Dichapetalum Cymosum (POISON-LEAF/GIFBLAAR) - A NEVER ENDING PROBLEM -

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ABSTRACT

Gifblaar is an extremely poisonous plant that results in livestock mortality. Gifblaar is found in South Africa, Botswana, Zimbabwe and Namibia. In Namibia, gifblaar occurs in the east and north-east of the country and is confined mainly to the fine, well drained and nutrient poor sandy soils.

During the 1960s the farmers in the Grootfontein District approached the South West Africa Administration (SWAA) for assistance regarding livestock mortality due to gifblaar poisoning. During 1961 the "Gifkommissie" (Department of Agricultural Technical Services in South Africa) was tasked to investigate the issue of gifblaar poisoning in this area. The SWAA then purchased property in the Grootfontein District for the sole purpose of establishing the Sonop Research Station to conduct research on gifblaar. Two projects were launched with the objectives of determining the possibility of judicious management systems and lick supplementation to alleviate livestock mortality, and the possibility of eradicating gifblaar by means of herbicides.

From the results obtained it was evident that gifblaar could be controlled by means of herbicidal control. However, this method is costly and not accessible to all farmers. The alternative of judicious management and protein supplementation to reduce livestock mortality proved to be the answer. From this research guidelines were established that were essential in the management procedures. Grazing of gifblaar infested areas and gifblaar free areas can be regulated during the two critical poisonous periods (spring and autumn) of the plant. Heavy stocking rates and over grazing must be avoided at all costs. Health care of the animals is essential. Animals must be kept free of internal and external parasites at all times. During the critical poisonous periods of the plant, female animals should have preferential access to gifblaar free areas. Handling of animals, such as dosing, should be avoided in gifblaar infested areas and a management programme planned accordingly. If possible, planted pastures should be established that could be utilized during the critical periods. Game are less susceptible to gifblaar poisoning and can be considered as an alternative option to livestock farming.

INTRODUCTION

Gifblaar is an extremely poisonous plant that results in livestock mortality. Gifblaar is found in South Africa, Botswana, Zimbabwe and Namibia. In Namibia gifblaar occurs in the east and north-east of the country and is confined mainly to the fine sandy soils of the Kalahari geological system underlain with Karoo basalt (Opperman and La Grange 1969). According to Correia and Van Rensburg (2000) the general ecological characteristics of the distribution area of gifblaar is a sandy, well drained and nutrient poor soil. The plants grow mainly at the foot of the northern slope of dunes, although the dunes themselves and depressions between the dunes are not free from this plant (Opperman and La Grange 1969; Du Plooy 1972). Gifblaar grows in association with trees such as *Combretum* species, *Burkea africana* and *Terminalia sericea* (Opperman & La Grange 1969; Du Plooy 1972; Van Vuuren 1960). According to Van Vuuren (1961) gifblaar was initially identified as *Dichapetalum cymosum* and *Dichapetalum venenatum* (Steyn 1934). The accepted scientific name for the plant in Namibia is *D. cymosum* and the two most common names are gifblaar and magougif. Correia and Van Rensburg (2000) also refer to another species, *D. rhodesicum*, which is found in the Kavango.

The first recording of gifblaar poisoning was in 1890, although research on it only commenced in 1910 (SWAA 1961). Steyn's (1928) study and description of the symptoms of gifblaar poisoning – its toxicology - were complemented by Leemann's (1935) work on the anatomy, morphology and physiology of the plant. Nearly a decade later, Marais (1943) isolated and synthesized monofluoroacetate as the active toxic compound in the plant. This breakthrough enabled further research on the plant's toxicology and pharmacology. Nonetheless, by the 1960s, the vagueness in the literature regarding the treatment of poisoned animals was being lamented (SWAA 1961). And despite further research, Remington's (1935) despair that "the hope of finding any specific prophylactic or curative substance (antidote) for use in gifblaar poisoning has become very remote" remains true today.

During the 1960s the farmers from the Horabe and Nurugas blocks in the Grootfontein District approached the South West Africa Administration (SWAA) for assistance regarding livestock mortality due to gifblaar poisoning. Mr. L.F. La Grange, an Extension Officer in Grootfontein, and a botanist, Mr. D.R.J. Van Vuuren, from the administration were appointed to investigate the issue of livestock mortality in this area. They compiled a report regarding the issue of gifblaar poisoning. During 1961 the "Gifkommissie" (Department of Agricultural Technical Services in South Africa) was also tasked to investigate the issue of gifblaar poisoning in this area. The SWAA then purchased property in the Grootfontein District for the sole purpose of establishing the Sonop Research Station to conduct research on gifblaar. Two projects were launched by the livestock researcher P.A.J. Brand, and the pasture researcher D.P.J. Opperman. The objectives of these two projects were (a) to determine the possibility of management systems and lick supplementation to alleviate livestock mortality and (b) to eradicate gifblaar by means of herbicides or digging the plant open and treating it with herbicides. During

1982, a similar project to the feeding trial conducted in the 1920s by the Veterinary Services in South Africa (Steyn 1928) with domesticated animals, was conducted in Namibia with game (Basson, Norval, Hofmeyer, Ebedes & Schultz 1982). In 1982 the Department of Agriculture and Nature Conservation was requested to compile a report on research done in the past regarding gifblaar poisoning and eradication. A report was compiled by the author as requested and later published in the Agricola of 1998. The issue of livestock mortality due to gifblaar poisoning remains never ending, and recently farmers from the Omaheke Region also sought information concerning measures to eradicate the plant. These requests led to a demonstration trial launched by J.A.J. Van Eck (2000) in Omaheke Region. Gifblaar is a unique plant and is very difficult to eradicate if certain precautions are not taken. The aim of this paper is, therefore, to enlighten those who are concerned about what has been done regarding gifblaar and precautions to be taken when attempting to control gifblaar (Figures 1, 2 and 3).

Figure 1. Gifblaar plant.

Figure 2. Gifblaar plant with fruit.

Figure 3. Flower of the Gifblaar plant.

CHARACTERISTICS OF GIFBLAAR

Leemann (1935) provides an in-depth description of the anatomical and morphological properties of the plant, which are of interest not only from a botanical point of view, but also insofar as its eradication is concerned. The plant consists of a set of branches (stems) just below soil level, spreading in a horizontal direction from a main stem that penetrates the soil vertically (Figure 4). These branches every now and then send tufts of leaves above ground (Figure 5). This branching below ground level may stretch for many meters, forming an extensive network of stems horizontally and vertically away from the main stem (Figures 6, 7 and 8). This branching network below ground may appear as a root system of the gifblaar plant but is anatomically the stem of the plant. The gifblaar plant from a botanical point of view is a climber that has gone underground. The plant still retains the characteristics of a climbing plant below ground and "the plant takes every opportunity to twist and climb even underground" (SWAA 1961).

In 1935, the Veterinary Services Division in South Africa conducted feeding trials in order to determine the exact stage

Figure 4. Main stem and its numerous branches.

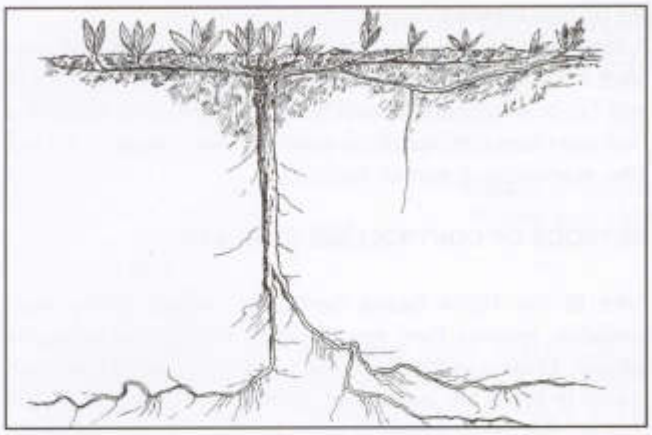

Figure 5. Main underground stem, with leaves above ground.

Figure 6. Extensive stem system of the gifblaar plant branching horizontally.

Figure 7. Stem system of gifblaar plant growing horizontally.

Figure 8. Stem system of gifblaar plant growing vertically

in the plant's growth cycle when the toxicity was at its highest. They established that this occurred in spring, when the plant produced new shoots, and in autumn, when it formed new leaves (Leemann 1935). Thus, the concentration of monofluoroacetate is highest when the plant sprouts. It is obvious, therefore, that climatic conditions play a role in determining

Figure 9. Mature gifblaar plant.

when and for how long the plant is toxic enough to kill livestock. Even as it matures, although the concentration of acid decreases the plant never ceases to be toxic (ibid.). Moreover, further research (Steyn 1928) found that all parts of the plant contained the toxin.

As the plant matures (Figure 9) the concentration decreases but it never ceases to be toxic (Leemann 1935). Therefore, it is obvious that climatic conditions play a role in determining when the plant is toxic and the length of the toxic period that results in livestock mortality. According to Steyn (1928) all parts of the plant contain the toxin monofluoroacetate (SWAA 1961).

Figure 10. Gifblaar leaves, showing the characteristic arches made by the veins.

According to Phillips (1927) a few other plants that occur in the same habitat as gifblaar, are very similar in growth habit. They also have well developed underground stems and grow in clumps, the same as gifblaar does. The leaves of these plants look very much the same as the leaves of the gifblaar plant, which may easily lead to confusion between the different plants. If the leaves are opposite or hairy (felt-like) the plant is not gifblaar. A very important anatomical feature of the gifblaar plant is the peculiar venation of the leaves – the main veins of the gifblaar leaves forming arches (Figure 10)

A feature of utmost importance is the ability of the gifblaar plant to sprout where stems have been damaged (Figures 11 and 12) or to propagate itself by setting roots and forming a new plant from cuttings of the stem that may remain in the soil after eradication (Leeman 1935).

Figure 11. Damaged plant sprouting.

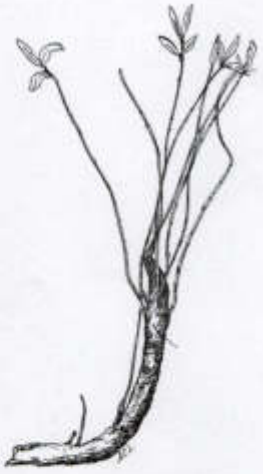

Figure 12. Damaged stem sprouting.

METHODS OF CONTROLLING GIFBLAAR

Prior to the 1950s before herbicides (weed killers) were available, farmers tried any possible measure to eradicate gifblaar. Measures that were tested were to pile salt over the leaves or spray the leaves with paraffin or insecticide (locust poison). All these methods were haphazard and led to no definite results. Leemann (1935), therefore, saw the necessity of investigating gifblaar eradication on a scientific basis. He was, according to Meissner (1964), the first researcher to control gifblaar successfully. Until the late 1960s different methods were researched in South Africa and Namibia to try and control gifblaar. The methods that were tested were (a) digging open and uprooting the whole plant, (b) digging the main stem open and using measures to treat the stem, and (c) foliage and soil treatment with chemicals and herbicides.

Uprooting of the Whole Plant

Digging the plant open (uprooting) and removing the main stem (whole plant) appeared not to be very successful. The reason is because the plant has the ability to form new suckers if damaged, or even worse, small cuttings of the stem that may remain in the soil tend to propagate themselves, forming new plants. Pioneer farmers experienced that ploughing increased the gifblaar infestation and therefore abandoned this method (Leeman 1935). Leeman (1935) warns against this method and states that "the evil is only increased". Van Eck (2004) demonstrated that removing the plant 15 cm below soil level manually is not a proposition and that the plants recovered 100 percent.

When using this method to control gifblaar, it is therefore necessary to make sure that every part of the plant is dug out and removed. In practice this is very nearly impossible and is dependent on the degree of infestation (number of plants) and area of infestation concerned.

Digging the Main Stem Open and Using Measures to Treat the Stem

- **Digging the main stem open and stem burning**

According to Van Vuuren (1960) it is possible to control small areas of gifblaar by digging the stems open and stem-burning them. However, this method is also dependent on the number of plants per area and the size of the area concerned.

- **Digging the main stem open and treating plants with chemicals**

The work initiated by Leemann (1935) was to test the effectiveness of different chemicals and combinations of these chemicals to kill the gifblaar plant. From the onset of

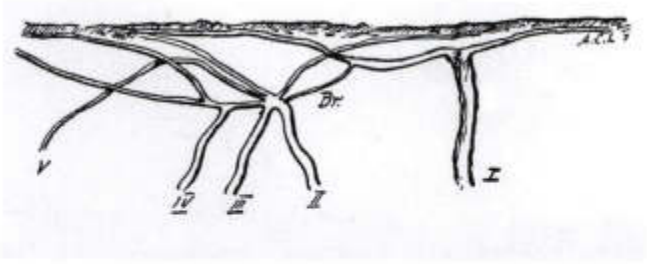

Figure 13. Multiplication by sending down new stems from lateral branches. Stem 1 is the original plant. Stems 3, 4, 5, and 6 are secondary stems sent down from branches.

his experiments, Leemann's approach was to dig open the main stem and apply the chemical substance to it. In the case where there were several stems going down vertically, each one had to be treated separately (Figure 13). According to Leemann (1935) no lasting effect can be obtained unless the main stem is treated. This contention was also confirmed by his experiments.

In his trials, Leemann (1935) tested chemicals such as copper sulphate, sodium chlorate and sodium arsenate. In order to get a wide range of information he applied three treatments using the different chemicals. In the first treatment the chemical (crystal form) was applied directly against the main stem, and in the second treatment the chemical did not make direct contact with the stem. A third treatment was either frilling (ring-barking or girdling) the stem, or leaving it uninjured.

Frilling and placing the chemical in contact with the stem gave the best results. However, the success rate was unsatisfactory. From the experiments it was concluded that the treatment should not be too violent, because the treated part of the plant dies too quickly and does not translocate the substance to the remote parts of the plant. To overcome this, Leemann (1935) placed sand, thoroughly drenched with a soluble mixture of the chemicals, around the main stem that had been girdled. With this method the success rate increased satisfactorily. Good results were obtained with all the chemicals. However, copper sulphate was recommended because it was not poisonous and therefore not harmful to animals or humans.

At the Sonop Research Station, Opperman & La Grange (1969) obtained good results by treating the girdled main stem with prussic acid. However, they found it tedious and time consuming to locate the main stem of the plant to be treated. Like all the previous methods, this method is also dependent on the number of plants per area and the size of the area concerned.

Foliage and Soil Treatment with Herbicides

At this point it would be appropriate to enlighten the reader that many authors refer to chemical control of plants. The correct term would be herbicidal control of plants. The newly developed herbicides have hormone active components that are mainly organic compounds. The herbicide is absorbed by the plant and affects the metabolism of the plant. For instance, the photosynthetic function of the plant is inhibited and the plant, in effect, dies of hunger. These herbicides are usually registered to control a certain group of plants and are marketed under a certain commercial name.

With the development of new herbicides (weed killers) with a hormone active component, new hope was raised. Despite the fact that these herbicides with a hormone active component were not specifically developed to control gifblaar, most of them were tested on gifblaar with the hope that they may kill the plant (Meissner 1964). Most of the results were disappointing. However, Meissner (1964) reported success with a few of the products such as 2,4,5T, Erobon and Fenac. These products are no longer available on the market. Methods of application that were tested were foliage application and soil application of the herbicide with a rucksack and fine spray nozzle. The herbicides applied were absorbed either by the leaves or the roots of the plant.

- **Foliage application**

Meissner (1964) reviews the research done during the 1960s in South Africa with these newly developed herbicides. Opperman and La Grange (1969) also tested some of these herbicides at the Sonop Research Station in the Grootfontein District in Namibia.

The results with the foliage spray were disappointing. According to Meissner (1964), this was due to the low ratio of above ground leaves, compared to the mass of stems and roots below ground. There were too few leaves to absorb enough herbicide to effectively kill the mass of stems and roots below ground. The poor results were also ascribed to the slow metabolism of the plant. The absorption of the herbicide through the leaves and transportation thereof from foliage to the roots was slow. Phillips (1927) describes the appearance of the leaves of the gifblaar plant as leathery, as the plant matures. It was found in Namibia that woody plants that have similar leaves or hairy leaves, were difficult to control with foliage application.

The research done in South Africa showed that the best results were obtained when applied on to the soil and the herbicide absorbed through the stems. The reason was that these herbicides had a long residual affect in the soil

Figure 14. Herbicide registered to control gifblaar with prescription.

compared to foliage application. It was therefore also possible to apply the herbicides on to the soil through the year. That is, from when the plant sprouts in the spring until autumn, when the plant dies. It was also found that the best results with foliage application were obtained when the leaves of the plant were thoroughly wetted with the herbicide. The costs of the application were then additionally increased. The main drawback of all the herbicides was that not one of them could control gifblaar successfully with only one season of application. One or more follow up treatments were needed, which raised the cost of control considerably.

Opperman and La Grange (1969) also obtained better results with applications to the soil. However, they found that the best results were obtained when the herbicide was applied to the soil during the spring, compared to late summer. The penetration of the herbicide during the spring was better than in the late summer. They also found the gifblaar could not be controlled with a single season's application.

Wessels (1983) reports successful results with the herbicide Tordon 225. Tordon 225 was registered as an herbicide to control woody plants. Another Tordon product, K22 was registered later as a herbicide to control gifblaar (Figure 14).

The most recent work done on herbicidal control of gifblaar in Namibia, was done by Van Eck (2004). Herbicides that were tested were Tordon Super, Access and Savana SC. Access yielded the best results with a 100 percent success rate. The costs per plant were also the lowest when using the herbicide Access. The costs per plant were, (a) Access 0.81 cent, (b) Tordon Super 1.99 cent and (c) Savana SC 1.40 cent per plant. The cost per plant plays an important role, considering that plant densities may be in the order of 100 000 to 200 000 plants per hectare (Figures 15, 16 and 17).

Figure 15. Foliage application of herbicide.

- **Removing leaves and feeding plant through translocation**

A method used by farmers is to cut off the leaves above-ground and feed the plant through a plastic pipe connected to the stem (translocation), from a bottle containing copper-sulphate (Van Vuuren 1960). According to the popular literature, many farmers have used this method with success

Figure 16. Cluster of gifblaar leaves.

and even eradicated gifblaar from the farm. This method may be cheap but is also dependent on the degree of infestation of the plant (Figures 18, 19 and 20).

REDUCING LIVESTOCK MORTALITY THROUGH JUDICIOUS MANAGEMENT

Despite the fact that many farms, according to Steyn (1934), are so heavily infested that fencing off would not be practical, and if undertaken would impair the carrying capacity of the farm, he still recommends spare camps and avoiding over utilized areas. Opperman and La Grange (1969) refer to the harmful effect of "veld milking" that obviously leads to over utilization of areas, forcing animals to graze gifblaar.

According to Steyn (1934) it is well known that animals that grew up on areas where other poisonous plants occur, do not necessarily become poisoned. Owing to the tastelessness of the gifblaar leaves and buds, animals that grew up in areas where gifblaar is prevalent are always liable to get poisoned (Steyn, 1934). Contradictorily, in Namibia the experience is that animals that grew up in a gifblaar area tend to avoid the plant. A measure that is taken by farmers is to remove the above ground leaves of the plant beforehand and only then to allow the animals to graze the area. The practicality of this measure is once again dependent on the degree of infestation (Van Vuuren 1960).

Figure 17. High density of gifblaar leaves.

There was no prophylactic treatment available that could be recommended before, or a remedy after, an animal had grazed gifblaar plants (SWAA 1961). Symptoms and death may occur a few hours or up to 24 hours after ingesting gifblaar plants. In acute cases, there is no time to apply any medicine after the animal shows symptoms of poisoning. However, this is dependent on the amount of gifblaar ingested. Many local remedies have been used with success. However, the successes are ascribed to rate of excretion of the toxin rather than to the treatment applied (SWAA 1961). Eland and kudu are much less susceptible to gifblaar poisoning than large stock and goats (Basson, Noval, Hofmeyr, Ebedes and Schultz 1982). Goats are more susceptible to gifblaar poisoning than large stock because of their feeding habits. It is worth mentioning that the goats on the Sonop Research Station were moved to the Uitkomst Research Station during the 1980s.

From the above-mentioned reports and the observations of farmers, Opperman and La Grange (1969) concluded that losses of livestock were considerably increased by poor management practices and overstocking. By the facts that the highest infestation of gifblaar occurred mainly on the northern slopes of the dunes and that gifblaar was not necessarily poisonous throughout the year, they were convinced that livestock mortality could be restricted by judicious management practices. Therefore, the project commenced in collaboration with P.A. Brand.

The main objective of the trial was to fence off the dune areas, where the gifblaar occurred most, from the area between the dunes, where no or little gifblaar occurred. These two areas were grazed separately with oxen and cows at three stocking intensities. The camps were grazed according to the conventional two camp system, the only difference being that the camps with gifblaar plants were not grazed during the critical sprouting period. The gifblaar free camps were unfortunately grazed during spring every year. The control group grazed a partially infested camp continuously at a low stocking rate.

There were no mortalities in any of the stocking intensities. The higher intensity caused the rangeland to deteriorate drastically and the performance of individual animals to drop. However, production per hectare was higher. The weaning weights of the calves in the higher grazing intensity camp tended to be lower.

From the results obtained at Sonop Research Station, and observations during the trial period, Opperman and La Grange (1969) concluded that judicious management could reduce or even stop mortality of livestock due to gifblaar poisoning. The main objectives of judicious management would be to avoid over grazing even in areas that are slightly infested with gifblaar and not to graze heavily infested areas when the plants are sprouting. Areas should be rested in order to accumulate sufficient grazeable material that can be utilized during the critical periods when plants are most poisonous. Animals that were agitated, under stress or ill, were likely to die after ingesting gifblaar. Animal health is therefore a prerequisite. Fasting for extended periods should be avoided and animals must have free access to water to avoid herding and waiting. Animals that have eaten gifblaar and show symptoms of poisoning must not be chased or allowed to drink water.

DISCUSSION AND RECOMMENDATIONS

Own experience and research done in the past have enabled farmers to overcome large scale mortality of livestock and to farm successfully in gifblaar infested areas. However, there are still requests from some farmers for means of eradicating the plant. The reason for this publication is to enlighten those who have the need for such information in order to reduce livestock mortality due to gifblaar poisoning.

Because the gifblaar plant has the ability to set roots and build up a new plant from fragments left in the soil after uprooting it, it is not recommended that this method be use to try and eradicate gifblaar. It may be argued that the few fragments that may remain can be either uprooted when a new plant has established itself or treated with herbicides. The fact remains that it is a tedious and a time consuming method that is dependent on the rate of infestation and the size of the area that is infested. Should this method be used, care should be taken to remove all fragments in the soil to avoid new plants forming.

When digging the plant open and treating the main stem with a chemical or herbicide, girdling (ring-barking) is essential, as it increases the uptake of the herbicide that is applied. Treating the girdled stem with a chemical is not recommendable as there is not a 100 percent guarantee of success despite the fact that chemicals have been tested. It is also essential that the main stem must be located and treated. Leemann (1935) guarantees poor results if the main stem is not treated. The many stems penetrating the soil must also be treated, rendering this method virtually impossible in highly infested areas. Damaging a stem also results in multiple stem formation. Digging the stem open and stem burning will also be dependent on the degree of infestation.

Research results show that it is possible to control gifblaar by using herbicides that are available on the market. It must be kept in mind that while gifblaar can be controlled with these products, it will not be possible to eradicate the plant, although this may be possible in areas that are not densely infested with gifblaar. When applying the herbicide to the leaves, it is essential that the leaves are thoroughly drenched with the fluid in order to ensure the best results. Herbicides are expensive and not always within the reach of many farmers. When using herbicides, it is essential that the recommendations on the label be followed to ensure the best results. Taking short cuts to cut costs, such as diluting the herbicide, is not recommended as it will only lead to poor results.

Due to the high costs of herbicides and the impracticalities of many of the methods that have been found successful, and on the basis of information gained by experienced farmers, the trial to test judicious management as a measure to reduce livestock mortality due to gifblaar poisoning was launched on the Sonop Research Station. From observation and the quantifiable results obtained, it was concluded that it was

possible to stop livestock mortality. A set of guidelines and recommendations were compiled in order to assist farmers.

Animals that are adapted to the area will not eat gifblaar if sufficient grazeable material is available. It is therefore of utmost importance that sufficient grazeable material is made available. The toxicity of monofluoroacetate is highest during spring when the plant sprouts and most of the other plants are still dormant. As the plant matures, the toxicity declines. Mortalities are less inclined to occur when gifblaar sprouts for a second time during the autumn. Based on these findings the mangement procedures that are recommended are as follows:

- Farms must be planned and fenced so as to have poison free camps available for the dry periods of early summer and spring when the gifblaar sprouts. A good system of range management is essential, and sufficient numbers of camps must be provided.

- Animals must graze gifblaar free areas during the most critical period that extends for 2 to 3 months in the spring when plants sprout.

- Areas or camps should be withdrawn from grazing and rested to build up sufficient grazeable material that can be grazed during the most critical periods when gifblaar is most poisonous.

- If it is unavoidable and areas that are infested with gifblaar have to be grazed during the critical periods, stocking rates should be low and the camp not heavily grazed. It is recommended that stocking rates should at all times be adapted to the amount of available grazeable material.

- If it is possible, areas infested with gifblaar and gifblaar free areas should be separated by means of camps. If it is not possible, the areas must be grazed accordingly.

- Overgrazing must be avoided at all costs as it is uneconomical, since production per animal drops, weaning weights are reduced and the rangeland is damaged. This makes a farmer more vulnerable to periodic and disastrous droughts.

- Animal numbers should be adapted annually to the available grazeable material to avoid overgrazing and the chances of animal losses through gifblaar poisoning.

- The physiological processes and health of the grazeable plants must be complied with, therefore resting of the rangeland is of utmost importance.

If winter is preceded by late rains, a good spring sprouting of gifblaar and forage bushes can be expected. However, in some years spring is dry and the quality of the grazing is such that animals cannot ingest sufficient feed for maintenance. They will then search for green growth, resorting to the gifblaar that sprouts earlier than other plants.

- Protein rich supplementation licks are absolutely essential during this dry period and should be provided from early winter.

The largest proportion of animal losses occurs when animals are handled or after handling, for instance dosing or chasing them. It appears that an animal might have ingested a threshold amount of gifblaar that would not normally affect it, but due to the physical activity poisoning becomes acute, resulting in the death of the animal.

- When animals are grazing gifblaar infested areas, handling of animals must be reduced to a minimum and management practices should be planned and implemented accordingly.

It is also found that cows, especially pregnant cows, are more susceptible to gifblaar poisoning than male animals.

- If sufficient gifblaar free camps are not available preferential access to the available camps or gifblaar free areas must be given to the female animals.

- If possible, planted pastures are an option that can be grazed by these animals during critical periods.

- Supplying extra feed, especially a protein rich supplement, to the female animals may also be an option. However, purchasing the extra feed is costly.

- The latter two options can be generalized, and applied for all farm animals.

Other management aspects that must be taken into consideration in order to reduce livestock mortality are:

- A health care programme is necessary.

- Animals must not be fasted (kraaled) for an extended period of time, which is the case when animals are milked.

- Animals must have free access to licks and water in order to avoid agitation and stress.

- Where possible, water points and kraals should not be erected in a gifblaar infested area. However, this may not be possible in many cases and such areas can be cleared by means of the various methods described above.

- Animals that are chased from one place to another, tend to grab any plant in sight while being chased. In the process gifblaar plants are also ingested. Service corridors (passages) can be erected to ease animal movement on the farm. These areas can also be cleared of gifblaar by the different methods of eradication. They can also receive a rest at certain periods and serve as grazing during critical periods.

- From research it was established that game are less susceptible to gifblaar poisoning and therefore game farming could be an option in order to avoid large scale mortality of animals.

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