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Background paper on *Dichapetalum cymosum* (Gifblaar in Afrikaans) & (Poison Leaf in English)



1. Introduction

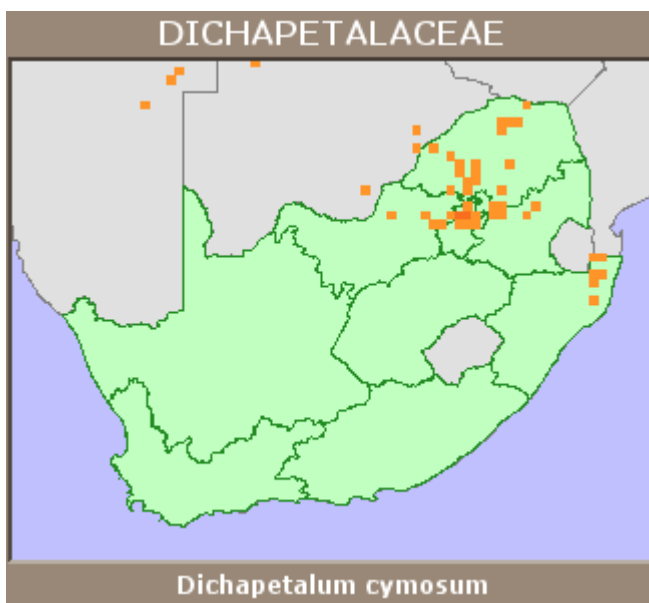
Toxic compound-containing plants grow worldwide and cause sudden death in livestock. The southern continents of Africa, Australia and South America are the common locations of these plants. Fluoroacetate (the chemical name of this toxic compound) is found in these tropical and subtropical plants generally at low concentrations although some are able to accumulate fluoroacetate in high concentrations. In Africa, most fluoroacetate-accumulating plants belong to the genus (tribe) *Dichapetalum*. Poison leaf or Gifblaar produces fluoroacetate as a defence mechanism against grazing by herbivores. Ingestion by livestock often results in fatal poisoning, which causes significant economic problems to cattle farmers in South Africa. Several approaches have been adopted to protect livestock from the toxicity with limited success, including fencing, toxic plant eradication and agents that bind the toxin. Genetically modified bacteria (GMB) capable of degrading fluoroacetate have been able to protect ruminants from fluoroacetate toxicity under experimental conditions, but concerns over the release of these microbes into the environment have prevented the application of this technology. Recently, a native bacterium from an Australian bovine rumen was isolated, which can degrade fluoroacetate. The discovery and isolation of this bacterium provides a new opportunity to detoxify fluoroacetate in the rumen.¹

¹ Leong, L.E.X., Khan, S, Davis, C.K., Denman, S.E., and McSweeney, C.S. (2017) Fluoroacetate in plants - a review of its distribution, toxicity to livestock and microbial detoxification. *Journal of Animal Science and Biotechnology* 8:55 DOI 10.1186/s40104-017-0180-6

Fluoroacetate poisoning due to the consumption of *Dichapetalum cymosum* (gifblaar), most frequently affects cattle, possibly because the distribution of the plant coincides with mainly cattle-raising areas. Gifblaar is deeply rooted and is generally eaten in spring, because the under-groundwater storage system allows it to sprout before the rains, when no other green forage is available. However, it is also reported to be particularly dangerous when the pasture is deteriorating at the end of the rainy season. Sudden death occurs as a result of acute heart failure induced by the affected animal drinking water or exercising, usually within 24 hours of eating the plant.² Ingestion of lethal amounts of gifblaar causes sudden death in ruminants (especially cattle) after a latent period of *four* to 24 hours. Poisoned animals are often restless, hypersensitive, tremble and exhibit rapid breathing. If allowed to rest, these animals may recover. Cattle that ingest lethal quantities of gifblaar typically drop dead after drinking water or following exertion.³

2. Distribution and Economic Impact of Poison Leaf

Occurrence: Angola, Botswana, Namibia, South Africa and Zimbabwe.



Dichapetalum cymosum commonly known as *gifblaar* in Afrikaans, *mogau* in SeTswana and poison leaf in English, is a small, low-growing shrub found in the northern parts of southern Africa. Poison leaf is a major cause of acute livestock plant poisoning in southern Africa. The shrubby plant is one of the known fluoroacetate-producing plants, and is considered a hazard

² Botha, C.J. and Penrith, M.-L. (2008) Poisonous plants of veterinary and human importance in southern Africa. *Journal of Ethnopharmacology* 11 549–558

³ Botha, C.J. and Venter, E. (2002) *Dichapetalum cymosum* [Internet]. Available from <<https://repository.up.ac.za/handle/2263/8441>> (Accessed on 16th September 2019).

to animals and people living nearby due to the presence of high levels of fluoroacetate poison in its tissues. Leaf poison is considered one of the 'big six' toxic plants in South Africa; it is a common cause of lethal poisoning in livestock. One of the most potent known poisons, monofluoroacetate (sodium fluoroacetate), which causes cardiac arrest in ruminants, is found in the poison leaf plant or gifblaar. Gifblaar occurs in large areas of southern Africa, including the north-eastern part of Namibia. Poison leaf (gifblaar) causes heavy annual mortality in domestic stock. For example, a 1996 estimate of plant poisoning cases in South Africa attributed 8 per cent of cattle mortality to this plant. A total of 70 per cent of fatal cases occur in Limpopo, with 10 per cent each in North West, Mpumalanga and Gauteng. Sodium fluoroacetate, present in all parts of the plant, is responsible for the toxic effects.

As the name implies, poison leaf contains a toxic compound that kills livestock when consumed in a lethal dosage of about 20 grams dry leave material. The ability of *Dichapetalum cymosum* to kill cattle is well-documented and generally well-understood by South African farmers grazing their livestock on infested rangelands. Catastrophic livestock losses, especially cattle still occur in the Limpopo, Gauteng, North West and Mpumalanga provinces of South Africa. These livestock losses occur mainly during the spring season when *Dichapetalum cymosum* puts forth new shoots and in autumn when it produces new leaves. There is no antidote for *Dichapetalum cymosum* poisoning of livestock. Wide scale eradication by conventional control methods are labour-intensive, expensive and often impractical due to the difficulty in destroying its enormous deep root system. In South Africa, the communal and emerging farmers are the most affected due to:⁴

- High costs associated with control measures such as fencing, supplementary feeding and veterinary expenses;
- Lack of grazing management with livestock numbers exceeding the biological carrying capacity of the rangeland due to lack of grazing lands; and
- Inadequate or improper rangeland management in communal and emerging farming sectors.

Poisonous plants are the most important cause of economic losses in the livestock industry globally, especially in those areas where rangeland and pasture grazing is practised. Of the conservatively estimated total annual loss of R105 million attributed to plant and fungal poisonings, *Dichapetalum cymosum* accounts for *eight* per cent. This is considered an underestimate, as it is virtually impossible to separate disease, accidents and predation losses from livestock poisoning losses. This economic impact therefore requires a focused research

⁴ Pule, H.T. (2013) Ecological niches occupied by *Dichapetalum cymosum* (Hook.) Engl. (Gifblaar) in South African rangeland communities. Unpublished MSc thesis submitted at the University of Pretoria, Pretoria.

on the ecology of poison leaf plant in rangeland communities to improve rangeland management and hence mitigate this loss, *inter alia*.⁵

Dichapetalum cymosum sprouts late during the winter season because of its enormous deep root system and remain the only green plant available for cattle starving of greenery. Affected animals will show shortness of breath and irregular heartbeat, with occasional neurological signs such as trembling, twitching and convulsions. Death occurs from *four* to 24 hours after swallowing the plant. Above ground, the plant is a small clumped, woody shrub of about 15cm in height. However, it has a huge underground root system and sends numerous shoots above ground in favourable conditions. The huge underground root system is actually likened to an underground tree that sends out numerous shoots above ground in favourable conditions. The most obvious above-ground parts are the bright green leaves, which are initially covered with fine hairs, and later become velvety. It has small white flowers, which occur as dense clumps in the early spring.^{6,7}

3. Treatment

3.1 Treatment often consists of helping animals to remain calm and rested. Animals are usually removed from the infected camp, but without exciting them. Withholding water for 48 hours can improve prognosis. There are no confirmed therapeutic measures that have been developed for the prevention or treatment of gifblaar poisoning. Removing all known plants from pastures may reduce risk of exposure.

4. Prevention (in the absence of a *known* cure)

- 4.1 Know which poisonous plants occur in your area, and keep livestock away from them.
- 4.2 Keep animals in good condition with supplementary food and licks during the dry season.
- 4.3 Take care when introducing animals from other areas, especially exotic breeds, as they may be generally unaccustomed to the plants in the new locality.
- 4.4 Avoid feeding your livestock on mouldy hay or hay cut from areas where *Dichapetalum cymosum* plants occur.
- 4.5 Farmers control the plant by spraying herbicide, sometimes fencing off patches where it grows or keeping cattle away during the early growth season.

⁵ Pule, H.T. (2013) Ecological niches occupied by *Dichapetalum cymosum* (Hook.) Engl. (Gifblaar) in South African rangeland communities. Unpublished MSc thesis submitted at the University of Pretoria, Pretoria.

⁶ Bester, FV (2005) Manual eradication of poison-leaf/gifblaar: *Dichapetalum cymosum*. Spotlight on Agriculture, No 92 June 2005. Ministry of Agriculture, Water and Forestry, Windhoek.

⁷ Botha, C.J. and Venter, E. (2002) *Dichapetalum cymosum* [Internet]. Available from <<https://repository.up.ac.za/handle/2263/8441>> (Accessed on 16th September 2019).

4.6 Animal house studies have demonstrated in principle that rumen bacteria engineered to hydrolyse the toxin could prevent toxicity, but approvals for the release of these organisms into the environment are unlikely due to current government regulatory restrictions (in Australia). However the recent discovery of a naturally occurring rumen bacterium capable of degrading fluoroacetate may provide a biotechnological solution to the problem of toxicity in rangeland animals. Even though the bacterium appears to be ubiquitous throughout the digestive systems of animals such as cattle, they are present in low numbers which may limit their ability to protect the animal from a lethal dose of the toxin. However, it is possible that there are other rumen bacteria able to degrade fluoroacetate, which are at higher abundance or could act in concert with other rumen microorganisms to ameliorate the full impact of the toxin. Therefore, further surveys for the presence of other fluoroacetate degrading rumen bacteria and studies on increasing the numbers of these bacteria and expression of the genes responsible for degrading the toxin seems a logical approach for developing a practical strategy to protect livestock from fluoroacetate poisoning.⁸

4.7 Manual eradication is not recommended because poison leaf is able to set roots and regenerate even from fragments of the plant left in the soil after uprooting it. It may be argued that once new plants are established from such fragments, they could also be uprooted or treated with herbicides, but this is a tedious and a time-consuming method whose success is subject to the degree of infestation in the area concerned. If this method is used, however, care should be taken to remove all fragments of the plant in the soil so that it cannot regenerate.

4.8 In chemical treatments, girdling (ring-barking) is essential as it increases the uptake of the herbicide. However, this method is not recommended because it does not guarantee success despite the fact that various chemical treatments have shown positive results. It is also essential that the main stem is located and treated with chemicals; otherwise, the results will be poor. In addition, all the stems penetrating the soil need to be treated, but this is virtually impossible in highly infested areas. The success of stem-burning also depends on the degree of infestation in a specified area.

⁸ Leong, L.E.X., Khan, S, Davis, C.K., Denman, S.E., and McSweeney, C.S. (2017) Fluoroacetate in plants - a review of its distribution, toxicity to livestock and microbial detoxification. *Journal of Animal Science and Biotechnology* 8:55 DOI 10.1186/s40104-017-0180-6