Pasture recovery after fire

Most fires have a drastic effect on a pasture. Fire changes the botanical composition and will retard the pasture leading to a reduction in the growth and carrying capacity of the pasture in the following season. Fire changes pastures in different ways according to a number of different factors: the intensity of the fire, the pasture species present, the fertility of the soil, the time of the autumn break and follow up rains.

Fire intensity

The intensity, or how hot the fire is in a particular paddock has a major effect on the recovery of the pasture. Three categories of burns can be defined by considering what was burnt and destroyed during a fire - and what was left.

Cool-moderate burn - most dead plant material burnt, some seed and perennial grasses and clovers survive unhurt. There will usually be a small residue (or stubble) of unburnt pasture remaining.

Hot burn - all dead plant material, many seeds, young and weaker perennial grasses destroyed. The topsoil usually appears charred and bare.

Very hot burn - the soil is virtually sterilised. All plant material and seed is destroyed as the fire burns into the top organic matter layer of the soil.

Generally cool-moderate burns occur where there is little dry grass cover before the fire. Hot burns occur where there is a heavy plant cover, for example, lightly grazed pasture or crop stubble. Very hot burns occur under hay bales, windrows, on sheep camps, on soils with a thick root mat or where an intense fire emerges from bush areas onto pasture land.

CSIRO researchers have noted that temperatures at the soil surface have reached 600°C, but usually reach 50-150°C in a cool-moderate burn and 100-250°C in a hot burn. The soil below 15 mm deep is usually not changed by more than 10°C and returns to its original temperature within five minutes. These figures suggest that plants that bury their seed or that have growing points below the surface should be best able to survive the effects of a fire

Effects on annual species

Grasses

Most annual grasses produce very little dormant seed. Usually 80-90 per cent of the seed in one season will germinate in the following autumn. This means that any factor, such as fire which destroys annual grass seed will cause a drastic reduction in the annual grass component in the pasture.

All the seed of the major volunteer grass species in our pastures such as barley grass, brome grass and silver grass remain on or very close to the soil surface. This makes the seed vulnerable to either being destroyed or the effects of high temperature as the fire passes.

Observations after three fires near Melbourne in 1968-69 showed that on average 53 per cent of the annual grass seed was destroyed. The germination of the surviving seed was also reduced by 66 per cent. Therefore, there was only about one fifth of the original amount of viable seed able to germinate in these pastures after the fires.

In addition, the annual grass seed that survives the fire is very vulnerable to removal by wind. After the Minhamite fire of 1982, there were large areas of moderate to hot burn where most of the protecting old plant stubble was destroyed. This allowed the surviving annual grass seed to be blown away before the autumn break, denuding whole areas of annual grass.

Subterranean clover

Subterranean clover has the ability to bury its seed. This substantially reduces the damage to the seed caused by fire.

Unlike the annual grasses, subterranean clover also has large reserves of dormant seed in its seed bank in the soil.

Despite this, after the 1968-69 Melbourne fires, 54 per cent of the subterranean clover seed was burnt and the germination of what survived was reduced by 56 per cent.

This means that there was still a significant reduction in the amount of viable seed remaining. The timing of the autumn break and follow up rains has a major effect on the recovery of subterranean clover after fire.

Following a good, early autumn break after the 1983 Cudgee fires, subterranean clover regenerated well on the cool-moderate burn areas. By May, subterranean clover provided between 25 per cent and 80 per cent of ground cover on the burnt pastures. Where there was a good regeneration of perennial grass, subterranean clover contributed less to the ground cover. Where there was little grass to regenerate, subterranean clover quickly dominated the recovering pasture.

Poor subterranean clover recovery after fire however was observed at Maldon in 1969 and parts of the western district in 1977 following late autumn breaks. The survival and growth of subterranean clover and the annual grasses is also highly dependent on follow up rains after the break. After what appears to be a reasonable germination, many plants may still fail to survive because the soil dries out faster where there is no surface litter and growth of surviving plants can be stunted following the initial set back.

Effect on perennial species

Grasses

Recently resown perennial grass pastures can be seriously damaged by fire. The young perennial plants without well-established root systems and reserves are more vulnerable to fire damage, especially if the pasture was sown with a cover crop.

Almost all well-established perennial grasses survive a cool-moderate burn well. The ability to survive a hot burn varies between species: grasses with growing points below the soil surface survive best. The grasses that were observed following the 1977 and 1983 fires, in decreasing resistance to destruction by fire, were: bent grass, phalaris, tall fescue, cocksfoot and perennial ryegrass. A very hot fire will usually kill all perennial grasses.

Near Hamilton, the density of surviving perennial ryegrass plants on burnt areas of pasture was compared with adjoining unburnt pasture. If the density of perennial ryegrass plants in the unburnt areas is called 100 per cent, the comparative densities on the burnt areas were:

Cool-moderate burn – 79 per cent to 98 per cent
Hot burn – 44 per cent and 38 per cent (separate situations)
Very hot burn – 0 per cent

These figures agree with the observations from other fires that the hotter the burn the poorer is the survival of perennial ryegrass plants.

Legumes

Observations of burnt white clover based pasture following the 1983 Cudgee fires indicated that the survival of white clover is very similar to the survival of perennial ryegrass.

The surface stolons (runners) of white clover can be destroyed in hot and very hot fires, but will largely survive cool-moderate burns well. Strawberry clover was observed to survive better than white clover, with the only severe damage occurring in the very hot burn areas.

Established lucerne survives even a very hot burn well despite the tops of the crowns being burnt. Newly sown plants (less than six months old) can be killed by a moderate burn particularly if there are a lot of weeds mixed through the stand to fuel the fire.

Effects on weeds

Perennial weeds with well established, deep root systems survive fire very well. Weeds such as flatweed, docks, sorrel and onion grass are the first plants to recover and are often prominent after fires.

The seed of annual weeds can be destroyed by fire in the same way as annual pasture plant seed. Even though almost all the annual weed seed can be destroyed in hot burns, the massive number of seed set by weeds such as capeweed often means that some still survive in the pasture but in reduced densities.

Following the 1983 Cudgee fires, strong perennial pastures which had little or no weed burden prior to the fire had very little if any weed problem when recovering.

In weaker, more run down pastures that received cool-moderate burns, weeds such as capeweed, erodium (corkscrew), onion grass and thistles that were present before the fire were very prominent after the fires. Their prominence was most likely to be due to lack of competition from preferred pasture species.

In 1977, thistles and capeweed were very dense after fires in annual pastures on stony country around Derrinallum; herbicide treatment was necessary in some cases.

Capeweed and Erodium thrived on the bare ground even though there were fewer plants than in a normal pasture.

Effect on soil fertility

A grassfire can change the fertility of the soil in the short term. Elements such as potassium may become temporarily more available to the recovering pasture.

Amounts of these nutrients that were previously tied up in standing plant material are released by the fire and returned to the pasture in the ash. In the long term a pasture does not gain any additional amounts of these nutrients as a result of the fire.

The amount of nitrogen available to the recovering pasture is generally reduced as the fire burns some of the organic matter near the soil surface. As a result many burnt pastures show symptoms typical of nitrogen deficiency (pale to yellow leaves) during the following winter.

During the recovery of pastures after the 1983 Cudgee fires, it was very evident that pastures with a good fertiliser history responded much faster and to a greater degree than those with a poor history.

Omitting the annual fertiliser application in the autumn following the fire, especially on cool-moderate burn pastures with low-moderate soil fertility can retard the recovery of these pastures.

Effects on carrying capacity

As well as the loss of standing feed, a fire reduces the regrowth and so the carrying capacity of the pasture in the year after the fire. The actual carrying capacity of a particular pasture during its recovery phase will depend on many of the factors already discussed. In general, the cooler the burn, the earlier and better the autumn break, the higher the proportion of improved perennials in the pasture before the fire and the higher the soil fertility: the higher will be the carrying capacity in the year after the fire.

Experience over the years indicates that a typical moderate rainfall, mixed annual and perennial grass sheep pasture is only capable of halting the normal stocking rate for 12 months after the fire. Such a pasture typically recovers its grazing capacity after a late summer fire as follows:

Table 1: Effect of fire on carrying capacity

Month	Carrying capacity (% of normal)
June	20%
July	30%
August	40%
September	50%
October	60%
November	70%
December	70%
January	70%
February	70%
March	70%

What can be done

There are several possible courses of action after a fire.

The appropriate one will depend on the intensity of the burn, the condition of the pasture prior to the fire and the finance and time available:

- Cool-moderate burn - the pasture should recover to its original density during the following year given adequate moisture and the absence of soil nutrient deficiencies.
- Hot burn - in most cases it is probably best to wait a season and see how the pasture recovers before considering resowing.
- Very hot burn - almost all plant material will be dead so the area should be cropped or resown to pasture following the fire.

The aim of pasture treatment following a fire is generally to speed up the return of the pasture to its original density and productivity.

Low pasture density is a more important factor than the type of species remaining in reducing pasture production during the year after the fire.

There are a number of management practices which may improve the recovery of pasture after fire:

- **Adding new pasture seed.** New pasture seed can be added to the new pasture in a variety of ways such as by direct drilling or chisel seeding. It is usually best to wait until there is a germination of annuals after the autumn break. If weeds are dense, chemical weed control may be necessary before sowing the seed.
- **Heavy harrowing.** Heavy harrowing can unearth buried seed and improve the germination, especially of subterranean clover. This harrowing may cause further damage to surviving perennial species.
- **Autumn saving.** Leaving stock off the burnt pastures for six or more weeks after the autumn break improves the vigour and the growth of surviving plants.
- **Fertiliser.** Where there is an adequate density of regenerating plants, or pasture seed has been sown. fertiliser application will speed the growth and the recovery of the pasture.
- **Broadleaf weed control.** Where broadleaf weeds start to dominate the recovering pasture, control measures such as the use of herbicides or spray-grazing are recommended.
- **Seedset.** The pasture plants should be encouraged to set seed in the spring following the fire. This can be assisted by avoiding heavy grazing pressure in the mid-late spring period and not cutting the pasture for hay.