St John's wort and Paterson's curse;
- tolerant to extended periods of heavy grazing;
- ease of establishment as a result of new cultivars with improved seedling vigour;
- excellent recovery after bushfires;
- good regrowth following attack by plague locusts and wingless grasshoppers;
- field resistance to underground grass grub attack, cockchafer, black beetle and Argentine stem weevil;
- good performance in poorly drained and waterlogged soils;
- excellent frost resistance and high productivity during the winter;
- very few diseases cause serious production losses on phalaris;
- excellent resistance to livestock trampling, particularly on wet, clay soils or under irrigation;
- responds quickly to autumn rainfall or irrigation. The **disadvantages** of phalaris are:
- susceptible to competition from annual grasses such as annual ryegrass, barley grass and vulpia during the establishment phase;
- requires good grazing management to maintain grass-legume balance. Phalaris can dominate pastures and exclude all legumes causing a decline in pasture quality and production;
- Requires attention to grazing management throughout the year, in particular during spring to enhance the plant's survival and vigour,
- some potential, although the incidence is very low, to induce phalaris poisoning;
- sensitive to soil acidity.

## SOIL REQUIREMENTS

Phalaris is adapted to a wide range of soils from shallow, moderately acidic, sedimentary soils to deep, self-mulching alkaline clays.

However, phalaris grows best on deep, heavy textured soils of high fertility, or soils having received regular applications of phosphorus or sulphur fertiliser, or both, to promote good clover growth which will meet the high nitrogen requirements of phalaris.

As rainfall decreases, soil type becomes more critical in determining the drought tolerance, persistence, plant vigour and the suitability of phalaris to an area.



W McDONALD

**Phalaris pastures can be used to replace unproductive pastures or major weed infestations.**

Phalaris is particularly suited to heavy black clay soils and deep self-mulching red volcanic loams in districts with good summer rainfall. However, in regions with dry summers, the deep cracking of self-mulching soils has killed phalaris probably because of root damage. It will grow and persist satisfactorily on lighter textured soils if there is a moisture retentive clay subsoil within 30 cm of the surface.

The deeper the soil profile the deeper the root system, hence the greater the drought tolerance. Phalaris can also be successfully grown in medium to lower rainfall areas if it is grown on deep soils of high moisture holding capacity. The shallower, sedimentary soils are satisfactory for phalaris in more favoured rainfall areas, such as the valleys and lower slopes in Tableland districts.

Most cultivars can withstand extended periods of waterlogged soil, however summer flooding has been observed to cause significant loss.

The currently popular phalaris cultivars (Sirosa and Sirolan) are moderately tolerant of acid soil problems (low soil pH combined with high levels of exchangeable soil manganese and aluminium).

However, phalaris is more sensitive to soil acidity than cocksfoot, ryegrass and tall fescue. Phalaris shows excellent tolerance to high soil manganese but is sensitive to high exchangeable soil aluminium levels. Sirosa and Sirolan seedlings have a slightly superior tolerance to high exchangeable aluminium when compared to cultivars Australian, Seedmaster and Uneta, which are quite sensitive. However, the greater spreading ability of Australian often allows it to maintain a denser stand on moderately acid soils than Sirosa and Sirolan.

**CLIMATIC REQUIREMENTS**

Phalaris originated in the Mediterranean region and hence is well adapted to survive the typical Mediterranean climates of mild, moist winters, and

hot, dry summers, typical of much of southern Australia.

**Rainfall**

Phalaris is best adapted to the medium to high rainfall areas of the northern, central and southern Tablelands and Slopes regions of New South Wales.

It will persist in winter-dominant rainfall areas where the average annual rainfall is 500 mm. Phalaris is not very productive in districts with less than 500 mm except in very favourable situations. It is important for phalaris that most of this rain falls in autumn to late spring to coincide with its main growth period. Except in cool environments, phalaris grows very little in summer.

In southern New South Wales rainfall should exceed 450–500 mm per annum; in northern New South Wales 600–700 mm is needed to ensure adequate rainfall during autumn-spring (see figure 1 – map). Suitable areas for phalaris may be more accurately defined as areas receiving more than 300 mm of effective rain between April and October (the main growing season). Phalaris can be grown at lower rainfalls in southern New South Wales due to higher incidence and greater reliability of cool season rainfall.

**Temperature**

Phalaris is very tolerant to variations in temperature, surviving both low winter temperatures and severe frosts on the Tablelands as well as high summer temperatures in the inland Slopes districts. Its maximum growth period is during autumn and spring, and it has moderate growth in mild winters. Phalaris grows best at temperatures between 15–25°C (typical of autumn and spring).

Winter growth is very slow in the colder Tablelands districts but growth can extend into the summer in these districts.

In much of New South Wales, except in some Tablelands districts, phalaris normally exhibits a moderate dormancy during summer. This dormancy generally lasts until temperatures decline in late February to early March when active regrowth follows autumn rains.

**PHALARIS VARIETIES**

There are a number of phalaris varieties in Australia. They can be grouped according to their winter growth rate and their dormancy during summer. Their classification is as follows :

**Semi winter dormant, moderate summer dormancy:** Australian, Uneta. Grasslands Maru, Australian II

**Winter active, low to moderate summer dormancy :** Sirosa, Sirolan, Holdfast, Landmaster

**Winter active, highly dormant in summer:** Atlas PG

**Figure 1. Phalaris climatic zones showing annual rainfall isohyets**

**In southern NSW, rainfall should exceed 500 mm per year; while in northern NSW, a slightly higher figure of 600–700 mm is needed to ensure adequate rainfall during autumn and spring for phalaris to be productive.**

## Australian

Australian was the first variety used in Australia. It was introduced to Australia in 1884 from the New York State Department of Agriculture. This seed is believed to come from Italy via the United States of America.

Australian is the second most important variety established throughout Australia today. However, its significance is declining due to the breeding and release of superior varieties such as Sirosa and Sirolan.

Australian has a prostrate, spreading growth habit and is most persistent under heavy grazing and drought in cool, high rainfall Tableland districts.

It is very tolerant to insect attack. It displays inferior persistence in drier marginal rainfall areas. The variety's limitations include poor seedling vigour, low winter production, greater risk of phalaris poisoning and poor seed retention.

## Uneta

Derived from the Australian cultivar, it was selected firstly by CSIRO, Canberra, and later by the University of New England (UNE) Armidale in New South Wales.

Uneta was derived from a single plant which stood out in a population of the Australian cultivar of phalaris grown from certified seed because it retained all seed firmly in the heads at full maturity. The other plants in the area by comparison had lost an average of 50 per cent of their seed 2 weeks after the first seed matured. This natural seed retaining mutant was crossed with other Australian phalaris to produce a non-shattering Australian phalaris type.

A disadvantage of Uneta is its poor seed yielding ability relative to other varieties, a feature which may jeopardise its future. CSIRO has selected an improved line from crosses between Uneta and Australian, to be released as Australian II. Uneta is identical to Australian in characteristics, but is slightly less vigorous and productive, due to the inbreeding caused by its single plant origin.

## Grasslands Maru

Grasslands Maru was selected and bred by the Grasslands Division of DSIR (now AgResearch) in Palmerston North, New Zealand, in 1979 from phalaris seed lines obtained from Argentina. This variety is currently licensed with Agricom (New Zealand).

**Table 1. A comparison of currently available phalaris cultivars (as at Dec. 1999)**

	<b>S I R O S A</b>	<b>S I R O L A N</b>	<b>H O L D F A S T</b>	<b>L A N D M A S T E R</b>	<b>A U S T R A L I A N</b>	<b>U N E T A</b>	<b>A T A S P G</b>	<b>M A R U</b>	<b>A U S T R A L I A N I I</b>
Seedling vigour .	***	***	**	**	*	*	***	*	*
Winter production	***	***	**	**	*	*	*	*	*
Total production	***	***	***	***	**	**	**	**	**
Growth habit	SE	E	SE	SE	P	P	E	P	P
Lateral spreading	*	*	*	*	***	***	*	**	***
Acid soil tolerance	**	**	***	***	*	*	*	*	*
Persistence under drought, floods and optimal rains	***	***	***	***	**	**	**	**	**
Grazing tolerance at heading	*	*	*	*	***	***	*	**	***
Suitability to Tablelands	***	**	***	***	***	***	*	**	***
Suitability to Slopes	**	***	**	**	*	*	***	*	*
Potential for phalaris poisoning: staggers form	*	*	*	*	***	***	*	*	***
sudden death form	***	***	**	***	***	***	***	***	***
Summer dormancy	**	**	**	**	**	**	***	**	**
Seed retention	*	*	***	***	*	***	***	*	***
Tolerance to waterlogging	**	**	**	**	***	***	**	**	***
PBR Protection	No	No	Yes	Yes	No	No	Yes	No	Yes
Approved variety	Yes	Yes	Yes	No	Yes	Yes	No	Yes	No
<b>Comparative performance :</b>	<b>Growth habit</b>								
*** <b>High</b>	SE		semi erect						
** <b>Medium</b>	E		Erect						
* <b>Low</b>	P		Prostrate						

Observations on growth habit in NSW indicate that it is intermediate between Australian and Siroso in seedling vigour and winter yield. However, it has a lower tryptamine alkaloid concentration than Australian. In New South Wales it has not displayed any outstanding qualities over and above currently available lines, however limited testing indicates improved tolerance to salinity than other varieties.

In general, its agronomic performance is inferior to Siroso and Sirolan, similar to Australian and Uneta but superior to Seedmaster.

### **Siroso**

Siroso was also bred by CSIRO Canberra and released in 1974. Siroso is by far the most widely sown variety in Australia although it is now being replaced by Holdfast. Siroso was developed from a complex breeding and selection program using a wide range of material from the Mediterranean and selected lines of the variety Australian. Siroso is variable in growth habit—on average it is more erect than Australian but more prostrate than Sirolan.

It displays excellent seedling vigour, high winter production, moderately low tryptamine alkaloid levels and good seed production and retention. Siroso adapts well in Slopes and Tablelands districts. It tends to flower slightly later than Sirolan and is better suited to cooler, higher rainfall areas. Siroso is not quite as drought tolerant as Sirolan but is superior to Australian and is approved for the main phalaris zone throughout the state.

### **Sirolan**

Sirolan is a low alkaloid variety released in 1978 to replace Sirocco. It was bred by CSIRO Canberra from selections and crosses of Sirocco, Australian and lines introduced from the Mediterranean region. It has high seedling vigour, good survival over summer, high winter production and low tryptamine alkaloid levels.

Sirolan is the second most widely sown variety in Australia after Siroso. It was developed for the drier marginal phalaris areas in eastern and southern Australia.

It is the most persistent variety in marginal rainfall areas such as the northern, central and southern Slopes regions of New South Wales, and has also performed well in better rainfall Tablelands districts. Sirolan is less summer dormant than Sirocco and Atlas PG, more summer dormant than Australian and still retains excellent drought tolerance.

### **Holdfast**

Holdfast was selected and bred by CSIRO and released in 1991. It was derived from selected

plants of Australian which displayed excellent seed retention. It was then back-crossed with Siroso and Sirolan material followed by out-crossings with selected lines from the Mediterranean.

It has similar agronomic characteristics to Sirolan and Siroso but has superior seed retention when fully mature. Holdfast can be sown in the main and drier phalaris growing districts. Holdfast is a suitable replacement for Siroso.

### **Landmaster**

Landmaster was bred by CSIRO and released in 1996 for use on skeletal, relatively infertile, mildly acid soils. The cultivar is primarily based on Holdfast related lines but also a summer dormant line and other lines of diverse backgrounds were involved.

Landmaster is very similar to Siroso and Holdfast in appearance, being a winter-active, erect and sparsely tillered cultivar. It retains seed in the head similarly to Holdfast.

On lower fertility soils to which Landmaster is suited, it produces more forage than either Holdfast or Siroso.

It is protected under Plant Breeders Rights.

### **Atlas PG**

Atlas PG was bred by CSIRO and is based on Moroccan material including Sirocco and El Golea. It is adapted to dry summer growing conditions, and should suit areas to the west of traditional phalaris areas in NSW.

The variety is similar to Sirocco in being winter active, and having erect and sparse tillers, but it was selected for greater seed retention to overcome the low seed yields of Sirocco. It flowers later than Sirocco, and its regeneration buds are a little less summer dormant, but still much more dormant than the buds of other varieties available. As a result, this cultivar is best suited to summer drought areas where dry conditions may be interrupted by a few rainfall events with cool conditions.

Atlas PG is protected by Plant Breeders Rights.

### **Australian II**

Bred by CSIRO, and based on Australian and Uneta varieties being very similar to Australian but with much increased seed retention. The proportion of flowers producing seed in Australian II is greater than in Uneta. Seed production potential should be superior to that of Uneta.

Australian II flowers a little later than Australian. The seedlings are larger than Uneta and similar in size to Australian.

As seed becomes available, Australian II is expected to overcome the shortage of seed of prostrate varieties, of particular importance where

a spreading plant is required in tableland pastures to assist with weed control and at the same time provide reliable production.

### GROWTH PATTERN AND YIELD

Phalaris is a more productive, stable and reliable species than other temperate grasses such as cocksfoot, fescue and perennial ryegrass as it has superior long term persistence, deep root development and drought tolerance.

Its most vigorous growth period is in autumn and spring. It is very quick to respond to early autumn rainfall.

In the Slopes area of New South Wales, which experience milder winters than Tablelands districts, phalaris can also make excellent growth in winter. Following its vigorous spring growth associated with the flowering-seed set stage, phalaris tends to exhibit a strong summer dormancy. During summer, in cool, high rainfall Tablelands districts, phalaris can still make reasonable pasture growth.

The dormancy of phalaris can be broken by summer storms followed by periods of cool-mild temperatures. The degree of summer dormancy varies between varieties but can be influenced by management and climate.

Current phalaris varieties have a high potential growth rate if they are well managed and have good soil fertility and moisture.

Total and seasonal growth of phalaris is largely influenced by rainfall and temperature. Growth patterns between Tablelands and Slopes areas vary,

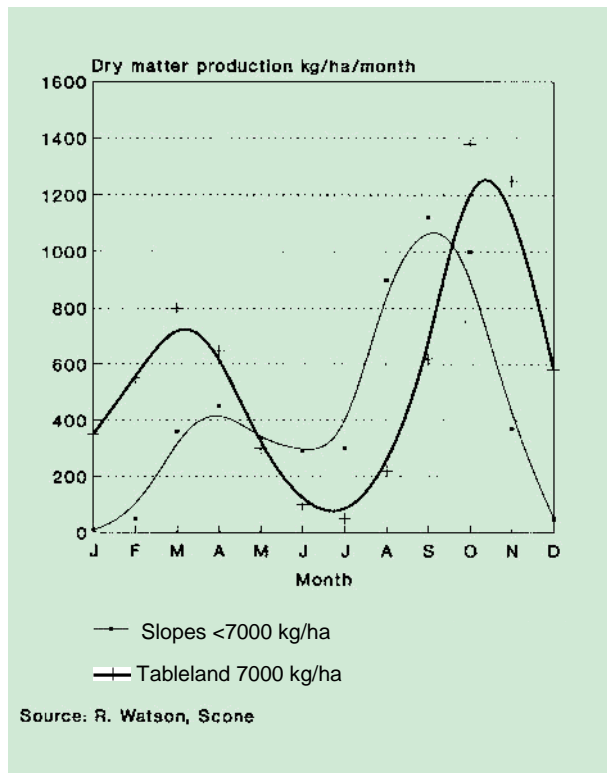


Figure 2. Growth pattern of phalaris dry matter production.

as do growth rates from season to season and year to year.

Established dryland phalaris pasture in Tablelands districts produce on average 7,000 kg/ha of dry matter (DM) a year of which 20 per cent is produced during summer, 30 per cent in autumn, 5 per cent in winter and 45 per cent in spring.

In the medium rainfall Slopes districts, phalaris pastures produce 4,000–6,000 kg/ha of DM a year and up to 8,000–10,000 kg/ha when well managed under good growing conditions. Due to the often hotter and drier conditions during the summer to early autumn, and milder temperatures in winter, phalaris tends to produce only 5 per cent of its annual growth in summer, 15 per cent in autumn, 30 per cent in winter and 50 per cent in spring.

Irrigated phalaris pastures produce 10,000–13,000 kg/ha of DM a year.

The winter active varieties Siroso and Sirolan produce 30–50 per cent more winter feed than Australian, Uneta or Seedmaster. In some locations

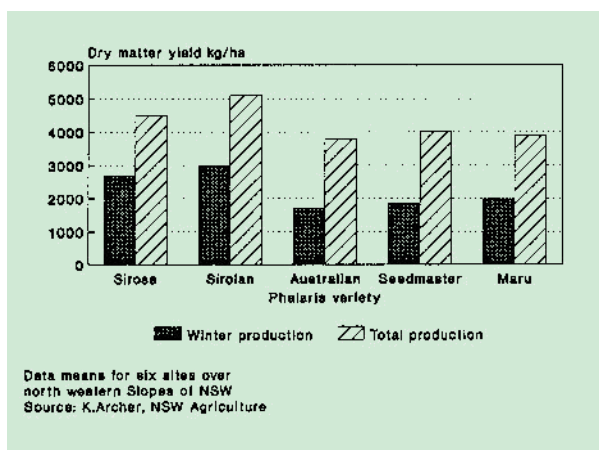


Figure 3. Phalaris comparison of average dry matter production (1985–86) in dryland conditions.

Siroso and Sirolan have produced twice the autumn-winter feed of Australian, particularly in the establishment year.

Siroso and Sirolan have maintained a significant annual yield advantage of 20–30 per cent more than other varieties when evaluated in several environments over a number of years. Holdfast has performed similarly to Siroso in southern districts, however experience in northern areas is limited.

### PERSISTENCE OF PHALARIS COMPARED TO OTHER TEMPERATE PERENNIAL GRASSES

Phalaris has a long and well-deserved reputation for its excellent persistence and drought tolerance—far superior to all other temperate pasture grasses such as cocksfoot, fescue and perennial ryegrass.



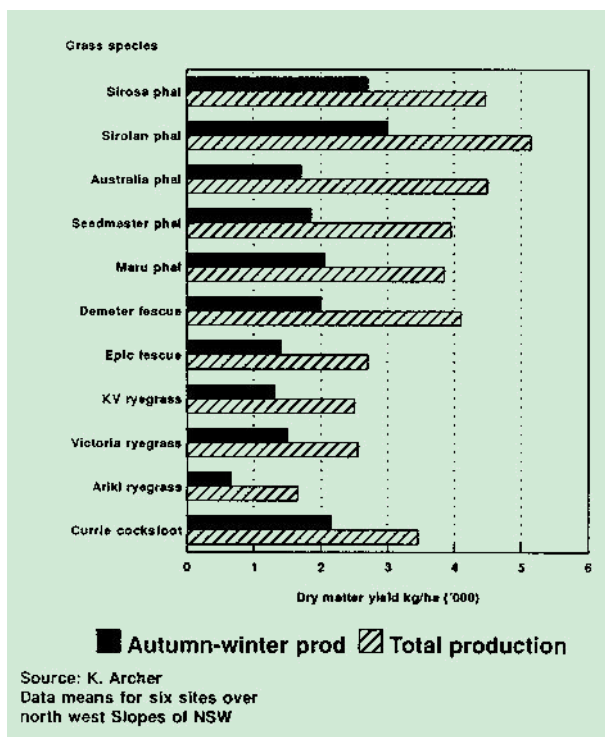


Figure 4. Perennial grass comparison of average dry matter production (1985–86) in dryland conditions.

Research has clearly shown the superior long-term persistence of the phalaris cultivars over all other temperate perennial grasses when grown in medium to high fertility, non acid soil types. The grasses were ranked in order of greatest to lowest persistence as follows: phalaris—cocksfoot—fescue—perennial ryegrass.

The comparative persistence of individual varieties is influenced by environment (that is, soil type, fertility, acidity, rainfall, and climate) and grazing management (see Table 1).

In favourable environments or where cattle grazing predominates, Australian, Sirosa and Sirolan have similar levels of persistence. However, under continuous, heavy sheep grazing, Australian has superior persistence to Sirosa, Sirolan and Holdfast. (For more information see 'Grazing management'.) In this situation Australian phalaris should be included in the pasture mixture with one of the other phalaris varieties or selected temperate grasses.

As yet, commercial experience with Landmaster and Atlas PG and Australian II is limited.

The hotter and drier the district, the greater and faster the difference in levels of persistence will be expressed between the different species of temperate grasses as well as the varieties of phalaris.

Conversely, the cooler and wetter the environment, the smaller the differences in persistence levels; thus the pasture persists longer at productive population densities. Extended and annual seasonal droughts are a feature of our

environment. Phalaris has the best 'design features' to survive the stresses of our environment. The drought resistance of phalaris comes from the combination of its unique plant features. They include;

- moderate seedling vigour to improve its reliability of establishment;
- early flowering habit which ensures crown bud and seed development under more reliable moisture conditions before onset of summer;
- strong summer dormancy of the underground crown buds which reduces the risk of the plant commencing regrowth during the hot, dry summer months as a result of summer storms;
- large, bulbous underground stem bases for carbohydrate storage to help maintain growth during periods of stress;
- extensive and deep fibrous root system which can exploit soil moisture to a depth of two metres thus supplying moisture to the plant during periods of low rainfall.

## SOWING RATES

Sow 2–4 kg of viable seed/ha on a prepared seedbed in a pasture mixture with appropriate legumes. With a seed count of 600,000 seeds/kg at 80 per cent germination, 2 kg/ha would result in approximately 96 viable seeds/m<sup>2</sup>. Under conventional seedbed conditions, often only 10–50 per cent of the seed establishes. Therefore, if only 30 per cent of the viable seed actually establishes, it would result in about 30 plants/m<sup>2</sup>. This density of seedlings would result in a dense phalaris pasture. A final establishment of 10–20 plants/m<sup>2</sup> is adequate.

When establishing phalaris by direct drilling or aerial seeding, often only 5–15 per cent of the seed sown establishes, therefore it is necessary to sow 3–4 kg/ha.

In each phalaris variety, there are both moderately tolerant and extremely aluminium sensitive plant types. In acid soils, higher seeding rates are recommended to allow for death of sensitive plants in the seed population. This ensures sufficient numbers of acid soil tolerant types are present to establish the pasture. Landmaster has a higher percentage of these types. Including cocksfoot or fescue in the pasture mix is also advisable on acid soils due to their greater tolerance to acid soil problems.

Use the higher seeding rates when sowing phalaris under irrigation, or where it is desirable to have high plant numbers early in the life of the pasture for weed control or for soil revegetation and conservation.

Check the germination of seed before sowing. Adjust the seeding rate to ensure the recommended rate of viable seed/ha is sown. For example, to sow

2 kg/ha of viable seed and the sample has a recent test of 70 per cent germination, then the amount of seed needed is :

$$\text{Seed weight required} = \frac{\text{Desired seed rate} \times 100}{\text{germination \%}}$$

$$\text{i.e.} \quad \frac{2 \text{ kg/ha} \times 100}{70} = 2.9 \text{ kg/ha}$$

Sowing too much seed can be as bad as not sowing enough. Sowing the recommended seeding rates using the recommended sowing techniques and management practices will result in more than adequate phalaris density.

## **SOWING TIME**

The best time to sow phalaris varies from district to district and sometimes year to year.

However, in most districts in most years, phalaris is best sown in autumn to early winter (April-June). In some high altitudes in high rainfall Tablelands districts, spring sowings (August-September) give more reliable establishment. Contact your nearest NSW Agriculture District/ Extension Agronomist for specific advice.

Phalaris germination and seedling growth is greatest when average daily temperatures are 15–20°C.

Late sowing of phalaris when average daily temperatures are less than 10°C significantly retards germination and seedling development.

Germination of phalaris seed can extend over several weeks. This staggered germination pattern can often be associated with seed maturity at harvest and inherent seed dormancy factors.

## **SOWING MIXTURES OF PHALARIS VARIETIES**

If strong weed control is needed or where pastures will be heavily stocked for long periods, particularly in spring, sow equal amounts of Australian or Uneta with Siroso or Sirolan to enhance the long term density of the pasture.

Australian and Uneta phalaris have a more prostrate growth habit than other varieties which gives better weed control. They are also less likely to be damaged by hard grazing than the more upright Siroso and Sirolan.

Compared to Australian, Siroso and Sirolan have a number of superior agronomic features which make them preferred varieties. Refer to Table I when considering variety selection. Consider all aspects of each variety before selecting the variety.

## **PHALARIS SEED**

There are about 600,000 phalaris seeds/kg, although seed numbers can vary between 500,000 to 700,000 seeds/kg.

Commercial certified phalaris seed must have a germination greater than 60 per cent. However,

most samples have 70–80 per cent. Low germination seed has either been harvested in an immature condition or is several years old.

Seed colour is a reliable guide to seed quality and germination ability.

Ripe, high germination seed is buff brown to brown in colour. Deep olive coloured seed also indicates ripe seed but there is a higher percentage of dormant seed in this colour group. However, germination of dormant seed generally improves with storage (called 'after ripening').

Immature seeds are straw and light green in colour. These seeds were not ripe when harvested and hence have not developed to the viable seed stage. These seeds are light weight, small and have a low germination. They will not 'after ripen'.

'Streaky' or 'flecked' seeds will not germinate. The streaking is possibly the result of seed sweating due to high moisture and inadequate ventilation of newly harvested seed.

The colour of the seed hulls is related to the colour and size of the seed. Ripe, mature seed fills the hulls and are dark brown; the greener the hulls, the lighter the colour and the thinner and smaller the seeds. Their germination percentage and vigour are also lower.

Mechanical damage to the seed is obvious and can be seen by eye in the sample. The germination of damaged seed is also significantly reduced as the seed embryo is often split, bruised or damaged.

Good seed is comparatively long-lived when stored under good conditions.

Air temperature of the storage area is important. If air temperatures are high then the humidity in the storage area must be kept low or the percentage of viable seed will fall. If temperatures are low, humidity is not important. Protect seed from dampness and insect attack.

Do not store newly harvested seed with a high moisture content in airtight, sealed containers or plastic bags as this encourages fungal growth on the seed and causes overheating and reduced seed viability. Under good cool conditions, seed has remained viable for up to eight years.

Germination testing is advisable, however, after storage for more than three years. Seed with a high germination level has a better storage life. Seed germination and purity tests are available from some private analytical laboratories.

## **PHALARIS ESTABLISHMENT**

Phalaris can be successfully established by conventional, direct-drilling or aerial seeding pasture establishment techniques.

### **Conventional**

This technique involves sowing the pasture into a cultivated seed bed. The seedbed should be well-

prepared, with a level fine surface tilth. Phalaris seed is best sown just under the soil surface to a depth of 5–10 mm. Do not sow seed deeper than 20 mm. Many establishment failures are caused by producers not paying enough attention to seed placement and seeding depth during sowing.



P CREGAN

**Phalaris must be sown shallow. The use of a levelling bar and bandseeder have proved very successful when sowing into prepared seedbeds. Rollers are useful on non-crusting soils to encourage quick, uniform establishment.**

Specially designed bandseeders and modified small seed boxes on combines have greatly improved the reliability of pasture establishment on prepared seedbeds. Bandseeders are recommended for sowing most pasture species on prepared seedbeds.

When sowing a new pasture, the best method is to band or drill the phosphorus based fertiliser into the seedbed at sowing. Do not exceed 15 kg nitrogen/ha in the drill row (at 18 cm spacings). Another option is to broadcast the fertiliser before sowing. Banding or drilling fertiliser with seed is preferred.

The use of rubber-tyred rollers and precision press wheels have significantly improved (2–10 fold increase) establishment of phalaris on cultivated seedbeds. Rolling, or using press wheels, is recommended on soils which do not crust or seal.

If you want reliable and uniform establishment as well as productive phalaris pastures do not establish phalaris under a cover crop. Cover crops such as oats, wheat and barley compete too strongly with phalaris seedlings. Shading and competition for moisture drastically reduces the density, vigour and survival of phalaris seedlings.

It also reduces the density and productivity of the phalaris pasture in following years: phalaris production the year after establishment can be dramatically affected by a cover crop in the establishment year. During the following autumn to winter, dry matter production of phalaris sown

under a cover crop is 10–60 per cent of a phalaris pasture sown without a cover crop.

It can take three years before a phalaris pasture sown under a cover crop becomes as productive as one established without a cover crop. If a cover crop was used, light grazing and careful grazing management is needed in these years to ensure its full development hence grazing production will be reduced in this period.

Sirosa and Sirolan have superior seedling vigour to Australian; however, they are still severely affected by cover crops. This was clearly demonstrated in a trial at Merriwa during 1988 when Sirolan phalaris was sown alone at 2 kg/ha, and with wheat at 15 kg/ha and 30 kg/ha.

Plant establishment, plant size, root development and dry matter production of the phalaris were severely reduced by the cover crops even at 15 kg/ha, despite a very favourable season for establishment.

#### Pasture establishment trial at Merriwa in 1988

Treatment	Phalaris yield kg/ha	Wheat yield t/ha
Phalaris only @ 2 kg/ha	5,100	–
Phalaris + wheat @ 15kg/ha	701	1.9
Phalaris + wheat @ 30 kg/ha	200	2.2

(Also see Figure 5.)

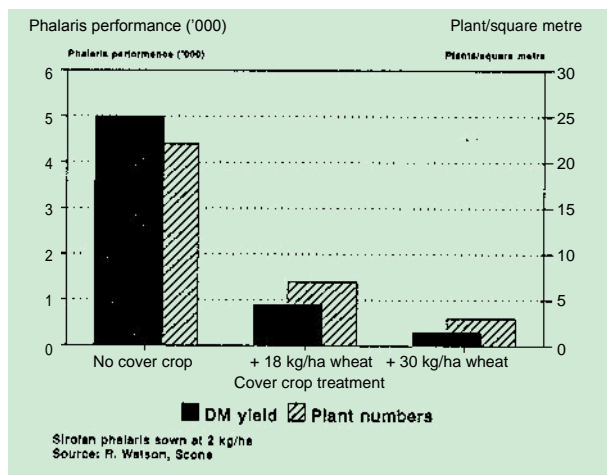
Undersowing in more favourable areas such as the tablelands has been more successful than in drier areas. This has usually been under crops as opposed to forages and where crop sowing rates have been reduced substantially.

If you sow phalaris under a cover crop, minimise the impact of the cover crop on the pasture and the risk of pasture failure by,

- using barley in preference to wheat—do not use oats
- if using wheat, use short season, early maturing varieties
- use only low cereal sowing rates (maximum of 15 kg/ha)
- sow crop on alternate or wide rows
- increase pasture sowing rates by 25–50 per cent
- only undersow pastures in paddocks with low weed pressure.

In some cool, high altitude, high rainfall Tablelands districts, phalaris pastures are successfully established under brassica forage crops (fodder rape) sown at low seeding rates (1kg/ha) during spring. Under this system, grazing management is critical to ensure pasture establishment. Another major concern when undersowing pastures is the intended herbicide use with the cover crop. Many herbicides used in cereals kill or damage the undersown pastures. Before undersowing a pasture, consider the

potential weed problems and herbicides likely to be used. An undersown pasture severely restricts the herbicide options available.



**Figure 5. Do not sow cover crops when establishing phalaris in most districts.**

Carefully plan your pasture program. You are planting a phalaris pasture for long-term grazing (10 years plus). Don't jeopardise its potential by taking short cuts. Do it once and do it right. For further information, read Agfact P2.2.3, *Pasture establishment*.

### Direct drilling

Thousands of hectares of phalaris based pasture have been successfully established using this technique.

Direct drilling needs particular attention to detail; it also requires additional management procedures compared to the conventional seedbed technique.

The system depends heavily on controlling competition to the seedling using grazing, herbicides, timing of operations, correct selection and setting of direct drilling machinery, and post sowing management. For more information read NSW Agriculture's *Prime Pastures Establishment Guide*.

### Aerial seeding

Phalaris based pastures have been successfully established using aerial techniques in many districts of New South Wales, since 1962.

Aerial seeding has continued to increase since Sirosa and Sirolan were released (in 1978) as they have better seedling vigour.

Herbicide is sprayed to control competition from weeds and existing pasture, followed by sowing of pasture seed and fertiliser. These operations are carried out by aircraft such as agricultural planes or helicopters. The technique is often referred to as the 'aerial-spray-sow' technique.



W. McDONALD

**Direct drilling of phalaris is a successful establishment technique. The paddock must be sprayed with herbicide before sowing to completely control all competition.**

**The application of herbicide is essential before establishing phalaris based pastures by either direct drill or aerial seeding.**

R. WATSON



W. McDONALD

**Thistles and barley grass can be replaced by phalaris and clover to form a highly productive drought tolerant, stable pasture.**



W. McDONALD

**A pasture of phalaris and companion legumes established in rocky terrain. Direct drilling and aerial seeding have a role in sowing such areas.**

To ensure the success of pasture establishment by this technique, it is important to consider:

- management of the paddock before and after sowing
- timing of herbicide and seeding
- accuracy of aerial operations.

Producers should be aware of the requirements of the Native Vegetation Conservation Act (1997) before replacing or modifying native vegetation. Consult the Department of Land & Water Conservation for details.

For further information, read Agfact P7.6.1, *St Johns Wort control*, Agfact P7.6.30, *Serrated tussock control*, Agfact P7.6.38, *Poa tussock control*.

## FERTILISER REQUIREMENTS

A productive phalaris pasture has very high requirements for nitrogen (N), phosphorus (P), potassium (K) and sulphur (S).

A typical dryland phalaris pasture producing 6,000 kg of DM/ha per year requires:

- 210 kg/ha of nitrogen
- 18 kg/ha of phosphorus
- 150 kg/ha of potassium
- 18 kg/ha of sulphur
- plus a balance of minor nutrients such as molybdenum, zinc and copper.

The total nutrient requirements of grazed phalaris pasture are significantly lower than this as much of the nutrients in the pasture material are continually recycled back onto the pasture by livestock; however, these figures highlight the high nutrient requirement of a phalaris pasture.

Cocksfoot and fescue tolerate low soil fertility better than phalaris or ryegrass. Phalaris and ryegrass respond to increased soil fertility more than cocksfoot or fescue.

The fertiliser requirements of a phalaris pasture can vary widely from paddock to paddock, property to property and district to district. Consult your nearest NSW Agriculture District or Extension Agronomist for specific fertiliser recommendations.

You can use soil tests, leaf analysis and fertiliser test strips to determine likely fertiliser requirements. Use laboratory analysis of phalaris leaf samples to identify nutritional disorders and assist in determining the pasture's fertiliser requirements.

When collecting leaf tissue samples of phalaris, pluck only the youngest fully expanded leaves on a large number of plants from the area you wish to have analysed. Do not contaminate samples with fertiliser or soil.

Contact your local NSW Agriculture District or Extension Agronomist for further details on the procedure for collecting plant tissue samples.

As a guide, the following nutrient levels should be present in phalaris leaf tissue samples:

	Growth stage at sampling	
	Vegetative nutrient %	Flowering nutrient %
Nitrogen (N)	4.0–5.0	2.0–3.5
Phosphorus (P)	0.35–0.40	0.25–0.40
Potassium (K)	2.0–2.5	1.5–3.5
Sulphur (S)	0.3–0.35	0.2–0.4
Calcium (Ca)	0.25–0.3	0.25–0.5
Magnesium (Mg)	0.16–0.20	0.20–0.35
Copper (Cu)	6–7 ppm	4–10 ppm
Zinc (Zn)	14–20 ppm	15–50 ppm
Manganese (Mn)	60–250 ppm	
Boron (B)	5–15 ppm	
Molybdenum (Mo)	0.3–0.4 ppm	
Cobalt	0.3–0.7 ppm	

A phalaris pasture growing in fertile conditions will produce more dry matter and have higher feed quality (protein, metabolisable energy) and mineral content than one growing on low fertility soils.

The quality of feed will significantly impact on your livestock's performance. In general, a regular topdressing program with single superphosphate or equivalent on low to medium phosphorus country or sulphur fortified superphosphate or equivalent on high phosphate, sulphur deficient country must be carried out to ensure that vigorous phalaris and legume components of the pasture are maintained.

The legumes in the pasture help meet the high nitrogen requirements of the phalaris promoting vigour and productivity. Unless a strong legume component is maintained, the phalaris will run-down in production and quality due to nitrogen deficiency.

## Phosphorus

Like all pastures, phalaris requires adequate levels of available soil phosphorus. Phosphorus is a key element that can be maintained by applying phosphorus based fertilisers such as single superphosphate.

Phalaris is best sown in areas naturally high in soil phosphate (basalts) or in areas having a good history of superphosphate application. If sowing phalaris on areas with low to moderate soil phosphorus, apply high rates of phosphorus and sulphur (250 kg/ha single superphosphate or equivalent) in the initial years to build up soil phosphate levels and encourage legume growth. Applications at lower rates (125 kg/ha) of superphosphate annually or every second year will maintain soil phosphorus levels thereafter. Apply molybdenum (Mo) treated fertiliser as required.

Where phalaris pastures are established by conventional or direct drilling techniques on low-medium phosphate areas that have low nitrogen, sow the pasture with a compound fertiliser containing nitrogen, phosphorus and sulphur instead of superphosphate which only provides phosphorus and sulphur.

These starter type fertilisers provide similar quantities of phosphorus and sulphur to single superphosphate as well as additional nitrogen for a similar cost per hectare. (15:13:0 (N:P:K) at 75 kg/ha provides equivalent amounts of phosphorus as single superphosphate at 100 kg/ha.) Do not exceed 15 kg/ha of nitrogen in the drilled row. The added nitrogen in the starter fertilisers promotes early growth of phalaris until legumes begin to effectively nodulate and maintain the nitrogen requirements of the pasture.

If direct drilling a pasture, select the fertiliser with the higher sulphur content. For example, use e.g. 15:13:0 (N:P:K) (10 per cent sulphur) in preference to MAP or DAP (3 per cent sulphur).

As direct drilling causes minimal soil disturbance and breakdown of organic matter, which stimulate the release of sulphur in the soil, temporary sulphur deficiencies can occur. Therefore apply a fertiliser with a high sulphur content when direct drilling than when sowing on a fully prepared seedbed.

## Sulphur

Phalaris is one of the few grass species that is highly sensitive to sulphur deficiency. Therefore, on deficient soils, apply fertilisers containing sulphur (single superphosphate) to ensure adequate sulphur is available.

A phalaris based pasture needs 6–10 kg of S/ha/year. This normally is adequately met with annual topdressing programs of, for example, 125–250 kg/ha of single superphosphate on low to

medium phosphate soil. On a high phosphate soil with an expected sulphur deficiency, apply sulphur fortified superphosphate at 70–100 kg/ha every 2–4 years.

A sulphur deficient phalaris pasture has a similar unthrifty appearance to a nitrogen deficient one, but a sulphur deficiency generally causes yellowing of the young, newly emerging leaves; nitrogen deficiency causes yellowing of the older leaves (the new leaves on the plant remain a healthier green colour).

It is possible for both nitrogen and sulphur deficiencies to occur in the same paddock, particularly in old established pastures with a limited fertiliser history and legume component.

## Nitrogen

Phalaris has a very high requirement for nitrogen. To meet its high nitrogen need, a phalaris pasture must contain a strong legume component or receive seasonal applications of nitrogen fertiliser. If the pasture does not contain a strong legume component, phalaris will display severe to mild nitrogen deficiencies very quickly. This seriously limits its production as well as its overall feed quality.



R. WATSON

**Phalaris is very responsive to high rates of nitrogen. High rates of nitrogen are needed to rectify severe nitrogen deficiencies.**

Regular applications of nitrogen fertiliser to dryland pasture is not widely practised or recommended as their application enhances the phalaris growth to the detriment of the all-important legume component, reducing legume density. The cost effectiveness of applying high rates of nitrogen to extensive areas of dryland pastures can be questionable.

However, strategic applications of moderate rates of nitrogen (75 kg N/ha or 100–150 kg urea/ha), in autumn and again in early spring to selected or special purpose fattening paddocks, can be profitable.

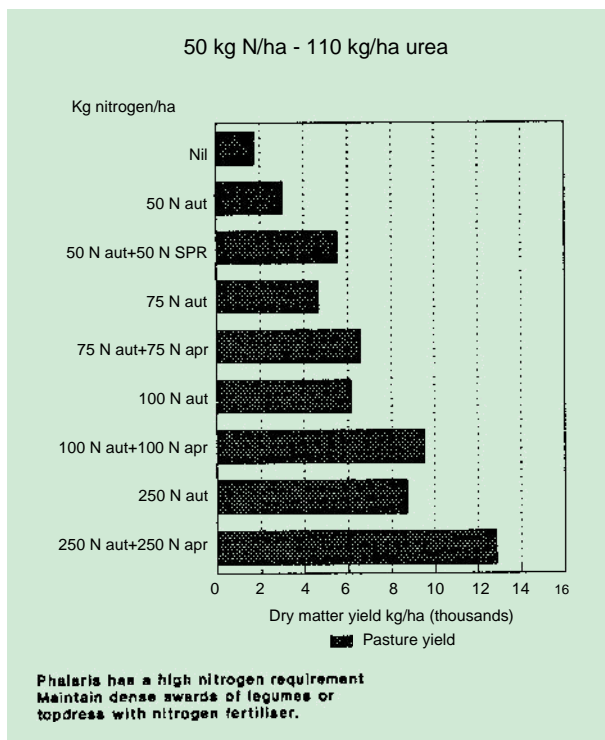
From a series of dryland fertiliser trials in the Upper Hunter, between 1986 and 1990, on nitrogen deficient phalaris pastures, profitable responses

were achieved with very high rates of nitrogen fertiliser. These trials showed a direct relationship such that for every 1 kg N/ha (2 kg urea/ha) the phalaris pasture generally produced an extra 20–50 kg dry matter/ha throughout the season.

These trials also demonstrated that split applications are better than single applications. For example, 50 kg N/ha in autumn plus 50 kg N/ha in early spring produced more feed during the year than one application of 100 kg N/ha in the autumn only.

Under favourable rainfall conditions, or supplementary irrigation, or more severe nitrogen deficiency, increased rates (75–100 kg N/ha or 150–200 kg urea/ha) in both autumn, winter and spring can be cost effective, assuming efficient utilisation of additional feed grown.

**Figure 6. Phalaris has a high nitrogen requirement.**



If phalaris based pastures are grown under full irrigation, additional nitrogen fertiliser applications are easily justified. Split applications of (75–100 kg N/ha or 150–200 kg urea/ha) in autumn, winter and spring are recommended.

When deciding whether to apply fertiliser nitrogen to an established dryland phalaris pasture, there are a number of factors to consider including whether the extra pasture growth will be fully utilised. Other factors include:

- subsoil moisture level at the time of the proposed application
- probability of follow-up rainfall and seasonal outlook
- the severity of nitrogen deficiency
- the density of phalaris.

A pasture containing a good legume component (30–40 percent of pasture) such as white clover, sub clover, lucerne or medic is capable of meeting the high nitrogen requirements of a phalaris pasture (see grazing management section).

### Potassium

Most soils in New South Wales have adequate levels of available potassium for phalaris pastures. However, some soils in the northern Tablelands and many soils in the Coastal and Sydney region are low in potassium.

Grasses such as phalaris are far more tolerant of potassium deficiency than legumes which have a high requirement for potassium. Soil and plant tissue testing can help to identify potassium deficient areas.

If additional potassium is required, apply muriate of potash fertiliser at 250 kg/ha/year. Split applications in early autumn and early spring are often desirable. Ensure additional feed produced is efficiently utilised.

### Acid soils

Phalaris is moderately sensitive to soil acidity (low pH (CaCl<sub>2</sub>), less than 4.5 with high levels of exchangeable aluminium). All phalaris varieties are sensitive to low levels of aluminium but are very tolerant to high soil manganese levels. The cultivar Landmaster, and Holdfast to a lesser degree, have some tolerance to these acid soil conditions.

To establish and maintain phalaris on acid soils, the application and incorporation of lime at 2.5 t/ha or the use of lime:superphosphate at 500 kg/ha drilled with seed is often needed to reduce or eliminate acid soil problems.

Accurate diagnosis and a soil analysis must be obtained to determine the need for lime. Request tests for soil pH, available phosphorus (Bray), cation exchange capacity (CEC), calcium (Ca), magnesium (Mg) potassium (K), sodium (Na) and aluminium (Al) to assist in the diagnosis of an acid soil problem.

In areas with acid soils, select or include more acid soil tolerant pasture species such as cocksfoot, ryegrass or fescue in preference to phalaris.

Sow selected acid soil tolerant legumes, such as white and sub clover, particularly in non-arable paddocks (aerial seeding and direct drilling) where lime cannot be applied and incorporated. (For more information on treatment of acid soils, see Agfact P1.4.1, *Liming problem acid soils*.)

### MANAGEMENT AFTER SOWING

The first 6–8 weeks is a critical period for the establishing pastures as it is very susceptible to insect attack, weed competition and grazing. Regular and close observations of the pasture (3 times a week) are required during this period.



W. McDONALD

**Get down on your hands and knees and make regular and close observations (two to three times a week during the early establishment phase of the pasture) for insect damage, weed problems and pasture growth.**

**Excellent establishment and early growth of a phalaris pasture.**

WATSON



You must make these regular inspections whether it be a conventionally sown, direct-drilled or aerially sown phalaris pasture. This ensures that you can make appropriate decisions or seek advice to ensure the successful establishment of the pasture.

After germination and emergence of the pasture, check (on your hands and knees) for insect damage, density of sown pasture species and weed competition.

### **Insects, mites and slugs**

Phalaris pastures are sometimes seriously damaged by blue oat mite, redlegged earth mite, aphids, seedharvesting ants, field crickets, white curl grubs (scarab grubs) and slugs and snails during the establishment stage. Established phalaris pastures are usually more resistant to insect attack, and rarely require the application of insecticides to protect them.

Only a few insects damage seedling phalaris. However, the few that do cause serious damage require close observation to determine their activity and damage levels and hence the need for treatment.

**Blue oat mite (BOM) and redlegged earth mite (RLEM)** are major insect pests of seedling phalaris. Both species cause serious damage to pasture seedlings soon after germination. Damage will be observed more on sown pasture legumes than on sown grasses, but serious damage can still occur on the seedling grasses.

BOM and RLEM feed by a rasping and sucking action on the leaves of the seedlings and young plants. Feeding is normally from late afternoon until early morning, but continues during the daytime in calm overcast weather. In sunny weather, look for mites under small clods and litter.

Grass leaves damaged by BOM and RLEM initially have greyish or silvery streaks similar to frost injury and later the tips turn brown and die. If feeding continues the leaves die back from the tips and turn brown. Very severely damaged plants die and severely damaged plants remain stunted and weak.

BOM and RLEM damaged legume plants have mottled and then whitened cotyledons and leaves. Sometimes the cotyledons are completely whitened, but the true leaves are either left untouched or only slightly damaged. Severe cotyledon damage can reduce nodulation, survival and growth of the plants. Check the paddock, fencelines and adjoining areas prior to sowing for mites. They can be controlled, if necessary.

More than one post sowing barrier or foliar spray may be needed to protect an establishing pasture if mite activity is severe.

Recent research has identified the existence of three species of BOM. The tolerance to insecticides may vary between these species.

Ensure insecticides are registered and follow label instructions, especially those concerning withholding periods and danger of drift to non target areas.

**Aphids** are often observed feeding on seedling phalaris plants but their presence and damage rarely warrants treatment as plants generally continue to grow. Aphids tend to be more damaging to the legumes in the pasture. On occasions very heavy populations of aphids have been observed on both seedling phalaris and sown legumes. They may occasionally warrant treatment but generally insecticide treatment is not justified over extensive dryland pastures.

### **Seed harvesting ants and field crickets.**

Considerable quantities of seed sown onto the surface of uncultivated ground may be removed by either seedharvesting ants or field crickets. Seed



harvesting ants can often be observed collecting surface sown seed. Seed treatment with a registered insecticide before aerial sowing effectively controls their activity. All seed to be aerially sown must only be treated with an insecticide registered for that purpose. Treatment of direct drilled seed may also be necessary if germination is likely to be delayed by dry weather, or if the seed is partially exposed.



M CAMPBELL

**Seed harvesting ants can collect all surface-sown seed in less than 24 hours. Treat all seed with insecticide before aerially sowing pasture seed.**

Damage by crickets can be particularly severe in autumns after dry summers, especially on soils which crack deeply in summer or on stony ground. Check these areas during December to February for signs of cricket build-up and, if necessary, control them by baiting or spraying with a registered insecticide.

**Slugs and snails.** Under wet autumn-winter conditions or where there is heavy pasture litter at sowing snails and slugs can be serious pests. They have caused problems in some direct-drilled and aerial sown pastures, due to retention of litter which harbours these pests.

They are rarely a problem in conventionally sown pastures except around the edges of paddocks as seedbed preparation tends to effectively destroy them and the trash they harbour under.

Placing wet hessian bags or pieces of masonite sheeting around the paddock 3–4 weeks before sowing will give you a good indication of their presence and populations. A decision on the potential need for treatment can be made after such assessment. Inquire through your District or Extension agronomist or adviser for the latest control measures.

The success of proprietary baits relies on physical contact or ingestion. They should only be used during periods of high surface activity by slugs and snails. Sometimes, spot baiting around trees with grass borders in paddocks may be all that is needed.

**White curl grubs (scarab grubs).** These larvae cut off roots and feed on underground stems of young plants, which wither and die or become stunted. Infestations are scattered within paddocks and damage may be only light thinning or the development of large bare patches. Pastures direct drilled, or sown into cultivated seedbeds on land that has been under pasture or grass weeds for several years may be seriously damaged.

For advice on the latest insecticide information, contact your local NSW Agriculture District Agronomist or adviser.

### **Pasture establishment**

If pasture establishment appears too disappointing, assess the population of sown pasture species to determine if reseeding is needed before the optimum sowing time passes.

As a guide, the achievement of the following indicate excellent establishment

- 10–30 phalaris seedlings/m<sup>2</sup> on conventional seedbed and direct drilled sowings; **OR**
- 20–40 pasture legumes/m<sup>2</sup> would be an excellent establishment.

Lower populations of phalaris can still make an excellent pasture if carefully managed. Be careful not to ‘write-off’ a paddock as a failure too early. Seek advice before deciding to resow an area.

### **Weed competition**

Heavy weed competition is often the major factor causing failure of many newly sown pastures. Early assessment and treatment is essential to ensure effective weed control and to avoid weed competition. To decide if you will need strategic grazing or a herbicide application or both, assess the density and species of weeds.

### **CONTROL ANNUAL GRASSES**

Many phalaris sowings fail as they cannot compete with dense infestations of annual grasses such as ryegrass, barley grass, vulpia, annual phalaris and soft brome during establishment. As phalaris does not thicken readily from seed drop, the initial establishment density is critical.

To avoid these failures, significantly reduce the annual grass density in the years leading up to pasture sowing. At present these grasses can not be selectively controlled in seedling pastures containing phalaris.

The seed set of annual grasses can be effectively reduced in pasture paddocks by fallowing in spring (‘spring fallow sprayout’), spray topping or pasture topping during the spring prior to pasture sowing. They can also be controlled by a herbicide program associated with cropping activities or commencing paddock preparation with a spring fallow using herbicides or cultivation prior to seed set. Paddock

preparation using spring fallow sprayout or pasture topping has proved a popular, effective and important part of many pasture improvement programs. Contact your local NSW Agriculture District Agronomist or adviser for further advice.

During spring (October 1985), a paddock heavily infested with annual ryegrass was spray topped to prevent its seed set. An untreated area was allowed to complete seeding. The spray topped area was prepared for pasture sowing the following autumn. A pasture containing phalaris, lucerne and clover was sown over the whole area in May 1986. The benefits of spray topping and also the detrimental effects of annual grass competition on the establishment and productivity of the phalaris pasture were very evident from soon after sowing to well after the pasture became established.

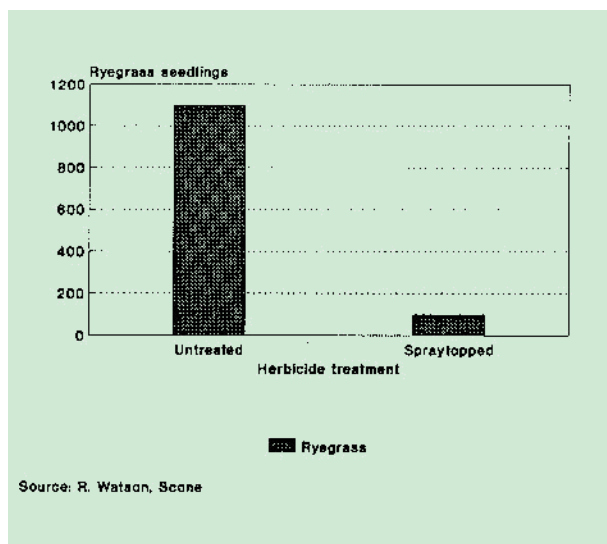
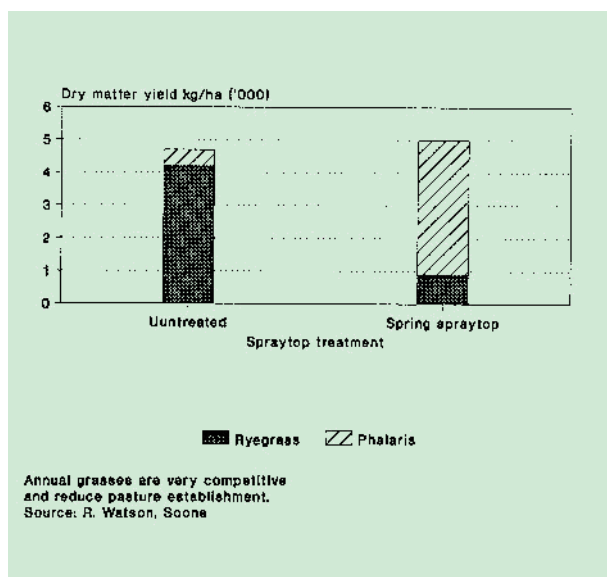


Figure 7. Spray topping in spring reduces annual grass problems during establishment.

Figure 8. Spray topping improves phalaris establishment. These results were taken 7 months after sowing.



Consider spray topping or pasture topping on all paddocks with annual grass problems, irrespective of whether they are to be sown by conventional, direct drilling or aerial seeding techniques.

During spring in the establishment year, seedling phalaris pastures heavily infested with annual grasses have also been successfully spray topped to reduce the competition from annual grasses the following year. This allows the sown pasture to improve in density and vigour. Seek advice on herbicide selection before treatment.

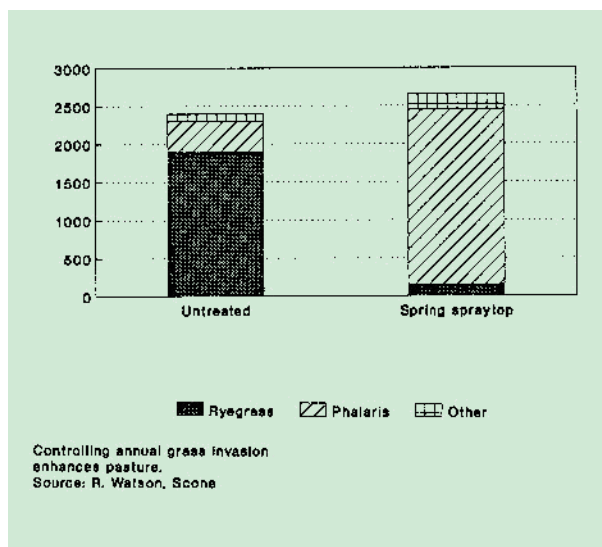
The re-invasion of annual grasses into an established phalaris pasture should also be preventable by proper grazing management (see 'Grazing management') and a sound fertiliser program. Follow-up spray topping or pasture topping can also help to reduce annual grass problems.

**Arable areas.** A cereal crop program using wheat, oats or barley for at least two years prior to sowing a permanent pasture is a good way of reducing barley grass and vulpia, and annual ryegrass.

Strict attention to weed control in the cereal crop is important in this strategy.

In cropping paddocks, broadleaf weeds and grasses can be effectively controlled by cultivation, strategic use of knockdown fallow sprays, the use of pre-emergent and post-emergent herbicides and a carefully planned crop rotation program. When using herbicides during the cropping phase in the year before pasture sowing, check the label for the residual life of the herbicide and the recommended plant back period for pasture species.

Figure 9. Spray topping improves phalaris pasture composition. These results were taken 18 months after spray topping.



Herbicides used regularly in cropping programs which may cause concern where pastures are sown the following year include the sulfonylurea group

(e.g. Glean<sup>®</sup>, Ally<sup>®</sup>, Logran<sup>®</sup>, Harmony M<sup>®</sup>) as well as atrazine, Tordon<sup>®</sup> herbicides, Lontrel<sup>®</sup>, and trifluralin. A number of these herbicides restrict the sowing of pasture species for 6–18 months following their application.

As new herbicides with some soil residual activity are being developed, you should consult the label or the chemical manufacturer for advice on recommended plant back periods for pasture prior to their use.

**Non-arable areas.** In non-arable areas where phalaris is to be established by direct drill or aerial seeding methods, the density of annual grass and broadleaf weeds also must be reduced by a planned weed control program in the one, two or three years before sowing to pasture.

A high degree of weed control in some non-arable situations is more difficult to achieve but every effort should be made to reduce major annual weed infestations in these areas. Major broadleaf weeds such as thistles, Paterson's curse, capeweed and turnip weed can be controlled by a number of means.

The use of 'crash' or strategic mob grazing of hill country paddocks with sheep can be effective. Some temporary electric subdivisional fencing may be required to achieve the desired effect on the weeds.

Running goats in paddocks for 2–3 years before pasture sowing can also greatly reduce major thistle and woody weed problems.

**The area on the left of the photo was spraytopped the previous spring. The area on the right was untreated. Note the heavy ryegrass infestation and poor phalaris growth in the untreated area.**

R WATSON



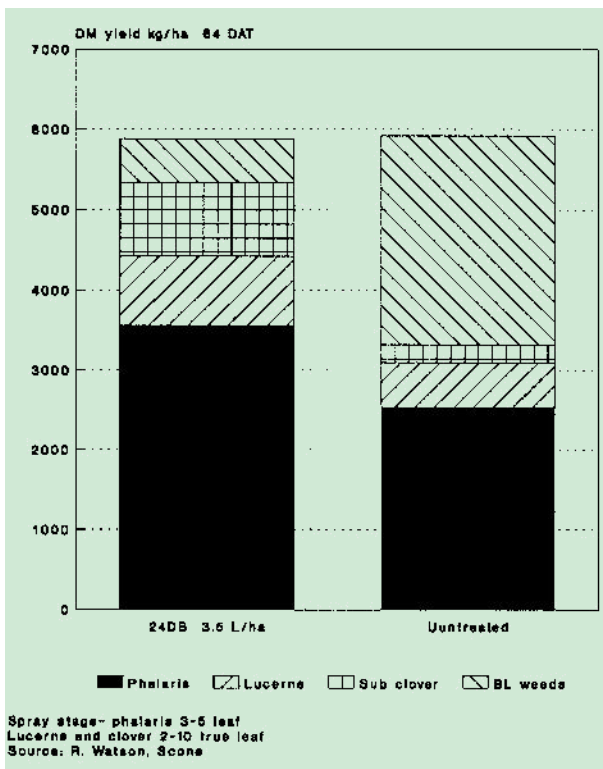


Figure 10. Early weed control is essential.

Use a well maintained and accurately calibrated boom spray tested with a reliable marking spray.

R. WATSON



### Weed control after sowing

Early weed control is essential. Newly sown pastures are best sprayed when seedling phalaris has 3–5 leaves (7–10 cm high), sown legumes have 2–8 trifoliate leaves and broadleaf weeds are small (2–6 true leaves or 10–20 cm in diameter for rosette forming broadleaf weeds such as thistle, turnip weed, capeweed and Paterson’s curse). These growth stages will mostly occur at a similar time. It is important that the weeds are treated at the correct stages.

Although a limited number of herbicides are available for selective weed control in seedling phalaris-legume pastures, the majority of broadleaf weed problems can be controlled with these products.

Unfortunately, pasture legumes such as lucerne, medic and subterranean clover which need to be sown with phalaris, are often more sensitive to herbicides. Therefore herbicide selection is largely governed by the herbicide tolerance of the sown legume and the resident weed problem.

Seek advice about selection and timing of herbicide for use on pastures.

Selection can depend on weed type, stage, density, pasture species present, climatic conditions and soil type.

For further information on herbicide tolerance of pasture species and herbicide recommendations, obtain a copy of the NSW Agriculture handbook, *Weed control in lucerne and pastures* which is updated biennially. It is available from your local NSW Agriculture District or Extension Agronomist.

### GRAZING MANAGEMENT

Grazing management needs to be considered along with a sound fertiliser, weed and pest control program to achieve good production and persistence

When planning grazing management strategies for your paddocks and farm as a whole, paddock size and stocking rate need to be considered, as well as any implications that phalaris poisoning may have ( See Phalaris poisoning).

### Establishment phase

Management should encourage the development of an adequate number of large robust seedlings by late spring. Large plants have deeper root systems, stronger tillers, and develop larger crowns enhancing the prospects for survival through summer and regeneration next autumn.

In most situations, avoid grazing until after flowering and seed set are complete. This allows young plants to fully develop and enter a strong period of dormancy over their first summer ensuring they survive until the following autumn.

Where sowing is early into fertile soils and good soil moisture is likely through spring and summer (e.g. under irrigation and high rainfall tableland conditions), light to moderate grazing pressure when pastures are about 20–25 cm tall can enhance tillering and plant development (graze to about 10–15 cm high). If annual weeds are a problem, a quick grazing once plants are well anchored, may reduce the potential damage of weeds.

Where possible, keep sheep off newly sown pastures for the first 6–12 months. Cattle are preferred if early grazing is appropriate. Ensure that plants are well anchored before grazing.

If late spring and summer soil moisture is unreliable, grazing should be limited to allow sufficient time for plants to flower and set seed.

Avoid cutting young pastures for hay or silage.

### Established pasture

Once the phalaris pasture is well established (the year following sowing), grazing management should aim to enhance persistence and production as well as maintain the legume content of the pasture (see sections on 'Grazing management and persistence' and 'Maintaining clover content').

Generally, the grazing management of an established phalaris pasture would follow the following program.

#### Autumn

Before the autumn break, reduce litter to encourage clover germination. Following the break, defer grazing for about six weeks, to build up feed availability to around 1500 kg/ha green dry matter or better. Apply moderate pressure until clover is established.

#### Winter

Rotational grazing (maintaining green dry matter above 800–1000 kg/ha) has been satisfactory especially in southern districts. If paddocks are set stocked, maintain green dry matter above 1000–1200 kg/ha. Where phalaris is vigorous and dominating in autumn, reducing the residual total dry matter to around 1000–1500 kg/ha will allow sub clover to grow satisfactorily.

#### Spring

Graze livestock to keep pasture at less than 3000 kg/ha dry matter. This will encourage white clover in high rainfall areas and sub clover to set seed elsewhere. Where annual grasses are a problem, use short periods of grazing to keep feed between 1500–3000 kg/ha of green dry matter.

In less favourable phalaris growing areas (e.g. western slopes) rest paddocks between stem elongation and the flowering/seed set stage. This prevents regeneration buds from shooting and promotes dormancy in buds. Delay any hay/silage cutting until after seed head emergence. Recovery from earlier cutting can be successful, where growing conditions following cutting are favourable for the grass to send up seed heads.

#### Summer

After seeding, the bulk of dry feed needs to be gradually reduced, but sufficient cover needs to be left to protect against erosion. In 'summer dry' environments, some carry-over stubble is considered useful. In elevated areas (tablelands) that receive reasonable summer rain, keep pastures short and leafy through summer.

In hotter areas, with more erratic summer rainfall (e.g. Northern Slopes), more carry over feed with flowering stems (e.g. 1500 kg/ha) prevents regeneration buds from shooting prematurely. Lack

of follow-up rain and hot weather can deplete root energy reserves and kill some small shoots where new growth occurs. This bulk then needs reducing at the end of summer (e.g. to about 1500 kg/ha) to allow legumes to develop. Where erosion is not a problem, this bulk can be reduced further, to enhance clover establishment. Some bare ground (e.g. 10–15%) should be adequate to allow legumes to establish. Phalaris leaf litter can adversely affect the establishment of sub clover.

**Degraded phalaris pastures:** Phalaris does not thicken readily from its own seed because of competition, seed theft by ants etc. Graze and rest strategically to encourage pastures to recover and increase phalaris vigour, plant size and enhance the chances of seedling recruitment. Defer grazing until after the autumn break for about six weeks. This allows around 1500 kg/ha of dry matter to accumulate. Then use long rests (8 weeks) and short grazing periods (1–2 weeks) through the remainder of autumn and winter.

If annual grasses are a major problem, use high stocking rates in rotation. Consider herbicides to 'winter clean' or 'spray top' to reduce dominance of annual grass and use selective herbicides to control broad leaved weeds. Reduce stocking pressure in spring to allow seed set of both phalaris and sub clover. They should not be heavily grazed during summer.

### Drought

Recent research has indicated that the survival of perennial grasses is greatly enhanced if paddocks are not hard grazed, even in moderately dry conditions. A residual amount of total dry matter of around 1000 kg/ha is a worthwhile target.

**A well managed established phalaris pasture is capable of providing high quality feed for large numbers of stock for extended periods.**

R WATSON



**Phalaris regrows from buds which are set at the base of old tillers. Seen below is the new tiller emerging from the crown bud. Dormant buds can also be seen at the base of the old tiller.**

R WATSON



W McDONALD

**Lax grazing allows phalaris to dominate the pasture, excluding the legumes. It also allows the phalaris to become tall and rank. At this stage its quality has declined markedly.**

**Graze phalaris down late in summer to reduce residue. This helps promote regrowth following the autumn break as well as improve clover regeneration.**

R WATSON



W McDONALD

**Maintain grazing pressure during the late autumn to early spring period. Do not overgraze pastures in the spring.**

### **Grazing management and persistence**

As a general rule subdivide large paddocks to enable phalaris to be managed correctly.

Spring grazing management is important for the persistence and regeneration of phalaris, especially in those cultivars that are more erect, and especially if regrowth is stopped by dry conditions before new buds are developed.

Hard, repeated or continual grazing of phalaris swards in spring can reduce plant vigour, regrowth and density the following autumn.

The more stressful the environment (shallow soils, acid soils, low soil fertility, northern or western aspects, cracking soils, low rainfall), the more critical grazing management (particularly during the spring) becomes for phalaris. In more favourable environments or seasons (high rainfall, irrigation, high soil fertility, deep soils), phalaris is better able to cope with and recover from periods of hard grazing.

During spring (September-November), survival over the summer and regrowth the following autumn is determined. As phalaris stems grow and develop seed heads, crown buds develop at the base of the stems.

Crown buds enable the plant to survive summer drought and produce new growth in autumn. The number of buds set (and their size) depends on the number and vigour of flowering stems which develop in the spring.

If the plant grows to the head emergence stage, the lower leaves become unpalatable, and the plant develops high numbers of large crown buds which remain dormant over summer. Heavy repeated grazing of phalaris earlier in spring can reduce the numbers of stems able to develop crown buds as well as reduce the potential energy reserves it can store in the crown and roots.

Removal of stems by grazing or cutting in spring can stimulate a percentage of formed crown buds to re-shoot just before going into the summer. The

plant then continues to use energy reserves for new leaf growth rather than storing them for survival over the summer or for next autumn's regrowth. If hot dry conditions follow, then it is likely that these new shoots will die, leaving fewer buds for autumn.

In marginal rainfall districts, heavy or repeated spring grazing has caused the rapid decline of phalaris pastures. You should therefore consider these points when organising your grazing management strategies for spring, particularly with the more erect varieties. Varieties with summer dormant buds, (e.g. Atlas PG) persist better than other varieties in districts that experience only occasional summer rain events.

In autumn and winter, phalaris paddocks are often overgrazed, especially in colder districts. Winter active varieties of phalaris are often more palatable than other species in the pasture. Rotational grazing can be used in these areas to reduce this problem.

Give phalaris a spell whenever possible, particularly following extended periods of hard grazing. The harder the paddocks are grazed, the longer the rest period needed.

### **Maintaining legumes**

Maintaining legumes in phalaris swards is a matter of balancing the needs of the pasture with those of the livestock which is not always easily achieved. In a mixed pasture, the grazing requirements of legumes are often at variance with those of phalaris. There is a need to balance the need of the phalaris and legumes for grazing and resting to promote balanced composition, persistence and seed production with those of the livestock grazing the pasture.

The three key pasture legumes sown with phalaris are lucerne, subterranean clover and/or white clover.

*Lucerne* is a deep rooting perennial like phalaris and tends to have a complementary growth rhythm with phalaris. Although lucerne can compete with phalaris, it makes a compatible and excellent pasture species to include with phalaris in the medium rainfall slopes districts where other pasture legumes are less persistent and reliable. Lucerne requires frequent spelling and rotational grazing—2 to 3 weeks on and 5 weeks off—to promote persistence.

It will compete strongly with phalaris for soil moisture under dry conditions. In most areas, the density of lucerne in a mixed pasture declines after 3–4 years.

*White clover* is a shallow rooted, relatively persistent species in high rainfall or irrigation areas. It is well adapted to sowing with phalaris under these conditions. It is also a useful species to

include with lucerne and subterranean clover when establishing phalaris pastures in medium and high rainfall areas of the Slopes and Tablelands. To allow white clover to develop in the pasture, apply moderate grazing pressure so stock only graze leaves, not stolons or runners. If white clover dies out during drought, it may regenerate from seed (especially Haifa white clover) or more seed may have to be sown.

*Subterranean clover* is well suited to grow with phalaris; both are of Mediterranean origin, both are active from autumn to spring, and both tolerate heavy grazing.

Graze phalaris hard in the summer to early autumn (before autumn rains) to reduce competition and maximise the establishment of subterranean clover seedlings. After a rest to allow the establishment of clover seedlings, grazing during winter should produce a pasture with a satisfactory clover content. Allow pasture to grow in spring; by easing the grazing pressure, phalaris should not smother clovers which would reduce their seed set.

A large residue of dry grass remaining over summer can reduce the breakdown of subterranean clover hard seed as well as inhibiting clover germination, establishment and growth; this will give a poor clover regeneration in autumn. Small seeded clovers such as balansa and cluster clover need similar conditions for establishment and combine well with phalaris.

However, such residue can improve the vigour of regrowth from phalaris plants as shading may reduce water loss from crown buds and soil. The best compromise is to allow phalaris to head in late spring and then stock to remove cover and residue gradually over summer.

Phalaris management must take account of the needs of the grazing enterprise; however, graziers also need to accept the concept of strategic grazing management to enhance the vigour, persistence and botanical composition of phalaris pastures.

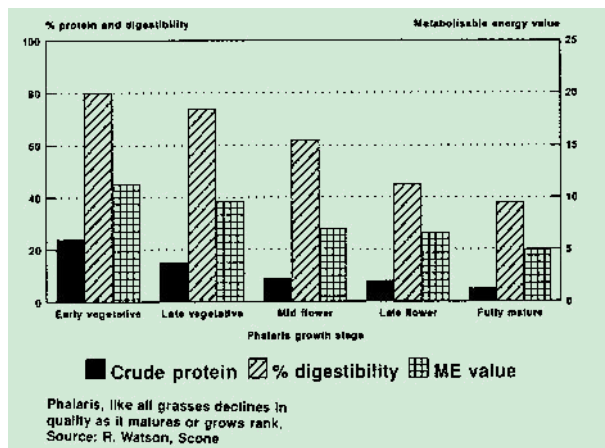
Climatic variability and stocking rate restrictions will mean that from time to time phalaris is placed under severe grazing pressure or is significantly under-grazed. You will need to rest the pasture following severe periods of stress to allow it to recover and, if necessary, renovate using mob stocking, ploughing or deep ripping and reseed clovers into under-grazed stands.

As a phalaris pasture is a dynamic system with many components and interacting variables, it is unreasonable (in the Australian climate) to assume that a perfect state of grass and clover balance, and high yield, can be attained all the time or without significant input from grazing management.

## PASTURE QUALITY

Phalaris is able to carry high stocking rates as well as produce high quality pasture for all livestock (beef cattle, dairy cattle, sheep, horses, goats and deer).

Phalaris, like all grasses, has its highest quality during the tillering-vegetative stage and then declines in quality as it approaches flowering and maturity (see Figure 11). The important feature of this information is the marked fall in quality as the plant passes from tillering to maturity.



**Figure 11. Feed quality of phalaris. Phalaris is at its best when it is leafy and actively growing.**

Fresh active leaf growth is of excellent nutritional value to livestock; while tall, rank, mature phalaris is of little feed value. As the plant

**Phalaris based pastures are widely used on the major thoroughbred horse studs.**

R WATSON



matures, fibre increases, and protein, digestibility and metabolisable energy decrease giving a lower feed value. This can be significant when considering the best stage to graze phalaris.

The lower quality may not be an important issue in a good mixed grass/legume pasture as livestock, particularly sheep, are highly selective in their grazing habit, and they will preferentially select green material, and sometimes legumes, in a phalaris pasture at the later growth stages (or if there is considerable carryover of the previous seasons growth)

Under these conditions, sheep can still maintain a good intake of high quality, green forage and maintain satisfactory performance. Cattle are less able to do this and are more affected by an overall decline in pasture.

When compared at identical stages of growth, the feed quality (protein, fibre content, digestibility and metabolisable energy) of phalaris is equivalent to other grasses such as cocksfoot, fescue and ryegrass.

There is unlikely to be any difference in the quality of foliage of different varieties when grown under the same conditions and at the same stage of growth.

Grasses are generally lower in protein and digestibility and are therefore lower in metabolisable energy when compared to pasture legumes. A balance of grass and legumes is needed for a stable, productive and nutritious pasture.



## LIVESTOCK PERFORMANCE ON PHALARIS PASTURES

Always remember with all livestock enterprises 'that more than half the breeding goes down the throat'. Pastures are grown to produce livestock.

A well managed phalaris pasture carries more livestock per hectare and often also gives more production per animal, resulting in a significant increase in total production per hectare relative to most annual and native grass pastures. Research by NSW Agriculture and the CSIRO since the early 1960's demonstrates the favourable performance of phalaris-based pastures in sheep and cattle production compared to other temperate grasses and pastures such as lucerne.

Research confirms there are only minor differences in animal performance from various temperate pasture grasses grazed for a number of years under similar conditions.

**Tall, rank mature growth like this is low in protein, digestibility and metabolisable energy. Phalaris at this stage is of low value to stock.**

R WATSON



However, there are some significant differences in the performance of livestock relative to the seasonal growth pattern of the pasture throughout the year.

Phalaris is capable of high livestock production during autumn, winter and spring, with only very

low to moderate production during summer. (In summer the plant becomes more dormant or low in feed quality, or both, following maturity.) It is important to select a pasture that best matches the feed requirements of the livestock enterprise throughout the year while maintaining important attributes such as ease of establishment, persistence under grazing, tolerance and resistance to drought, tolerance to mismanagement, and so on.

The phalaris cultivar Australian was evaluated in most of the livestock research discussed in this publication. Given the proven superiority of both Siroso and Sirolan phalaris in winter production and total production over Australian phalaris, further improvements can be expected with the more erect types.

### Sheep performance

Considerable research has been conducted throughout New south Wales on the performance of sheep (Merino versus crossbred, wool versus prime lamb production, and adult sheep versus young sheep) on phalaris-based pasture relative to other temperate pastures including lucerne.

Phalaris-based pastures are capable of livestock production similar to lucerne and equal or better than other temperate grass species.

Phalaris gives the highest weight gains in ewes during winter and lambs in spring. It also gives the highest ewe fleece weight (in spring), but the lowest weaner gains during summer.

A comparison of crossbred and Merino breeding ewes reproduction, wool production, ewe weight, lamb mortality, weaning percentage and lamb growth on lucerne or phalaris pastures in the Southern Tablelands concluded that:

- Annual fleece weights of merino and crossbred ewes grazing phalaris pasture declined less for each additional ewe carried over a range of stocking rates of 9–18/ha.
- Annual fleece weights of ewes grazing phalaris were heavier than those grazing lucerne.
- there was a greater need for supplementary feeding in late pregnancy to avoid losses from pregnancy toxaemia of ewes grazing lucerne.
- Phalaris pastures were less sensitive to increases in stocking rates, mismanagement and unfavourable physical and chemical soil conditions (low pH, waterlogging) than lucerne. There was no advantage in growing lucerne for wool production by breeding ewes.
- Ewes grazing phalaris had more multiple births than those on lucerne.

The disadvantages were:

- Ewes grazing on lucerne were heavier at joining and gained more weight in the weeks before joining than did ewes on phalaris pastures.

**Table 2. Pasture species under grazing and sheep performance. (The figures are averages for the 5 years (1962-66)).**

	Australian Phalaris	Perennial Ryegrass	Tasmanian Ryegrass	Brignoles Cocksfoot	Currie Cocksfoot	Demeter Fescue	Annual Soft Brome	Semi Dormant Lucerne
Average fleece weight (kg)	3.62	3.49	3.26	3.35	3.44	3.2	3.31	3.5
Ewe weight gain in winter (kg)	3.62	1.36	0.45	-1.8	0.9	1.36	2.29	1.36
Ewe weight Nov. (kg)	51	50	47	46	48	46	46	51
Lamb growth g/day	208	199	181	181	181	172	158	208

Source: A Axelsen and F Morley (1968). Proceedings Animal Production Society of Australia 7:92-98

- Spring lambing Merino and crossbred ewes grazing dryland lucerne were generally heavier throughout the year than ewes grazing phalaris subterranean clover mix pastures even though they experienced greater weight loss in winter. These losses were largely overcome by the compensatory weight gains during spring and summer.
- Lambs on lucerne were significantly heavier than those on phalaris pasture at both 6 and 12 weeks of age due to the higher quality and greater availability of lucerne during late summer-early autumn.
- Crossbred lambs grazing lucerne had a higher average daily growth rate of 210 g/head/day compared to 170 g/head/day for lambs grazing phalaris and subterranean clover pastures during 1970-71.

Weaning percentages were similar on lucerne and phalaris pasture.

Optimum stock rates for phalaris pastures were 9-13.5 dry sheep equivalent (DSE)/ha.

Phalaris based pastures are suitable for breeding ewes and wool production, while lucerne was superior for spring-born prime lamb production.

Other grazing research with pure swards of Sirosa phalaris, Australian phalaris and Demeter fescue at Glen Innes showed there were slight differences between liveweights and wool production of animals grazing the various pastures. However, there were obvious changes in body weight in response to growth patterns of the grasses. Sheep on phalaris tended to be heavier in winter and spring and lighter in summer compared to those on fescue.

### Cattle performance

Research on beef cattle grazing phalaris based pastures in Australia is limited.

Studies at Trangie in New South Wales during 1973-74 evaluated the performances of seven combinations of irrigated perennial pastures. Sirocco phalaris was sown with Woogenellup subterranean clover and Jemalong medic. Phalaris was compared to perennial and annual ryegrass pasture. The pastures were stocked from April to November at an average 3-4 steers/ha (250-350 kg liveweight) and fattened during this period.

Phalaris pastures maintained moderate cattle growth rates throughout the period, with peak production in winter.

Average liveweight gains over the period from the phalaris and subterranean clover pasture combination were 0.54 kg/hd/day in April-June; 1.26kg/hd/day in June-mid August; 0.89 kg/hd/day in September-November. These weight gains are similar to those achieved by cattle grazing oats over the same period.

Pasture quality of the phalaris was moderate to high ranging from 12-18 per cent crude protein in the dry matter throughout the growing season.

The performance of cattle on dryland pastures is much more variable. Cattle liveweight gain is linked with the amounts of green pasture available.

Pastures affect animals through differences in availability and quality which are themselves consequences of pasture type and also the effects of animals grazing the pasture.



W MCDONALD

**Phalaris based pastures are widely used on many cattle breeding and fattening properties throughout NSW.**

Differences in the amount of green pasture on offer are largely a consequence of the season (rainfall and temperature) and stocking rate. These factors may also influence the botanical composition of the pasture which can in turn influence the quality of the pasture.

At Canberra over four years at stocking rates of 1.5 steers/ha, 2.0 steers/ha and 2.5 steers/ha, cattle

grazing lucerne based pastures had marginally better liveweight gains than those grazing phalaris pastures.

A phalaris and subterranean clover pasture produced daily weight gains in autumn (0.53 kg/head/day) and winter (0.25 kg/head/day) as did pure lucerne pasture.

But cattle performed slightly better on the lucerne pastures compared to the phalaris based pastures in late spring to summer (0.7–1.0 kg/head/day, largely due to the greater response of lucerne to late spring and summer rains. The study also indicated that the advantages of pure lucerne may be nullified by the costs of bloat, including both treatment, deaths and extra management.

Cattle have a limited ability to select the more attractive components of the pasture, and usually are unable to avoid ingesting relatively large amounts of dead, low quality herbage even when greener foliage is available. Animal intake could be restricted and weight loss could occur in winter or in summer if mature herbage is carried over from a previous season.

In the Canberra trial, the botanical composition of the two pasture types was assessed at the beginning and end of the trial—the density and ground cover of the phalaris remained unchanged—an indication of its stability while the lucerne declined in density. The maximum gross margins on each pasture were obtained at 2 yearling steers/ha.

Commercial dryland pastures in the Upper Hunter which have a mixture of phalaris, lucerne and clover pastures have been reported to carry an average stocking rate of 1–2.5 steers/ha (300 kg liveweight or 10–15 DSE/ha) during April–November and produce liveweight gains of 0.9–1.2 kg/head/day.

## PHALARIS POISONING

Phalaris can sometimes poison sheep, cattle, goats and horses. The low alkaloid cultivars, such as Sirosa and Sirolan, are potentially just as poisonous as older varieties. Research at the Orange Agricultural Institute identified the different forms of phalaris poisoning, and in the process uncovered previous errors in the classification of phalaris poisoning syndromes. The following information is based on that research.

Phalaris can produce the following potentially poisonous substances: indole alkaloids, thiamine or pyridoxine antagonists, and tyramine compounds. The first group cause phalaris staggers, and the second probably cause the PE (polioencephalomalacia-like) form of sudden death. Phalaris, like many grasses, can also accumulate nitrate and cyanide compounds, but these rarely reach significant levels. The two major

causes of stock losses on phalaris pastures are phalaris staggers and the PE form of sudden death.

### Phalaris staggers

This nervous disorder can sometimes occur in livestock grazing phalaris dominant pastures growing on soils with moderate to low cobalt levels or high manganese levels. Limestone, sandstone, and granite associated soils pose the greatest risk, and basalt associated soils the least. If insufficient cobalt is present in the rumen of the animal then the indole alkaloids in the grass are not broken down fast enough and can be absorbed into the animals' bloodstream. These alkaloids can then affect the brain and spinal cord.

With older varieties such as Australian this process can occur fairly quickly and an outbreak of staggers may develop after only one to three weeks. With the lower alkaloid varieties such as Sirolan and Sirosa, it may take up to three to four months of grazing before the staggers develops. However, sheep and cattle affected by the lower alkaloid varieties can be much slower to recover and many may never fully recover. In addition the phenomenon of delayed onset of clinical signs is much more common with the lower alkaloid varieties. These animals appear perfectly normal when moved off a phalaris pasture but go on to develop staggers several weeks or months later.

Sheep affected by phalaris staggers display the following signs: excitability, tremors, twitches, head shakes, head nodding, leg weakness, leg stiffness, bounding, hopping, jumping, saw horse rocking, kneeling, buckling over, and frequent falling followed by vigorous struggling to get up again. Some affected sheep will fully recover over a few weeks, but others will never recover, and a percentage of sheep will die as a result of misadventure.

Affected cattle develop slightly different signs to sheep. They become very excitable but don't develop the severe tremors that occur in sheep. They display a mild hind limb weakness and mild incoordination. Many lose weight or fail to gain weight because, unlike sheep, cattle suffer damage to the nerves supplying the face and jaw, which makes it difficult for them to chew and swallow. The tongue may protrude slightly much of the time and the animal may drool saliva.

Phalaris staggers may be prevented by increasing the amount of cobalt in the rumen whilst the phalaris is being grazed. This can be done by the oral administration of cobalt bullets, by addition of cobalt to pasture topdressing programs, by the provision of cobalt-containing stock lick blocks, or by the incidental daily ingestion by stock of soil with moderate to high cobalt content. The most reliable form of cobalt administration is use of oral cobalt bullets every one to two years.

Soil manganese and cobalt levels are interrelated. High soil manganese results in low cobalt availability to plants. In addition cobalt and manganese are only available to plants when they are in their reduced state. This process is dependent on soil temperature and moisture levels. Consequently in south-eastern Australia pasture cobalt levels will generally be at their highest between November and March, and at their lowest between June and September. To prevent phalaris staggers, it is essential on many soil types to provide supplementary cobalt to livestock during this latter period.

### Phalaris sudden death

The PE form of sudden death can cause large sheep losses in a very short period of time. The poisons responsible appear to rise rapidly in new phalaris shoots during periods of moisture stress. Concurrent frosting will make this situation worse. In dry years the period of greatest danger is at the start of the growth season from February to June. Sometimes the risk can re-emerge during December. The short, fresh shoots produced in response to light, intermittent rain, are the most poisonous. PE sudden death has occurred on Australian, Sirocco, Siroso, Sirolan and Holdfast phalaris cultivars.

The period of greatest stress is the first 48 hours after livestock are placed on the toxic pasture. Test grazing the pasture for less than 12 hours at a time will give no indication of the pasture's potential toxicity. Sheep managed under a restrictive grazing system, such as rotational or cell grazing, will be at greatest risk, as will sheep that have recently been transported a long distance, or held off feed for extended periods in stock yards or shearing sheds. If sheep are allowed to adapt to the phalaris poison more slowly, they are able to successfully detoxify it.

The cardiac form of sudden death occurs much less frequently, and affects far fewer sheep, than the PE form. The cardiac form occurs in flocks that may have been grazing phalaris for several weeks without a problem. However, the ingestion of significant amounts of the causal poison, places these sheep at risk of experiencing a heart attack should they be inadvertently forced to exercise. This generally happens when the flock is mustered. Affected sheep will suddenly collapse, have an abnormal heart beat, abnormal breathing, and dark discolouration of the mucous membranes around the eyes. Some will die rapidly but others will spontaneously recover. Horses can also be affected by this form of phalaris sudden death.

Note that occasional death in horses has been associated with a related species *Phalaris coerulescens*. This species is known to occur in

NSW. If poisoning is suspected as a result of horses grazing pastures containing *P. coerulescens*, it is essential that an accurate identification of the plant is made.

The many benefits of phalaris far outweigh the risks of poisoning. Considering the large area of phalaris pastures sown throughout south-eastern Australia, and the many millions of animals that graze these pastures each year without ill effects, the incidence of phalaris poisoning is very low.

### In summary:

- If you see symptoms of phalaris staggers or phalaris sudden death, move stock immediately to alternative feed and consult a veterinarian.
- There are two different, unrelated forms of phalaris poisoning, sudden death and staggers.
- All ages, breeds and sexes of sheep are susceptible to phalaris poisoning.
- Sudden death and phalaris staggers of cattle occur, but they are not common.
- Sudden death occurs more commonly on phalaris pasture regrowth just after the break of a dry season, or during drought periods.
- Hungry sheep are the most likely to be poisoned.
- Frosts have often preceded major outbreaks of sudden death.
- Phalaris poisoning can occur on old and newly sown pastures.
- All varieties of phalaris can cause phalaris poisoning.
- Sudden death is favoured by rotational grazing management systems, and by placing recently transported sheep on previously spelled phalaris pastures.
- Phalaris staggers can be prevented by administering cobalt bullets when the phalaris grazing season starts.

### DISEASES OF PHALARIS

Several parasitic diseases of phalaris are known in New South Wales but most of them rarely cause severe damage. The most troublesome are the ergot diseases and stem rust.

#### Ergot

There are two ergot fungi known on phalaris in New South Wales. They are *Claviceps purpurea* and *Claviceps phalaridis*.

*C. purpurea* is a common ergot found widely on cereals and many grasses.

It produces dark purple to black bodies on infected florets (flowers). Usually only a few florets in a head are infected and in phalaris it does not usually occur in sufficient quantities to cause a problem.

In seed crops, the ergot sclerotia are harvested with the seed and should be cleaned out.

Common ergot is a toxic fungus and if florets containing ergots are eaten by grazing animals, symptoms of poisoning can develop.

The other ergot, *C. phalaridis*, occurs in the southern half of New South. Unlike *C. purpurea* which infects only a few florets, *C. phalaridis* infects all florets in a head and infected plants produce no seed. The fungus is present in all above-ground parts of the plant and, once a perennial grass like *Phalaris aquatica* is infected, it never produces seed again.

Every year, the ergot fungus in the plant converts all the florets into small, pale-fawn, ergot sclerotia. In seed crops, this results in lowered seed yield and causes a problem in cleaning out the ergots from harvested seed. This can be difficult and expensive as the ergots are similar in size to phalaris seed.

*C. phalaridis* can also infect several other grasses including rye grass, cocksfoot and other introduced and native species.

### Stem rust

Stem rust (*Puccinia graminis*) occurs commonly on phalaris. The occasional heavy infections on stems and leaves cause damage.

### Other diseases

The grass downy mildew fungus (*Sclerophthora macrospora*) occasionally causes thickening, twisting and distortion of leaves and shoots in isolated plants.

Various minor leaf spots caused by the fungi *Bipolaris* spp., *Stagonospora foliicola* and *Ramularia pusilla* have been recorded but are rarely severe.

Lodging of plants due to lower stem damage by the wheat eye spot fungus *Pseudocercospora herpotrichoides* is seen occasionally in damp springs in southern districts; root and crown rots are rarely observed.

The common cereal and grass powdery mildew *Erysiphe graminis* has not been seen on perennial phalaris, *Phalaris aquatica*, but occurs on other species such as annual phalaris, *P. minor*.

Barley yellow dwarf virus occasionally causes stunting of plants, with red and yellow discolouration of the leaves.

A new disease *Stagonospora foliicola* has recently been identified on phalaris in Victoria, where it is widespread in wet winters. It is a fungus not previously reported in Australia. The extent and importance of this disease is not known in other parts of Australia. The disease is known to occur on *Phalaris arundinacea* (reed canary grass) in North America and Europe but it is only of minor importance in these areas. Symptoms generally appear on older leaves as dark brown elongated spots about 1 mm by 2 mm, and up to 3

mm by 9 mm. The spots are sometimes accompanied by yellowing of the leaf. Heavy infestation of leaves in pastures can cause yellowing of the entire leaf resulting in symptoms similar to those attributed to waterlogging (that is, yellowing and reduced growth of plant). On large (roadside) clumps of phalaris, moderate infection causes premature browning off of the leaf tip so that the plant looks rather ragged.

These are few published accounts of this disease or any basic research anywhere in the world. More information is needed. Plants suspected of being infected with this or other diseases should be forwarded to your nearest NSW Agriculture office for identification and recording.

### CERTIFIED SEED

Depending on seasonal conditions, 300–500 tonnes of certified and 50 tonnes of uncertified phalaris seed are grown in Australia each year

About 75 per cent of this seed harvest is used in Australia and the remainder is exported.

Seed production varies each year, depending on seasonal conditions.

Certified seed production from phalaris is a specialised enterprise requiring true-to-type stands, special production techniques and equipment, and a sound knowledge of the agronomic requirements of the crop. Like most seed production, it requires specialisation and attention to detail.

Seed certification guarantees the varietal purity of a seed lot by a series of inspections, checks and tests by NSW Agriculture Seed Certification officers.

Copies of the certification rules and further information on seed certification are available from any NSW Agriculture Seed Certification Officer or District or Extension Agronomist.

The only way a buyer can be assured of the varietal purity of the purchased seed is by requesting certified seed. Only seed produced under the supervision of an officer of NSW Agriculture can be sold as certified seed.

For information on commercial seed production of phalaris contact your nearest NSW Agriculture Seed Certification Officer.

### GROWING YOUR OWN SEED

Under good seasonal conditions, you can harvest seed from phalaris pastures.

There is no restriction on harvesting seed of publicly owned varieties for your own use, but there are requirements to be met under the NSW Seeds Act 1982 if you wish to offer seed for sale. Seed of varieties protected by Plant Breeders Rights (PBR) cannot be sold without complying with the license and PBR provisions, which are

Buy only certified seed. Always request to see a recent germination and seed purity report on seed you intend to buy. Commercially harvested seed contains seed of a range of colours. Light to dark brown seed colour can be a guide to seed maturity and viability.

R WATSON



available from the owner of the variety. Most new cultivars of phalaris are protected by PBR. Landmaster, Atlas PG, Australian II and Holdfast are examples of PBR protected varieties. Farmers can harvest seed of these varieties for their own use, but cannot sell or trade the seed without a contract with the head licensee.

The vendor or owner of the seed must provide an analysis to comply with the Act. Under the NSW Seeds Act 1982, uncertified seed offered for sale must have:

- an identifying code or number to distinguish the seed lot on the bags and the label fixed to the bag.
- The label must state the:
  - crop species and variety
  - minimum percentage of pasture seed
  - maximum percentage of all other seed
  - minimum germination percentage
  - names of any chemical applied after harvest
  - weight of bag
  - list of declared weeds and number per kilogram.

No seed can be offered for sale which contains prohibited weed seeds. A full list of prohibited and declared weed seeds is contained in 'The Seeds Regulation 1994'. This document and the NSW Seeds Act 1982 is available from the Government Printer or may be viewed on the Internet-Foundation Law site ([www.fl.asn.au](http://www.fl.asn.au)).

To obtain the information for the label, you must collect a representative sample of the harvested seed and have a complete seed analysis and report carried out by a reputable analytical testing laboratory. A list of seed testing companies can be obtained from your local NSW Agriculture District or Extension Agronomist. If you want to grow your own seed, the following guidelines are provided to assist you:

- Select one area and manage it specifically for seed production.
- Select a high fertility paddock supporting a dense stand of the desired variety of phalaris or alternatively sow an area to the chosen variety. Use high quality certified seed to sow this crop.
- Select a paddock free of stones, stumps or obstructions which could cause damage to equipment used during harvesting.
- Select the area required based on an expected seed yield of 50 kg/ha.
- Control all weeds in the phalaris by grazing management, a fertiliser program or herbicide program, or both. A wide range of herbicides can be used safely in pure swards of phalaris to provide complete weed control. Weed control is critical to ensure high yields of clean seed.

Maintain a phosphorus and sulphur fertiliser program at all times.

Pure or dense swards of phalaris will need nitrogen fertiliser to promote tillering and seed production. Topdress selected paddocks with 40–60 kg/ha of nitrogen (100–150 kg/ha or urea or Nitram) during April to May and again at the first signs of stem elongation (usually early to mid September).

Graze the area evenly and lightly during autumn-winter. Remove all stock in mid to late August to allow phalaris to commence flowering and complete seed set. Leave stock out until after harvest.

Control insect pests, particularly during the flowering to seed ripening stage (heliethis, army worm, thrips).

Phalaris seed heads flower and ripen in a definite pattern, with seed developing and ripening at the top first and the bottom last. When the plants are nearing maturity, you can see ripe seed at the top of the head, while the lower seeds are green and often immature. The Australian, Sirosa and Sirolan varieties are very prone to shattering when they are mature resulting in a large seed loss. The timing of harvesting can be very critical. A delay of one day can be too much. The timing of harvesting of phalaris by different methods are as follows:

**Troughing.** This is a simple and inexpensive method of harvesting but it is an inefficient operation as much of the seed shatters and falls to the ground during harvesting.

Troughed seed is usually of high quality because only the very ripe dry seed is harvested and it is not damaged by threshing.

Equipment consists of a solidly constructed sheet metal trough mounted on the front of a tractor or a four-wheel-drive vehicle. Mounting the trough on a front-end loader is ideal as it can be raised or lowered to suit the crop.

The trough should be about 2–3 m wide, 30–45 cm deep at the front, 90 cm deep at the rear and 30–40 cm from front to back.

Troughs can be fitted with dished fingers made from heavy grade flat sheet metal. These comb the heads and catch the seed shaken out as the trough passes through the crop. The fingers increase the amount of seed harvested. The seed vibrates down the fingers into the trough. At the rear of the trough, in front of the radiator, fly screen gauze is fitted to a height of 50–60 cm across the trough to reduce the entry of seed head material into the radiator.

The shaker fingers should be about 60 cm long, 15 cm wide at the trough end, 6 cm wide at the point and 3 cm deep. They should be about 4 mm apart at the trough end with the gap getting wider

towards the tips. The fingers have a shivering effect on the stalks so the ripe seed falls into the dished shaped fingers and roll back into the collecting trough.

Start trough harvesting when ripe seed starts to shed from the top of the seed head. To determine if the seed head has any ripe seed, rub some seed heads in your hand or walk through crop with your arms held out beside you so as to hit the seed heads. Look for ripe seed.

Drive the trough through the crop in one direction slowly (about 7 km/h) first to establish harvesting wheel tracks and then all later harvests at a faster speed of 17–18 km/h. Repeat harvests every 2–3 days until most, or sufficient, seed is harvested.

**Direct heading.** This involves directly harvesting the seed with a header when the seed is at 17–18 per cent moisture. Test a sample with a moisture meter. This seed moisture content often corresponds with when the top one third of the seed has shed its seed and the lower two thirds are yellow to tan in colour. Green seed is immature and has high moisture. If the seed is drier than this, it will crack; if it contains more moisture it will bruise and its viability will decline.

The header must be carefully set up to produce a clean sample, free of excessive green material.

Phalaris seed is easily damaged by excessive drum speed and insufficient concave clearance. Adjust settings as necessary.

Direct harvested seed will need to be immediately dried to 9 per cent moisture, otherwise germination percentage will decline rapidly.

Small quantities of seed can be dried by laying it out in a thin uniform layer 5–10 cm deep over a shed floor or on hessian on a slatted shearing shed floor. Rake and mix the seed daily to promote quick, even drying.

Alternatively seed can be dried by commercial seed drying machines.

In addition to drying the seed, in some cases, the seed may need to be graded to remove excess husk and straw material to allow sowing through seeding machinery.

Producing and harvesting phalaris seed is a specialist operation. High yields are needed to justify the time and cost. For older cultivars, producers are better served by buying certified high quality phalaris seed rather than attempting to grow their own. However, Uneta (Australian type) and Holdfast (Sirosa type) retain their seed strongly at maturity and can be harvested reliably by direct heading.

## FURTHER INFORMATION

For further information contact your local NSW Agriculture District or Extension Agronomist or Seed Production Officer.

## FURTHER READING

The following Agfacts contain information on phalaris. The Agfacts are available at your local NSW Agriculture office.

- P7.6.38 *Poa tussock control*
- P7.6.30 *Serrated tussock control*
- P7.6.1 *St Johns Wort control*

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## Notes on Pasture Improvement

Pasture improvement may be associated with an increase in the incidence of certain livestock health disorders. Livestock and production losses from such disorders is possible. Management may need to be modified to minimise risk. Consult your veterinarian or adviser when planning pasture improvement.

The Native Vegetation Conservation Act (1997) restricts some pasture improvement practices where existing pasture contains native species. Inquire through your office of the Department of Land and Water Conservation for further details.

## Always read the label

Users of agricultural or veterinary chemical products *must always* read the label and any permit, before using the product, and strictly comply with the directions on the label and the conditions of any permit. Users are not absolved from compliance with the directions on the label or the conditions of the permit by reason of any statement made or not made in this publication.