Fire belt preparation methods

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A fire belt is a planned firebreak. Its location, dimensions, preparation method and time of preparation are planned by fire managers. Although fire belts will not stop all fires from crossing boundaries, it should stop most. Preparing fire belts include the preparation of trace belts. In addition, fire belts should also serve as a point of attack or defence in the face of a fire threat. All factors considered; fire belts must be cost-effective.

When preparing fire belts, landowners are therefore challenged by the following questions:

- What are the minimum legal requirements that I must adhere to?
- Which method of preparation is the best?
- What is it going to cost me?
- How effective will my fire belts be?
- How much time do I have to prepare my fire belts before the fire season arrives?
- What else can I do to create a fire belt?

Personal observations revealed that landowners often use a single method to prepare all fire belts. Logistically this practice is the easiest and requires little skill. The important questions, however, to answer is if it is the most cost-effective method and if all legal requirements are met?

In this article, effort will be made to provide answers to these questions and to introduce the reader to alternative ways to create fire belts.

What are the minimum legal requirements that I must adhere to?

Although the National Veld and Forest Fire Act (NVFFA) 101 of 1998 is not prescriptive in the method or dimensions of fire belts, it states that:

- A fire belt is required on a property if there is risk of veldfires.
- Fire belts should be long and wide enough to provide a reasonable chance to stop a fire.
- The environment should not be damaged when preparing a fire belt.
- Fire belts should be reasonably clean of burnable material; this allows the fire manager fire belt preparation options that are cheaper and be less damaging to the environment.

Which method of preparation is the best?

Responsible landowners do not only consider 'cost' and 'effectiveness' when preparing fire belts but also the impact of the fire belt and the preparation method on the environment. Factors guiding the choice of preparation method includes:

- Soil sensitivity: sandy soils are very erodible and wind and water can lead to loss of topsoil and vegetation. In low rainfall areas like the Kalahari where denuded areas are subject to wind erosion and vegetation to slow recovery, a jeep track often serves as the only reasonable fire belt (Figure 1). In high rainfall areas like Zululand in KwaZulu-Natal, wind and rain are erosion factors to consider.
- Steep slopes: manual preparation of trace and fire belts often leads to water erosion.
- Biodiversity: use of herbicides to prepare trace belts may not have the same effect of erosion as in the case of manual belt preparation but may lead to loss of biodiversity and promote the establishment of pioneer vegetation (often weeds) in trace belts (Figure 2).
- Endangered/sensitive species: habitats of endangered plant or insect species can be significantly reduced/damaged by indiscriminate fire belt preparation methods.
- Riparian zones: water sponge areas ie swamps, marshes and catchments or riverbanks can be negatively affected when belts are prepared in the wrong season, using wrong methods or when water flow is disrupted.

If these situations are encountered, fire managers should consider alternative methods to prepare fire belts, even if these methods are expensive and less effective.

Figure 1: Jeep track serving as fire belt in sensitive sandy soils of the Kalahari (stock.adobe.com)

Figure 2: Disturbance of vegetation after repeated trace belt preparation using herbicides.

Jeep-tracks serving as firebreaks works well but it may be necessary to mow down the centre and along the edge of the road to reduce tall fuels.

The following preparation methods are used often and can be regarded as the 'traditional' belt preparation methods:

Burning

This method is the cheapest and fastest method to create a fire belt. Unfortunately, it is also the riskiest. Spot fires are reported with up to 40 percent of fire belt burning operations. The main reason for this is inexperience and incompetent fire managers/fire fighters, wrong resources at the fire, too little resources at a fire and pressure on fire managers to complete burning operations in a very small window period. With climate change that cause longer fire seasons, less suitable days for planned burning and out of season weather, fire managers are forced to take unnecessary risks to complete fire belt burning. Burning operations are often undertook on days less suitable for burning and on suitable days shifts are longer resulting in tiredness and carelessness.

Trace belt preparation is the expensive and time-consuming part of fire belt burning but necessary to facilitate safe burning. Traditionally trace belts are sprayed with contact herbicides when the vegetation is still green and then burned (Figure 3). After tracers are prepared, burning of the entire belt follows (Figure 4).

Figure 3: Trace belt preparation by burning vegetation killed by a contact herbicide

Figure 4: Burning fire belt by using trace belt as anchor point for the fire

One of the elementary mistakes made by landowners who make use of the burning method to prepare fire belts, is a lack of planning. By planning a burn carefully, potential human error can be eliminated. Planning is done best in a structured way. This implies that planning should be done on paper by addressing a pre-determined list of questions. These plans can be saved and used again during the following cycle of burning and should be improved after the burn is completed.

A planning document should typically include the following items:

- Based on biological and physical characteristics of the site
  - Type and status of vegetation
  - Topography
  - Soil characteristics
- Weather conditions predicted for the day of burning (three days before the burn day, the day of the burn and three days after the burn day). This will ensure that burning conditions on the day conform to expectations and prevent smouldering material that might reside in the belt to re-ignite the following days.
- Resources needed and available
- Legal aspects ie burning permit and communication to neighbours and other role players
- Predicted fire behaviour
- Starting point and time of the fire
- Short summary of the burn afterwards.

Hoeing

Hoeing is manually removing of vegetation by hoeing and then distributing the hoed vegetation in the adjacent area with hay forks (Figure 5). This is probably the most expensive fire belt preparation methods and hoeing the same area repeatedly will leave scars in the environment and will be conducive to erosion. When hoeing trace belts, the root systems of vegetation should not be removed from the soil.

Figure 5: Hoed vegetation from the trace belt is distributed with a hay fork

Ploughing/disking/grading

Ploughed/disked firebreaks are used with mowing if grass fuels are tall and/or heavy. Disked firebreaks are best made after mowing first, then disking twice, in opposite directions. It is important to ensure that residual vegetation grass does not form continuous fuel (Figures 6 and 7).

Figure 6: Ploughed fire belt next to road

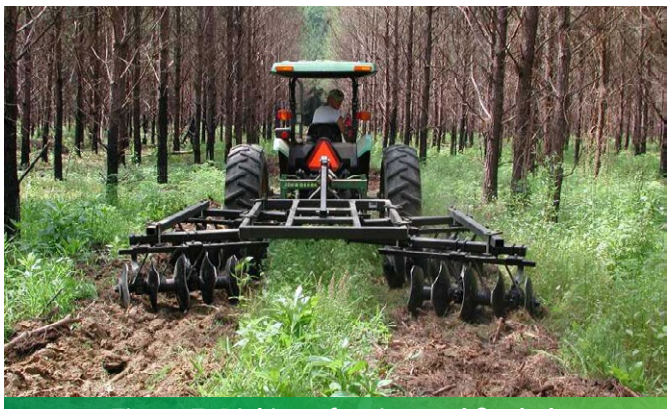

Figure 7: Disking of an internal fire belt

Graded trace belts should be scraped and not excavated. It is important not to leave piles of soil containing fine fuels such as grass in the burn area of the belt. Rather push soil piles outside of the burn area. Piles of soil mixed with vegetation may cause ground fires. In addition, brush should be pushed inside the burn area and scattered. Brush piles along a firebreak create hot spots that can catch fire when the belt is burned.

Roads

Roads work well as fire belts but the road reserve adjacent of the road should be disked, mowed, slashed or burned to create a more effective break (Figure 8).

Figure 8: Road reserves that are disked, create a more effective fire belt

Natural and other fire belts

Natural and other fire belts including rivers, streams, dams, indigenous forests, rocky outcrops and open areas can be incorporated into a fire belt system to save costs. It should, however, be kept in mind that these areas may not be located at the best places in the landscape to 100 percent effective (Figures 9 and 10).

Figure 9: Small stream used as a trace belt to facilitate fire belt burning

Alternative fire belt preparation methods

Some alternative fire belt preparation methods that need closer investigation will be discussed in this section. Keep in mind that the NVFFA only requires "fire belts that are reasonably clean of burnable material".

Grazing

An area where the vegetation has been grazed down to its roots, can serve as a fire belt (Figure 11).

Figure 10: The indigenous forest with its ecotone serves as a firebreak

Figure 11: Grasses grazed down to their roots provide a situation/area that can serve as a fire belt

Farmers in the Free State, as well as Lion Match Forest Company in the Piet Retief area, has experimented with grazing belts by applying molasses to grass in areas where a belt is required (Figure 12). Cattle are attracted to these areas and will graze grasses down to its roots.

Figure 12: Quad bike fitted with boom to spray molasses (www.quadmaster.co.za)

According to nafstore.co.za (2018), there are various benefits of using molasses as supplement in animal feeds. By spraying molasses over cured grass, some of these advantages will benefit the animals grazing it. Molasses improves the palatability of the grass and is rich in easily digestible energy. All animals but especially working animals like horses, benefit from this high-energy intake. The basis of this energy is found in certain B vitamins and minerals contained in molasses and in addition, molasses is also a source of sulphur and potassium. Potassium facilitates the control of water absorption by organs, bones and muscles.

Mulching

Mulching is often used in forestry and as part of weeding project to chip woody material into a mulch. Mulched woodchips are then distributed in a thin compacted layer on the ground and serves as a fast-decomposing humus layer. In addition, it also reduces the flammability of organic material in these areas, as organic fuels are compacted, reducing the exposed surface area of the fuel and incorporating it with the soil. Mulchers are not only able to mulch woody material but also herbaceous material like grass (Figures 13 and 14). Mulching is unfortunately expensive and mulching machines are limited by terrain.

Figure 13: Mulcher incorporating woody material with the soil (www.prinoth.com/en/vegetation-management)

Figure 14: Mulcher working between eucalyptus tree rows

Green belts

Green or living plant material usually does not burn. By establishing evergreen plant species in areas where fire belts are needed, a permanent belt can be established (Figures 15, 16 and 17).

Figure 15: Spekboom (Portulacaria afra) fire belt planted in a hedge to protect a house from fire

Figure 16: Kikuyu grass (Cenchrus clandestinus) fire belt planted next to a commercial plantation

- The kikuyu grass can be irrigated and grazed or baled. In areas receiving frost, these belts should be mowed before the frost season (Figure 17).

Figure 17: Evergreen legumes planted in the road reserve

Raking and baling

In areas where dead litter accumulate like under tree canopies (Figure 18), a belt can be created by raking the area clean of loose material. In Figure 19 the result of a mechanical raking operation leaves a fire belt clean to mineral soil.

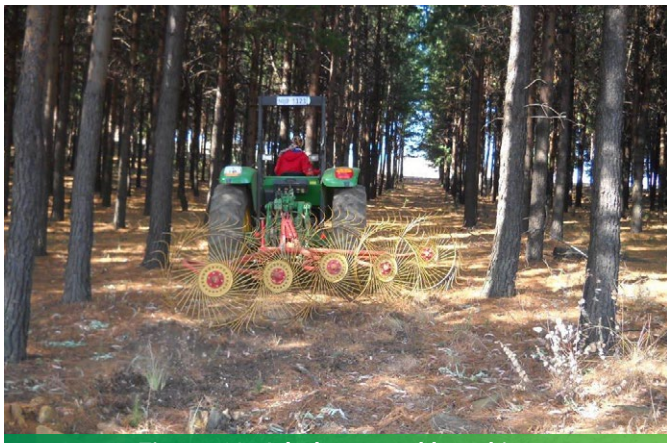

Figure 18: A belt created by raking the area clean of loose material

Figure 19: Cutting and baling grass in sensitive areas where a fire belt is required will also serve as a firebreak

Figure 20: Mowed and baled grasslands can serve as a fire belt.

Windbreaks

The purpose of a windbreak is to block and break the velocity of wind. Farmers have been using the practice of windbreaks very successfully to protect crops from the brunt of strong winds. Wind is the weather factor with the biggest impact on ire behaviour and the spread of veldfires. By reducing the wind velocity, the spread rate of a veldfire can be reduced to the extend that it can be controlled.

In many commercial plantations Eucalyptus belts (20 to 40m wide) used to be planted across the plantation. The

theory was that these trees can grow very tall and serve as a windbreak as well as a fire brand (burning sparks/embers transported by wind and causing spot fires), catchers. Litter and vegetation under these had to be removed annually to prevent surface fires. This practice was abandoned because it was labour intensive to maintain a clean area under these belts and because of the flammability of the crowns of Eucalyptus trees. This is, however, a practice that needs to be re-investigated. Not only should different species of trees and shrubs be incorporated in these belts but it can be kept clean underneath through mechanical means.

In Figure 21, the effect of a windbreak on the wind patterns is illustrated. Simplefendorfer (1989) states that a well-designed windbreak can reduce the speed of the wind up to 70 percent within five tree lengths from the windbreak. A windbreak can also reduce the windspeed up to twenty tree lengths from the windbreak before it resumes its original velocity. Figures 22 and 23 display multi-storey windbreaks. These windbreaks are designed to elevate the wind. The hypothesis is that if the wind is elevated, fire brands will be elevated with it and reduce the chances of the fire brand starting a spot fire in the opposite side of the windbreak. In addition, if the plant species used to establish the firebreak are fire resistant, like wattle trees - Acacia mearnsii, it could stop or slow down the fire.

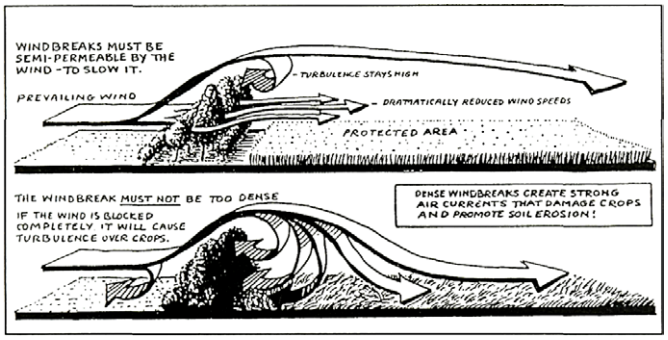

Figure 21: Windbreak design. (Adapted from www.worldagroforestry.org)

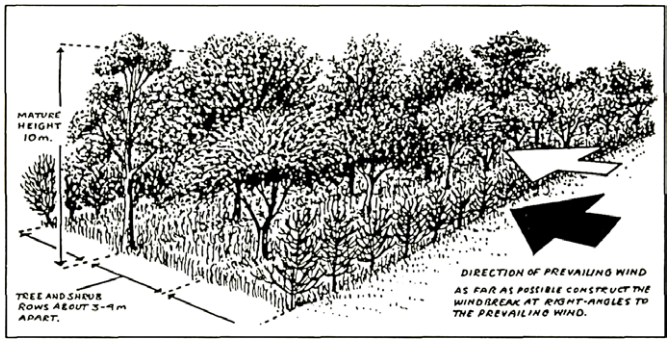

Figure 22: Multi-storey windbreaks (Adapted from Montana State University Extension Bulletin 366)

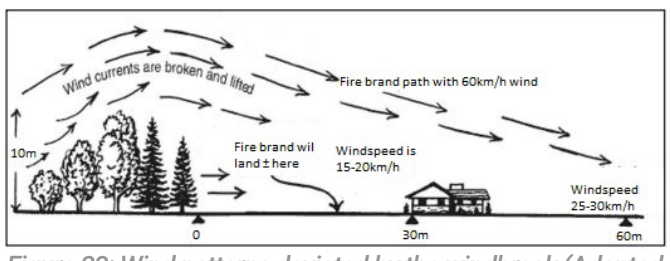

Figure 23: Wind patterns deviated by the windbreak (Adapted from Montana State University Extension Bulletin 366)

Black wattle (Acacia mearnsii) is well known for its resistance to fire. Because of its nitrogen fixation and allelopathy characteristics, undergrowth in stands is supressed and decomposition of the forest litter layer accelerated (Figure 24). These qualities of black wattle make it ideal to use in a windbreak belt. The only challenge that fire managers may face in using black wattle to establish green fire belts, is the invasive status of the tree.

Figure 24: A well maintained wattle stand with a very thin litter layer and a void of undergrowth

Mechanical burning of trace belts

The use of herbicides to prepare trace belts for burning has been questioned in recent times because of the negative effects that these herbicides have on the environment. Since international environmental custodial organisations like the Forest Stewardship Council (FSC) have been frowning about the use of these chemicals, many alternative methods have been investigated as cost-effective ways to prepare trace belts.

An interesting method used by organic farmers to kill weeds between their crops, needs to be investigated as a possibility. Flame throwers are used to incinerate green unwanted vegetation (Figures 25 and 26). A tractor-mounted flame thrower can be used on level areas suitable for a tractor to drive (Figure 26) and a hand-drawn model (Figure 25) can be used in difficult terrain.

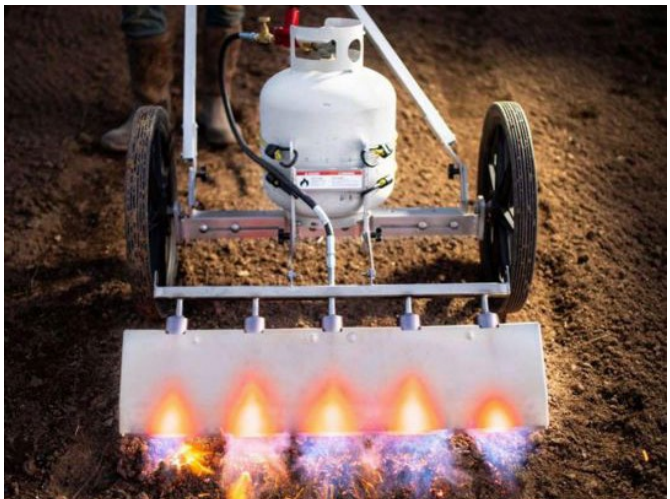

Figure 25: Hand drawn mechanical igniter (www.terrateck.com)

Figure 26: Tractor-mounted flamethrowers used to incinerate green plant material

Leaf blowers

The last decade saw the use of leaf blowers to extinguish fires. The same way that a burning match can be blown out, a fire can also been blown out. In Figure 27 a demonstration of effective use of blowers to facilitate safe burning can be seen.

Figure 27: Leave blowers used to facilitate belt burning (https://www.youtube.com/watch?v=pSjyO2Uoi8o)

Open-ended fire belts

The open-ended fire belt burning technique is used by experienced fire managers to create fire belts. Two parallel lines of fire are lighted up three to five metres apart and then the two flame fronts are pulled into the middle of the two lines because of convection. Remaining fire on the outside edges of the fire belt are easily extinguished with fire beaters.

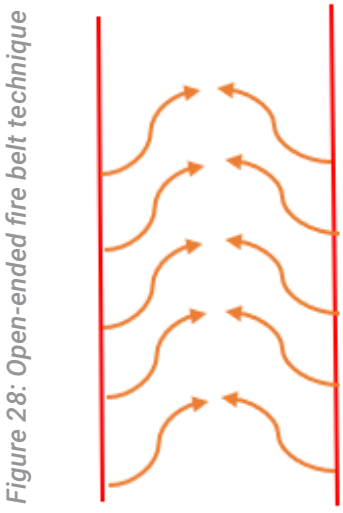

Figure 28: Open-ended fire belt technique

How much time do I have to prepare my fire belts before the fire season arrives?

The answer to this question is a difficult one as the fire season depends on the weather. Some years' the fire season will arrive early in the year because of drought or early frost. The opposite can also be true. Fire managers should therefore pay close attention to medium term weather predictions to get an idea when all fire belts should be done.

One of the biggest limiting factors preventing the timeously completion of fire belts is the weather window that presents burning opportunities. From the time that vegetation is cured enough to burn, the number of suitable burning days is counted. If one considers that planned burning usually does not occur on Fridays or weekends, this challenge becomes real.

By making use of alternative fire belt preparation methods (other than burning), weather does not play a role and more time is available to complete fire belts before the fire season.

Conclusion

Fire belt preparation has been identified as one of the most important fire management strategies. There are, however, many factors that make the preparation of cost-effective fire belts difficult. Although fire belt preparation is an expensive activity, the law requires the timeous construction of fire belts before fire season.

To achieve this, fire managers need to consider the time available as well as the biological and physical characteristics of the area where planned burning must take place. Successful fire belt preparation therefore requires the investigation and application of the method most suitable to ensure minimum damage to the environment, effective fire belts and timeous completion of the fire belts on a property.

Landowners as well as organisations and authorities involved in fire management should invest in research that will identify fire belt preparation methods for the best operating practices in specific areas and for specific situations.