



agriculture,
forestry & fisheries

Department:
Agriculture, Forestry and Fisheries
REPUBLIC OF SOUTH AFRICA

BEST PRACTISES MANUAL
FOR THE CONTROL AND MANAGEMENT OF
BANKRUPT BUSH (*Seriphium plumosum*)

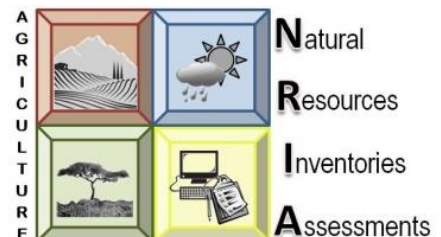
Paul Avenant
Ivan Riggs

2016
Version 1.2

Department of Agriculture, Forestry & Fisheries

Directorate Land Use & Soil Management

Sub-directorate: Natural Resources Inventories & Assessments



INDEX

INTRODUCTION	3
1. How to identify Bankrupt bush	3
2. Where to find Bankrupt bush	9
3. Pre control actions:	10
a. Which area is encroached?	10
b. What is the density of the population?	10
c. Plant phenological stage	13
HOW TO USE THE OPTION-MANUAL	15
OPTIONS:	
A. CHOPPING OUT PLANTS BY HAND	16
B. APPLY GRANULAR HERBICIDE BY HAND	20
C. APPLY HERBICIDE SUSPENSION BY HAND	25
D. APPLY HERBICIDE WITH TRACTOR MOUNTED BOOM SPRAYER	31
E. USING TRACTOR WITH DISK OR PLOUGHING IMPLEMENT	35
F. USING TRACTOR WITH SLASHER IMPLEMENT	38
G. APPLY HERBICIDE WITH AIRPLANE	41
H. USING FIRE AS MANAGEMENT TOOL	45
I. USING ANIMALS AS MANAGEMENT TOOL	48
ANNEX A – How to determine clay content of soil	51
LITERATURE REFERENCES	52

INTRODUCTION

Bankrupt bush (*Seriphium plumosum*), also known as (*Stoebe vulgaris*), always has been part of our indigenous vegetation, but slowly and somewhat unnoticed, encroached large areas of our precious grassland to keep up to its reputation of leading to many farmer's bankruptcy.

This woody dwarf shrub can grow up to 1m high and is really built for survival. The large crown may easily cover an area of 1m², over-shadow and pushing out all other species, especially grasses that need to compete with the extensive root system for water and nutrients. The very small leaves restrict transpiration to the minimum while the grey to bluish colour reflects the harsh rays of the sun. Unpleasant smelling volatile oils keep away any browsers and fine seeds are distributed by the wind in their millions, which can be lying dormant in the ground for more than five years. Growing points situated just beneath the soil surface ensure the survival of the plant against any fires or above ground damage.

The aim of this manual is to provide the land user with a toolbox of options on how to eradicate and manage the encroachment of Bankrupt bush on his/her land.

1. How to identify Bankrupt bush



**Bankrupt bush
encroachment**





Inflorescence



Old plants



Young plants



Very small leaves arranged into small clusters on the stems



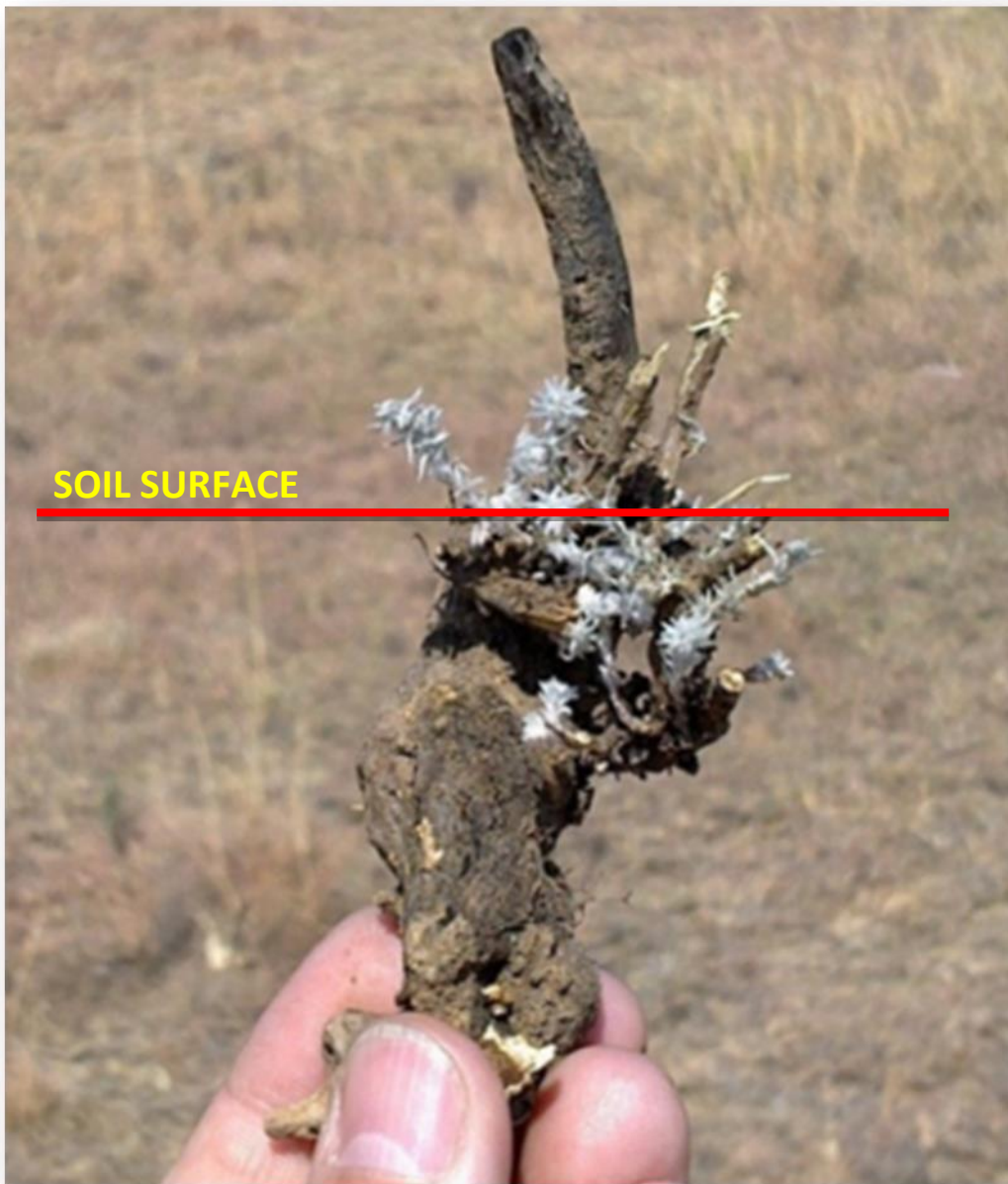
Flowers arranged in clusters along the top part of new shoots.



White galls forming on the shoots due to insect damage are often confused for flowers.



Fluffy white galls are easily confused for flowers.



Underground burl where all the growing points are situated

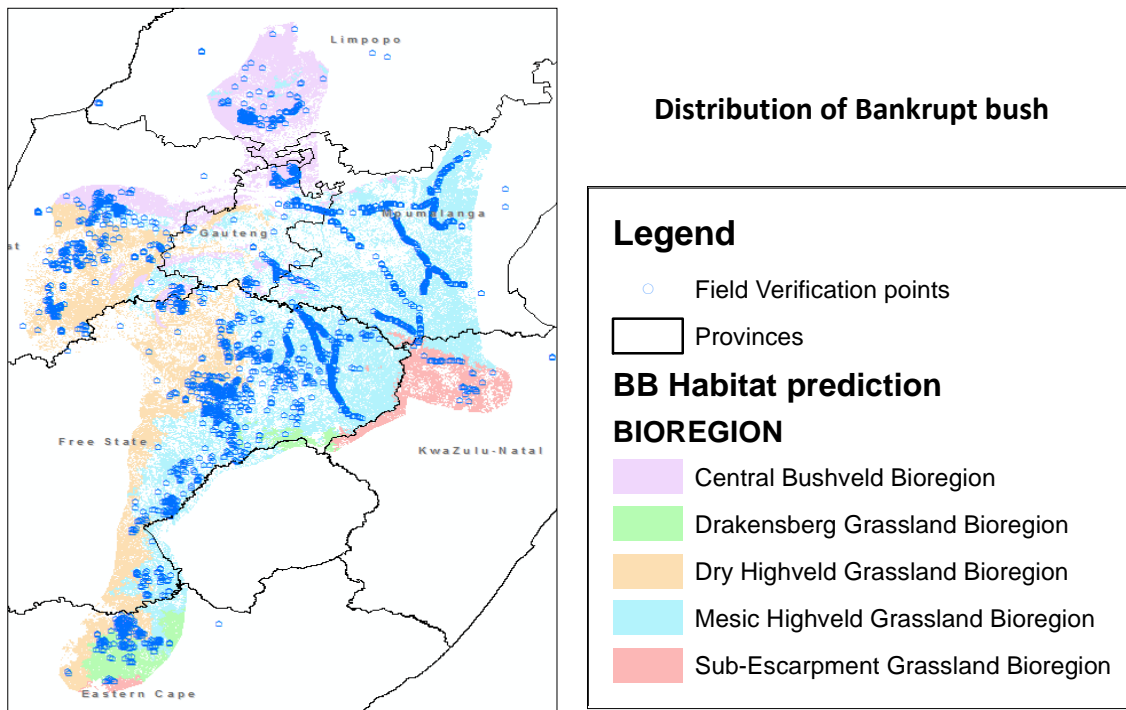
2. Where to find Bankrupt bush

Bankrupt bush occurs in a wide area with a mean annual rainfall from 550mm to 800mm per annum. It usually prefers well drained slopes, but in some cases will also encroach into wetter areas and areas with slightly higher clay content. The plants are sensitive to salt as well as high levels of nitrogen or soils with a high organic content.

Bankrupt bush is however a very opportunistic encroacher that will firstly populate open areas for example old cultivated fields or degraded veld, but from there, will rapidly spread into adjacent areas, even veld with good cover and with a good species composition.

Currently the affected provinces are as follows:

- Free State (eastern parts)
- North-West (east of Wolmaransstad)
- Eastern Cape (Aliwal-North to Dordrecht)
- Gauteng (Eastern Highveld areas)
- Limpopo (Waterberg district)
- KwaZulu-Natal (Northern Sandy grasslands)
- Mpumalanga (Western Highveld and sour grasslands)



3. Pre control actions:

Before commence any control actions, it is important to answer the following questions:

a. Which area is encroached?

If a total camp is more or less homogenously encroached, the camp size can be used, but if not the case, the area in hectare (ha) or (m²) need to be determined for each homogenous patch or population of Bankrupt bush plants.

Satellite imagery can be a very useful tool to demarcate populations of encroachment, as found on the internet in programs such as Google Maps or ESRI Base maps. The use of a GPS or similar tools and applications on smart phones can also be used to demarcate and calculate the size of an area.



A Google earth picture used to demarcate Bankrupt bush

b. What is the density of the population?

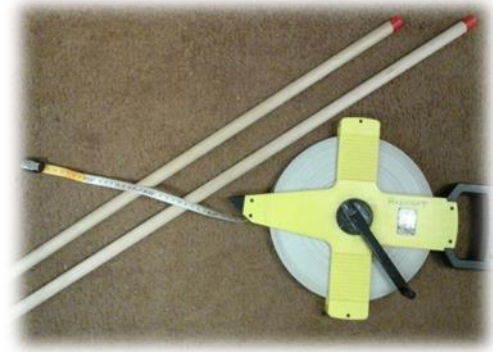
To know the exact density of plants for a specific area is very important when the amount of herbicides needed for control has to be calculated. In principle the methodology is based on the following two steps:

- i) Demarcate a small, but representative area within the larger population
- ii) Count the number of plants in the area (YES, ALL PLANTS!)
- iii) Use this count to calculate the density per hectare.

The following method is the one most used by the department to determine plant density:

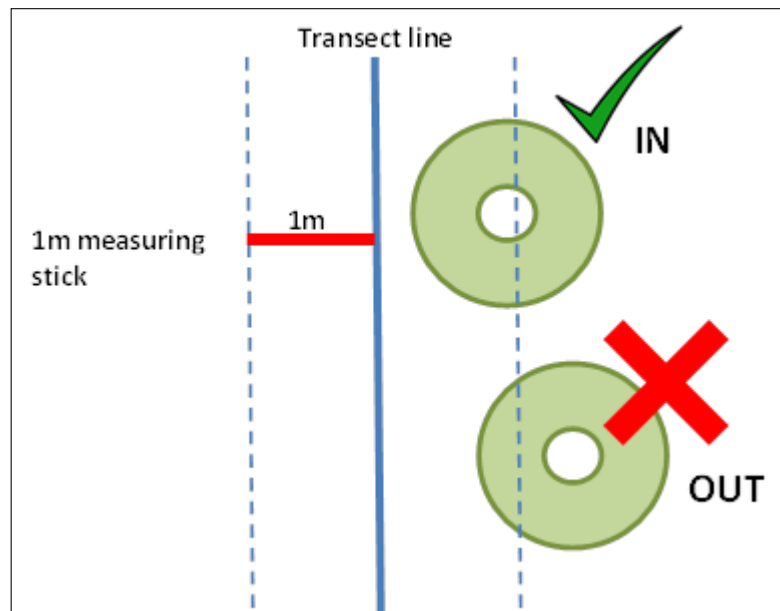
Equipment needed:

- 1 x 100m measuring tape OR
- 1 x 100m Nylon Ski Rope
- 2 x 1m measuring sticks
- Data sheet and pencil



How to do the plant density survey:

1. Lay out a 100m measuring tape or rope through a homogenous area of Bankrupt bush.
2. In some cases, where the infestation is very dense and very homogenous, a 50m transect will be sufficient.
3. If only one person, take a 1m measuring stick and start walking along the one side of the line. Hold the measuring stick horizontally with the one end aligned with the transect line. This will mark a 1m wide belt.
4. While walking along the transect, count all plants of which the center points are within the 1m belt.



5. Look closely for any seedlings or young plants hidden between or under other vegetation.
6. When reaching the end of the transect line, return along the opposite side, doing exactly the same.
7. Where 2 persons are available to do the count, they can walk simultaneously along the line. This will half the counting time.
8. The plant counts on both sides should not differ too much – this can be used as a check for accuracy, especially where 2 persons did the count.



A team busy counting plants

Calculating density:

1. Write down the total count for the transect (both sides), for example 400 plants.
2. This means that there are 400 plants per 200m² (100m x 2m)
3. To convert to plants per hectare: Multiply the plant count with 50, for example 400 x 50 = 20 000 plants / ha.
4. If a 50m transect was used, multiply the count with 100 to get plants per hectare.
5. This is the **DENSITY** of encroachment.
6. Both the AREA of infestation (in ha) and the DENSITY (plant/ha) must be provided when applying for herbicide assistance or calculating the amount of herbicide needed for control.

c. Plant phenological stage:

The plant phenology is an indication of the growing stage that plants are in, for example seedling, young, mature, old (moribund), flowering and seeding. The phenological stage of plants usually has an effect on the way that the plant will react on the control method applied. Most herbicides are taken up more quickly and effectively during the active growing period of the plant and seedlings and young leaves absorbed herbicides more effectively than older or moribund plant material. If flowering and seeding times take into account when controlling plants, bigger impact will be achieved by controlling before seeds ripening and shedding, for example.



Large, old moribund plants with ripe seeds will shed lots of seeds when handled during control.



Young regrowth is the most susceptible for herbicide control.



Seedlings are very vulnerable to herbicides and trampling by animal hooves

HOW TO USE THE OPTION-MANUAL

In this manual, nine methods or approaches to Bankrupt bush management and control are discussed. Please read through the options carefully and decide which one or combination of methods will be most suitable for your specific situation (and your budget!).

Each methodology is discussed under 6 categories:

1. **The methodology name**
2. **Resources needed** – what equipment and skills will be needed for this specific method
3. **Methodology** – a detailed, step by step description of the methodology
4. **Targets** – What area can be expected to be cleared, with how many people in what time
5. **Risk & Hazards** – What may go wrong and how to prevent damage and injury
6. **Cost example** – An estimate of cost, according to 2015 prices.

Remember that Bankrupt bush encroachment is not a problem that will disappear overnight, and consistent follow-up actions and effective long term management will be required.

DISCLAIMER

Although utmost care has been taken in the compilation of the content of this manual, neither the Department of Agriculture, Forestry & Fisheries nor its employees shall be held liable for any loss, damage, inconvenience or any other liability suffered as a consequence of the use of this manual.



OPTION A

1. METHOD: CHOPPING OUT PLANTS BY HAND

2. RESOURCES NEEDED

a) Pick or hoe



b) Trained labour with supervision

3. METHODOLOGY

Labourers use picks or hoes to chop out individual plants.

The burl or stump, that contains most of the plant's growing points, is situated just beneath the soil surface. **It is of utmost importance that the plant is chopped off deep enough to totally remove this burl otherwise it will just start to grow again.**



The underground burl
with growing points
producing new shoots

In many cases, especially in very hard or dry soil, the ordinary hoe is too light to cut deep enough into the soil. It may work for very sandy or very soft (wet) soils, but otherwise it is recommended too rather use a pick.




← Stems cut off with a hoe, but did not cut deep enough to remove the burl

It is recommended to do this during the rainy season when soils are soft and easy to cut deep enough. Training of labourers and supervision is the key to success.

It is best to disturb or move uprooted plants as little as possible. By piling up plants may look more impressive and may be helpful to show progress made, but will disperse millions of seeds.

If plants are piled up – **NEVER burn these piles!** The intense heat will totally sterilize the soil beneath and leaving open patches of soil that may take a very long time to restore. Drafts created by the intense fire may also blow burning bushes into the air that will set alight adjacent vegetation.

This method is mainly limited to plants that invade natural veld with low plant densities of up to 5000 plants/ha.

 *For higher plant densities – consider OPTIONS B, C, D & G*

It is recommended that this method is followed before February to limit the dispersal of seed during handling of the plants which produce seed from February to April.



In the photograph above, workers are busy chopping out Bankrupt bush with hoes. Note the low density of plants and the open spaces between plants that typically made this situation favorable to control by hand. In the back the piles of uprooted plants are visible (not recommended).

FOLLOW UP: Follow up should be done during the next raining season, probably during September - October, when seedlings start to emerge. This is the most important phase of this option and neglecting to do so will undo all the effort and money spent during the previous season. Ensure that all regrowth, new growth and seedlings are removed. This action will have to be repeated every year after the area can be declared as totally free of Bankrupt bush. **Do not let any Bankrupt bush plants get to flowering and seeding stage!**



4. TARGETS

0.1 ha /person/day depending on plant density, soil condition and climate.

A team of 10 workers will clear an area of ± 1 ha per day.

5. RISKS & HAZARDS

- a) Wrong application of method due to inadequate training.
- b) Climatic conditions like continuous rain will influence time frames.
- c) Exhaustion of workers due to weather extremes.
- d) Unmotivated workers due to the tedious nature of the job.

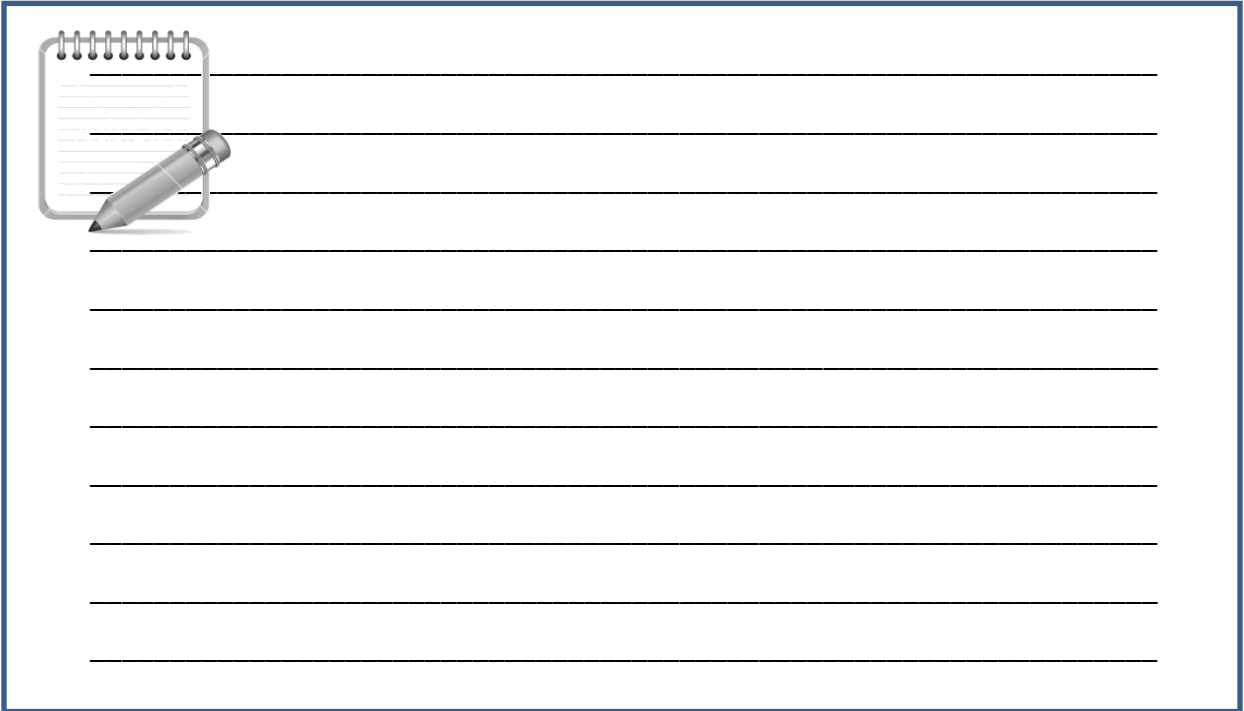
6. COST EXAMPLE

R100/person/day (2015 Minimum wages for farmworkers = R93/day)

EPWP workers use a wage of R80/person/day

0.1 ha /person/day = R80 - R100/ha

Total cost: R800 – R1000/ha





OPTION B

1. METHOD: APPLY GRANULAR HERBICIDE BY HAND

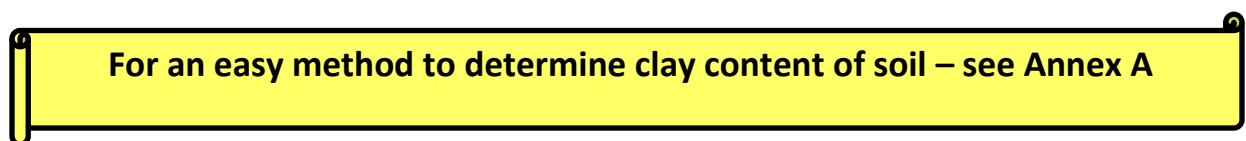
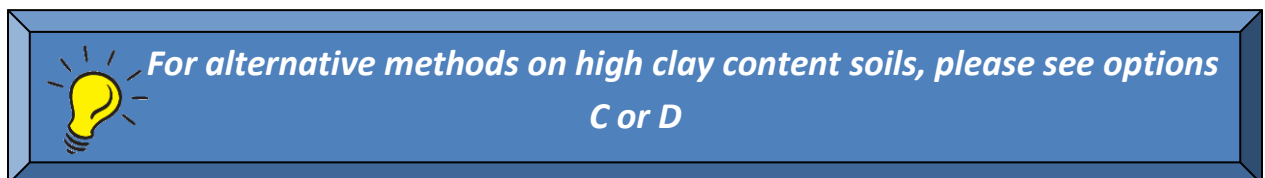
2. RESOURCES NEEDED

- a) Soil based systemic herbicide in granular form
- b) Knapsack to carry granules
- c) Funnel mounted on PVC pipe
- d) Protective clothing
- e) Markers (e.g. toilet paper)
- f) Trained labour with supervision

3. METHODOLOGY

GENERAL INFORMATION

- This option applies to areas with an encroachment of **<5000 plants/ha**.
- This option is also recommended for areas where there is no water available, or inaccessible for transport of water for the preparation of soluble formulations.
- Because the soil based formula needs to be washed into the soil by rain, it is recommended that it is done just **before the beginning of the raining season**.
- For the herbicide to move effectively through the soil profile, it is recommended that it is **not used on soils with clay content higher than 20%**.
- Soils with an **organic matter content of over 10%** will also decrease the mobility and efficiency of the herbicide movement in the soil profile.



- Also take into account that fire will destroy the active ingredient of the granules laying on the surface, thus the area need to be **protected from fire** until the granules have been washed into the soil by rain.
- Systemic soil based herbicides like Tebuthiuron may have an **after effect** in the soil of up to three years that will also minimize seedling recruitment.

a) Training

According to legislation (Act 36 from 1947) all workers applying herbicide must be trained in the safe use thereof and work under the control of a registered pest control applicator.


b) Choose a herbicide

Formulations based on the active ingredient **Tebuthiuron** can be used for this option. Please contact your nearest agent or co-operative to assist in this matter.

- c) Assure that all workers are supplied with protective clothing and each worker needs to sign a register that he/she knows how to use the protective clothing and equipment for their own safety.
- d) One of the biggest challenges of this option is to know which plants have already been dosed and which are not. If possible, the area can be divided with rope, markers, flagpoles or even toilet paper, as long as it will enable the worker not to double dose or miss plants during the process.
- e) Line up the workers and work through the problem area in **an orderly and systematic way**.
- f) As illustrated in the photograph below, place the plastic pipe into the bush, right up to the center of the plant. Scoop the correct amount of granules, or take from the bag and deposit via the funnel and pipe to the center of the plant.





 *Very large, mature plants with lots of moribund material may first be rejuvenated by using options F, H or I depending on the terrain and circumstances*

FOLLOW UP: Most of these formulations have a long after effect in the soil and another application won't be necessary for at least 2-3 years. Due to the soil based nature of the herbicide, it will also kill new seedlings. It is however important to monitor the area for plants that may have been missed during control and deal with them as well. After 3-4 years it is recommended to rather use a foliar applied formulation to treat emerging plants, which is less harmful to the environment and have a much shorter half-life.



Also remember that soil based systemic herbicides will take a long time, even up to eighteen months, to totally kill the target plant. Don't think that the control was unsuccessful or become impatient and apply more herbicide. This will be catastrophic!



4. TARGETS

±1-2 ha / person / day depending on plant density, terrain and climate.

5. RISKS & HAZARDS

a) Over dosage is one of the biggest concerns for this option. It is extremely important to comply with the recommendations on the label of the product that is used.

Especially where a number of granules per plant are prescribed, the client must make sure that IN TOTAL, the application PER HECTARE is not exceed.



- b) Workers that are tired, unmotivated or poorly trained may over dose or under dose areas.
- c) Rainfall patterns, distribution, amount and intensity may not play along as predicted.
- d) Fire may destroy the granules.

Herbicides are hazardous material and if not applied correctly can lead to:

- Poisoning of the worker
- Damage to non-target vegetation such as other woody shrubs or the grass sward
- Soil sterilization
- Very low success rate in killing target species
- Waste of money. Over application and under application is a waste of money.

The photograph below illustrates the effect of over dosage on natural veld



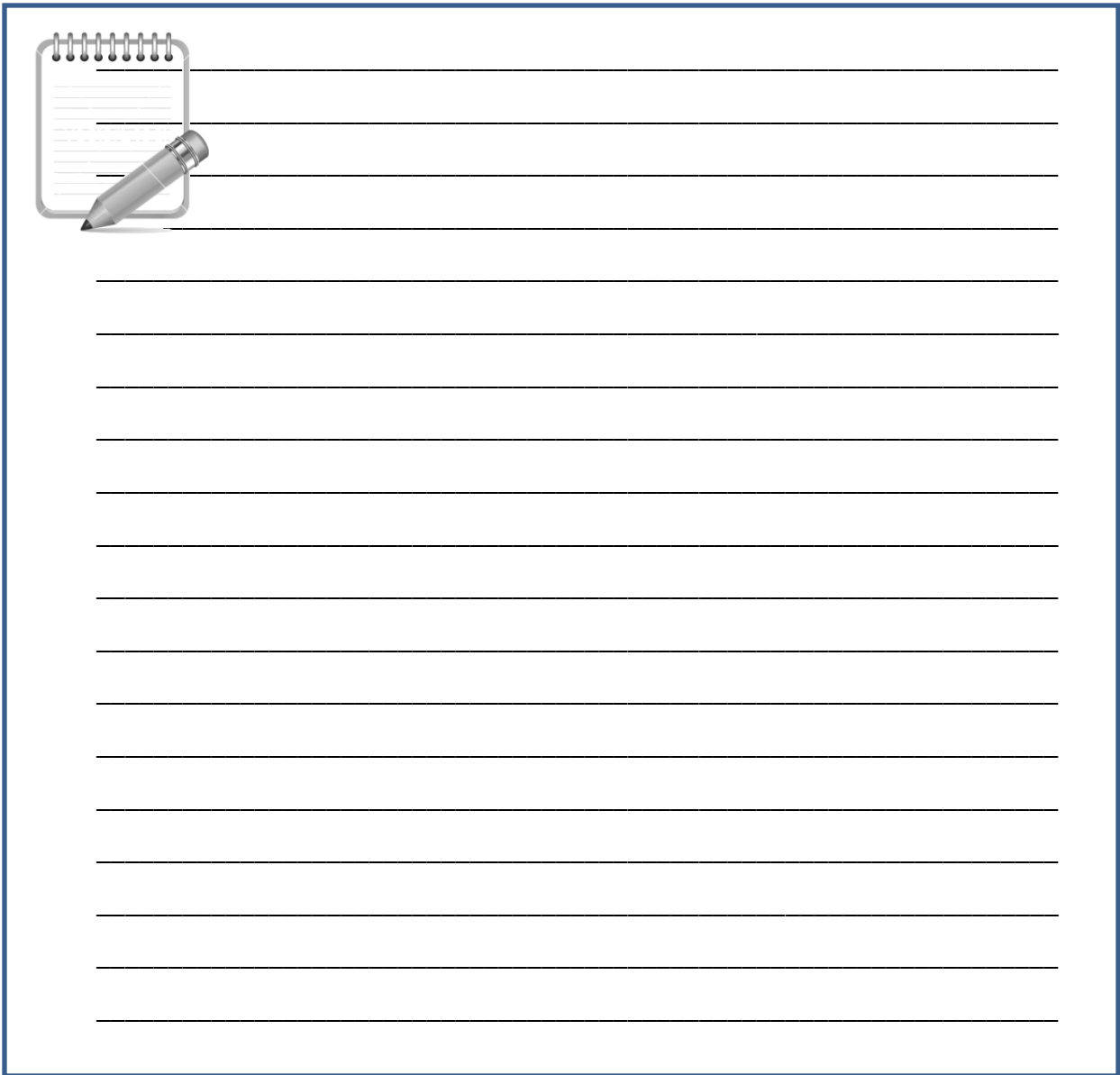
6. COST EXAMPLE

Herbicide: R110 / kg @ 3.5 kg/ha average = R385/ha

Labour: R80-R100/person/day @ 1ha/person/day = R80-R100/ha

Transport: (not included in this calculation)

Total cost: R485/ha



The image shows a large rectangular box with a blue border. On the left side of the box, there is a small illustration of a spiral-bound notebook with a pen resting on it. The rest of the box is filled with horizontal lines, providing a space for writing or calculations.



OPTION C

1. METHOD: APPLY HERBICIDE SUSPENSION BY HAND (FOLIAR OR SOIL APPLICATION)

2. RESOURCES NEEDED

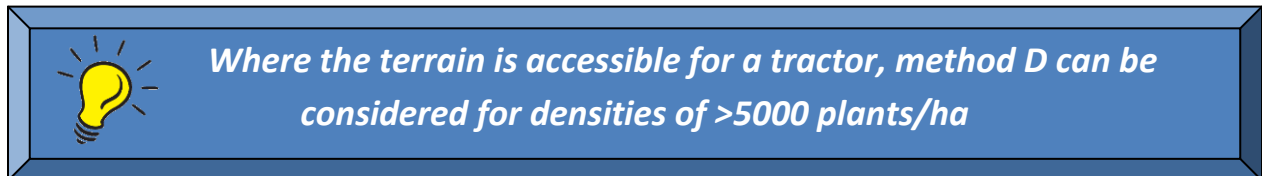
- a) Herbicide suspension for foliar or soil based application
- b) Water tank / cart with clean water to prepare suspensions [\pm 300-400 L water/ha]
- c) 5L Plastic containers and dosage syringes for soil based application
- d) Rucksack for foliar application
- e) Colour dye and wetting agent
- f) Protective clothing
- g) Trained labour with supervision



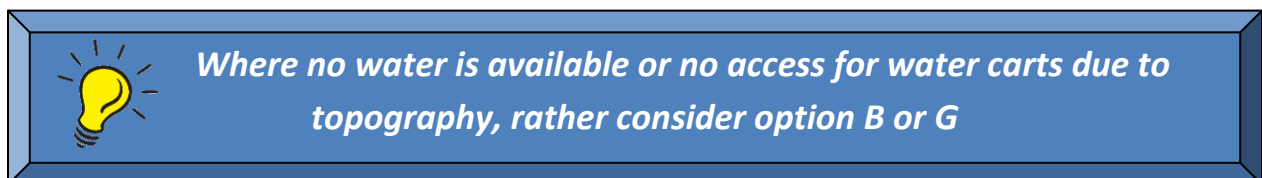
3. METHODOLOGY

GENERAL INFORMATION

- This option applies to areas with an encroachment of **<5000 plants/ha**.



- Both these applications will need access to water to prepare suspensions.



- Because the soil based suspension needs to be washed into the soil by rain, it is recommended that it is done just **before the beginning of the raining season**.
- For the herbicide to move effectively through the soil profile, it is recommended that it is **not used on soils with clay content higher than 20%**.



- In the case of **foliar application, grazing animals must be removed from the area for at least 28 days**. Soil applied herbicide poses no risk to grazers and animals don't have to be removed from the area.

a) Training

According to legislation (Act 36 from 1947) all workers applying herbicide must be trained in the safe use thereof and work under the control of a registered pest control applicator.

b) Choose a herbicide

Formulations based on the active ingredients **Tebuthiuron** (soil based) or **Metsulfuron** (foliar application) may be used for these options. Please contact your nearest agent or co-operative to assist in this matter.

c) When preparing suspensions it is very important to use **good quality water**. Use only water of which the quality is suitable for overhead irrigation. Poor water quality may influence the effectiveness of the suspension. In some cases it may be necessary to add a pH buffer to the suspension. Consult your herbicide agent for more information.

d) If using foliar application, remember to add a wetting agent and an assimilation agent to improve the uptake and effectiveness of the herbicide.

e) Assure that all workers are supplied with protective clothing and each worker needs to sign a register that he/she knows how to use the protective clothing and equipment for their own safety.

f) Line up the workers and work through the problem area in **an orderly and systematic way**. (See picture on next page)



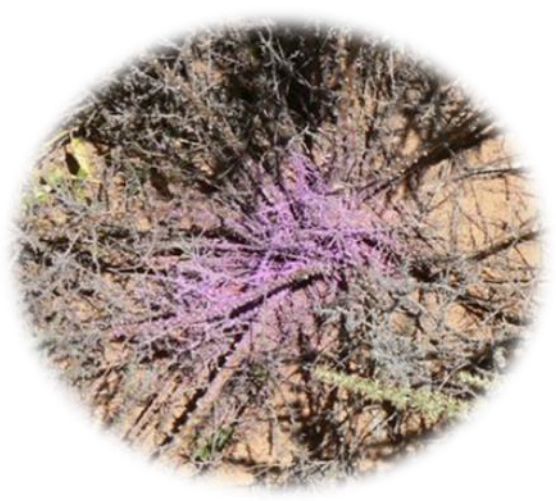


- g) For soil based herbicides, apply the recommended amount of milliliters in the center of the plant, as close as possible to the main root. Mature plants need to be “opened up” by foot to get access to the center.



Very large, mature plants with lots of moribund material may first be rejuvenate by using options F, H or I depending on the terrain and circumstances

- h) For foliar applications, trying to reach all areas of the plant with the herbicide spray until it start to drip from the plant.



Container with coloured herbicide suspension and dosage syringe; Herbicide applied correctly into the “opened-up” center of the plant.



Spraying with a rucksack



Mixing or spraying herbicide suspensions during very warm weather with high temperatures can be extremely dangerous. Always use masks when handling the herbicide, even when preparing the solution. Rather spray early in the day when temperatures are still low.

FOLLOW UP: Tebuthiuron based formulations have a long after effect in the soil that also kill emerging seedlings after treatment and another application won't be necessary for at least 2-3 years. Metsulfuron based formulations do not have any long term effect and follow-up will be necessary in two years' time from application. Metsulfuron will also **NOT KILL** seedlings that emerged after treatment, so follow-up will be crucial to make a substantial impact.



Also remember that these systemic herbicides will take a long time, even up to eighteen months, to totally kill the target plant. Don't think that the control was unsuccessful or become impatient and apply more herbicide. This will be catastrophic!

4. TARGETS

Terrain and climate may also have an influence.

Foliar application ± 0.5 ha / person / day @ 2500 plants/ha.

Soil application 2.5 ha /person / day @ 2500 plants/ha

5. RISKS & HAZARDS

- a) Over dosage with the soil based formulations is one of the biggest concerns for these options. It is extremely important to comply with the recommendations on the label of the product that is used.

Herbicides are hazardous material and if not applied correctly can lead to:

- Poisoning of the worker
- Damage to non-target vegetation such as other woody shrubs or the grass sward
- Soil sterilization
- Very low success rate in killing target species
- Waste of money. Over application and under application is a waste of money.

- b) Foliar applications may not be applied sufficiently to cover as much as possible of the plant.
- c) Rainfall patterns, distribution, amount and intensity may not play along as predicted.
- d) Veld fires directly after application of herbicides may decrease effectiveness.

6. COST EXAMPLE (Prices for 2012 and ± 4000 plants/ha)

Foliar application

Herbicide: ± R135/ha (including wetting agent and pH buffer and dye)

Labour: R80-R100/person/day @ 1ha/person/day = R80-R100/ha

Transport: (not included in this calculation)

Total cost: R235/ha

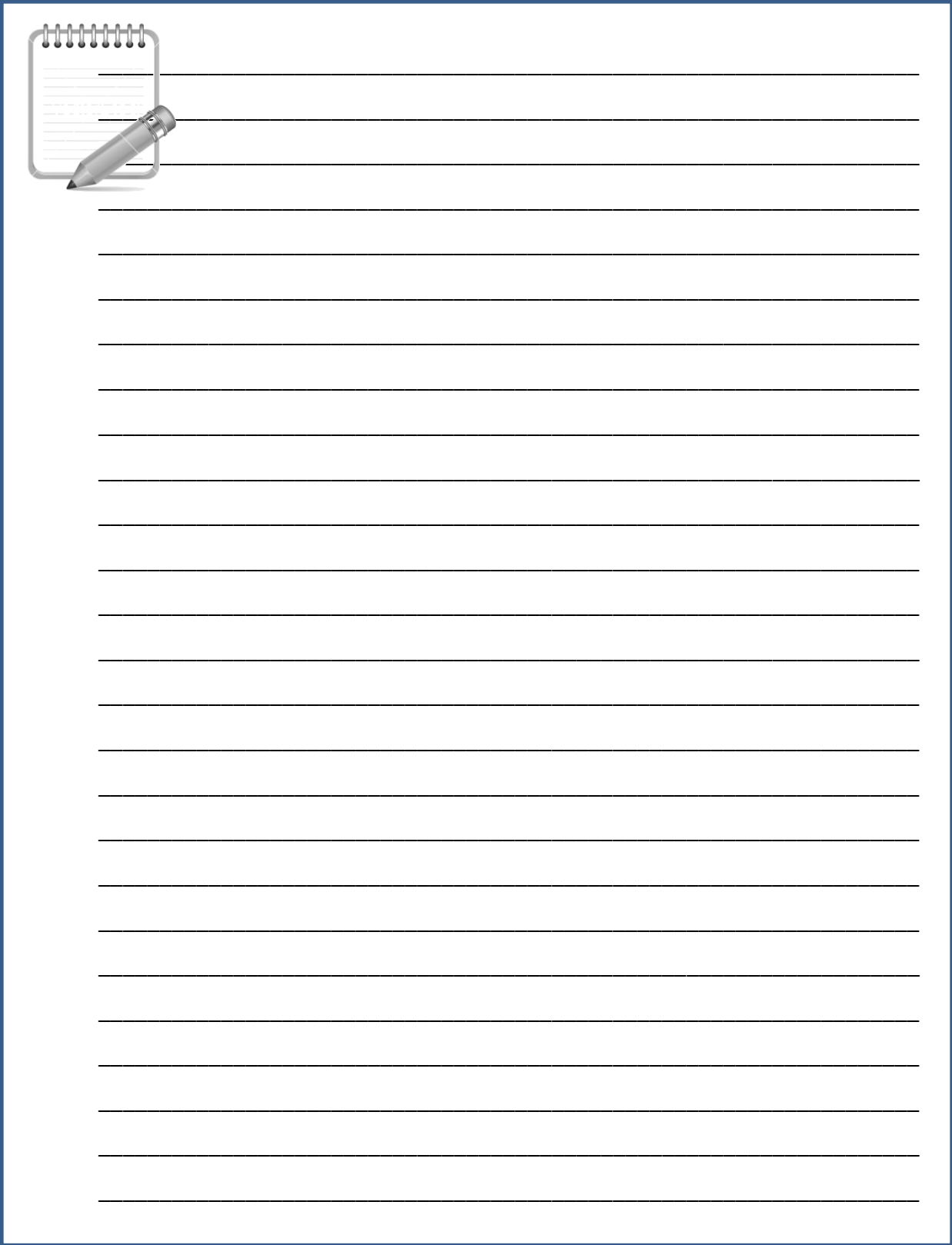
Soil application

Herbicide: ± R440/ha (including wetting agent and pH buffer and dye)

Labour: R80-R100/person/day @ 1ha/person/day = R80-R100/ha

Transport: (not included in this calculation)

Total cost: R540/ha



A spiral-bound notepad with a pen resting on it, positioned in the top-left corner of a large rectangular frame. The frame contains 20 horizontal lines for writing.



OPTION D

1. METHOD: APPLY HERBICIDE WITH TRACTOR MOUNTED BOOM SPRAYER (FOLIAR OR SOIL APPLICATION)

2. RESOURCES NEEDED

- a) Herbicide suspension for foliar application (e.g. Metsulfuron) or soil application (e.g. Tebuthiuron)
- b) Water tank / cart with clean water to prepare suspensions [\pm 200-400 L water/ha]
- c) Tractor with **calibrated tractor mounted boom sprayer** (advise label directions or your nearest co-operative for calibration instructions and support)
- d) Fuel for tractor
- e) Protective clothing
- f) **Trained tractor driver** that will keep at the recommended speed for correct herbicide application rates.



3. METHODOLOGY

GENERAL INFORMATION

- The main constraint for this option is the **accessibility of the terrain**. Mostly suited for level topography with slopes <10% and easy access to a tractor with a boom sprayer.
- This option usually applies to areas with an encroachment of **>5000 plants/ha**.
- Both these applications will need access to water to prepare suspensions.




Where no water is available or no access for water carts due to topography, rather consider option B or G

- Because the soil based suspension needs to be washed into the soil by rain, it is recommended that it is done just **at the beginning of the raining season**.
- For the herbicide to move effectively through the soil profile, it is recommended that it is **not used on soils with clay content higher than 20% or organic content of >10%**.

For an easy method to determine clay content of soil – see Annex 1

- After application, grazing animals must be removed from the area for **at least 28 days**.

a) Training



According to legislation (Act 36 from 1947) all workers applying herbicide must be trained in the safe use thereof and work under the control of a registered pest control applicator.

b) Choose a herbicide

Suspensions based on the active ingredients **Tebuthiuron** (soil based) or **Metsulfuron** (foliar application) may be used for these options. Please contact your nearest agent or co-operative to assist in this matter.

c) When preparing suspensions it is very important to use **good quality water**. Use only water of which the quality is suitable for overhead irrigation. Poor water quality may influence the effectiveness of the suspension. In some cases it may be necessary to add a pH buffer to the suspension. Consult your herbicide agent for more information.

d) If using foliar application, remember to add a wetting agent and an assimilation agent to improve the uptake and effectiveness of the herbicide.

e) Drive the tractor at the recommended speed and spray strips as wide as the boom sprayer allows. **Avoid overlapping of swaths** and **close the nozzles** while starting, slow movement, turning and stopping to prevent over-application.

f) Do not apply herbicides with a tractor mounted boom sprayer when wind speed is too high.



Very dense stands of plants with lots of moribund material may first be rejuvenated by using options F, H or I depending on the terrain and circumstances



Islands of Bankrupt bush that were missed when treated with tractor mounted boom sprayer.



Mixing or spraying herbicide suspensions during very warm weather with high temperatures can be extremely dangerous. Always use masks when handling the herbicide, even when preparing the solution. Rather spray early in the day when temperatures are still low.

FOLLOW UP: Tebuthiuron based formulations have a long after effect in the soil that also killed emerging seedlings after treatment and another application won't be necessary for at least 2-3 years. Metsulfuron based formulations do not have any long term effect and follow-up will be necessary in two years' time from application. Metsulfuron will also **NOT KILL** seedlings that emerged after treatment, so follow-up will be crucial to make a substantial impact.



Also remember that these systemic herbicides will take a long time, even up to eighteen months, to totally kill the target plant. Don't think that the control was unsuccessful or become impatient and apply more herbicide. This will be catastrophic!

4. TARGETS

± Half an hour per hectare at an application rate of 5km/h

5. RISKS & HAZARDS

- a) Over dosage with the soil based formulations is one of the biggest concerns for these options. It is extremely important to comply with the recommendations on the label of the product that is used.
- b) Mechanical failure of tractor or equipment may cause serious delays
- c) Incorrect calibration of boom spray may cause over- or under dosage.
- d) Challenges in the terrain like rocks or dongas may complicate accessibility.
- e) Foliar applications may not be applied sufficiently to wet the plants completely
- f) Rainfall patterns, distribution, amount and intensity may not play along as predicted.
- g) Veld fires directly after application of herbicides may decrease effectiveness.

6. COST EXAMPLE (Prices for 2013)

Foliar application

Herbicide: ± R360 per hectare (depending on type of product used)

Labour: Tractor running cost @ R140/ha (driver included)

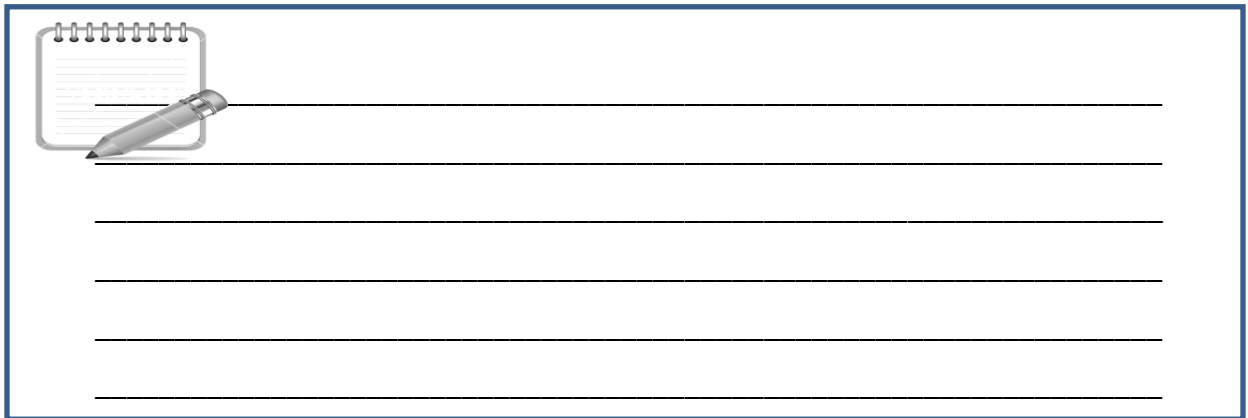
Total cost: R500/ha

Soil application

Herbicide: ± R470 per hectare (depending on type of product used)

Labour: Tractor running cost @ R140/ha (driver included)

Total cost: R610/ha



OPTION E

1. METHOD: USING TRACTOR WITH DISK OR PLOUGHING IMPLEMENT



Remember that a cultivation permit under CARA and NEMA may be applicable where virgin land is ploughed or to plough land that have been cultivated more than 10 years ago.

2. RESOURCES NEEDED

- a) Tractor and disk or plough
- b) Fuel for tractor
- c) Tractor driver

3. METHODOLOGY

GENERAL INFORMATION

- **This option is mostly use to clean old cultivated fields from Bankrupt bush infestation as preparation to establish pastures or crops.**
 - If possible, this option must be done before the Bankrupt bush plants set seed.
 - Plant material worked into the soil will also improve organic content and fertility.
 - It will be crucial to monitor seedling recruitment during the first year after cultivation to keep the land clean of any emerging Bankrupt bush plants.
- a) If possible, it will be helpful to get rid of very dense stands of Bankrupt bush through burning first. This may also limit the dispersal of seed during cultivation.
 - b) Pastures with a good crown cover or tufted pastures e.g. *Eragrostis* are usually better equipped to compete with Bankrupt bush seedlings, while other pastures with sparse cover e.g. *Digitaria*, will probably need a bit of support during the first year or two.

- c) It is also very important to keep headlands free of Bankrupt bush.



Neglect to do so will re-infest cultivated areas and all efforts will be fruitless.

- d) If it is observed that disking is not sufficient to cut very big stumps and roots effectively, rather use ploughing as an option.

- e) Remember that Bankrupt bush is also **sensitive for high Nitrogen levels**. Fertilizing pastures will give the pasture a good start but negatively impact on Bankrupt bush seedling recruitment and survival.



Ploughing may be more effective than disking to cut Bankrupt bush roots

FOLLOW UP: Will depend on the type of pasture or crop planted. Crop fields that are cultivated every season will stay clean from infestation, but Bankrupt bush seedlings need to be treated until permanent pastures take the lead in competition. Keep headlands clean from any Bankrupt bush.



4. TARGETS

Depends on average tractor speed, personal skill and experience.

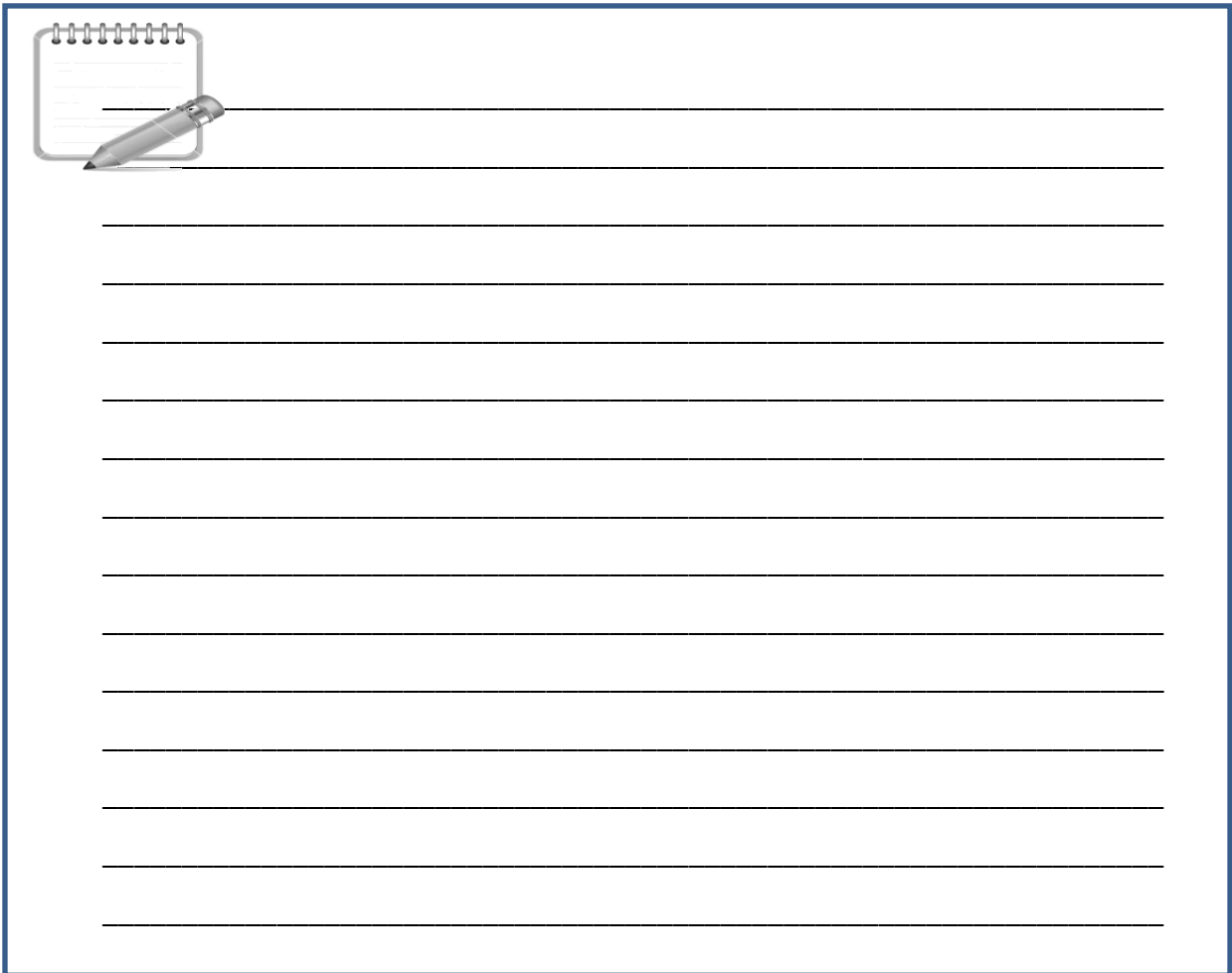
5. RISKS & HAZARDS

- a) Mechanical failure of tractor or equipment may cause serious delays
- b) Planted pastures that establish very slowly will be at risk of Bankrupt bush infestation.
- c) Disk blades did not actually cut deep enough, leaving the plants still rooted.

6. COST EXAMPLE (Prices for 2012)

Use current tractor and fuel prices to calculate cost.

Add tractor driver cost as per salary agreement.



The form consists of a large rectangular area enclosed in a blue border. In the top-left corner, there is a small icon of a spiral-bound notebook with a pen resting on it. Below this icon, there are 15 horizontal lines spaced evenly down the page, intended for handwritten notes or calculations.

OPTION F



1. METHOD: USING TRACTOR WITH SLASHER IMPLEMENT

2. RESOURCES NEEDED

- a) Tractor with slasher
- b) Fuel for tractor
- c) Tractor driver

3. METHODOLOGY

GENERAL INFORMATION

- **This option is mostly used to reduce plant material for two reasons:**
 - Better **access** to an area and to **identify individual plants** more clearly for control actions by hand.
 - **Repetitive slashing** (twice during the active growing season) put the Bankrupt bush under stress and will eventually deplete the plant reserves to such an extent that it will die.
- If possible, this option must be done before the Bankrupt bush plants set seed.
- Slashed material will improve soil cover and reduce loss of soil moisture.
- Keep in mind that this is **just an accessory method** and **cannot** be used to effectively and totally eradicate Bankrupt bush encroachment.



- a) Slashing will have the biggest impact when done during the growing season.
- b) Systematically work in strips through the area and note all “islands” that cannot be reached by the tractor. Control plants in these areas as soon as possible before they encroached into controlled areas.
- c) Slashing during the growing season will unfortunately also impact negatively on the grass sward, especially late in the growing season. Make sure that grasses will have enough time to regrow and seed before winter.



Slashing Bankrupt bush veld.



Six weeks after slashing

FOLLOW UP: Will depend on the reason for slashing. If it was to get rid of biomass, follow up with mechanical or chemical control as described in OPTIONS A-D. If it was to weaken plants, follow up after regrowth with another slashing. Remember to control plants in the safe “islands” between slashed areas.



4. TARGETS

Depends on average tractor speed, personal skill and experience.

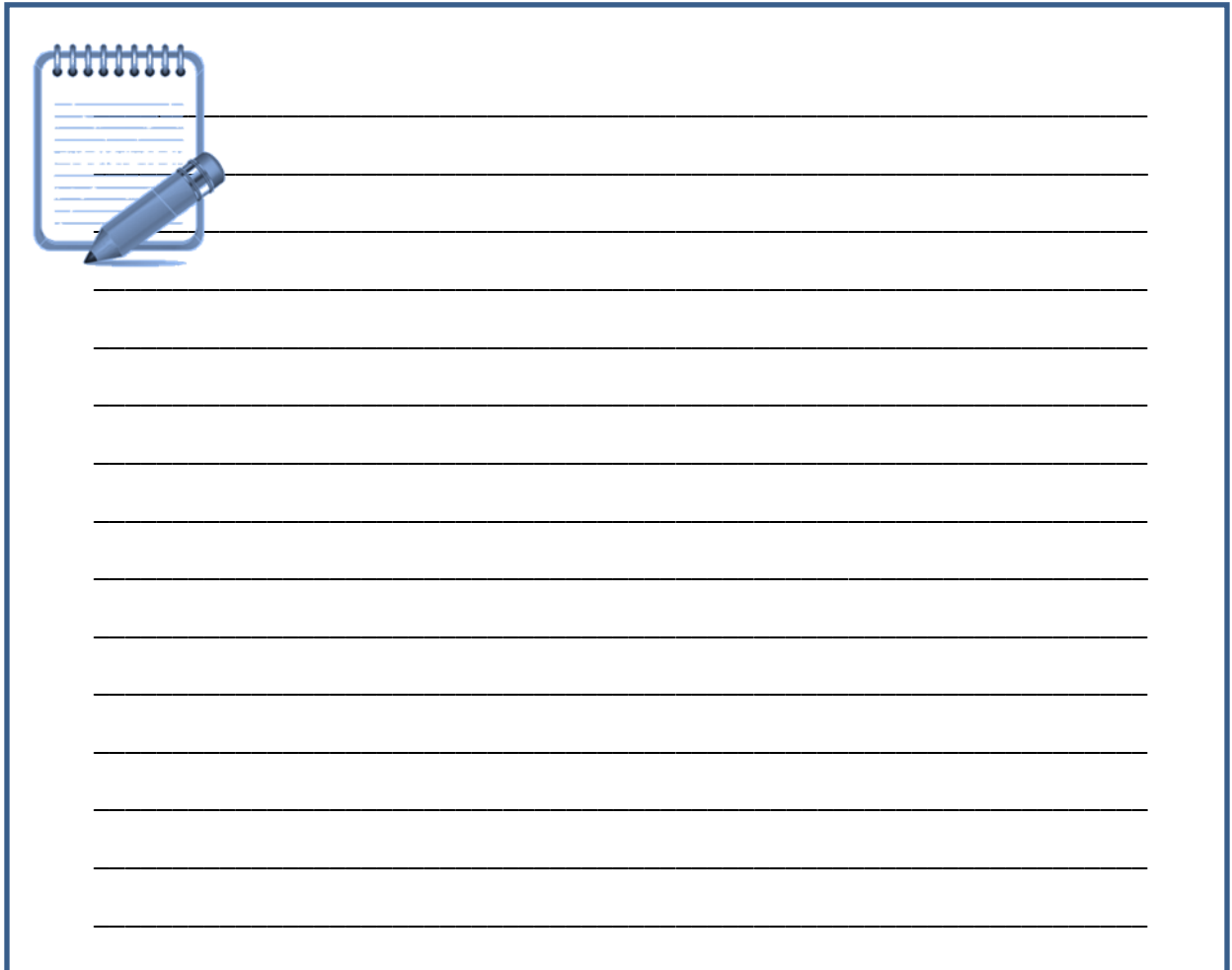
5. RISKS & HAZARDS

- a) Mechanical failure of tractor or equipment may cause serious delays
- b) Cannot follow up with control quickly enough after slashing.
- c) Heavy grazing directly after slashing may hurt the grass sward.

6. COST EXAMPLE (Prices for 2012)

Use current tractor and fuel prices to calculate cost.

Add tractor driver cost as per salary agreement.





OPTION G

1. METHOD: APPLY HERBICIDE WITH AIRPLANE (FOLIAR OR SOIL APPLICATION)

2. RESOURCES NEEDED

- Herbicide suspension for foliar application (e.g. Metsulfuron) or granules for soil application (e.g. Tebuthiuron)
- Water tank / cart with clean water to prepare suspensions [\pm 200-400 L water/ha]
- Airplane equipped with herbicide spraying equipment.

3. METHODOLOGY

GENERAL INFORMATION

Aerial application may only be done by a registered Aerial Application Operator using a correctly calibrated, registered aircraft according to the instructions of SANS Code 10118 (Aerial Application of Agricultural Pesticides).



- This option is usually used with Bankrupt bush densities of **> 5000 plants / ha**.
- and where the terrain and topography made it difficult to reach by foot, vehicle or tractor.
- This option will need access to water to prepare suspensions for foliar application.
- Because the soil based suspension needs to be washed into the soil by rain, it is recommended that it is done just **at the beginning of the raining season**.
- For the herbicide to move effectively through the soil profile, it is recommended that it is **not used on soils with clay content higher than 20% or organic content of >10%**.
- After application, grazing animals must be removed from the area for **at least 28 days**.

For an easy method to determine clay content of soil – see Annex A



Very dense stands of plants with lots of moribund material may first be rejuvenate by using options H or I depending on the terrain and circumstances

- a) Choose a herbicide

Suspensions based on the active ingredients **Tebuthiuron** (soil based) or **Metsulfuron** (foliar application) may be used for these options. Please contact your nearest agent or co-operative to assist in this matter.

- b) When preparing suspensions it is very important to use **good quality water**. Use only water of which the quality is suitable for overhead irrigation. Poor water quality may influence the effectiveness of the suspension. In some cases it may be necessary to add a pH buffer to the suspension. Consult your herbicide agent for more information.

- c) If using foliar application, remember to add a wetting agent and an assimilation agent to improve the uptake and effectiveness of the herbicide.

- d) Ensure that the spray mixture is **distributed evenly over the target area** and that the loss of spray material during application is restricted to a minimum.

- e) Stop spraying if the wind speed exceeds 15 km/h.

- f) Stop spraying under turbulent, unstable and dry conditions during the heat of the day.

- g) In case of soil applied **granules**, the aerial application can only be carried out by fixed wing aircraft fitted with the specially designed application apparatus. Contact your supplier or the registration holder for more information.

- h) The **target area must be clearly marked out** and the markers used must be clearly visible to the operator.

Fixed wing aircraft busy spraying herbicides





Mixing or spraying herbicide suspensions during very warm weather with high temperatures can be extremely dangerous. Always use masks when handling the herbicide, even when preparing the solution. Rather spray early in the day when temperatures are still low.

FOLLOW UP: Tebuthiuron based formulations have a long after effect in the soil that also killed emerging seedlings after treatment and another application won't be necessary for at least 2-3 years. Metsulfuron based formulations do not have any long term effect and follow-up will be necessary in two years' time from application. Metsulfuron will also **NOT KILL** seedlings that emerged after treatment, so follow-up will be crucial to make a substantial impact.



Also remember that these systemic herbicides will take a long time, even up to eighteen months, to totally kill the target plant. Don't think that the control was unsuccessful or become impatient and apply more herbicide. This will be catastrophic!



4. TARGETS

± Half an hour per hectare at an application rate of 5km/h

5. RISKS & HAZARDS

- h) Over dosage with the soil based formulations is one of the biggest concerns for these options. It is extremely important to comply with the recommendations on the label of the product that is used.
- i) Mechanical failure of tractor or equipment may cause serious delays
- j) Incorrect calibration of boom spray may cause over- or under dosage.
- k) Challenges in the terrain like rocks or dongas may complicate accessibility.
- l) Foliar applications may not be applied sufficiently to wet the plants completely
- m) Rainfall patterns, distribution, amount and intensity may not play along as predicted.
- n) Veld fires directly after application of herbicides may decrease effectiveness.

6. COST EXAMPLE (Prices for 2013)

Foliar application

Herbicide: ± R300 per hectare (depending on type of product used)

Airplane cost: Average of R120 –R180/ha

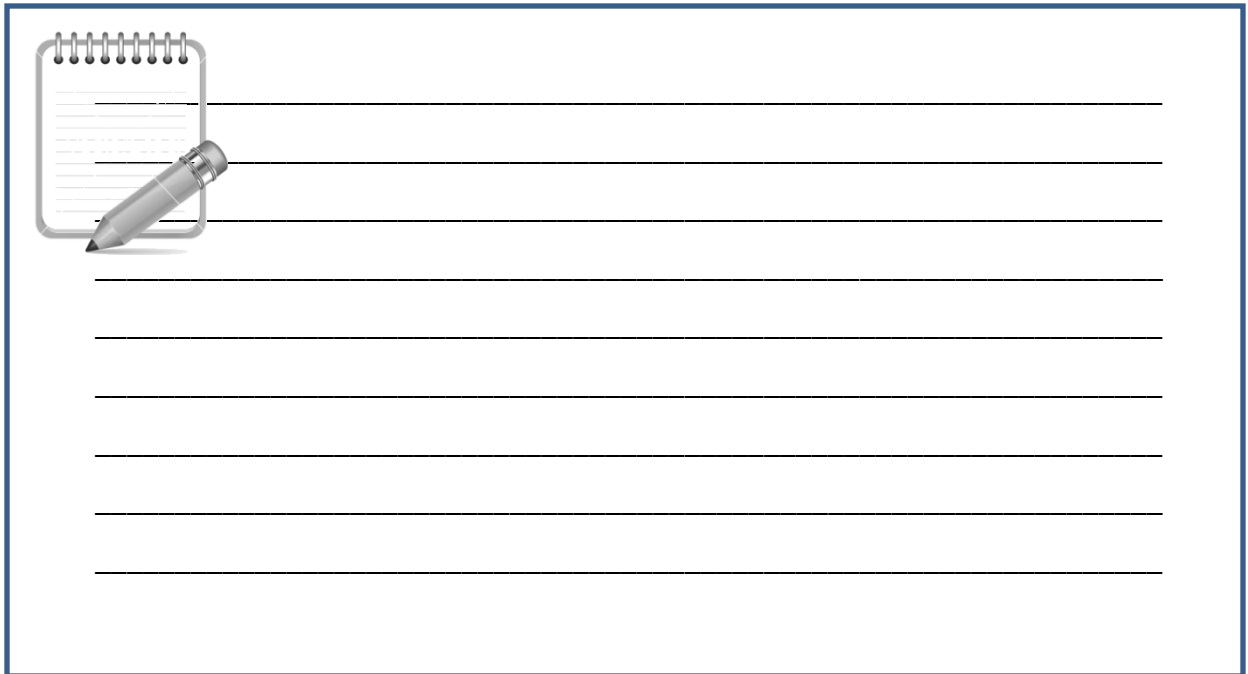
Total cost: R/ha

Soil application

Herbicide: ± R620 per hectare (depending on type of product used)

Airplane cost: Average of R120 –R180/ha

Total cost: ± R770/ha



A large rectangular box with a blue border, containing a graphic of a spiral-bound notepad and a pen on the left side. The notepad is open, showing several lines of text. The pen is silver and black, resting on the notepad. To the right of the notepad and pen, there are several horizontal lines for writing, extending across the width of the box.

OPTION H

1. METHOD: USING FIRE AS MANAGEMENT TOOL

2. RESOURCES NEEDED

- a) Firefighting equipment
- b) Firefighting team



3. METHODOLOGY

GENERAL INFORMATION

Before any controlled burning, it is mandatory for the land user to apply for a burning permit at the Department of Agriculture, Forestry & Fisheries. (Regulation 12 of the Conservation of Agricultural Resources Act (Act 43 of 1983)).

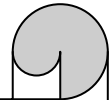
It is also mandatory to get permission from the local Fire Protection Agency (FPA).

It is also mandatory to inform all adjacent land owners of your intent to burn veld, including the proposed date and time.

Burning will only be allowed on days with a safe “fire index”, as issued by the SA Weather Services.

Adequate fire breaks need to be in place, to safeguard the land owner against legal action.

- **This option is mostly used for two reasons:**
 - To remove moribund material and expose **individual plants** more clearly for control actions by hand.
 - Regrowth of plants will assimilate herbicides faster and more efficiently.
 - **Remember that the use of fire will NOT completely kill Bankrupt bush plants**
 - Due to the growing points of the plant that are safely hidden beneath the soil surface, it will survive the fire and will start to regrow within a week from burning.
 - Due to the volatile oils in Bankrupt bush, the plants burn with a ferocious fire and proper precautions need to be taken.
- a) Burning must preferably take place during winter, to minimize damage to other natural vegetation.



- b) Although burning during the active growing season may even kill Bankrupt bush, it will also damage other natural vegetation and may even kill the entire grass sward that will lead to bare soil and erosion hazards.
- c) Research shown that burning in early spring (September – October) will effectively kill most seedlings.



Bankrupt bush burning.



Regrowth one week after burning

FOLLOW UP: After burning, follow up with mechanical or chemical control as described in OPTIONS A-D or option I for animals.



4. TARGETS

Areas as large as that can be safely managed.

5. RISKS & HAZARDS

- a) Run-away fires may result in damage to adjacent properties and legal liability.
- b) Damage to the grass sward when burning at the wrong time of the year.

6. COST EXAMPLE

Cost to hire a firefighting team

Cost of fire-fighting equipment

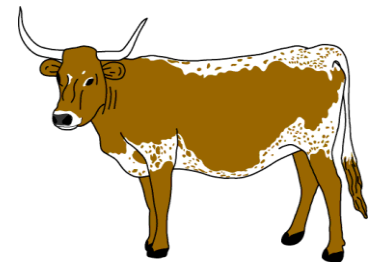
A large rectangular box with a blue border. In the top-left corner, there is an icon of a blue spiral notebook with a blue pen resting on it. Below the icon, there are ten horizontal lines for writing, extending across the width of the box.

OPTION I

4. METHOD: USING ANIMALS AS MANAGEMENT TOOL

5. RESOURCES NEEDED

- a) Grazing/Browsing Animals (Cattle/goat/sheep)
- b) Electric fencing (only when lacking infrastructure like camps)



6. METHODOLOGY

GENERAL INFORMATION

The use of animals will not eradicate Bankrupt bush completely, but it can be a very useful tool in the process of manage encroached veld.

By excluding all utilization from encroached veld will NOT make the Bankrupt bush disappear!



Under-utilized veld provides a “safe haven” for vulnerable Bankrupt bush seedlings to germinate and survive.

- a) Continue with normal grazing practices to the benefit of the grass sward, especially where encroachment does not yet reached levels of more than 5000 plants/hectare.
- b) Intensive utilization inhibits the growth of Bankrupt bush in the following ways:
 - i. The trampling action of animal hoofs destroy seedlings
 - ii. Trampling also opens up the canopy – favouring the grasses and disfavour Bankrupt bush seedlings.
 - iii. Trampling also break up old, large Bankrupt bush plants, and by continuing to do so, discourage growth and weakening the plants.
 - iv. Animal dung and urine increase the organic status of the soil, creating a non-favourable environment for Bankrupt bush.
- c) Some animals, like sheep, specifically browse young inflorescences, preventing the plants to reproduce through seed.
- d) Most livestock will however not browse Bankrupt bush by choice, but will take an occasional bite from young plants.
- e) Trials showed that, where large amounts of animal dung were scattered onto encroached land, the Bankrupt bush started to suffer and decrease in numbers due to the high organic content as well as the strong competition from the grass sward.

- f) Some game species, however, like Eland and Rhinoceros will browse Bankrupt bush.



Old Bankrupt bush plant trampled by livestock.



Bankrupt bush topped by livestock.

FOLLOW UP: Trampling of plants can be done regularly through the growing season. The idea is to prevent the plants from reaching maturity and produce seed. Continue normal grazing cycles to maintain grass sward health.



7. TARGETS

Animal herd size will determine the area that can be handled.

8. RISKS & HAZARDS

- a) Animals that are too long in very poor veld will lose some condition. Ensure that animal got access to good grazing between periods on encroached veld.

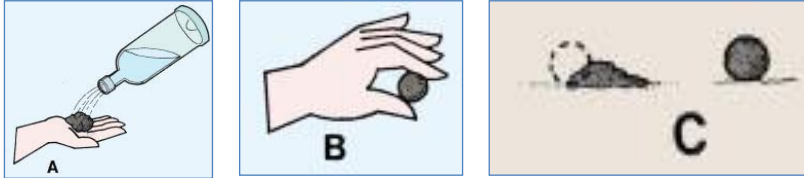
9. COST EXAMPLE

No cost implication except if additional animals need to be hired/bought/borrowed.

A large rectangular box with a blue border, intended for notes. On the left side, there is an illustration of a blue spiral notebook and a blue pen. The rest of the box is filled with horizontal lines for writing.

ANNEXURE A: SOIL TEXTURE: SAUSAGE TEST

[A] Take a handful of soil and wet it so that it begins to stick together, but without sticking to your hand;



[B] Roll the soil sample into a ball about 3 cm in diameter;

[C] Put the ball down...

- If it falls apart, it is **sand** [**< 10% Clay**]
- If it sticks together, go on to the next step.

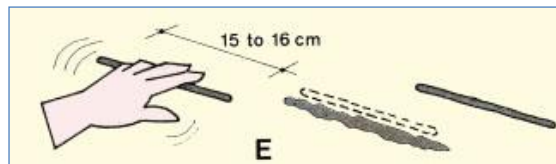
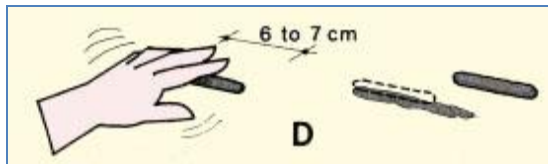


[D] Roll the ball into a sausage shape, 6-7 cm long ...

- If it does not remain in this form, it is **loamy sand** [**10 – 15% Clay**]
- If it remains in this shape, go on to the next step.

[E] Continue to roll the sausage until it reaches 15-16 cm long ...

- If it does not remain in this shape, it is **sandy loam** [**15 – 20% Clay**]
- If it remains in this shape, go on to the next step.



[F] Try to bend the sausage into a half circle ...

- If you cannot, it is **loam** [**20 - 25% Clay**]
- If you can, go on to the next step.



[G] Continue to bend the sausage to form a full circle ...

- If you cannot, it is **heavy loam [25 – 35% Clay]**
- If you can, with slight cracks in the sausage, it is **light clay [35 – 55% Clay]**
- If you can, with no cracks in the sausage, it is **clay. [>55% Clay]**



LITERATURE REFERENCES:

- AVENANT P. 2015. Report on the National Bankrupt bush (*Seriphium plumosum*) Survey (2010-2012). Department of Agriculture, Forestry & Fisheries. Pretoria.
- JORDAAN F.P. & JORDAAN D.G. 2012. *Seriphium plumosum*, Bankrotbos – Die weiveld dief in die Noordwes Provinsie. Department Agriculture and Rural Development, North West Provincial Government.
- KRUPKO, IRENA & DAVIDSON, R.L. 1961. An experimental study of *Stoebe vulgaris* in relation to grazing and burning. *Empire Journal of Experimental Agriculture*. 29:175-180.
- MUCINA, L. & RUTHERFORD, M.C. (eds) 2006. The vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19. South African National Biodiversity Institute, Pretoria.
- SNYMAN, H.A. 2010. Knowledge of seed ecology essential for *Seriphium plumosum* control. *Grassroots*; publication of the Grassland Society of Southern Africa. Vol. 10 (1). p. 9-14.
- SNYMAN, H.A. 2012. Habitat preferences of the encroacher shrub, *Seriphium plumosum*. *South African Journal of Botany*. 81: 34-39.
- VAN WYK, A.E & MALAN, S.J. 1997. *Field Guide to the Wild Flowers of the Highveld*. Struik, Cape Town. p44 & 272.
- WEPENER, J.P. 2007. The control of *Stoebe vulgaris* encroachment in the Hartebeesfontein area of the North West Province. North-West University, South Africa.