

# CHEMICAL BUSH CONTROL ON VARIOUS INVADER SPECIES, USING DIFFERENT ARBORICIDES AND CONTROL METHODS – AN ANALYSIS

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## INTRODUCTION

Chemical bush control is an ongoing and costly business, and errors can hardly be tolerated. Because bush encroachment is a very serious problem in Namibia, it is imperative that all relevant research results reach all land users as soon as possible. Officers from the NBRI as well as the Okahandja Extension Office initiated a bush control project to investigate the effects of different arboricides on various invader species on different soils. Various methods of application were also investigated. Calculations of costs were included in this project.

### Bush species considered to be problematic in Namibia

*Acacia* species:

*A. mellifera*

*A. erubescens*

*A. fleckii*

*A. reficiens* (western Namibia)

*A. luederitzii*

*A. nebrownii* (northwestern and southern Namibia)

Other invader species:

*Dichrostachys cinerea* (central and northern Namibia)

*Colophospermum mopane* (northwestern Namibia)

*Terminalia prunioides* (northern and northwestern Namibia)

*Terminalia sericea* (eastern Namibia)

*Catophractes alexandri* (northern and central Namibia)

*Rhigozum trichotomum* (southern Namibia)

*Prosopis* spp. and *Nicotiana glaucum* (riverbeds)

*Phaeoptilum spinosum* (Seeis area)

(For a complete list of the tree/bush species discussed in this article, including their English and Afrikaans common names, please refer to page 49.)

### Essential knowledge for successful bush control

1. The root system of the plant.
2. Physiological functions of the bush.
3. Soil (clay percentage, pH, depth and organic matter).
4. Which arboricide to use on a particular species; which application method yields the best results; and when (in which month) to apply the arboricide.
5. Product cost.
6. Labour cost.

The farm Uitkyk, in the Otjozondjupa region, was used for trial work. The farm is situated roughly 80 kilometres east northeast of Okahandja in Namibia's camelthorn savanna. Long-term average rainfall is 380 mm/year.

Invader species on the farm are: *Acacia mellifera*, *Acacia luederitzii*, *Dichrostachys cinerea*, *Catophractes alexandri* and *Phaeoptilum spinosum*.

Nineteen sites were identified on the farm Uitkyk. Treatment of these sites started in March 2001 and sites were surveyed each year until June 2006. The surveys were all 100 point botanical surveys, but also included bush density surveys in different height classes.



Figures 1 and 2. Examples of the extensive root system of *Acacia mellifera*.

Site 1: After bush was cleared and stumps sprayed



**Targeted spp.:** *Dichrostachys cinerea*.

**Botanical composition before treatment:** 95 % annuals and 5 % forbs.

**Bush density:** 2 650 bushes/ha.

**Arbicides used:** Access (240 g/L Triclopyr 24 %).

**Treatment:** All bushes were cut down with a chain saw and the stumps were treated with a 2 % Access per Actipon water mixture within one hour of being cut down.

**Follow-up treatment:** Regrowth was sprayed using 200 ml of a 1 % Access mixture.

**Treatment costs:**

1,2 L active/ha @ N\$ 198.00/L = N\$ 238.00/ha, + labour @ N\$ 60.00/day for 4 days = N\$ 480.00/ha, + chainsaw costs which included chains and fuel for

April 2006, after treatment



4 days for both chain saws amounting to N\$ 1 720.00. The total cost of clearing one hectare was therefore N\$ 2 438.00.

**Follow-up treatment costs:**

200 ml Access @ N\$ 198.00/L = N\$ 40.00, + N\$ 60.00 for labour. Total cost = N\$ 100.00/ha.

**Results:** The results after the first year showed a success rate of 80 %. With the aftercare treatment of spraying the regrowth in March 2002, a success rate of 100 % was achieved.

**Recommendation:** This method is recommended for clearing fences, roads and roadsides, but not for large areas, because it is expensive and time-consuming.

Site 2: March 2001, before treatment



**Targeted spp.:** *Dichrostachys cinerea*.

**Botanical composition before treatment:** 76 % annuals, 6 % forbs and 18 % bare areas.

**Bush density:** 4 150 bushes/ha.

**Arbicides used:** Access (240 g/L Triclopyr 24 %).

**Treatment:** 1 % Access and Actipon water mixture was sprayed onto the leaves of bushes with a Stihl blower pump (no 2 nozzle) on a windless day and at temperatures lower than 28 °C.

**Treatment costs:**

300 ml active/ha @ N\$ 198.00/L = N\$ 59.00/ha, + N\$ 60.00 for labour (2 x half day wages). Total cost = N\$ 119.00/ha.

April 2006, after treatment



**Follow-up treatment:** Regrowth was sprayed with a 1 % Access mixture and a larger no 3 nozzle.

**Follow-up treatment costs:**

600 ml/ha @ N\$ 198.00/L = N\$ 118.00, + N\$ 60.00 for labour. Total cost = N\$ 178.00/ha.

**Results:** The first year success rate was 35 %. When surveyed in 2006, it was 40 %.

**Recommendation:** Foliar spraying with Access is only recommended as an aftercare method on smaller bushes (up to 1,5 m tall), on regrowth of bushes previously chopped for making charcoal, and on *Phaeoptilum spinosum*, which does not react to root-absorbent herbicides.

**Site 3:****March 2001, before treatment****Targeted spp.:** *Dichrostachys cinerea*.**Botanical composition before treatment:** 64 % annuals, 1 % forbs and 35 % bare areas.**Bush density:** 3 150 bushes/ha.**Arbicides used:** Tordon Super (120 g/L Picloram 12 % plus 240 g/L Triclopyr 24 %).**Treatment:** 1 % Tordon and Actipon water mixture was sprayed onto the leaves of the bushes, at 400 ml active/ha and a no 2 nozzle on the pump.**Treatment costs:**

400 ml active/ha @ N\$ 360.00/L = N\$ 144.00/ha, +  
 N\$ 60.00 for labour (2 x half day wages).  
 Total costs = N\$ 204.00/ha.

**April 2006, after treatment****Follow-up treatment:** Regrowth was sprayed with a 1 % Access mixture and a no 3 nozzle on the pump.**Follow-up treatment costs:**

800 ml Access @ N\$ 198.00/L = N\$ 158.00, +  
 N\$ 60.00 for labour. Total costs = N\$ 218.00/ha.

**Results:** The first year success rate was 30 %. When surveyed in 2006, it was 45 %.**Recommendation:** Foliar spraying with Tordon Super is only recommended as an after-care method on smaller bushes up to 1,5 m tall, onto regrowth of bushes previously chopped for making charcoal, and on *Phaeoptilum spinosum*, which does not react to root-absorbent herbicides.**Site 4: After bush was cleared and stumps sprayed****Targeted spp.:** *Dichrostachys cinerea*.**Botanical composition before treatment:** 79 % annuals, 5 % forbs and 16 % bare areas.**Bush density:** 3 700 bushes/ha.**Arbicides used:** Tordon Super (120 g/L Picloram 12 % plus 240 g/L Triclopyr 24 %).**Treatment:** The bushes were cut with a chain saw at a height of 20 cm above ground level and sprayed with a 2 % Tordon per Actipon water mixture within 1 hour of being cut.**Follow-up treatment:** Regrowth was sprayed with a 1 % Access mixture.**Treatment costs:**

1,2 L active/ha @ N\$ 360.00/L = N\$ 432.00/ha, +  
 labour @ N\$ 60.00/day for 4 days = N\$ 480.00/ha.  
 The costs of the two chain saws used were not added to

**April 2006, after treatment**

the total but can be: 1 chain/day @ N\$ 140.00 + fuel  
 (1 L oil @ N\$ 25.00, + 5 L petrol @ N\$10.00/L = N\$ 75.00)  
 = N\$ 215.00 x 2 for both chain saws = N\$ 430.00  
 x 4 days = N\$ 1 720.00/ha.

The total cost for this treatment can therefore easily  
 rise to N\$ 2 632.00/ha.

**Follow-up treatment costs:**

300 ml Access @ N\$ 59.00/L, +  
 N\$ 60.00 for labour. Total cost = N\$ 119.00.

**Results:** The first year success rate was 52 %. When surveyed in 2006, it was 90 %.**Recommendation:** Chopping or sawing of *Dichrostachys cinerea* and stump spraying with Tordon Super is very expensive – roughly double the cost of Access. It is not recommended because Tordon Super is an oil suspension which should be mixed with diesel.

**Site 5:****October 2001, before treatment****Targeted spp.:** *Dichrostachys cinerea*.**Botanical composition before treatment:** 71 % annuals and 29 % bare areas.**Bush density:** 2 800 bushes/ha (target species).**Arborealicides used:** Molopo GG 200 (Tebuthiuron 20 %).**Treatment:** Molopo GG 200 granules were applied manually, at 2 g per 0,5 m bush height. 82 % of sickle bushes that were treated were in the height class of 2–4 m and 18 % in the height class < 2 m. 20 kg Molopo GG 200 was applied per hectare; 70 % overdosed by using this method.**Costs:** 20 kg arborealicide @ N\$ 67.00/kg  
= N\$ 1 340.00/ha.**April 2006, after treatment****Results:** The first year success rate was 91 %. When surveyed in 2006, it was 98 %.**Recommendation:** This arborealicide and method is highly recommended for controlling invader bush up to bush densities of 2 000 bushes/ha, with a height class of 1,5 m. Where the height class is more than 2 m it becomes more expensive than aerial application. The cost of clearing site 5 manually was N\$ 1 340.00 per hectare. An aerial application of 6 kg/ha would, however, only cost N\$ 490.00/ha. *Dichrostachys cinerea* is difficult to control with arborealicides especially in the height class 2–4 m. We recommend that Savana SC be used instead.**Site 6:****October 2001, before treatment****Targeted spp.:** *Dichrostachys cinerea*.**Botanical composition before treatment:** 88 % annuals and *Aristida* species, with 12 % bare areas.**Bush density:** 3 600 bushes/ha (target species).**Arborealicides used:** Molopo SC 500 (Tebuthiuron 50 %).**Treatment:** Molopo SC 500, mixed with water (5 L on 30 L of water) was applied manually with a syringe onto the soil, next to the stem of the plant, at a rate of 2 ml per 0,5 m bush height on invader species.**Costs:** 2 L active/ha @ N\$ 150.00/L  
= N\$ 300.00/ha total cost.**Results:** The first year success rate was 40 %. When surveyed in 2006, it was 55 %.**April 2006, after treatment****Recommendation:** This arborealicide and method is highly recommended on invader bush within the height class of 1,5 m and a density of 2 500 bushes/ha. One labourer at N\$ 60.00/day can easily apply arborealicides to 1 ha, with a bush density of ± 2 500 bushes/ha. When the height class goes up to 2–4 m with the same density (2 500/ha), up to 3 L active per hectare will be needed, increasing the cost to N\$ 450.00/ha plus labour. It is therefore important first to determine the bush density and height class before deciding on the cheapest method of controlling bush.

Site 7:

October 2001, before treatment



**Targeted spp.:** *Dichrostachys cinerea*.

**Botanical composition before treatment:** 30 % annuals, 51 % forbs and 19 % bare areas.

**Bush density:** 2 800 bushes/ha (target species).

**Arborealicides used:** Savana SC 500 (Tebuthiuron 25 %, Bromacil 25 %).

**Treatment:** Savana SC 500 mixed with water (5 L to 30 L of water) was applied manually with a syringe to the soil, next to the stem of the plant, at a rate of 2 ml per 0,5 m bush height. 3 L active was applied per hectare. 74 % of the invaders were in the height class of 2–4 m.

April 2006, after treatment



**Costs:** 3 L active/ha @ N\$ 150.00/L = N\$ 450.00.

**Results:** The first year success rate was 75 %. When surveyed in 2006, it was 80 %.

**Recommendation:** Savana SC is the best arborealicide with which to combat *Dichrostachys cinerea*. The best method is through manual application, especially where most of the bushes occur in the height class of 2–4 m and higher, with an average dosage of 16–20 ml/bush of 2–4 m. When aerial application is done at, for example, 5 kg/ha, aftercare will be needed on *D. cinerea*. For this a Savanna SC manual application is recommended.

In March 2002 the 2001 trials were surveyed. Based on the positive results obtained on sites 2 and 3 (treated with Access and Tordon Super respectively), it was decided that this foliar spraying method would be repeated. Sites 8 and 9 were treated in March 2002, and sites 10 to 14 in October 2002. However, the nozzle of the Stihl spraying pump was set on 4 for site 8, and on 5 for site 9 to increase the amount of active per hectare. The strength of the mixture was also doubled from 1 % to 2 %, and only Access was used on both sites instead of Tordon Super. Sites 8 to 14 were surveyed each year until March 2006.

Site 8:

March 2002, before treatment



**Targeted spp.:** *Dichrostachys cinerea*.

**Botanical composition before treatment:** 10 % annuals, 61 % forbs and 29 % bare areas.

**Bush density:** 3 750 bushes/ha.

**Arborealicides used:** Access 2 %.

**Treatment:** Foliar spraying was done with a no 4 nozzle on the pump.

**Costs:** 1,6 L active/ha @ N\$ 198.00/L = N\$ 316.00/ha.

**Results:** The first year success rate was 28 %. When surveyed in 2006, it was 30 %.

April 2006, after treatment



**Recommendation:** This method cannot be recommended for bushes taller than 1,5 m, simply because the spray does not reach the leaves at this height. It is recommended only on regrowth of bushes that were cut down previously. On species like *Phaeoptilum spinosum* and bushes smaller than 1,5 m the success rate of the first treatment may well reach 60 %, but a second treatment or aftercare may be needed.

Site 9:

March 2002, before treatment

April 2006, after treatment



**Targeted spp.:** *Dichrostachys cinerea*.

**Botanical composition before treatment:** 15 % annuals, 45 % forbs and 40 % bare areas.

**Bush density:** 3 850 bushes/ha.

**Arbicides used:** Access.

**Treatment:** 2 % Access and Actipon water mixture foliar spraying was done with a no 5 nozzle on the pump.

**Costs:** 1,8 L active/ha @ N\$ 198.00/L = N\$ 356.00/ha.

**Results:** The first year success rate was 25 %. When surveyed in 2006, it was 32 %.

**Recommendation:** This method cannot be recommended for bushes taller than 1,5 m, simply because the spray does not reach the leaves at this height. It is recommended only on regrowth of bushes that were cut down previously. On species like *Phaeoptilum spinosum* and bushes smaller than 1,5 m the success rate of the first treatment may well reach 60 %, but a second treatment or aftercare may be needed.

Sites 10–12 were treated in October 2002.

Site 10:

October 2002, before treatment

April 2006, after treatment



**Targeted spp.:** *Dichrostachys cinerea* and *Acacia* spp.

**Botanical composition before treatment:** 62 % annuals and *Aristida* spp., 20 % forbs, and 8 % bare areas.

**Bush density:** 2 600 bushes/ha.

**Arbicides used:** Molopo GG P200 pellets with active ingredient Tebuthiuron.

**Treatment:** Manual application.

**Costs:** 15,8 kg/ha @ N\$ 67.00/kg = N\$ 1 058.00/ha.

**Results:** The first year success rate was 96 %. When surveyed in 2006, it was again 96 %.

**Recommendation:** This herbicide and method is highly recommended for controlling invader bush up to bush densities of 2 000 bushes/ha, with a height class of 1,5 m. Where the height class is more than 2 m it becomes more expensive than aerial application. The cost of clearing site 5 manually was N\$ 1 340.00 per hectare. An aerial application of 6 kg/ha would, however, only cost N\$ 490.00/ha. *Dichrostachys cinerea* is difficult to control with herbicides especially in the height class 2–4 m. We recommend that Savana SC be used on this species.

Site 11:

October 2002, before treatment

April 2006, after treatment



**Targeted spp.:** *Dichrostachys cinerea* and *Acacia* spp.

**Botanical composition before treatment:** 41 % annuals and *Aristida* spp., 35 % forbs, and 24 % bare areas.

**Bush density:** 4 750 bushes/ha.

**Arboreticides used:** Savana 500 SC (liquid) Tebuthiuron and Bromacil.

**Treatment:** Manual application with Savana 500 SC in liquid form.

**Costs:** 6 L active/ha @ N\$ 150.00/L = N\$ 900.00/ha.

**Results:** The first year success rate was 94 %. When surveyed in 2006, it was again 94 %.

**Recommendation:** Savana SC is the best arboreticide with which to combat *Dichrostachys cinerea*. The best method is through manual application, especially where most of the bushes occur in the height class 2–4 m and higher, with an average dosage of 16–20 ml/bush of 2–4 m. When aerial application is done at, for example, 5 kg/ha, aftercare will be needed on *Dichrostachys cinerea*. For this, Savanna SC manual application is recommended.

Site 12:

October 2002, before treatment

April 2006, after treatment



**Targeted spp.:** *Dichrostachys cinerea* and *Acacia* spp.

**Botanical composition before treatment:** 35 % annuals and *Aristida* spp., 41 % forbs, and 23 % bare areas.

**Bush density:** 3 250 bushes/ha.

**Arboreticides used:** Molopo 500 SC, in liquid form, with active ingredient Tebuthiuron.

**Treatment:** Manual application of Molopo 500 SC.

**Costs:** 4 L active/ha @ N\$ 150.00/L = N\$ 600.00/ha.

**Results:** The first year success rate was 91 %. When surveyed in 2006, it was again 91 %.

**Recommendation:** All three arboreticides used on sites 10–12 (Molopo GG P200 pellets, Savanna 500 SC and Molopo 500 SC) are recommended to eradicate invader bushes. As mentioned with site 5, care should be taken with the application of Molopo GG P200 pellets, as it can easily be overdosed, thus resulting in extreme costs. Molopo 500 SC can be used on soils with a clay content of up to 12 %. Savanna 500 SC is recommended on soils with a clay content of more than 12 % and especially to eradicate *Dichrostachys cinerea*.

Sites 13 and 14 were treated in November 2002.

**Site 13: November 2002, before treatment**



**Targeted spp.:** Only invader species were treated: *Dichrostachys cinerea*, *Acacia mellifera*, *A. luederitzii*, *Grewia flava* and *G. flavescens*, *Mundulea sericea* and *Catophractes alexandri*. (Aerial application is not selective, therefore *Combretum apiculatum*, *Albizia anthelmintica* and *Tarchonanthus camphoratus* – not invaders – were also eradicated.)

**Botanical composition before treatment:** 63 % annuals and *Aristida* spp., 2 % perennials (*Stipagrostis uniplumis*) and 30 % bare areas.

**Bush density:** 5 400 bushes/ha.

**Arborealicides used:** Molopo GG P200.

**Treatment:** 5 kg/ha Molopo GG P200 by aerial application.

**Cost:** 5 kg/ha @ N\$ 67.00/kg Molopo GG P200, + flight cost @ N\$ 87.50/ha = N\$ 422.50/ha.

**April 2006, after treatment**



**Results:** The first year success rate was 95 %. When surveyed in 2006, it was again 95 %.

**Recommendation:** The quantity of arborealicides used per site, as well as cost per hectare, differs substantially between manual and aerial application. Manual application is selective, but is twice as expensive as aerial application. It is therefore very important to determine bush densities before deciding on the method to be used, to work out the cost per hectare and to identify the species to be targeted. The golden rule is: If there are fewer than 2 000 bushes/ha in a height class of < 1,5 m, then manual application is the recommended methodology. When the population exceeds 2 000 bushes/ha and is taller than 1,5 m, then aerial application will be cheaper per hectare with a high probability of a success rate > 80 % (*Acacia* spp. 100 % and *D. cinerea* 60 %).

**Site 14: November 2002, before treatment**



**Targeted spp.:** The following invader species were treated: *Dichrostachys cinerea*, *Acacia mellifera*, *A. reficiens*, *Grewia flava*, *G. flavescens*, *Mundulea sericea* and *Catophractes alexandri*. (Aerial application is not selective, therefore *Combretum apiculatum*, *Albizia anthelmintica* and *Tarchonanthus camphoratus* – not invaders – were also eradicated.)

**Botanical composition before treatment:** 60 % annuals and *Aristida* spp., 3 % perennials (*Stipagrostis uniplumis*), 8 % forbs and 29 % bare areas.

**April 2006, after treatment**



**Bush density:** 6 250 bushes/ha.

**Arborealicides used:** Molopo GG P200.

**Treatment:** 6 kg/ha Molopo GG P200 by aerial application.

**Cost:** 6 kg/ha @ N\$ 67.00/kg Molopo GG P200, + flight cost @ N\$ 87.50/ha = N\$ 490.00/ha.

**Results:** The first year success rate was 96 %. When surveyed in 2006, it was again 96 %.

**Recommendation:** As for site 13.



Sites 15 and 16 were treated in March 2003.

**Site 15:** March 2003, before treatment



**Targeted spp.:** *Catophractes alexandri*.  
**Botanical composition before treatment:** No survey was done before treatment.  
**Bush density:** 3 500 bushes/ha.  
**Arboricides used:** 2 % Access and Actipon water mixture.  
**Treatment:** Foliar spraying with the arboricide Access 2 % solution and a no 2 nozzle on the pump.  
**Costs:** 1,6 L active/ha @ N\$ 198.00/L = N\$ 316.00/ha.  
**Results:** The first year success rate was 35 %. When surveyed in 2006, it was 55 %.

**April 2006, after treatment**



**Recommendation:** This method is not recommended for the eradication of *Catophractes alexandri*, because the hairiness of the leaves makes the absorption of the arboricide difficult. Arboricides used on sites 10–12 are therefore recommended.

**Site 16:** March 2003, before treatment



**Targeted spp.:** *Acacia mellifera* – in the height class less than 1,5 m.  
**Botanical composition before treatment:** 77 % annuals and *Aristida* spp., and 23 % bare areas.  
**Bush density:** 3 100 bushes/ha.  
**Arboricides used:** 2 % Access and Actipon water mixture.  
**Treatment:** 2 % Access and Actipon water solution foliar application with a Stihl blower pump and no 2 nozzle.  
**Costs:** 1,4 L active/ha @ N\$ 198.00/L = N\$ 277.20/ha.  
**Results:** The first year success rate was 65 %. When surveyed in 2006, it was 75 %.

**April 2006, after treatment**



**Recommendation:** This method is recommended only for clearing small areas such as fences and roadsides.

Sites 17–19 were treated in November 2003.

These three trials manually simulated an aerial application, where soil types and clay presentation were the main focus points. Three different soil types: shallow calcareous soil; reddish soil type (Hutton) with 12 % clay; and the same soil type with an 18 % clay content were treated with Molopo GG P200 (pellets) broadcast by hand at 3,5 kg/ha, 4,0 kg/ha and 5 kg/ha respectively.

The simulation of the aerial application was done as follows:

Areas of 10 x 100 metres were measured out, and three 100 m ropes were used to split the areas. Molopo pellets were weighed in honey jars in the following quantities:

- 350 g/jar for the 3,5 kg/ha site;
- 400 g/jar for the 4 kg/ha site; and
- 500 g/jar for the 5 kg/ha site; all per 1 000 m<sup>2</sup>.

The three sites measured 10 hectares each. Each site was divided into 100 strips, and each strip measured 10 x 100 m. Pellets were evenly broadcast by hand over the 10 x 100 m areas until all 100 strips were treated. The three ropes were frequently shifted to treat the areas as accurately as possible. Bush surveys were done on all three sites prior to treatment.

**Site 17 (3,5 kg/ha on calcareous soil):**  
**November 2003, before treatment**



**Targeted spp.:** *Acacia mellifera*, *A. luederitzii*, *Grewia* spp., *Dichrostachys cinerea* and *Catophractes alexandri*.  
**Botanical composition before treatment:** 31 % forbs, 24 % annual grasses and 15 % bare areas.  
**Bush density:** 2 640 bushes/ha.  
**Arbicides used:** Molopo GG P200 pellets.  
**Treatment:** 3,5 kg Molopo GG P200 pellets/ha.  
**Costs:** 3,5 kg pellets/ha @ N\$ 67.00/kg = N\$ 234.50/ha.  
**Results:** When surveyed in 2008, the success rate was 90 %.

**April 2008, after treatment**



**Recommendation:** 3.5 kg/ha aerial application of Molopo GG P200 is recommended on shallow, calcareous soils where the roots of the bushes are close to the surface as the chemicals do not need to penetrate too deep into the soil to be effective.

**Site 18: (4 kg/ha on reddish soil that consists of 12 % clay)  
November 2003, before treatment**

**April 2008, after treatment**



**Targeted spp.:** *Acacia mellifera* as the major invader and *A. reficiens*, *Grewia flava* and *Dichrostachys cinerea* as the minor invaders.

**Botanical composition before treatment:** 37 % forbs, 22 % annual grasses, 2 % perennial grasses and 39 % bare areas.

**Bush density:** 1 760 bushes/ha.

**Arbicides used:** Molopo GG P200 pellets.

**Treatment:** 4 kg/ha Molopo GG P200 pellets/ha.

**Costs:** 4 kg pellets/ha @ N\$ 67.00/kg = N\$ 268.00/ha.

**Results:** When surveyed in 2008, the success rate was 91 %.

**Recommendation:** 4 kg/ha aerial application with Molopo GG P200 is recommended for soil with a clay content of between 10–14 %, and 4,5 kg/ha on soil with a clay content of 15–17 %.

**Site 19: (5 kg/ha on reddish soil that consists of 18–20 % clay)  
November 2003, before treatment**

**April 2008, after treatment**



**Targeted spp.:** *Acacia mellifera* as the dominant species.

**Botanical composition before treatment:** 63 % forbs, 11 % annual grasses and 26 % bare patches.

**Bush density:** 1 600 bushes/ha.

**Arbicides used:** Molopo GG P200 pellets.

**Treatment:** 5 kg/ha Molopo GG P200 pellets/ha.

**Costs:** 5 kg pellets/ha @ N\$ 67.00/kg = N\$ 335.00/ha.

**Results:** When surveyed in 2008, the success rate was 97 %.

**Recommendation:** 5 kg/ha aerial application is recommended on soil with a clay content of 18 % and higher. When the clay content of the soil exceeds 25 %, aerial treatment becomes risky and is not recommended at all.

Table 1. Summary of treatments, quantities of arboricides used, bush densities, cost/ha and the success rate of treatments over 19 sites

Site No	Date treated	Treatment (active ingredient)	Quantity /hectare	Density bushes /hectare	Price /Litre or kg (N\$)	Cost /hectare (N\$)	Labour/ flight cost/ha	1st Year success rate*	Success rate 2006**
1	Mar. 2001	Access 2 %	1 200 ml active/ha	2 650 (1 750 target spp.)	198/L	238.00	480.00	80 %	–
1	Mar. 2002	Access 1 %	200 ml active/ha	2 650	198/L	40.00	60.00	–	100 %
2	Apr. 2001	Access 1 % (foliar spraying)	300 ml active/ha	4 150 (3 750 target spp.)	198/L	59.00	60.00	35 %	–
2	Mar. 2002	Access 1 % (foliar spraying)	600 ml active/ha	4 150	198/L	118.00	60.00	–	40 %
3	Apr. 2001	Tordon 1 % (foliar spraying)	400 ml active/ha	3 150 (2 950 target spp.)	360/L	144.00	60.00	30 %	–
3	Mar. 2002	Access 1 % (foliar spraying)	800 ml active/ha	3 150	198/L	158.00	60.00	–	45 %
4	Mar. 2001	Tordon 2 %	1 200 ml active/ha	3 700 (3 050 target spp.)	360/L	432.00	480.00	52 %	–
4	Mar. 2002	Access 1 % (on regrowth)	300 ml active/ha	3 700	198/L	59.00	60.00	–	90 %
5	Oct. 2001	Molopo GG P200	20 kg/ha	4 400 (2 800 target spp.)	67/kg	1 340.00	48.00	91 %	98 %
6	Oct. 2001	Molopo 500 SC	2 000 ml active/ha	4 150 (3 600 target spp.)	150/L	300.00	48.00	40 %	55 %
7	Oct. 2001	Savana 500 SC	3 000 ml active/ha	3 250 (2 800 target spp.)	150/L	450.00	48.00	75 %	80 %
8	Mar. 2002	Access 2 % (foliar spraying)	1 600 ml active/ha	3 750	198/L	316.00	120.00	28 %	30 %
9	Mar. 2002	Access 2 % (foliar spraying)	1 800 ml active/ha	3 850	198/L	356.00	120.00	25 %	32 %
10	Oct. 2002	Molopo GG P200	15,8 kg/ha	2 600 (treated)	67/kg	1 058.00	48.00	96 %	96 %
11	Oct. 2002	Savana 500 SC	6 000 ml active/ha	4 750 (treated)	150/L	900.00	48.00	94 %	94 %
12	Oct. 2002	Molopo 500 SC	4 000 ml active/ha	3 250 (treated)	150/L	600.00	48.00	91 %	91 %
13	Nov. 2002	Molopo GG P200	5 kg/ha	5 400	67/kg	422.50	87.50 flight cost	95 %	95 %
14	Nov. 2002	Molopo GG P200	6 kg/ha	6 250	67/kg	490.00	87.50 flight cost	96 %	96 %
15	Mar. 2003	Access 2 % (on <i>C. alexandri</i> )	1 600 ml active/ha	3 500	198/L	316.00	120.00	35 %	55 %
16	Mar. 2003	Access 2 % (on <i>A. mellifera</i> )	1 400 ml active/ha	3 100	198/L	277.20	120.00	65 %	75 %
17	Nov. 2003	Molopo 3,5 kg/ha (manual broadcast)	3,5 kg/ha	2 640	67/kg	234.50	48.00	–	90 %***
18	Nov. 2003	Molopo 4,0 kg/ha (manual broadcast)	4,0 kg/ha	1 760	67/kg	268.00	48.00	–	91 %***
19	Nov. 2003	Molopo 5,0 kg/ha (manual broadcast)	5,0 kg/ha	1 600	67/kg	335.00	48.00	–	97 %***

\* First survey done one year after the initial treatment.

\*\* Last survey done in 2006 on all sites.

\*\*\* Last survey done in 2008.

Table 2. Tree/bush species referred to in this article

Scientific name	English common name	Afrikaans common name
<i>Acacia mellifera</i>	black-thorn	swarthaak
<i>Acacia reficiens</i>	red-thorn	rooihaak
<i>Albizia anthelmintica</i>	worm-cure albizia	aroe
<i>Catophractes alexandri</i>	trumpet-thorn	ghabbabos
<i>Combretum apiculatum</i>	kudu-bush	koedoebos
<i>Dichrostachys cinerea</i>	sickle-bush	sekelbos
<i>Grewia flava</i>	velvet raisin	fluweelrosyntjie
<i>Grewia flavescens</i>	sandpaper raisin	skurwerosyntjie
<i>Mundulea sericea</i>	silverbush	visgif
<i>Phaeoptilum spinosum</i>	brittle-thorn	brosdoring
<i>Tarchonanthus camphoratus</i>	camphor bush	vaalbos

Table 3. Annual and perennial grasses found on the farm Uitkyk during the first surveys

Scientific name	English common name	Afrikaans common name
<i>Aristida adscensionis</i>	annual bristle-grass	eenjarige steekgras
<i>Aristida thinochloa</i>	large seed bristle grass	skurwesteekgras
<i>Chloris virgata</i>	feather-top chloris	klossiegras
<i>Enneapogon cenchroides</i>	nine awned grass	eenjarige negenaaldgras/klakgras
<i>Eragrostis porosa</i>	windgrass	blousoetgras
<i>Melinis repens</i> subsp. <i>grandiflora</i>	red-top	eenjarige fluweelgras
<i>Tragus racemosus</i>	large carrotseed grass	wortelsaadgras
<i>Urochloa brachyura</i>	–	–

Table 4. Perennial grasses found after treatment during the 2006 surveys

Scientific name	English common name	Afrikaans common name
<i>Andropogon chinensis</i>	hairy blue-grass	tweevingergras
<i>Cenchrus ciliaris</i>	buffalo grass	bloubuffelsgras
<i>Eragrostis lehmanniana</i>	Lehmann's love-grass	krietjiesgras
<i>Eragrostis scopelophila</i>	mountain love-grass	bergpluimgras
<i>Eragrostis trichophora</i>	hairy love-grass	behaarde pluimgras
<i>Fingerhuthia africana</i>	thimble grass	vingerhoedgras
<i>Heteropogon contortus</i>	spear grass	assegaaigras
<i>Panicum maximum</i>	guinea grass	groot panicum
<i>Panicum coloratum</i>	small panicum	bont panicum
<i>Stipagrostis uniplumis</i>	silky Bushman-grass	blinkhaarboesmangras
<i>Schmidtia pappophoroides</i>	Kalahari sand quick	Kalaharisandkweek
<i>Urochloa oligotricha</i>	dubi grass	meerjarige beesgras

## RESULTS

In March 2008, 40 quadrates (1 x 1 m<sup>2</sup>) were clipped in each of sites 17, 18 and 19, as well as 40 quadrates in a control site, next to site 19. Site 19 compared well to the rest of the farm that had not yet been treated. The results were as follows:

Site ID	Treatment dosage (kg/ha)	DM prod/ha (kg DM/ha)*	Stocking Rate @ 50 % utilization (kg AB/ha)**	Increase in stocking rate (%)	Income (N\$/ha)
Control	–	350	16	–	64.40
17	3,5	1 664	76	475	305.90
18	4,0	2 102	96	600	386.40
19	5,0	1 376	64	400	257.60

\* kg Dry Material/ha

\*\* kg Animal Biomass/ha

The difference in dry matter production (DMP) between sites 17, 18 and 19 is due to the different soil types and the different perennial grass species that grow on each soil type. The most common species found on sites 17 and 18 are *Cenchrus ciliaris* and *Stipagrostis uniplumis*, both with a higher DMP than those species growing on site 19. Site 19 had a higher clay content and perennials such as *Panicum coloratum*, *Urochloa oligotricha* and *Schmidtia pappophoroides* were the bulk species.

The bulk of the annual grasses in the control site consisted of *Aristida* spp., while *Eragrostis lehmanniana* made up the bulk of perennial grass species.

## CONCLUSIONS

Chemical bush control does pay if the difference in dry matter (DM) between the control and the other three sites are compared. The difference in income that can be generated from treated sites is also much higher than from untreated sites. The grass yield on treated sites improved between 400 % and 600 % after treatment.

Management of treated sites is very important and an aftercare programme should be put in place if the re-vegetation of intruder bush is to be prevented. Re-vegetation can occur within 8–10 years after initial treatment. It is recommended that treated sites be rested for the first two growing seasons. This will allow perennial seedlings to reestablish properly.

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