Pasture recovery after bushfires

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This edition expands on the Edition 1, written in 2010 by NSW DPI officers Nathan Ferguson, District Agronomist, Tumut and Ian McGowen Former District Agronomist, Yass.

Likely pasture damage caused by bushfires

Fire heat

The burn heat depends on the amount of dry pasture plant material and wind speed. Where plant material is sparse, cool to moderate burns occur. Denser dead plant material, such as lightly grazed pasture or crop stubble, provides enough fuel for a moderate to hot burn. Very hot burns occur where hay bales or windrows catch fire, or on sheep camps. Areas underneath or near eucalypt shelter belts are also subject to very hot burns.

CSIRO research indicates that during a bushfire, the temperature at the soil surface usually varies from 50°C to 250°C. Soil surface temperatures range from 50°C to 150°C in a cool to moderate burn and 150°C to 250°C in a hot burn.

Temperature below soil surface is not changed dramatically. Below 15 mm it is normally not raised more than 10°C, and returns to its original temperature within five minutes. This suggests that plants that bury their seed, such as sub clover, or that have growing points below the surface, such as many perennial grasses, will survive well.

Figure 1  Tropical grass pasture recovery after the 2013 Warrumbungle bushfire (Photo: Robert Freebairn)
Pasture recovery after a bush fire is affected, to a major degree, by the heat of the fire. Groundcover levels, the pace of the fire passing, temperatures and humidity influence the heat level of the bushfire, which is likely to have areas burnt in the following categories:

**Cool burn.** Dead plant material is burnt, but most seeds and perennial grasses survive.

**Moderate burn.** Dead plant material is burnt, with some seed and young perennial grasses destroyed. Summer annual grasses, for example liverseed grass) may be severely damaged or destroyed. A small amount of unburnt dead plant material remains.

**Hot burn.** Dead plant material is burnt, with many seeds and the younger or weaker perennial grass destroyed. Summer growing annual grasses are also destroyed.

**Very hot burn.** All plant material is destroyed, with the soil surface virtually sterilised. Soil organic matter and much of the surface root material is incinerated. Soil is baked, causing reduced moisture infiltration and poor plant re-establishment.

**Pasture types**

Many pastures are resilient and will recover well once good soil moisture conditions return.

**Native perennial grasses**

Native summer growing perennial grasses generally survive well, even after severe bushfires. Regrowth time and rate largely depends on soil moisture as well as severity of the burn.

For example, pastures burnt in the 2013 Warrumbungle fire had commonly recovered sufficiently to provide cattle feed one month after the fire where reasonable enough had occurred. Areas where rain fell began to green up within a week of the fire.

![Native grass pasture recovering after 2013 Warrumbungle bushfire](Photo: Robert Freebairn)
Introduced tropical grasses

Introduced tropical perennial grasses, such as Premier digit grass, are also generally able to survive bushfires and can quickly recover when soil moisture is restored. As with native perennial grasses, well managed pastures tend to have greater root reserves and faster recovery rates with lower plant losses. This was generally the case after the 2013 Warrumbungle fire.

Figure 3  Three days after rain falling on a burnt tropical grass pasture (Photo: Robert Freebairn)

Temperate perennial grasses

Temperate perennials such as phalaris are generally dormant or semi-dormant in summer, especially if a dry period has preceded the fire. These grasses often they recover well, especially if stands have been well established and well managed. However recovery often does not occur until autumn when conditions are cooler and good rain falls.

Lucerne

Lucerne also has a generally good track record for recovery after a fire, especially if stands are strong. Soil moisture affects recovery time and rate. However, older stands or those with low root reserves as a consequence of grazing management, may be more severely damaged.

Winter annual legumes

Viable seed reserves of sub clover, a major winter growing pasture annual species, are particularly adept at surviving bushfires. Most varieties grown in central west, north west and tableland areas of NSW are varieties that have a large percentage of seed buried into the ground at normal spring seed down. This helps preserve seed from extreme heat. Also a reasonable percentage of the seed is hard, which provides additional protection against short-term elevated soil temperature.

Winter annual legume species such as serradella, biserrula, medics, rose clover, gland clover, woolly pod vetch and naturalised clovers (for example ball clover, burr medic, narrow leaf clover), are aerial seeders, but also tend to have reasonable levels of soil seed reserves survive after major bushfires. Commonly by mid to late summer, much of the seed of these species has fallen to the ground and is mixed into the surface soil where it gains some protection from extreme heat. Also like sub clover, in most instances there are soil seed reserves from previous years (a feature of hard seeded species and varieties) that are buried in the top soil and therefore, to a degree, protected from extreme heat.
Commonly by mid to late summer, much of the seed of these species has fallen to the ground and is mixed into the surface soil. A good percentage of this seed is also hard which helps to protect it from fire.

Levels of annual legume soil seed reserves before a bushfire are also an important consideration for their ability to regenerate. Fortunately for many pastures, 2016 was a good spring with good levels of seed set by annual legumes. Previous management, including soil fertility correction affects previous seed set and therefore soil seed reserves.

### Annual grasses

Annual grasses such as rye grass, brome grass and barley grass can suffer major seed loss as seed is often adhered to stems of dry plant material. However, in most grazed pastures, typically reasonable quantities of seed have been trampled with useful levels of seed mixed into the upper soil levels giving some fire protection.

### Pasture recovery rate will depend on rain events

Pasture recovery rate and timing is dependent on the rain events that follow the fire. Summer growing perennials such as native grasses, tropical grasses and lucerne for many situations will only occur after rain. Typically soils leading up to the fire are low on soil water as spring pastures can largely deplete good spring rainfall and the summer growing species take up any useful summer rains.

Should good rains occur before the late autumn – early winter, summer growing species will be able to grow at a significant rate, especially pre-mid May.

Winter species such as clover serradella best respond to rain events from around mid-March onward. Their establishment post fire, or in any situation before a mid to late March seasonal break, always depends on further, reasonably timely follow-up rain to ensure they establish well for production and survival.

Soil type is also a factor to consider. Lighter soil paddocks will likely utilise minor rainfall events more effectively than heavy soil pastures, and if the autumn is relatively dry may well respond better than heavier soils.

### Early grazing management

Following a fire, shortage of pasture feed is clearly a significant issue. The challenge is to maximise post fire pasture and crop growth, which generally requires holding off grazing stock to allow plants to develop an adequate root system (annuals) and to enough leaf area to adequately absorb light, which is essential for maximum plant growth.

Grazing recovering burnt pastures immediately following rain events will therefore likely result in less available feed over the following months. Also, fire-affected perennial plants may be low on root reserves (level depending on previous grazing management) and more vulnerable to death or at least stress until reserves have rebuilt.

### Lack of ground cover post fire

Lack of ground cover for crops and pastures can be an issue following fire, especially with hard setting soils or on sloping land. Where applicable (e.g. arable areas and in soil that can be adequately penetrated) a tillage, often with tillage lines spaced along contour lines, can help reduce rapid run off and improve soil moisture absorption until ground cover builds up.

Soil erosion can be a problem post fire following storm events and with lack of groundcover.

### Weeds

Weeds are typically a major issue after bush fires when followed by good summer rain events, for example Bathurst burrs, catheads and fleabane. The issue can be worsened where pastures have low levels of summer active pasture species. This is common after cropping phases where cropping was not replaced by successful new pasture establishment, where a pasture may have been heavily continually grazed for lengthy periods in the pre-fire period or where new perennial pasture has not yet fully established.
Rock fern is a weed to watch on lighter country post fire. While not commonly an issue, it recovers well from fire and if it is the only feed available it can be poisonous to livestock.

It is especially important to check weed situations after fires as it is possible for many to appear quickly, especially after rainfall events.

Controlling weeds post fire includes managing pastures (native or introduced) to encourage building up the density. Grazing management is a key aspect.

Winter weeds following a summer bushfire are generally comparable to normal weed problems and require similar control strategies.

New weed issues post fire can also be a result of donated fodder, therefore it is important to monitor and control new outbreaks of weeds. Weeds to especially look for include blue heliotrope, St John’s wart, African lovegrass and Coolatai grass.

**Future pasture strategy**

After fires can be a good opportunity to assess how to plan for future pastures to perform at their maximum productive and nutritious level, and be resilient long-term. Pastures post fire, drought or just coping with normal seasonal variation will be most productive and nutritious if the right mix of species is included (for example perennial tropical species plus winter legumes), they are well established, soil nutrient deficiencies are addressed and appropriately grazed.

For example, plan a high standard fallow weed control for at least two consecutive years, (preferably three) combined with winter fodder crops such as oats, which are an important part of preparation before sowing tropical grasses. The crop provides the ability to rid the paddock of weeds before sowing pasture, as well as providing an option for income from cattle or sheep feeding over winter.

Sowing tropical grass pastures too soon after a bushfire will not prevent the establishment of weed burdens.

**Cropping. Need for rapid feed.**

Winter dual-purpose or grazing only crops are a priority for many farmers post bushfire. Many suggestions that follow are offered in the context of aiming for an ideal situation. However, it is appreciated there will be situations where crops will be sown on burnout country with well below ideal conditions, such areas as where stored soil moisture will be minimal.

**Early sowing**

With improved weather forecasts, including temperature, it is occasionally possible to sow earlier than previously considered viable. For example, in areas like Dunedoo, Coolah, Leadville, Cassilis and Uarbry, it may be possible to sow, even on lower altitude country in late February if rain has occurred and forecasts for the following 10 days are for mild temperatures. While research has not determined actual viable temperatures for sowing, for crops such as oats a rule of thumb is that if current and predicted mean daily temperatures are around 23°C or lower, (average of minimum and maximum) it can be a good proposition to go ahead and sow.

The highest probability of success with early sowing generally occurs with choosing the lightest textured soil available on the property (another valuable feature of light soils).

If summer rains have not been conserved (for example used by weeds or sowing burnt native pasture areas) the probability of sowing success drops as crops will have no subsoil moisture to access unless follow-up or well above average rain falls.

Some farmers on lighter soils successfully establish winter fodder crops after rain events as low as 8 mm, depending on stored soil moisture levels, sowing equipment and stubble cover. In other situations, such as in a heavy soil paddock and where all subsoil moisture has been used by pasture and or weeds, far more than 25 mm would be needed to achieve germination.
Pasture recovery after bushfires

Figure 4  June. Left: oats sown March into a paddock with conserved soil moisture and no weed competition; Right: oats sown directly into pasture, photograph taken the same day. The difference is a consequence of a lack of conserved moisture. (Photos: Robert Freebairn)

Press wheels help to achieve germination following a lighter rainfall event. Timeliness is also critical as there may only be a day or two to sow on small falls of rain.

Moisture laden light soils best for early fodder crops (but not possible in many post fire situations).

An ability to successfully sow early following small rain events is a priority consideration. In paddocks prepared for winter fodder crops, timely control of summer weeds is important for preventing weeds seeding (reducing the seed bank) as well as for conserving fallow moisture. Sometimes, in a wetter summer, this can mean around five herbicide applications.

After a bushfire, sowing winter forage crops will commonly be into little or no subsoil moisture, such as a burnt native grass paddock. The probability of success is higher on lighter soils, although for all soil types it is more risky than sowing into prepared paddocks.

Choice of winter grazing cereal varieties

There is a wide range of dual purpose or grazing only winter fodder crops, including oats, wheat, triticale, barley, cereal rye and canola.

Longer-season oat varieties, often with no or little winter habit, tend to provide rapid early feed and, if soil moisture is fine, they can repeatedly form new tillers to provide green grazing well into the spring. This broad group of varieties, due to their late maturity, tend to be very inconsistent grain recovery producers. Not grazing them too low to the ground is important for getting the best out of the crop.

Some quicker maturing non-winter habit oat, barley, triticale and cereal rye varieties also are rapid early growers and, if carefully managed and in suitable seasonal conditions, can also provide a long period of winter to early spring grazing. They tend to mature faster than the slower maturing no-winter habit oat varieties.

Oat varieties such as Yarran and Yiddah tend to have not much winter habit, but perform well from early mid sowing, and can yield well for grain or hay. They mature quickly, unlike the slow spring types.

Varieties with differing levels of winter habit include several wheats, oat, barley, and triticale varieties. These tend to initially grow slower than spring types (although by mid-winter can surpass them) and better tolerate heavy grazing. Some of this group can convert to high grain yield if closed from grazing as winter habit runs out.

Variety choice also largely depends on the likely disease threat, soil type, seed cost, and role in the rotation. Few, if any, oat varieties have good resistance to leaf rust.
Pasture recovery after bushfires

Very early sowing can also increase the risk of rust diseases occurring in autumn and/or barley yellow dwarf virus (BYDV), a disease spread via aphids. Seed can be treated with a fungicide and insecticide to reduce the risk of rust or virus (note there will be a withholding grazing period if using most of suitable products, commonly nine weeks after sowing).

**Adding nitrogen to winter fodder crops**

Nitrogen deficient fodder crops commonly only produce one third or less to their potential, therefore feed quality and animal performance is also generally poorer.

Fodder crops such as oats can initially produce good volumes of fodder and use up what may have initially been a good level of soil nitrogen. Topping up with nitrogen fertiliser can result in production gains of several hundred percent.

It is best to top-dress nitrogen ahead of reliable weather predictions of at least 5 mm of rain (more needed on heavy country).

![Fodder crops and animals](image)

*Figure 5  Typical big nitrogen response to 100 kg/ha urea added post first grazing. Note top-dressed in background, not top-dressed in foreground. (Photo: Elliot Shannon, Bugaldie)*

Before top-dressing nitrogen onto fodder crops it is important to assess other factors such as other soil deficiencies or diseases including barley yellow dwarf virus. Applying nitrogen will not help to a great extent if these are an issue.

The amount of nitrogen to apply depends on a good knowledge of soil deficiency status (soil or tissue tests are helpful). Commonly, rates of 40–80 kg/ha actual nitrogen are required. Urea is 46% nitrogen so approximately double those rates are required to deliver the given amount of nitrogen.

**Planning for future all year around feed supply**

After a major bushfire, decisions such as sowing winter fodder crops will be made despite paddocks coming from pasture and having little sub soil moisture. Starting a long-term plan to upgrade pastures can fit into a post-bushfire recovery strategy.

While the Dunedoo, Coolah, Leadville, Cassilis and Uarbry areas are subject to more summer dominant rainfall, the reality is that rain can occur at any time of the year.

It is important to consider a range of pastures and fodder crops, with at least some able to grow when rainfall is received.
An example of how to best plan for inconsistent rainfall combines summer growing and winter growing species as well as winter crops sown on summer conserved soil moisture.

A typical example (only as a guide) is to plan to have 40–50% of a grazing enterprise established to tropical grasses or lucerne (if lucerne was to suit, but not for acid or waterlogged prone soils) with winter legumes. Improved native pastures (native grasses plus winter legumes) could comprise 40% of the farm and 10–20% winter dual purpose cereals. These winter crops are sown where soil moisture is conserved over summer (clearly not possible for many paddocks after a major fire) to maximise the probability of timely sowing and reliable winter feed.

Tropical grasses begin their growth as winter legumes hay off, although through spring they generally both contribute to feed. Tropical grasses can produce up to 160 kg/ha/day quality green feed (on a drymatter basis) if suitable rains occur. One good rainfall provides an good amount of feed.

![Graph showing daily drymatter production for various crop and pasture types](image)

**Figure 6** Typical daily drymatter production (kg/ha day) levels for various crop and pasture types in environments such as the Dunedoo, Coolah, Leadville, Cassilis and Uarbry areas.

Carefully selected varieties of tropical grasses grow through summer and well into late autumn. As their growth slows into autumn, winter legumes and annual grasses such as ryegrass, depending on autumn and winter rain, pick up their growth rate. Unlike lucerne, if well selected, established and managed, they can last indefinitely.

The role of winter crops such as oats, wheat or barley, sown in early autumn (time depends on temperature forecasts and soil moisture) is to provide late autumn/winter feed even if dry autumns occur with late breaks of annual pastures in tropical and native pastures.

While introduced tropical grasses are far more productive over spring, summer and autumn than native grasses, natives tend to be less competitive against annual legumes in autumn and again in spring. Natives slow faster as temperatures cool and leave more of often limited soil moisture for annuals such as clover, serradella and ryegrass. As a consequence, while natives provide less summer, feed their winter growth can commonly be greater.

For this grazing system to work best, soil deficiencies need to be addressed in both fodder crops and pastures. Also important are grazing management strategies which include retaining good groundcover, and for perennials – periodic rest and recovery periods.


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