NSW DEPARTMENT OF
PRIMARY INDUSTRIES

THE DROUGHT RECOVERY GUIDE

Third Edition

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NSW DEPARTMENT OF
PRIMARY INDUSTRIES

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Foreword

The Drought recovery guide has been prepared by NSW Department of Primary Industries to assist producers in drought recovery strategies and in making other important management decisions.

Severe drought has a significant long-term impact on livestock numbers, including breeding stock. The cropping sector may also be significantly affected. As a result, farmers have to make difficult financial and management decisions as they prepare to move into drought recovery.

Although it includes a wide range of information regarding cropping and livestock issues, this guide is not intended to be a complete manual on managing the farm in the wake of a serious drought. Nor will it apply to all NSW producers at any point in time, with drought affecting different parts of the state in different ways.

However, the Drought recovery guide does include a range of important information about restocking, cropping and the protection of plant and animal health. This information is designed to help producers who are moving into drought recovery, as well as those who hope to do so in the near future.

More detailed information on other aspects of drought recovery management is available from the NSW Department of Primary Industries web site at www.dpi.nsw.gov.au/drought and from NSW Department of Primary Industries offices. Assistance is also available from the NSW Department of Primary Industries drought hotline on 1800 814 647.

I trust that you will find this document valuable as you move to meet the challenges of resuming normal operations following a difficult time.

BD BUFFIER
DIRECTOR-GENERAL

ACKNOWLEDGMENTS

Sourcing Cereal Seed: Stephanie Belfield, District Agronomist, Moree

Preparing for cropping after drought – removing pastures – Greg Brooke, District Agronomist, Wellington

Managing pastures after drought – Warren McDonald, formerly Technical Specialist (Pastures), Tamworth

Soil management following drought – Abigail Jenkins, Advisory Officer Soil Management, Wollongbar

Weed strategies following drought, fire and flood – Bob Trounce formerly Agronomist (Weeds), Orange and Jim Dellow, Agronomist (Weeds), Orange

Cereals for Grazing – Gerald Hennessy, formerly District Agronomist, Mudgee, Bruce Clements, District Agronomist, Bathurst

Dryland summer grain and forage crop opportunities – John Kneipp, Program Leader Northern Farming Systems, Tamworth

Controlling vertebrate pests after a drought – David Croft, Agricultural Protection Officer, Wagga Wagga

Animal health following drought – bloat – Sarah Robson, Veterinary Officer, Wagga Wagga

Enterotoxaemia in cattle – Dr Steve Dunn, Senior Field Veterinary Officer, Gunnedah

Animal health following drought – prussic acid poisoning – Sarah Robson, Veterinary Officer, Wagga Wagga

Animal health following drought – nitrate and nitrite poisoning – Sarah Robson, Veterinary Officer, Wagga Wagga

Buying sheep can be a health hazard – John Seaman Program Leader Flock Health, Orange

Bovine Johne's disease zoning – Tim Jessep, formerly Technical Specialist Bovine Johne's Disease, Goulburn

Tax issues for livestock producers during and after drought – Lloyd Davies, Agricultural Economist, Paterson

Sources of market information – Fiona Scott, Agricultural Economist, Tamworth

Dryland winter crop opportunities – Northern NSW information – Frank McRae, Fiona Scott, Loretta Serafin, Jennie Spenceley, Bob Freebairn, Ian Collett, Jacinta Christie, and Jan Edwards. Central NSW information – Greg Brooke, Leigh Jenkins, Frank McRae, Bob Freebairn, Ian Collett, Jacinta Christie, Dean Patton, and Jan Edwards. Fiona Scott, NSW Department of Primary Industries Farming Systems Economist, Tamworth

How much can you afford to pay when restocking? – Lloyd Davies, Agricultural Economist, Paterson and Karina Wood, formerly Livestock Officer (Business Skills), Cowra.

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Section 1
Planning

- Planning for drought recovery
- Drought recovery for intensive livestock industries

Planning for drought recovery

Good rainfall can be the trigger to resume cropping, grazing and restocking, but it may also create short-term difficulties including:

- flooding following heavy storms;
- death of weak animals due to flooding, bogging, low feed-quality, and exposure;
- soil erosion and loss of nutrients and seed reserves from the soil;
- germination of weed seeds brought in with fodder and grain;
- additional cash requirements for crop and pasture sowing and for livestock replacement and farm repairs, in addition to continuing family living requirements.

THE NEED FOR PLANNING

After drought, it is vitally important to rebuild a farm's productive capacity as quickly as possible. **Ideally, farmers should have a plan in place – even before drought conditions set in.** The drought and recovery should then be managed according to these plans. After drought, the aim should be to re-establish the pre-drought pattern of production and cash flow as quickly as possible – the 'drought recovery plan' should determine how these patterns are re-established.

If such a plan was not in place before the drought set in, then it is important to be aware that decisions made now will have long-term implications for the farm's natural resource base and future earning capacity. Farmers need to plan carefully during this drought recovery period. This is best done by involving all those directly affected (including your family and farm staff).

STEPS IN PLANNING

Signs of initial farm recovery

The signs that will trigger drought recovery planning and activity include:

- adequate pasture growth to warrant grazing with reduced supplementary feeding;
- sufficient soil moisture for pasture or crop establishment;
- adequate water for stock and domestic use.

Stocktake of farm resources

The next step in planning is to assess the condition of the farm – especially following a prolonged drought – as farm resources may be in a different condition to that normally experienced. A comprehensive stocktake will make planning easier and more reliable and should include:

- the recent history of each paddock to determine its short-term and long-term capacity;
- soil structure and fertility;
- erosion damage;
- vegetation remaining and germinating (including pastures, weeds and crop stubbles);
- condition of paddock trees, shelter belts and areas of native bushland;
- water quality and quantity in the soil, in the dams or tanks, and in the streams, and for domestic supplies and irrigation;
- farm infrastructure including fences, contour banks, buildings, machinery, and roads;
- the numbers, types, ages and health of all livestock;
- seed supplies for crop or pasture sowings;
- financial resources;
- human resources;
- other physical attributes or limitations.

The capability of individual paddocks should be considered as components of the overall farm so that the management of each paddock can suit its capability and be coordinated into a whole-farm plan.

A realistic assessment of the overall financial capacity to remain in farming should be part of the stocktake. In many cases, professional advice

will be needed to assess assets, liabilities, equity, availability of credit, cash flow opportunities and ongoing commitments. A financial assessment will unfortunately, show that for some farmers, leaving the farm is an option that should be considered seriously.

Setting farm goals

A management plan should be developed to achieve the goals of the farm family and its business partners. Goals may include 'maximum profit', 'better lifestyle', 'returning the farm to a better condition', 'establishing the children in new ventures', 'increased equity', and other topics. The various goals should have differing time frames – some will be short-term (within a year), while others will be long-term (up to 10 years or longer).

Devise some time indicators which will be used to measure the success or failure in achieving these goals; for example:

Year 1 Farm cash flow re-established.

Year 5 Conservation works installed.

Year 10 Sufficient fodder in storage to manage the impact of the next drought on your property.

Don't be too ambitious in your goal-setting. Break the goals down into 'bite-sized' pieces which can be checked off, for instance, every three months, on a wall planner that you can have on display in the farm office or house. Record your successful programs.

The capacity of the farm to meet goals may be analysed by:

- listing the opportunities provided by the farm resources, the drought, and the recent rains;
- listing the problems that have arisen during the drought;
- assessing the strengths of the farm business (for instance, equity, breeding stock, the management plan) which enables problems to be overcome and opportunities to be capitalised on;
- assessing the weaknesses in the farm business (for instance, repairs needed, debts, land degradation) which may restrict the farm's capacity to recover sustainably from the drought.

These assessments enable a re-examination of your goals and help you to decide whether they are achievable in the context of the farm's resources.

YOUR MANAGEMENT PLAN – TYING IT TOGETHER

Using the stocktake of farm resources and the farm goals, you can now develop a property management plan to achieve the goals for your farm business. Your management plan should include broad decisions on enterprises (as well as detailed individual paddock plans), and may relate to local LandCare and catchment planning.

Publications on NSW Department of Primary Industries website *Drought recovery* page provide more details to help in drought recovery planning as well as reference material and contacts for more specific information.

Drought recovery planning is an integral part of long-term property management planning and should ideally fit in with the needs and capacity of the surrounding catchment.

A key point to remember is that recovery from drought and establishing your farm on a sound footing to survive future droughts, will not necessarily be achieved by more of the same. **Sound physical and financial planning is the cornerstone of recovery, survival and development, and is the very first thing that needs to be done.**

Further Information

- *Natural Resource Management Guide – A practical guide for detecting changes occurring at the property or catchment level*. Department of Natural Resources, Queensland Department of Primary Industry. (Available from NSW Department of Primary Industries through the Continuing Education Unit, CB Alexander Agricultural College 'Tocal', Paterson, phone 1800 025 520.)

Drought recovery for intensive livestock industries

Drought recovery for intensive livestock industries is usually dependent on the use of cash and capital reserves to supplement a return to normal seasonal conditions and feed prices.

DAIRYING

While milking cows have often been sustained in reasonable condition during drought, dry cattle and replacement heifers usually suffer by comparison.

The following strategies will, therefore, assist in bridging the gaps to help return to an abundant paddock feed supply:

- The use of fodder reserves still available to feed stock that have suffered the most (these are often the replacement heifers, from weaning to mating), while maintaining the milking herd on a high nutrition level.
- The development of a 'feed plan' which includes provision for a large fodder reserve – whether it is silage or hay – for future paddock feed shortages.
- An assessment of the possible availability of reasonably-priced grain or supplements, either from existing reserves or from summer-grown grass. **The autumn and winter periods are critical for this, particularly as this is the time when costs of producing milk are the greatest**.
- Consideration of agistment if it becomes available, particularly for young stock.
- Re-establishment of contacts with contract rearers, many of whom will have suffered during the drought and who could now be looking for stock.

Dairy farmers should also prepare for the next drought by seeking the following information:

- Advice on financial assistance (see *Financial management during drought recovery*).
- Advice from dairy processors on changes to milk supply systems and options available to increase production flexibility.
- Advice from NSW Department of Primary Industries on management skills or systems relating to farm, stock and financial management, including advice on the economics of installing an irrigation system on non-irrigated farms to increase feed security.
- Advice from bank managers or other lenders of funds concerning arrangements that may have been amended during the drought.

See sections on: *Restocking after a drought*, *Animal health following drought*, and *Grazing management following drought*.

PIGS

In past droughts, pig producers have been adversely affected by high feed prices and some have ceased production for the duration of a drought. Grain may continue to be in short supply and at a high price until the new season harvest replenishes stocks, although summer grain crops such as sorghum may alleviate existing grain shortages.

If pig prices remain at or below the cost of production for many piggeries, there is therefore little incentive to restock closed piggeries and, in fact, more piggeries may destock. Some producers will, in these circumstances, take the opportunity to destock their piggeries for renovation. Producers intending to refurbish their piggery should, however, consider the latest information on piggery design. There is also the added opportunity to restock with pigs which are free of diseases such as pneumonia and dysentery. Markets need to be followed closely so that opportunities for restocking with the best stock available can be identified and used.

Further information

Approval process for development or expansion of a piggery in NSW

BEEF FEEDLOTS

Feedlotters have to make some hard decisions in a post-drought period to ensure they stay in business, maintain market share, and meet market requirements. These producers are likely to be faced with higher input costs without any improvement in returns. Small operators and opportunity feedlotters are most at risk in these circumstances if they make the wrong decisions. Feedlotters must therefore pay constant

attention: to market prices of feeder stock; to feed costs; and to beef prices.

Issues of concern

- Anticipated shortage and high-cost of feeder steers. Operators may therefore need to restructure in order to use available classes of stock or may need to take on other farm enterprises in the interim.
- Anticipated high feed costs for the next 3–6 months or longer, depending on the next winter cereal crop. Cash flow budgets need to take account of expected – not past – feed prices.
- Consumers have changed their eating patterns and are buying less beef. This means that there is unlikely to be sufficient increase in beef prices on the domestic market to compensate for higher input costs. Marketing strategies will, in this circumstance, be important.
- International and domestic market approaches need careful consideration.
- It is believed that large feedlots, feeding 80 per cent or more for export, are likely to feed at a loss for 6–12 months after the end of a drought in order to maintain market share. This strategy needs to be costed out so that the value of maintaining market share is not eroded completely by losses.
- All of the above could make feedlotting uneconomic, especially for smaller operators and opportunity feedlotters for at least 12 months after a drought breaks, so operators must carefully consider opportunities for other enterprises.

Further information:
The New South Wales Feedlot Manual.
Opportunity Lotfeeding of Beef Cattle

Further assistance

- NSW Department of Primary Industries Livestock Officers (Beef)
- Australian Lotfeeders Association

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Section 2
Pastures, crops and soils

- Grazing management following drought
- Managing pastures after drought
- Soil management following drought
- Weeds – a threat to drought recovery
- Weed strategies following drought, fire and flood
- Preparing for cropping after drought – removing pastures
- Dryland winter crop opportunities
- Winter cropping following drought
- Cereals for grazing
- Sourcing cereal seed
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- Tree management after drought
- Controlling vertebrate pests after a drought

Grazing management following drought

Livestock need particular attention following drought-breaking rain. This period brings its own specific problems, not the least of which are those brought about by the change in diet arising from the new pasture growth.

Stress due to wet conditions, and what can be a period of low nutrient intake, needs to be managed carefully if the transition to normal pasture conditions is to be successful.

RAIN – THE IMMEDIATE EFFECT

Prolonged wet conditions will often cause stock to limit their intake, that is, 'to go off their feed'. Where stock are being fed on the ground, much of this feed can be lost in wet conditions through trampling (especially if the feed is grain). When feeding directly onto the ground, select well-drained areas and increase the feeding rates, ideally with hay, which is less prone to loss through trampling.

If rain is coupled with windy conditions, stock will need sheltered areas – particularly if the stock are in poor condition. Low temperatures will compound this problem with the nutritional stress experienced by stock in cold, wet, windy conditions likely to increase substantially. An increase in feeding rates, preferably with hay is, therefore, likely to be required in order to prevent stock losses. Keep in mind that sudden dietary changes can severely disrupt the rumen. One negative effect of this can be tender wool in sheep.

THE GREEN PICK

The early pasture growth following rain, called 'green pick' is high in water content and low in dry matter content. It is the dry matter, however that contains the nutrients required by livestock. Dry sheep need about 400 kg of pasture dry matter per hectare (400 kg DM/ha) to maintain their weight each year. This is equivalent to an average pasture height of 1.5–2 cm. For dry cattle, the availability for maintenance is about 900 kg DM/ha (3–4 cm pasture height) per year.

A particular problem with this 'green pick' phase following drought is that animals will normally stop eating the supplied feed and will prefer the green pick. Generally the green pick, though, is not sufficient to sustain stock early after rain, and stock can actually die from starvation! It is therefore important to keep livestock restricted to paddocks where they will continue to eat supplied feed until sufficient paddock feed is available. It is also important not to stop hand feeding too early following the availability of paddock feed. Grain and/or hay feeding should be reduced slowly over 2–3 weeks (see *Animal health following drought*).

Where stock have been confined for feeding, access to pasture will need to be restricted. While still keeping stock confined mainly to the feeding area, provide a limited amount of grazing on pasture. This will not only benefit the stock but aid in the rehabilitation of the valuable pasture resource. The time spent each day should increase slowly until full-grazing is provided after about one week.

ANIMAL HEALTH

When making grazing management decisions after drought, you need to consider the types of pastures being grazed and the implications of this for stock health.

Due to a lack of competition during drought, new pastures can often be dominated by plants that can affect livestock health. Some pasture species are also toxic in their early growth phase. For example:

- rapidly-growing phalaris can induce phalaris staggers;
- rapid growth of improved grasses, cereals and broadleaf weeds such as variegated thistle can lead to nitrate/nitrite poisoning;
- legume-dominant pastures provide a bloat risk; and
- sorghum grazed too early can cause prussic acid poisoning.

It is therefore important that stock never be allowed to go onto these types of pastures when they are hungry. Maintain a careful watch and, at any sign of abnormal behaviour, remove stock from the paddock. Unfortunately, with nitrate/nitrite poisoning you may not see abnormal behaviour before deaths occur.

The rapid movement of digestible young pasture growth through the gut can also trigger the

onset of **pulpy kidney**. Therefore, ensure that vaccination programs are maintained. Boosters may be needed every three months for cattle. Also follow a sound management program to ensure effective worm control.

See *Animal health following drought* and *Managing pastures after drought*.

PASTURE MANAGEMENT

Grazing management decisions after drought cannot be divorced from the general management requirements of pastures (see *Managing pastures after drought*). The sooner your farm returns to a highly-productive pasture base, the more viable it will be into the future.

Generally, the lower stocking rates from destocking through the drought will normally ensure rehabilitation. Keep this in mind if you are considering a rapid restocking program.

A grazing plan based on pasture type, pasture condition and stock requirements should be developed as part of your property management plan. Pasture considerations in such a plan are discussed more fully in the section *Managing pastures after drought*.

Livestock components of the plan may include the following:

- assessing the condition of all stock classes;
- setting short-term and medium-term objectives for these classes, with particular emphasis on the fertility of breeders and finishing stock within critical time periods;
- interlinking these livestock objectives with the need to rehabilitate pastures;
- considering accepting stock on agistment to control excessive pasture growth or, alternatively, seeking agistment if drought recovery is slow;
- if pasture growth rates are high, concentrating stock on a smaller number of paddocks to ensure pastures remain vegetative (that is, leafy, and not rank and running to head) for as long as possible. A vegetative pasture with a minimum of 1500 kg DM/ha for sheep and 2500 kg DM/ha for cattle should maximise growth rates and production
- consider conserving pastures that are likely to become rank and thereby replenish depleted hay or silage reserves. These pastures can be used as a low-quality feed source through winter. The hay/silage option may also be an important strategy for weed control.

Managing pastures after drought

CAUTION

Livestock health disorders

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

It is vitally important for our grazing industry to quickly rebuild the State's stock numbers and also to improve each producer's earning capacity as quickly as possible after a period of drought. For this reason, the potential from reviving pastures must be realised as soon as possible.

EFFECTS OF DROUGHT ON PASTURES

The effects of drought on pastures are extremely variable and subject to a large number of factors.

Research and observations based on past droughts are outlined below. In a very severe and prolonged drought, the loss of pasture species may be greater than losses experienced in previous droughts when these observations were made.

Perennial pastures

Large areas of perennial pastures will have thinned out, depending on: the severity of drought; stock pressure; the species involved; and soil fertility.

Research on drought survival of species

Research undertaken on the Northern Tablelands by the University of New England and the CSIRO looked at survival of perennial grasses during drought. It showed the following:

- Where stubble was retained (more than 1000 kg of dry matter per hectare), the survival of perennial grasses was significantly better than where feed was grazed out completely.
- Losses following prolonged dry conditions (where some green feed may be available) were actually greater than the losses from severe droughts such as those experienced about one year in ten. Researchers concluded that, in longer-term droughts, plants are more likely to cease growth altogether, whereas in prolonged dry spells, the plants continue to grow and the feed is grazed-off, gradually debilitating the plants' energy reserves and resulting in the death of weak plants.
- Under Tablelands conditions and on good-fertility soil, shallower-rooted species such as perennial ryegrass and cocksfoot were lost in significant numbers, whereas phalaris, fescue, and the native grasses wallaby grass (*Austrodanthonia richardsonii*) and weeping rice grass (*Microlaena stipoides*), survived.

Each drought is different. When looking at what is likely to have survived the drought and what may need to be resown, we can be guided by these research results and by observations of the survival levels of major pasture species in previous droughts.

Introduced temperate perennial grasses

Phalaris

Experience has shown that, of the introduced major perennial grasses, phalaris has been the outstanding survivor, followed by cocksfoot, fescue and then ryegrass.

Provided fertility is good, and particularly on the heavier soil types, phalaris persists well, even under heavy, prolonged grazing pressure. The more erect varieties, typified by Sirosa and Sirolan, have been less-persistent than the old prostrate Australian variety.

Tall fescue

The combined effect of dry, hot summer and heavy stocking, particularly with sheep, caused a widespread failure of fescue. This was more apparent in areas receiving less than 650 mm rainfall (Northern Tablelands) and 750 mm (Southern–Central Tablelands). These experiences serve to emphasise the need to exercise more careful grazing management of fescue-based pastures, especially under a sheep enterprise during summer, and to employ some form of rotational grazing to reduce stress on individual plants.

Cocksfoot and ryegrass

These species have exhibited poorer survival compared with phalaris and, in many situations, compared with fescue, although survival has

been better on heavier soils and where pastures were stocked with cattle rather than sheep.

Mediterranean cocksfoots (like Currie) have survived better than European types, although cocksfoot failed eventually under the combined effect of drought and consistent heavy stocking pressure, with most perennial ryegrass dying before cocksfoot.

In some situations, regeneration of ryegrass and cocksfoot from soil seed reserves was surprisingly good in the higher-rainfall areas (> 800 mm) following the drought of the early 1980s.

Introduced temperate perennial legumes

Lucerne

Lucerne also has a good track record of drought-hardiness, but this depends on the intensity of grazing pressure. Semi-dormant and selected winter active varieties appear to survive better than highly winter-active varieties – unless strict rotational grazing has been practised.

White clover

Shallow-rooted perennial legumes such as white clover generally do not survive as perennial plants, although varieties such as Haifa have good potential to recover from soil seed reserves. This is assuming that the pasture has been well-established and has had a good opportunity to set adequate seed.

Subtropical grasses

Of the more commonly-grown grasses – Bambatsi panic, Premier digit grass, Consol lovegrass, Forest bluegrass and Buffel grass – have survived better than Purple pigeon grass or Rhodes grass in recent droughts.

Native perennial grasses

Experience has shown that native perennial grasses survive well, although the pressure on some paddocks has been so extreme in some areas that losses inevitably occur. Survival and the potential for quick regeneration from seed is, however, very dependent on the species involved, the management applied, and on the recruitment opportunities.

Annual pastures

Well-established introduced annual pastures have the advantage of generally good soil seed reserves and the ability to respond rapidly when conditions allow. However, annual pasture paddocks have the disadvantage of having very little ground cover left and may be very prone to erosion. Seed reserves may also be depleted in heavily-grazed sheep pastures but, in long-term pastures, there is normally adequate seed left to enable reasonable regeneration to occur.

In recently-sown pastures (especially if sown with relatively soft-seeded varieties of sub clover – Woogenellup, Denmark), resowing may be necessary.

EFFECTS OF DROUGHT ON SOIL FERTILITY

While individual soils react differently to weather changes, there are some general principles that can help when recovering from a prolonged drought:

- Nitrogen (N), phosphorus (P) and sulphur (S) are major nutrients required for plant growth and these tend to be at slightly higher levels in soils recovering from drought. These higher levels will assist production in the short term (3–4 months) but where pre-drought levels were markedly deficient, growth will still be checked by nutrient deficiency.
- P and S fertilisers applied just prior to the drought can be assumed to be still available, although if resowing pastures, a small amount (for instance, 5 kg P/ha) should be sown with the seed.
- Where improved pastures were maintained at critical levels of P and S pre-drought, fertilising could be withheld for about six months, unless a soil test indicates otherwise.
- If you are not sure of specific paddock fertiliser needs, do a soil test or apply fertiliser strips.
- The drought is unlikely to have any significant long-term effects on soil pH.

FIRST, ASSESS WHAT HAS SURVIVED

Before working out a strategy, consider the needs of the pasture and how the drought has affected it. The survival of both perennial grasses and legumes will have been variable and influenced by:

- total rainfall and rainfall incidence

- pasture composition
- soil type, slope and aspect
- type of stock and stocking rate
- grazing management
- pasture pests, such as wingless grasshoppers, pasture scarabs, lucerne aphids and earth mites
- health of pastures before the drought.

The first task after drought should be to check paddocks after growth has recommenced, ascertain what is left, and determine what the potential of the remaining pasture is, given a reasonable chance of recovery and reasonable seasonal conditions. For annuals you may have to wait until spring (for warm-season annuals) or autumn (for cool-season annuals).
If you need help to determine what species are regrowing, seek advice from your district agronomist, consultant or commercial representative. When checking pastures, keep in mind that the density of perennial species is more important than that of annual species.

Density of surviving pasture

How dense a pasture should be in order for it to be retained depends on many factors and will vary from district to district. For example, at Wagga Wagga or Tamworth, lucerne densities of 15 plants/m^2 are relatively thick, but 9 plants/m^2 would be acceptable; however, at Trangie, 8 plants/m^2 is thick and 5–6 plants/m^2 is acceptable.

Remember that the remaining perennial plants in a drought-affected pasture (especially lucerne) have the ability to compensate so that as stands thin out, remaining plants take advantage of the additional space, nutrients, and moisture, and may still produce reasonable yields.

Erosion potential

The erosion potential of all paddocks also needs assessing. Adequate ground cover is the key to this. This will vary with the situation (slope, soil, likely rainfall intensity); for example, 70 per cent ground cover is considered adequate for gently sloping red soils on the Northern and Central Slopes.

Value of surviving pasture

Consider also the composition of the surviving pasture in relation to its value to the enterprise following the drought. Perennial pastures are very expensive to resow, and native grass pastures in most cases cannot readily be resown. These high-value pastures must then be given priority for rest if it is apparent that further grazing may threaten their survival.

After checking the potential of pastures for survival and for future production, rank your pastures according to their potential value after the drought, as follows:

A. List paddocks that have a moderate-to-good density of desirable species but have been under severe stress from drought and grazing pressure. Maintaining a grazing regime that continually removes regrowth is likely to threaten survival further.

B. List paddocks that have moderate-to-good density of desirable species but have not been under severe stress from drought and heavy grazing. These paddocks offer the possibility of some grazing as conditions improve but will need management to allow full recovery in the short-term.

C. List paddocks where the pasture density is too thin in order for it to become worthwhile pasture after a return to more normal conditions. This last group can be considered for immediate grazing ('sacrifice paddocks'), cropping possibilities, resowing or pasture renovation treatment.

HOW TO MANAGE WHAT'S LEFT

In practice, pastures are under a great deal of pressure after the drought breaks. Feed is expensive, and it is tempting to continue grazing paddocks in the hope that the growth will improve dramatically and gradually meet stock needs. This is very damaging to pastures. It is important to develop a strategy where:

- the high-potential paddocks, identified as A above, are given priority for rest;
- the second group, B, are scheduled for rest as soon as practicable;
- paddocks in the last group, C, can be used as sacrifice paddocks where drought feeding can continue until growth on better paddocks improves; importantly, these paddocks are suitable for resowing, renovation or being sown down to forage/fodder crops.

'Ideal' post-drought management procedures are not well-understood for many commonly-used species, so we can only base guidelines on limited research and observations made following previous droughts.

During drought, pasture management is compromised if:

- Pastures are rested less (if at all).
- Pastures are grazed harder for longer periods and are grazed lower than normal.
- Energy reserves are depleted and the plant is weakened, often to the point of death.

Where pastures are compromised in this fashion, they need to be compensated. A good fall of rain in itself does not overcome drought-stress. The plant has to be allowed a period of recovery to build-up energy reserves so that it is capable of reaching its full production potential. The time required to reach this stage depends very much on the degree of rest or compensation.

Lucerne is particularly responsive to resting. Ideally, after drought, it should be allowed to reach full-flower, at which stage, with good growing conditions, it will have replenished its root reserves fully, and normal grazing practice can resume. Research has shown that energy reserves in lucerne roots are at their lowest level two weeks after regrowth commences. Grazing the green pick shortly after rain can, therefore, weaken a plant significantly. The more regrowth that is allowed before grazing, the better the chance that plants have for a complete recovery.

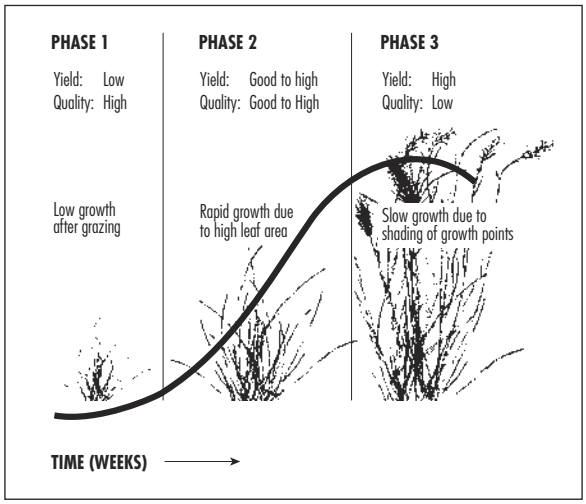
When to graze

The simplified growth curve shown in Figure 1 can be used to indicate when pastures should normally be grazed. Generally, avoid grazing pastures while the important perennial components are in Phase 1. At this stage, they are weak and have insufficient leaf area to produce feed quickly. Ideally, pastures should be allowed to reach Phase 3 (flowering) after a long, severe stress period. At this stage, the plant's energy reserves have been replenished – this is assuming that flowering has not been premature (that is, forced by dry conditions).

At the very least after drought, delay grazing until pastures are into Phase 2, at which stage they are growing actively and have sufficient leaf area to produce feed efficiently. Where you are forced to graze paddocks early, plan to rest them, and preferably, allow perennial grasses to seed down as soon as conditions permit. Also, rotate livestock quickly.

Pasture height at these growth stages will vary considerably, depending on species, density, and growing conditions. As a guide, a typical, healthy, dense perennial grass/legume pasture would be in Phase 2 when it is between 3–11 cm in height (1000–2500 kg dry matter/ha). The pasture may take 4–6 weeks to reach this stage – assuming that responsive plants are present.

Figure 1. Simplified growth curve of pastures



Source: *The PROGRAZE Manual*

RESOWING/CROPPING/ RENOVATION OPTIONS

Where paddocks are identified as having low recovery potential, **resowing, cropping** or **renovation** are options that need to be considered. Such options include a full seed-bed preparation for a forage or cash crop, or direct drilling to re-establish a permanent pasture. Some annuals, such as sub clover, can also be surface-applied in higher-rainfall areas.

Table 1 summarises the options for typical paddock situations following the break of the drought.

Forage crop selection

Fast-growing forage crops fit in well to a pasture regeneration program after drought. Once established, they can take the pressure off the high-potential pastures, thereby allowing them to recover. These species are also useful for cleaning paddocks of weeds prior to resowing pasture and for replenishing hay and fodder reserves quickly.

The most suitable forage crop will depend on:

- when the feed is required
- what quality of feed is needed
- sowing conditions, including soil temperatures
- suitability of the soil type.

Often after a drought, feed is required as soon as possible, and Japanese millet or early-maturing cereals are, in these circumstances, recommended.

Where crops are required to provide feed over a longer period, forage sorghums or hybrid millets are ideal for the Slopes and Plains as are brassica forages on the Tablelands.

STOCK HEALTH

With the return of good growing conditions, watch for bloat in stock grazing clover-dominant pastures, and ensure that livestock vaccinations, for conditions such as enterotoxaemia,

are up-to-date. Also, stock grazing on actively-growing lucerne need close monitoring. Lucerne growth can be rapid after a drought, increasing the risk of bloat and red gut.

Following drought, the 'sudden death' form of phalaris poisoning can occur, especially where pastures are growing rapidly following a break. This is because phalaris is more persistent than other grass species and can therefore dominate. This form of phalaris poisoning is associated with short, actively-growing phalaris-dominant pastures in autumn or late winter–spring, and is more prevalent where hungry sheep are involved.

Similarly, other pasture plants may dominate during the recovery period. The intake of plant toxins may, therefore, form an unusually high proportion of the diet and be a cause for concern (such as photosensitisation with panic grass species).

Nitrate poisoning can also occur with grass on high-fertility soils growing quickly following the break. Improved grasses, cereals and broadleaved weeds, such as variegated thistles, have also caused poisoning in the past.

The incidence of worm and fluke problems can also increase because stock concentrate on new, fresh growth in areas such as valley floors.

WEEDS – EXTRA CARE NEEDED

One of the unfortunate consequences of droughts is the spread of new and existing weeds into pastures – dramatic spread occurred following the 1982 drought. Seeds would have

Table 1. Options for pasture renovation

Paddock situation	Options
Totally degraded. Substantial loss of introduced perennial grasses. Heavy weed invasion.	• Annual forage crop (for instance, Japanese millet, cereals). • Short-term pasture (Italian ryegrass/red clover). • Cash crop (cereals, oilseeds, ryegrass, coarse grains to allow selective weed control). • Select the most arable and fertile paddocks first. • High priority.
Partial loss of introduced perennials. Some weed invasion. Reasonable legume recovery likely.	• Weed control and direct drill to re-establish perennial pastures. • Seasonal weed control (winter clean spray-graze). • Moderate priority.
Survival of perennials more than 70 per cent . Poor legume survival. Some weed invasion.	• Reintroduce legume by sod-seeding or broadcasting. • Resume fertiliser applications to lift P and S, or when cash flow allows. • Selective broadleaf weed or annual grass removal, or use of 'weed wiper' equipment. • Moderate priority.
Fair to good survival of native perennial grasses. Poor legume survival. Some weed invasion.	• Low priority for early action. • Add legume seed and P and S fertiliser when cash flow improves.

been introduced through brought-in feed and by stock movements.

Also, following the break, pastures are weakened and less able to compete with vigorous weeds, especially annual species. Therefore, be prepared for several years of vigilance. Do not delay checking the identification of any strange weeds you find, especially if they are found where you may have fed-out fodder.

FODDER CONSERVATION

While the most recent drought is still fresh in your mind, build-in to your program a 'fodder conservation' strategy to reduce the effects of the next drought.

Remember that silage and hay can be made from a wide range of pasture and crop materials.

USEFUL REFERENCES

- Agfact P2.5.41 – *Forage sorghum and millet*
- Agnote DPI-367 – *Cereals for grazing*
- *Pasture grass, legume and herb varieties used in NSW*
- Agfact P4.2.16 – *Summer legume forage crops: Cowpeas, lablab, soybean*s

Soil management following drought

The principle aim for farmers after rain has broken a drought should be to get pasture or crop cover established on bare paddocks as soon as possible. This principle applies especially to red soil areas but is also important for clays.

Many soils will not be in their 'normal' condition following drought. Some will be bare and powdery on the surface, some will be further eroded by wind or water, and some will have higher levels of nitrogen (N) and phosphorus (P) than expected.

Loss of effective ground cover (due to grazing or cultivation) generally leaves soil prone to erosion by wind and water. Research by the Department of Sustainable Natural Resources' *Soil Services* has shown that erosion due to drought-breaking rain can make up 90 per cent of the total soil loss in a 20–30-year cycle.

Available N and P levels in the soil are generally higher following a drought than in a normal season. However, most of the N and P are in the topsoil so, if erosion strips the topsoil, much of this benefit is lost.

SOIL STRUCTURE AND EROSION

Cracking black, grey and brown clays can develop wide and deep cracks during drought. Generally speaking though, their structure is as good as it is ever likely to be.

On the other hand, the structure of non-cracking red loam soils generally deteriorates during drought. Topsoils can become very dry and powdery, and are highly-vulnerable to erosion.

A useful first strategy is to sow your most-vulnerable paddocks early to make use of available nutrients. Planting grazing oats provides good surface cover quickly. Reserve your less vulnerable paddocks for your main winter crop. (See *Grazing management following drought* and *Managing pastures after drought*.)

Also consider the benefits of pasture retention, rather than cropping, for those paddocks in reasonable condition. The strategy should be in line with your property management plan.

Controlling weeds by spraying, rather than cultivation, will help retain some surface ground cover. However, you may need to cultivate bare soils initially to create some surface roughness to improve infiltration of water and to reduce wind and water erosion. If this is the case, do this as early as you can when the soil is moist but not too wet or too dry. Use a ripper or chisel plough and cultivate on the contour to catch maximum rainfall and reduce run-off.

Try to confine machinery traffic to narrow laneways and keep stock off wet soils. Uncontrolled machinery traffic and stock trampling are major factors causing structural degradation, and subsequent erosion, of soils.

A good time to apply gypsum to sodic clay soils is when the soil is cracked. When rain falls, this will move the gypsum into the strongly-cracked soil to maintain good infiltration after the cracks have closed.

To reclaim eroded areas or prevent further erosion, consider the construction of contour furrows or soil conservation earthworks. These reduce and slow run-off, limit the movement of soil and organic matter, and decrease the sedimentation and nutrient contamination of dams and waterways. (Refer to *Soil Services*, from the Department of Lands.)

Low-interest loans are available for soil conservation works. See the section on *Soil Nutrition.*

In paddocks that were sown during the drought but which failed to produce a crop, soil nitrogen levels are likely to be higher than usual for two reasons. The first is that most of the nitrogen incorporated before sowing the crop that failed will still be available, provided the crop was not grazed or cut for hay. The second reason is that mineralisation of nitrogen (conversion to plant-available forms) increases markedly once it rains.

As a consequence, weeds are likely to grow rapidly after rain and need to be controlled, preferably by spraying. If cultivation is used, soils are more exposed to erosion. For further information, see *Weeds – a threat to drought recovery*.

Despite high soil N levels, starter fertiliser and some side dressings may still be required; consult your agronomist, and refer to Agnote DPI–356 *Winter cropping following drought* for more information.

Higher soil temperatures and a longer growing season result in greater root exploration and, hence, the need for less fertiliser.

As with a 'normal' season, soil testing for plant-available phosphorus is advisable to help you decide how much phosphate fertiliser you need. This is an important decision: too little reduces plant growth and yields, too much wastes your money and may have damaging effects on the environment.

LONG-TERM SOIL MANAGEMENT

Conservation farming practices and the efficient management of fertilisers are two important ingredients for long-term, sustainable, profitable production. Such measures help you prevent or slow soil erosion and other soil-degrading processes and should be part of your defence against drought.

Some important conservation farming practices

- Use minimum tillage or no tillage and direct drilling.
- Retain stubble on the surface for as long as is practicable; if burning is necessary, wait until the main period of high-erosion risk has passed.
- Use herbicides, rather than tillage, to control weeds during fallows.
- Use crop/pasture rotations that include well-managed perennial pastures and legumes.
- For irrigated row cropping, use permanent, raised beds.
- Confine machinery traffic as much as possible.
- Improve grazing management to minimise soil compaction and maintain adequate surface cover, particularly during droughts.
- Increase topsoil organic matter levels by stubble incorporation, mulching, and the including of pastures in crop rotations.
- Judiciously apply lime and/or gypsum to acid soils and sodic clay soils.
- Promote vigorous plant growth through sound soil, crop and water management practices.

Guidelines for efficient fertiliser management

As far as possible, match the supply of nutrients, principally nitrogen and phosphorus, to the needs of the plant, through soil and/or plant tissue testing and improved timing of fertiliser application.

- Incorporate (rather than broadcast) fertiliser wherever possible.
- Do not broadcast fertiliser on bare soil, especially when storms are likely.
- Do not fertilise close to or across dams or waterways.
- Store fertiliser under cover on impervious or compacted soil away from dams and waterways and divert run-off from higher ground around and away from the fertiliser stockpiles.
- Keep records of fertiliser usage and calibrate spreading equipment to reduce the likelihood of overuse.

Weeds – a threat to drought recovery

Drought provides the ideal environment for weeds to demonstrate their competitive ability. It is therefore important to maintain vigilance once rain arrives so that weeds do not become a serious threat to drought recovery on your farm.

Weeds are a major form of land degradation and are a high cost to the community in both environmental damage and lost production for the farming and grazing industries.

LIKELIHOOD OF WEEDS

The weed situation in cropping and pastoral areas varies. In cropping areas, the immediate problem is fallow weeds, which quickly rob the soil of both valuable nutrients and moisture. Fallow weeds can be controlled by a combination of cultivation and herbicide spraying (see *Soil management following drought*). The weed species likely to cause most concern are:

- common heliotrope (*Heliotropium europaeum*)
- summer burrs – Bathurst and noogoora burrs (*Xanthium spp.*)
- caltrops (*Tribulus terrestris*)
- *Amaranthus* spp.
- thistles
- panic grasses (*Panicum* spp.)
- mintweed (*Salvia reflexa*)
- Johnson grass (*Sorghum halepense*)
- wireweed (*Polygonum aviculare*).

In **pastoral and Tablelands areas**, noxious weeds that quickly recover and spread include:

- serrated tussock
- blackberry
- blue heliotrope (*Heliotropium amplexicaule*)
- nodding thistle (*Carduus nutans*)
- Scotch thistle (*Onopordum* spp.)
- St John's wort (*Hypericum perforatum*).

Weeds provide an additional financial burden in both lost production and cost of control after a long period of low farm productivity.

GENERAL PROBLEMS

Summer burrs (both Bathurst and noogoora burrs) pose immense problems, as does the potential spread of the perennial weed, silverleaf nightshade (*Solanum elaeangifolium*) – a serious, long-term threat to farming and pastoral areas.

WEEDS FROM INTRODUCED FODDER AND GRAIN

Weeds currently present and new introductions are highly-likely to appear as a consequence of feeding drought fodder and grain.

Major weeds of concern in NSW that originate in other States are parthenium weed from Queensland and bifora (*Bifora testiculata*) and bedstraw/cleavers (*Galium tricornutum*) from South Australia. These latter two plants are already widespread in the South Australian wheat belt. If purchased grain has originated from these areas, it is therefore important to check for any weed emergences, especially in areas where stock have been fed.

Other likely weed contaminants of both grain and fodder are silverleaf nightshade (mentioned earlier), wild radish (*Raphanus raphanistrum*) and spiny emex (*Emex australis*). These species are already major weeds in NSW but will probably be further spread as a consequence of drought-feeding.

Imported grain from overseas sources provides a huge potential for introducing new/exotic weeds such as kochia (*Kochia scoparia*) from the United States.

The procedures for feeding introduced fodder and grain are well-publicised (see *Weed strategies following drought, fire and flood*), and producers are encouraged to adopt a program to minimise the spread of weeds from contaminated fodder and grain.

POISONOUS PLANTS

Following summer rains, there can often be an increase in livestock weed poisoning. Stock losses in these circumstances can be attributed to both direct plant poisoning and photosensitisation with:

- *Panic* spp. causing photosensitisation, mainly in sheep;
- *Amaranthus* spp. causing kidney failure in sheep and cattle;
- thistles causing nitrate poisoning in sheep and cattle.

With an increase in the presence of useful grazing species, the poisoning situation will normally only be short-lived.

See also *Animal health following drought* and *Grazing management following drought*.

PLANT IDENTIFICATION

Early identification and control are the first and most important steps in weed control and eradication. District extension officers can provide identification and technical information on new weed species, such as bifora and bedstraw/clevers.

HERBICIDE RESISTANCE

Fodder and grain contamination with herbicide-resistant weed seeds, mainly annual ryegrass, is the quickest means of introducing herbicide-resistant weeds onto farms where, perhaps, herbicides have never been used. Good farm hygiene and the rational feeding of introduced fodder and grains are the best avoidance procedures for keeping out weeds.

Herbicide resistance is widespread in the grain belts of South Australia and Western Australia – large quantities of grain are often obtained from these areas when there are drought conditions in NSW. The manner of drought feeding, particularly of grain, will determine the spread of herbicide-resistant weeds on individual farms.

CONTROL STRATEGIES

Control strategies in both cropping and pastoral situations are generally adequate. Pesticide orders are in place to control such weeds as blue heliotrope. The most important aspect of control of newly-introduced weeds is early identification, detection, and immediate control.

Drought conditions will often result in a serious setback for a producer's long-term strategy and program for controlling pastoral and cropping weeds. An accurate assessment of this situation and a well-planned long-term strategy form the basis of an effective weed control program.

Weed strategies following drought, fire and flood

Because of their competitiveness, weed species readily invade bare areas of ground denuded of vegetation. Drought, fire, and even floods can create these conditions by devastating existing ground cover and, thereby, removing the competition for light, nutrients, moisture and space. This allows quick weed establishment when more favourable conditions arrive. Weeds already on a property can also quickly spread to new areas with weed densities increasing.

The two classes of land most at risk of weed invasion are cropping and grazing land. Cropping land is most at risk through weed imports in contaminated seed at sowing time and weed seed being spread from contract machinery – especially harvesters. Grazing land is at risk of weed importation through the contamination of fodder. Weed seed may also be inadvertently spread around a property at the time of feeding or in dung, days after the contaminated fodder has been eaten. Animals introduced onto a property, either in a restocking program or returning from agistment, can also introduce weeds.

The presence of livestock on a property will usually benefit the spread of weeds as these plants are generally unpalatable and are therefore not readily grazed.

It is important to avoid importing new weeds but also to avoid introducing strains of common weeds which are resistant to herbicides. Ryegrass is particularly prone to resistance, especially on land which is sown to crops.

It is important to have a strategy in place for combating potential weed problems before, not after, they occur.

LIVESTOCK OWNERS

- Obtain as much detail as possible about the source of the fodder or grain that is being brought onto your property.
- Consider carefully where the grain and fodder are to be fed. In considering herbicide resistance, it is best to avoid cropping paddocks.
- Restrict the feeding area as much as possible. A small 'sacrifice paddock' may be the best option, preferably located where regular checks can be made after rain. Flat, arable areas are the best selection as these usually allow easy access and the opportunity for many options for control (mechanical, chemical, biological, or grazing management).
- Feed in areas where there is the basis of a good, strong perennial grass pasture, as this provides quicker competition against establishing weeds.
- Livestock are, unfortunately, excellent distributors of weed seeds. For many weeds, therefore, a livestock quarantine period of at least two weeks is recommended. This includes for livestock returning from agistment.
- Restrict the movement of livestock. Fortunately, annual ryegrass seed is normally digested by sheep, and very little viable seed passes through the digestive tract.
- Keep a close watch for unknown plants and have them identified early. Don't let them establish and set seed.

COUNCIL STAFF

- A general weed alert should be publicised by councils in all areas at risk.
- All council weeds officers should identify the properties in their areas most at risk. These are normally properties which have imported fodder from areas of known weed infestations, such as parthenium weed areas of Queensland.
- When rains return, roadsides should be inspected every four weeks.
- All properties considered at risk should be inspected as soon as possible after first sightings of weeds.
- Council staff should familiarise themselves with weeds which grow in areas that supply emergency fodder.

INFORMATION AND PLANT IDENTIFICATION

A list of potential weeds from the southern States of Australia can be obtained by referring to the following publications:

- *Crop Weeds*, by JL Wilding, AG Barnett and RL Amor, Inkata Press, Melbourne and Sydney 1986.
- *Weeds – An illustrated botanical guide to the weeds of Australia*, by BA Auld and RW Medd, Inkata Press, Melbourne 1987.
- *Noxious Weeds of Australia*, by WT Parsons and EG Cuthbertson, Inkata Press, Melbourne and Sydney, revised edition November 2000.

For information on paddock management or weed control options, consult your district agronomist. These officers can also assist with the identification of unknown plants. Alternatively, you can contact your local council weeds officer.

Plant specimens which are not identifiable locally can be pressed in dry newspaper for a few days and then forwarded by mail, along with the details of where the plant was growing, to the National Herbarium of NSW Botanical Information Service at the following address:

Botanical Information Service
National Herbarium of NSW
Royal Botanic Gardens
Mrs Macquaries Road
Sydney NSW 2000

Preparing for cropping after drought – removing pastures

SHOULD I REMOVE PASTURE TO PLANT A CROP

Many mixed farming enterprises may consider planting additional crop areas to help generate quick cash flow and on condition that the season permits it. However, before removing pastures for cropping, risk management options and livestock requirements should be weighed up carefully. Dramatically increasing your cropping area following a year when crops made slim or negative profits can quickly erode equity unless the season is favourable.

Pasture paddocks with reasonable densities of perennial species (for example, 8–10 lucerne plants per square metre) should recover well and could be utilised for grazing. These pastures can also be used as a low-risk source of feed for fattening stock, rebuilding strength in drought-weary breeding stock, or rebuilding stock numbers.

The most suitable paddocks for cropping, other than long-fallowed paddocks, are failed crop paddocks from the previous year. Important considerations should be residual herbicides, disease pressure, and nitrogen levels. There is well-documented evidence from previous droughts that much of the fertiliser applied to badly drought-affected crops, along with any mineralisation of nitrogen, is available for the next crop.

Removing pastures

Removing pastures following a drought can be a different proposition than it is for normal seasons.

Continuous heavy grazing tends to run down a plant's root reserve, thereby weakening the plant. Following rain, pastures can also take longer to respond and to produce leaf than they normally would. In this circumstance, removing pastures with herbicides may not be effective. Removal with tillage may be more effective as there will be less surface trash to cause blockages and the plant will be already partly weakened.

Following significant rain, perennial pastures can be removed with herbicides, however, fresh growth is required for plants to take up chemicals properly. Be aware that good falls of rain will be required following pasture removal to wet the soil profile. Unless there is a metre of wet soil, planting a winter crop may be too great a risk.

Seed survival of annuals

Seed reserves of hard-seeded annuals such as sub clovers (as well as weeds) may well have survived from previous years and could become a pest in very early sown crops.

Paddocks which should have been spray-topped or fallowed last winter/spring but missed out, may be carrying higher than normal weed burdens.

Species and grazing management will have partly determined if this will be an issue. For example, sub-clover paddocks which have been heavily stocked with sheep will have much of the seed containing burr cleaned up, whereas barley grass which seeded down last year could be a particular pest this season.

In other situations, allowing these pastures as well as weeds to germinate and utilising a pre-plant knockdown spray or cultivation would be beneficial.

Consider also paddocks which were used to feed stock with introduced feed stuffs.

These paddocks should be monitored for new and/or higher than normal numbers of weeds. Some paddocks may be too dirty to consider cropping this year and may be better left out to control weeds.

The soil profile in many perennial pasture paddocks will likely be very dry and could take considerable 'wetting up' to allow for lower risk cropping. Usual guidelines should be adhered to – 1 m of wet soil for many crops in northern environments.

Dryland winter crop opportunities

NSW Department of Primary Industries has, over the years, published series of summary sheets which list the major considerations when choosing a winter crop for a given paddock. These summaries are a guide to help prompt questions rather than provide all the answers. It is therefore important to remember that each paddock is different. The information on these sheets can be found at the NSW DPI website or from your local district agronomist.

A similar set of summer crop information is also available from these sources.

The information below is a summary only. More detailed information is available from the '*Winter crop variety sowing guide*' and the '*Productive dual-purpose winter wheats*' (available free from all NSW DPI offices). The winter crop budgets can be found on the NSW DPI web page and information is also available from NSW DPI district offices.

Given the variable nature of rainfall it is vital that any planting decision be based on good information about stored soil moisture and soil fertility levels.

Concentrate on cropping the best paddocks that are most likely to give good returns per hectare. Generally, inputs should be targeted to make the most of available soil moisture. Yield targets should match soil moisture profiles and soil fertility levels.

If sowing a dual-purpose crop, pasture and grazing management will be important. Seek advice from your local district agronomist.

As with any season, successful winter crops will depend on good agronomic management. The following are some of the considerations this season.

Stored soil moisture

Carefully check the level of stored soil moisture. It may be better to fallow the paddock through to a summer crop, rather than risk planting on marginal moisture. Total moisture requirements are greater than a grain crop because they are sown very early for grazing and grain purposes.

Seed supplies

Seed supplies for winter crops will be very tight. Obtain seed supplies as early as possible. If using seed retained on-farm from previous seasons, a germination test is essential.

Level of experience

There are considerable risks associated with growing a crop for the first time. Do not grow large areas unless you have previous experience with the winter crop selected. New crops can be risky and have large variable costs. Another consideration is how the crop fits your current rotation. Consider joining a TOPCROP group or developing a learning partnership with an agronomist and increase the area grown over time.

Markets and prices

An evaluation of market prospects is a key part of the crop selection strategy as crop prices can fluctuate dramatically.

Residual herbicides

Carefully check paddock spray records. Paddocks may have had pre-sowing residual herbicides applied (such as Group B sulfonyl ureas) which will, unfortunately, prevent the sowing of some winter crops.

Soil nitrate

Crops such as canola, wheat and barley require significant levels of available N. Winter pulses, however, do not. Winter pulses planted into paddocks with high available N (for example, where N was applied but not used by a winter crop) will have reduced N fixation. Dual purpose crops do require high soil fertility, particularly nitrogen.

Insect control

Monitoring of winter crops for insects, particularly in winter pulses is vital.

Overall rotation

Although there is pressure to generate cash flow by planting winter crops, maintaining a balance of winter and summer crops in the rotation is the key to risk management in northern NSW.

Level of risk

Winter cropping can be risky in some parts of the state. This risk can be partly compensated by good levels of stored soil water.

Gross Margin Budgets

Cropping gross margin budgets are a guide to the costs and returns associated with major broadacre summer and winter crop enterprises in northern, central and southern NSW. They include all the major broadacre crops as well as specialist crops such as dual purpose oats and wheat. There are also budgets available for cattle, sheep and vegetables.

Economic considerations are just as important as the agronomic considerations when it comes to deciding which crop enterprise gives the 'best' return. One of the best ways to make economic decisions is to do a gross margin budget. A gross margin is the gross income from an enterprise less the variable costs like seed, fertiliser, pesticides, fuel, oil, harvesting costs, freight and insurance. Fixed or overhead costs such as depreciation, interest payments, rates, or permanent labour are not included because these costs have to be met regardless of the enterprise mix.

Gross margins can be used to directly compare similar enterprises within and between years. They can also be used to analyse actual enterprise performance by monitoring costs and returns. These are available from NSW DPI offices and via the internet at: *www.dpi.nsw.gov.au/agriculture/budgets*

Gross margins should not be used if major changes are being considered as more comprehensive budgeting techniques would be required to account for changes in resource use. Other budgeting techniques include a partial budget, whole farm budget, cash flow budget and development budget.

Winter cropping following drought

Winter cropping is a traditional investment following a drought that is aimed at generating cash flow into the farm business.

The potential for a good season following drought is an opportunity for recovery which should be taken to best advantage. The following points will assist in making decisions on winter cropping.

MARKETING

Markets for all grades and types of grains may not follow traditional relationships. This is because specific market needs, such as local intensive livestock industries, need to replenish or increase grain reserves. It will therefore be important to watch market trends.

ROTATIONS

Follow planned rotations and aim to get paddocks back into sound agronomic rotations as quickly as possible, in line with your property management plan. Taking shortcuts by sowing successive winter cereal crops may well prove costly because of a build-up of diseases and weeds and an increased risk of erosion.

YIELD MAXIMISATION

Give your crop the best chance, with careful attention to weed control (see *Weeds – a threat to drought recovery*), phosphorus applications, timely sowing, and choice of variety.

SOIL

See *Soil management following drought*.

Soil phosphate

Soil phosphate levels usually increase only slightly during droughts due to low utilisation and, possibly, unused phosphorus from previous failed crops. Soil phosphorus testing is therefore useful in this situation.

Soil nitrogen

During droughts, soil nitrate nitrogen increases by mineralisation and may be quite high. In addition, most of the fertiliser nitrogen applied to the previous year's failed crops should be available in the current year. However, prolonged heavy rains will move this soil nitrogen down the soil profile where it may not be readily available to young winter crops.

If weeds are allowed to grow abundantly, they may well use the available soil nitrogen, leaving little for winter crops.

Consider deep (rooting-depth) soil tests to assess the available nitrate.

Acid soils

Soil manganese is likely to increase following droughts, so avoid sowing susceptible crops like canola on problem acid soil paddocks.

SOWING TIME

Aim to optimise yield and capitalise on accumulated soil nitrogen by sowing as early as possible within the recommended sowing period for the particular variety. Of course, you must pay special attention to possible take-all infections in early-sown wheat by maintaining sound rotations.

VARIETIES

Ensure that purchased seed is true to the variety claimed by the vendor so that the variety can be sown within the sowing time available. Select only those varieties suited to your area.

DISEASES

Select varieties with good disease resistance. Diseases, particularly leaf diseases like stripe rust in wheat, are usually more prevalent and may even be devastating in good seasons which commonly follow drought.

SEED QUALITY

All grain legume seed and all cereal seed from previous harvests should be germination-tested to ensure that it is satisfactory.

CROP ESTABLISHMENT

There may be opportunities to establish crops with minimum tillage. However, to ensure successful crop establishment, plan to carry out weed control before sowing. (See Soil management following drought.)

FURTHER INFORMATION

Publications:

- *Weed Control in Winter Crops*
- *Winter Crop Variety Sowing Guide*
- Agfact P1.3.3 *Tractor fuel savings*
- Agfact P3.E.1 *Cereal seed treatment equipment*
- Agfact P5.2.7 *Linseed growing*

FURTHER ASSISTANCE

Contact your local NSW DPI District Agronomist for further assistance.

Cereals for grazing

THE ROLE OF CEREALS IN GRAZING

Forage cereals play an important role in grazing enterprises. They do this by helping to overcome winter feed shortages. They also have higher winter growth rates than most pastures (see Figure 2 for a typical example) and, with their higher carrying capacity, are able to ease the grazing pressure on pasture paddocks. All cereals can be grazed, but some have been specifically-bred for this with an emphasis on dry matter (feed) recovery after grazing and, in many cases, also for grain recovery. Saving autumn growth from early-sown crops, particularly in high Tablelands areas, can be used to carry feed through into winter. Forage cereals can also play an important role prior to sowing a pasture by conditioning the soil and by aiding in weed control.

CHOOSING A CEREAL

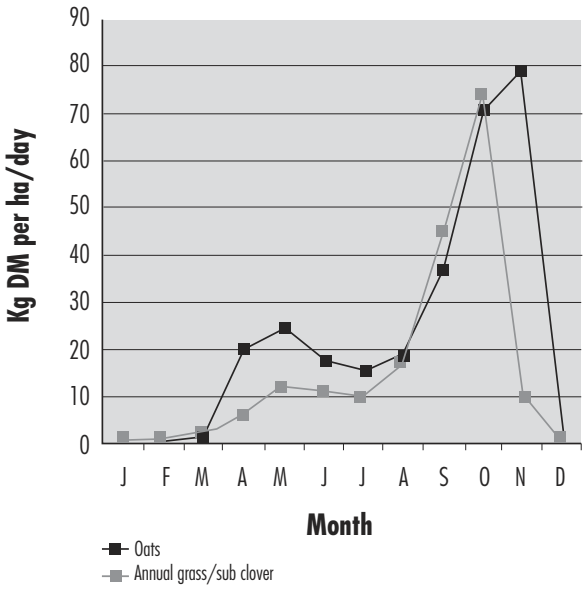
For overall forage production, oats will generally produce more than wheat, barley, cereal rye or triticale. The total amount of feed available will be influenced by the type of crop, variety, disease resistance and sowing time. Grain recovery though, is not so clear-cut, with winter wheats and triticale often having yields comparable to oats. Where a grain harvest following grazing is required, specific, dual-purpose varieties should be chosen. Cereals that produce large awns can cause mouth injuries to livestock and should be avoided for hay production or where head emergence under grazing cannot be controlled. These cereals include barley, triticale, cereal rye, and some wheats.

Selecting crop types or varieties tolerant to root and/or leaf diseases will lessen the disease impact in susceptible situations (see the *Winter crop variety sowing guide*). Where annual grass control (vulpia, soft brome, barley grass and ryegrass) has been poor in the winter/spring prior to sowing, cereal root diseases are likely to cause serious production losses. Highly-susceptible crops such as wheat and barley should be avoided; cereal rye has good tolerance, with oats the next best, followed by triticale.

Barley yellow dwarf virus is a disease on the Slopes and Tablelands causing serious losses in both dry matter and grain production in susceptible crops – particularly oats and barley when sown in early autumn. Tolerance to barley yellow dwarf virus will, therefore, influence crop and variety choice.

Quality tests on the forage of oats, wheat, barley, cereal rye, and triticale, when they are all grown under similar conditions, show no significant differences in levels of protein, energy and digestibility. The decision to sow an alternative cereal to oats is, therefore, mostly made when grain recovery is sought with higher returns. Soil acidity will also influence cereal choice as species and varieties vary in their tolerances. Even when highly-acid soils are limed, acid-tolerant types may still need to be considered where the subsoil remains acidic.

Figure 2 compares the estimated growth rates of oats and of annual grass/sub clover on the Central Tablelands (from the PROGRAZE® manual)



Growth habits

A knowledge of the winter habit and maturing time of varieties (see the *Winter crop variety sowing guide*) will influence the choice of variety, sowing time and expected grazing performance.

Winter habit. Varieties with a strong winter habit (Brennan wheat, Blackbutt oats) are suitable for early sowing as head initiation does not occur until there has been exposure to periods of cold temperature. This requirement is called 'vernalisation' and exposure can be cumulative. Once these requirements have been met, head emergence begins as temperatures rise and day length increases. The degree of winter habit will depend on the genetics of the varieties. Varieties described as semi-winter types have a shorter vernalisation requirement to initiate heading.

Late maturing. Late maturing cereals do not necessarily have a strong winter habit. Without the requirement for vernalisation, these types, when sown early in warm or long day conditions, will quickly initiate heads. These immature heads are concealed in the tiller and removing them by grazing or cutting results in the death of the tiller. Re-growth is then significantly delayed and total forage production reduced as plants are forced into producing new tillers, a slow process that can take weeks. Late maturing types without a winter habit, when sown early, often require quick and early grazings to retard early growth and head emergence. This earlier-than-normal grazing assists subsequent future regrowth.

PLANT MANAGEMENT

Sowing

Cereals used for either grazing or grain production will only attain maximum production if seed rates are kept high and crop nutrition is adequate. Optimum seed rates vary with climate and area of the State. Local advice should therefore be sought. Optimum nutrition requirements will, likewise, vary according to climate, soil type and paddock history. Wide row sowings should be avoided if maximum dry matter and grain yields are to be achieved. (In a recent experiment at Gulgong, in the lower Central Tablelands, on a light granite soil, a 25 cm row spacing compared with the normal 17.5 cm row spacing resulted in a reduction of nearly 12 per cent in early dry matter yields of Coolabah Oats). Wide rows, however, whilst reducing potential yield and increasing the risk of weed invasion, may aid in the reduction of leaf diseases by allowing better air movement through the crop.

Early sowings, particularly on the Tablelands, will allow good growth before cold winter temperatures restrict growth.

Fertiliser

Fertiliser rates for grazing crops should generally be higher than for grain-only crops owing to the longer growing season.

Phosphorus rates in the range of 15–20 kg/ha should be considered, but this will depend on soil tests, paddock history, anticipated yield and soil type.

Nitrogen application requires particular attention unless there has been a recent history of good legume growth. A good oat crop used for grazing and grain could be expected to use up to 100 kg/ha of nitrogen. The contribution of pulse crops and legume pasture to soil nitrogen depends on the amount of plant material produced and/or subsequent grain yield.

Insects

Red-legged earth mites and blue oat mites are the most widely-occurring insects attacking grazing crops. Their chlorophyll-destroying effect is worse in moisture-stressed crops and, in these situations, may require treatment.

Adding an insecticide to the spring fallow herbicide can, however, aid in their suppression.

Army worms can also attack crops; usually grain crops as they ripen. Chewed leaf margins and spikelets on the ground indicate their presence.

If insecticides have been used for insect control, the withholding periods must be observed before introducing grazing stock.

Weeds

Planning in the previous season to prevent annual weeds from seeding helps to reduce in-crop weeds and improves crop production. This is especially the case for grass weeds. Control can be through pasture cleaning, topping or early fallow.

Herbicide usage can depend on crop type. Herbicides can be registered for use on some crops but not others or the rates specified on the label may also be different. For example, the maximum label rate for 2,4-D amine (500 g/L) on wheat is 2.1 L/ha, whilst on oats it is 1 L/ha.

If herbicides are used for weed control, withholding periods must be observed before introducing grazing stock. Some grass herbicides have withholding periods of up to 60 days that may affect grazing strategies.

Higher seeding rates help to compete against weeds and maintaining crop canopy (bulk) will also help discourage weed recovery.

GRAZING MANAGEMENT

Grazing time

The earliest time to start grazing is when the plants are well-anchored and reach the tillering stage (growth stage 21–29). For most grazing types under good growing conditions, this will occur 6–8 weeks from plant emergence, depending on the variety. With winter types, by deferring early grazing, more feed can be accumulated and saved for winter. For erect types, crops will usually be 20–25 cm high and, for prostrate types, 10–15 cm high. Varieties that do not have a strong winter habit but are sown in early autumn should be grazed even before tillering to retard growth and subsequent premature stem elongation and head initiation. When stem elongation occurs, immature heads are located just above the highest node (joint). If these are removed, tiller death occurs. While the plant is usually able to produce more tillers, forage production (and grain production) is severely reduced under these conditions.

The latest time and severity of grazing of crops intended for grain recovery or hay production should be governed by the position of the immature head in the stem. Some growers opt to graze late and remove these heads, particularly if the crop or variety is prone to lodging. These growers choose to accept lower grain or hay yields as a trade-off for having a standing crop at harvest. Late grazing of semi-dwarf types can also greatly reduce crop height, causing subsequent harvesting problems in rocky or uneven paddocks.

Frost

Frost injury to grazed crops can be severe, particularly if crops are only a few centimetres high and the soil is loose and dry. Under severe frosty conditions, stock should be removed nightly. This is because damage can occur through the trampling of frost-covered leaves and the plants' growing points. Some crop varieties, particularly the oat varieties Blackbutt and Nile, have very low growing points and this type of damage is minimal.

Diseases

Diseases such as leaf rust on oats or powdery mildew on barley may also influence the timing and severity of grazing. By removing the canopy and opening up the crop, the incidence and severity of leaf diseases can be greatly reduced. Barley yellow dwarf virus, sometimes a

serious disease of early-sown susceptible crops, especially oats and barley, is best controlled by choosing tolerant varieties. When this is not possible, sowing in late autumn when aphid activity is lower will reduce the risk of infection.

Loose faeces

All cereals in the vegetative stage under good growing conditions are highly digestible for stock and often contain 80–85 per cent moisture (15–20 per cent dry matter). The resultant loose faeces is normal on highly-digestible, high-moisture green feed. Adding hay or roughage to the diet will slow down animal performance as the animal substitutes the hay or roughage for the higher-quality forage. In some cases, this may be of benefit by extending the grazing life of the paddock. Veterinary advice should be sought if abnormal scouring occurs, as this may be the result of internal parasites.

Stocking densities

Stocking densities will depend on specific animal production targets. Research has shown that continuous grazing of winter forage cereals gives better animal performance, as the best feed on offer will always be selected. This will only be achieved if stocking rates are balanced with crop growth rates and the feed on offer is not being significantly depleted (see Table 2).

High stocking densities are used under rotational grazing but lower animal performances can be expected than from continuous grazing. With continuous grazing, stock densities should be determined so as to leave plants with enough residual leaf material to enable both good regrowth and animal performance. Benchmarks exist for both instances. Residual plant heights of around 5–10 cm for prostrate types and 10–20 cm for upright types will correspond fairly closely to benchmarks of around 1000 to 1500 kg/ha for lactating ewes and fattening steers.

Rotational grazing can, however, be used to maximise the grazing value of a crop, by reducing wastage from trampling and/or frost damage or by the restriction of intake per head. Techniques such as strip grazing or limiting access times to the crop can be used for rationing feed.

ANIMAL HEALTH DISORDERS

Disorders can occur under certain growing conditions and veterinary advice should be sought for animal treatment. The most likely disorders are enterotoxaemia (pulpy kidney), hypomagnesaemia (grass tetany), hypocalcaemia (milk fever) and nitrate/nitrite poisoning. The possibility of these occurring should be considered when planning the grazing operation.

Table 2. Sustainable continuous stocking rate for oats

Stock class	Kg of forage dry matter removed per head*	Sustained stocking rate/ha**
Ewe & lamb (six weeks)	3.2	9.3
Weaned lamb (30 kg)	2.0	15
350 kg steer	12.4	2.4
450 kg steer	13.9	2.1
Cow & calf (three months)	19.1	1.5

* calculated using GrazFeed™ for green oats at 2000 kg DM / ha, 20 cm tall, 73% DDM (digestible dry matter) assuming 25% spoilage rate.

** assuming 30 kg DM/ha/day crop growth.

Sourcing cereal seed

Seed is the most important single input into a farming system. When drought has dominated for more than one season and over a broad area of the cropping belt, farmers will be faced with the dilemma of finding a reliable seed source in order to sow the winter crop when the drought finally breaks.

As a grower you therefore need to assess your situation and look at all the options. Ideally, good-quality seed from the latest harvest would be preferable. However, if you don't think you have good seed from that year but have some stored from the previous year, you need to weigh up the odds of using the available seed or buying fresh seed. Seed prices may be significantly higher following a severe drought. So the challenge for those farmers with no seed reserves is finding quality seed, of the preferred variety, at a reasonable price.

Seed quality fundamentals

Following the basic guidelines set out below is essential for maintaining the farming system.

- Choose seed of the highest-possible germination percentage.
- Vigour test seed to assess potential field performance.
- Check for freedom from weed seeds that will be a problem on your farm (especially prohibited weeds).
- Ensure the seed lot has not been contaminated with seeds of other cereal species.
- Ensure you choose a current recommended variety suited to your area.

Inferior quality seed

Using inferior seed can result in:

- bringing problem weeds (especially herbicide-resistant weeds) onto your farm
- having to re-sow paddocks
- unthrifty crops with low yield potential
- inefficient use of fertiliser
- poor competition with weeds
- dockages for contaminated grain.

Seed quality testing

While germination tests can be performed at home, these tests will not pick up weak or slightly-damaged seedlings. It is strongly advisable, therefore, to have seed germination and vigour tested through an ISTA-accredited laboratory. If the decision is made to sow seed that is not of the highest quality, be careful not to plant too deep, particularly on hard-setting soils where sowing rates may need to be increased to help compensate. Also avoid seed dressings that may reduce coleoptile length. It is important to remember that, in even the best management systems, a poor seed source will result in a poor crop.

The ability of a seed to germinate can be affected by disease, weather damage, length of storage, storage conditions and insect damage. Good-quality cereal seed should have a germination percentage greater than 90 per cent. In times of drought, frost or flood, this number can be as low as 15–20 per cent. Small and shrivelled seed is most likely to exhibit poor germination and vigour rates, while seed stored incorrectly over time, no matter the condition, can also display severely-reduced germination rates. Grading to preclude smaller seed can improve the germination and vigour capacity of the seed batch significantly.

Plant Breeders Rights (PBR)

It is important to remember the laws surrounding the sale of PBR-protected varieties. Although growers are allowed to retain PBR-protected seed for their own use in subsequent sowings, they are not permitted to sell the seed for sowing without the breeders' or agents' permission. Growers are, however, able to freely buy PBR-protected varieties and freely sell the produce from them. PBR protection on a cultivar confers ownership of that variety giving the owner exclusive rights to market the variety. Either seed royalties or end-point royalties are then collected to contribute to the cost of the breeding program.

A full list of PBR-protected varieties is available from the PBR office website at *www.affa.gov.au*

Further information is available from Agnote DPI-312 *PBR – What it means to you*.

SUMMARY

- Seed is the most important single input.
- Always choose seed of the highest possible germination.
- Get your seed tested for germination and vigour.

NSW DEPARTMENT OF
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This document is part of a larger publication. The remaining parts and full version of the publication can be found at:

http://www.dpi.nsw.gov.au/agriculture/drought-bushfire-emergencies/drought/recovery/drought-recovery-guide-2005

Updated versions of this document can also be found at the above web address.