

Pasture recovery after fire

Most fires have a drastic short-term effect on a pasture. Fire may change the botanical composition and impede the pasture, leading to a reduction in growth and carrying capacity in the following season. Fire can change pastures in various 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 plant material is burnt; some seed and perennial grasses and clovers survive. There will usually be a small residue (or stubble) remaining of unburnt pasture
- Hot burn – all dead plant material, many seeds, young and weaker perennial grasses are 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 limited dry grass cover before the fire. Hot burns occur where there is substantial 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 can reach 600°C, but usually range between 50–150°C in a cool-moderate burn and 100–250°C in a hot burn.

In most circumstances the soil (to a depth of 15 mm) will only vary in temperature by 10°C before returning 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 adapted 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 annual grass species in 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 damaged by 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, about 20 per cent of the original amount of viable seed was able to germinate in these pastures after the fires.

In addition, the annual grass seed that survives the fire is extremely vulnerable to movement by wind. After the Minhamite fire of 1982, there were large areas of moderate to hot burn where most of the protective old plant stubble was destroyed. This allowed the surviving annual grass seed to be blown away before the autumn break, stripping 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 annual grasses, subterranean clover also has large reserves of dormant seed 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. 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 Cudjee fires, subterranean clover regenerated well on the cool-moderate burn areas.

By May, subterranean clover provided between 25 - 80 per cent of ground cover on the burnt pastures. Where there was good regeneration of perennial grass, subterranean clover contributed less to ground cover. Where there was minimal grass to regenerate, subterranean clover quickly dominated the recovering pasture.

Poor subterranean clover recovery after fire was also 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 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 too quickly, due to insufficient surface litter and growth of surviving plants can be stunted following the initial this 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. 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 support the observations from other fires that the hotter the burn the poorer the survival of perennial ryegrass plants.

Legumes

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

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

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

EFFECT 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 annual weed seeds can be destroyed in hot burns, the massive seed bank of these weeds, such as capeweed often means that some will survive in the pasture at reduced densities.

Following the 1983 Cudjee 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 rundown 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 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 for control 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 grass fire can change the fertility of the soil in the short term. Nutrients that were previously tied up in standing plant material are released by the fire and may be returned to the pasture in the ash. Elements such as potassium may become temporarily more available to the recovering pasture.

However, in the long-term a pasture doesn't 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) in the following winter.

During the recovery of pastures after the 1983 Cudjee fires, it was 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 inhibit the recovery of these pastures.

EFFECT ON CARRYING CAPACITY

As well as the loss of standing feed, a fire reduces the regrowth and carrying capacity of the pasture in the following year. 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 perennial species before the fire and the higher the soil fertility resulting in a higher carrying capacity in the year after the fire.

Observations of previous fire events indicate that in a moderate rainfall, mixed annual and perennial grass pasture, which has been burnt, will take approximately 12 months to recover to its normal carrying capacity.

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 time and resources 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.

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

- **Grazing fire-affected pastures.** Should be avoided until there has been sufficient growth to replenish the root reserves of the grass species present to ensure persistence. This generally occurs at the three-leaf stage for ryegrass and the four-leaf stage for cocksfoot, phalaris and most native pasture species
- **Dry matter and groundcover.** Consideration should be given to the amount of dry matter (DM) grown as part of a whole-of-farm grazing strategy and to maintain ground cover above 70 per cent
- **Stock containment areas.** Can be an important tool to manage grazing pressure while pasture species recover
- **Adding new pasture seed.** New pasture seed can be added in a variety of ways such as by direct drilling, chisel seeding or broadcasting followed by rolling the seed for good seed soil contact. 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. However, 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 – introduced species.** 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 by not cutting the pasture for hay

- **Seedset – native species.** Native grass species recruit mainly from seed rather than from tillering. Deferred grazing, whereby native pastures are not grazed once seed heads start to emerge in late spring through to early autumn, is a successful method to allow seed set to increase existing native pastures.

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