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Chemical control of signalgrass for establishing Tanzania-grass

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ABSTRACT. Herbicides have been used to control Brachiaria grass in pastures established or in formation given their practicality, however their efficiency is questionable due to the lack of specific graminicides for different forage species. Therefore, the goal of this study was to evaluate the efficiency of glyphosate and fluazifop-p-butyl in the control of *Brachiaria decumbens* (signalgrass) and the intoxication levels of *Panicum maximum* cv. Tanzania (Tanzania quinea grass) in pasture establishment. The experiments were designed in randomized blocks, in a 2 × 5 × 4 factorial arrangement of two herbicides (fluazifop-p-butyl and glyphosate), five doses equivalent to the commercial dosage of each herbicide (0.25; 0.50; 1.00; 1.50; 200), and four evaluation times after herbicide application (15, 21, 30 and 45 days). There was interaction between doses and evaluation times. The dose 1.5 L ha^{-1} fluazifop-p-butyl provides efficient control of signalgrass, however, leads to high intoxication in Tanzania guinea grass. Glyphosate is efficient in the control of signalgrass even at the lowest dose (90 g ha^{-1}), however, it causes high intoxication in Tanzania guinea grass, preventing its use in developing pastures. It can be concluded that fluazifop-p-butyl and glyphosate herbicides are not recommended for the control of *B. decumbens*, cv. Basilisk in developing pastures of Tanzania guinea grass.

Keywords: signalgrass; Tanzania-grass; ACCase enzyme; fluazifop-p-butyl; glyphosate.

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Introduction

Panicum maximum cv. Tanzania (syn. *Megathyrsus maximus*), also known as Tanzania guinea grass, has been used by farmers in Brazil because of its high productivity, quality and adaptability (Cecato et al., 2000; Jank, Marstuscello, Euclides, Valle, & Resende, 2010; Silva et al., 2016). Because it is a more demanding genus considering soil fertility and management than other forages (Jank, Braz, & Martuscello, 2013), it requires special care in order to ensure species longevity facing competition for nutrients and space, especially in areas where plants of the genus Brachiaria (syn. *Urochloa*) occur.

Brachiaria decumbens (syn. *Urochloa decumbens*), also known as signalgrass, is a forage widely spread in Brazil due to its wide climatic and soil adaptation, high aggressiveness and competitiveness, and in certain situations it can be considered as a weed, due to the damage it can cause to crops of interest, even in pastures (Santos et al., 2012; Dias et al., 2017). The control of signalgrass plants is difficult, mainly due to labor costs and their high persistence in the areas, due to the large seed pool in the soil (Pereira & Campos, 2001). Thus, the use of herbicides has become a constant practice by farmers to control this species in pasture areas.

Among the most widely used herbicides, glyphosate (N-phosphonomethyl glycine), a post-emergence herbicide belonging to the chemical group of substituted glycines, non-selective, with systemic action by inhibiting the action of the enzyme 5- enolpyruvylshikimate-3-phosphate (EPSP) synthase, which prevents the formation of amino acids essential for protein synthesis and some secondary metabolites (Alarcón-Reverte et al., 2015), and fluazifop-p-butyl, recommended for controlling signalgrass in corn. This is a systemic action herbicide that inhibits the acetyl coenzyme (ACCase), which is responsible for the synthesis of lipids in the meristems, thus preventing cell proliferation (Burke, Thomas, Burton, Spears, & Wilcut, 2006; Kaundun, 2014).

Glyphosate and fluazifop-p-butyl can be used for grass control in pastures (Dias et al., 2017; Santos et al., 2012; Santos et al., 2010). However, studies reporting intoxication and/or control of each forage species exposed to them are still incipient. In the case of *Panicum* pastures, this information is fundamental to ensure a good establishment in areas already established by signalgrass.

In this context, the objective of this study was to evaluate the efficiency of different doses of herbicides (fluazifop-p-butyl and glyphosate) in the control of signalgrass in pots grown with Tanzania guinea grass, and to evaluate the intoxication caused by herbicides in forage of the genus *Panicum*.

Material and methods

Two experiments were conducted in a greenhouse belonging to the Federal University of Jequitinhonha and Mucuri Valleys, in Diamantina, State of Minas Gerais, located at 18º 14 '58” South latitude and 43º 36' 01” West longitude, at 1,183 m altitude and average annual temperature is 18.1°C. The climate is classified as Cwb (tropical altitude).

Both experiments were designed in randomized blocks, in a triple factorial arrangement (2 × 5 × 4), with five replications. The factors analyzed were two herbicides (fluazifop-p-butyl and glyphosate), five doses of each herbicide and four evaluation times after herbicide application (15; 21; 30 and 45 days). The herbicide doses used were equivalent to 0.25; 0.5; 1.0; 1.5 and 2.0 times the commercial dose indicated by the manufacturers to control signalgrass: 90; 180; 360; 540 and 720 g ha^{-1} glyphosate and 50; 100; 200; 300; 400 g ha^{-1} fluazifop-p-butyl.

Each experimental unit consisted of a plastic pot containing 5 L Red-Yellow Latosol previously sieved, acid-amended with dolomitic limestone and nutrients, with 0.5 kg P_2O_5, 0.03 kg $(NH_4)_2SO_4$ and 0.02 kg KCl for each 100 kg soil, and cultivated with two signal grass plants and two guinea grass plants.

First, the forage species were sown in trays at 1.0 cm depth. After 20 days of emergence, two seedlings of each species were replanted interchangeably in the experimental pots. To maintain moisture at 80% field capacity, irrigation was performed daily in the pots. Every 14 days, topdressing fertilization was performed with 2.5 g of 20-05-20 (N-P_2O_5-K_2O) per pot. Other plant species that occurred in the pots were eliminated manually.

Herbicides were applied when the plants were on average 20 cm high, with the aid of a backpack sprayer equipped with a bar with two XR 11002 flat spray nozzles, spaced 0.5 m apart, at a bar height of 0.5 m under a constant pressure of 210 kPa. The commercial products used were Roundup Original®, at a concentration of 360 g ha^{-1} glyphosate, and Fusilade®, at a concentration of 250 g ha^{-1} fluazifop-p-butyl.

On days 15, 21, 30 and 45 after herbicide application (DAA), we evaluated visually the control of signal grass and the intoxication of guinea grass, both using a scale from 0 to 100, in which 0 is the lack of control and absence of intoxication, and 100 is the total control and severe intoxication with irreversible damage (plant death), respectively, for signalgrass and guinea grass (European Weed Research Council [EWRC], 1964). These evaluations were performed by three experts, individually, each of whom was unaware of the scores of the other evaluators (blind).

Mean values were tested by analysis of variance at 5% probability using the SAS software. Subsequently, data referring to control of signalgrass and guinea grass intoxication were subjected to response surface analysis, with the aid of the software Sigma Plot®, version 12.5. The best fit equation was selected according to the coefficient of determination, the level of significance of the regression coefficients and the biological response.

The following statistical model was used:

$$\hat{y}_{ijkl} = \mu + \beta_j + H_j + D_k + E_l + HD_{jk} + HE_{jl} + HDE_{jkl} + e_{ijkl}$$

where, ß is the effect of the i-th block; H is the effect of the j-th herbicide; D is the effect of the k-th dose; E is the effect of the l-th evaluation time; and e is the experimental error.

Plants and herbicides were evaluated separately for the effects considered in the model.

Results and discussion

Dose, season, herbicide effect and interaction between these factors ($p < 0.05$) were observed for the two forages analyzed (signalgrass and Tanzania guinea grass). Data were studied by response surface for each forage and herbicide evaluated.

Fluazifop-p-butyl

There was a significant interaction between doses and times (days after the application of fluazifop-p-butyl) for both forage species, indicating that the applied dose had an effect on the level of guinea grass intoxication and control of signalgrass over time.

In this study, the lower doses of fluazifop-p-butyl (0.25 and 0.50) were probably not able to completely inhibit the ACCase (Acetyl Coenzyme A carboxylase) enzyme in guinea grass plants, as there was a reduction in the level of intoxication over the days after herbicide application, thus demonstrating the recovery of this forage at these doses, as can be seen in Figure 1. Fluazifop-p-butyl has the function of inhibiting ACCase which acts in the synthesis of lipids, in which the first symptoms of the action of this herbicide in plants are observed in the meristematic region, where lipid synthesis for membrane formation is intense. Thus, plant growth stops due to the lack of substrate to form new membranes required for cell growth and multiplication (Gronwald, 1991; Ohlrogge & Browse, 1995; Vidal, 1997; Burke et al., 2006).

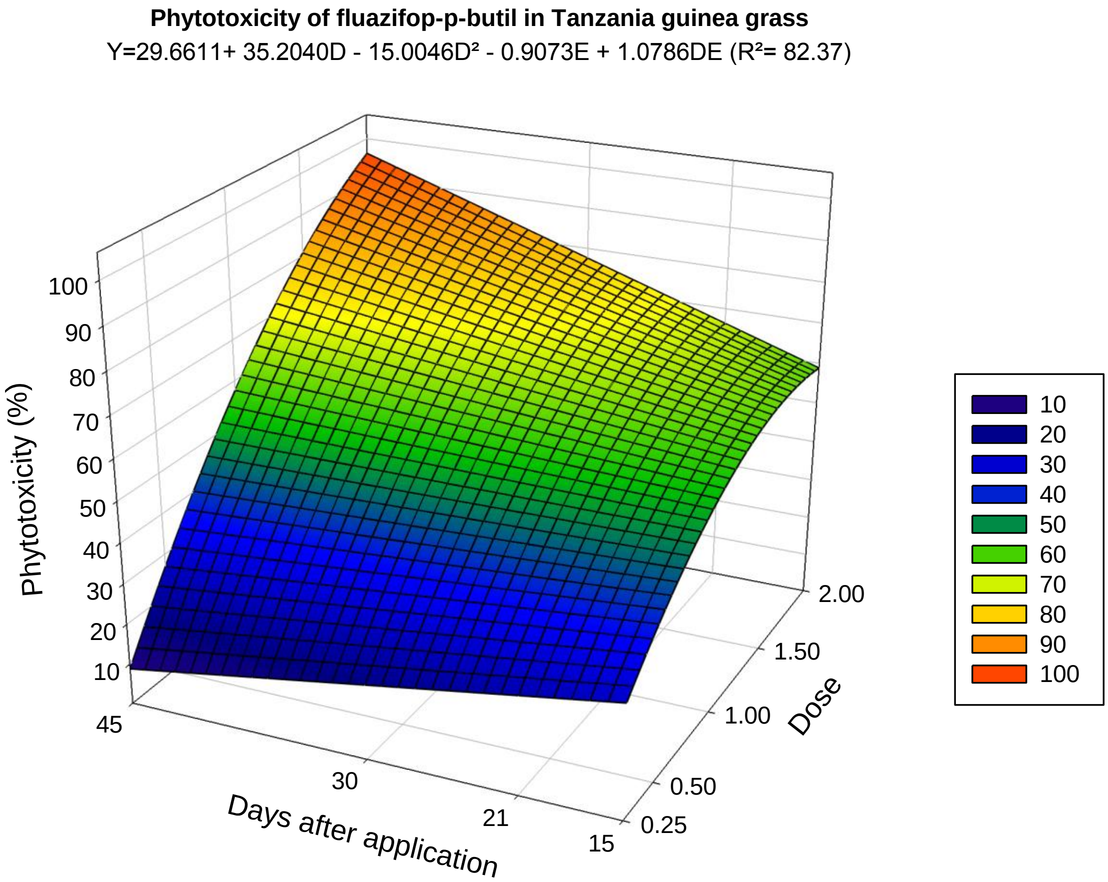

Figure 1. Intoxication of Tanzania guinea grass subjected to different doses of fluazifop-p-butyl at 15, 21, 30 and 45 days after herbicide application.

The same was true for signalgrass with lower doses of fluazifop-p-butyl (0.25 and 0.50). Signalgrass showed a reduction in the intoxication level with advancement of herbicide application days (Figure 2).

For dose 1.0, i.e. the manufacturer's recommended dose, Tanzania guinea grass was found to have a 60% toxicity level, regardless of the time of evaluation. At doses of 1.5 and 2.0 herbicide, the levels of Tanzania guinea grass intoxication were even higher, with 80% and 96% intoxication, respectively, at 45 days after application. These results indicate that fluazifop-p-butyl should not be used at high doses in areas containing Tanzania guinea grass, when the objective is to control signalgrass, because forage of the genus *Panicum* is also highly sensitive to this herbicide molecule.

Signalgrass showed a phytotoxicity level of approximately 60% at all times evaluated with the application of dose 1.0. In turn, high doses of herbicide (1.5 and 2.0) resulted in 85% and 100% intoxication at 45 days after application, respectively. Similarly, Barroso et al. (2010) observed that application of 125 g ha^{-1} fluazifop-p-butyl showed reasonable control (72% at 44 DAA) of *B. decumbens*.

Similarly, Dias et al. (2017) evaluated the action of fluazifop-p-butyl on meristematic development of signalgrass plants, and reported that doses up to 200 g ha^{-1} reduced tillering after 30 DAA. According to the same authors, plants subjected to higher doses, 300 and 400 g ha^{-1} at 30 days of application, did not have live tillers, that is, they were totally dead. Therefore, we can infer that plants of the genus *Brachiaria*, especially *B. decumbens*, have lower tolerance to fluazifop-p-butyl compared to Tanzania guinea grass plants, even at reduced doses.

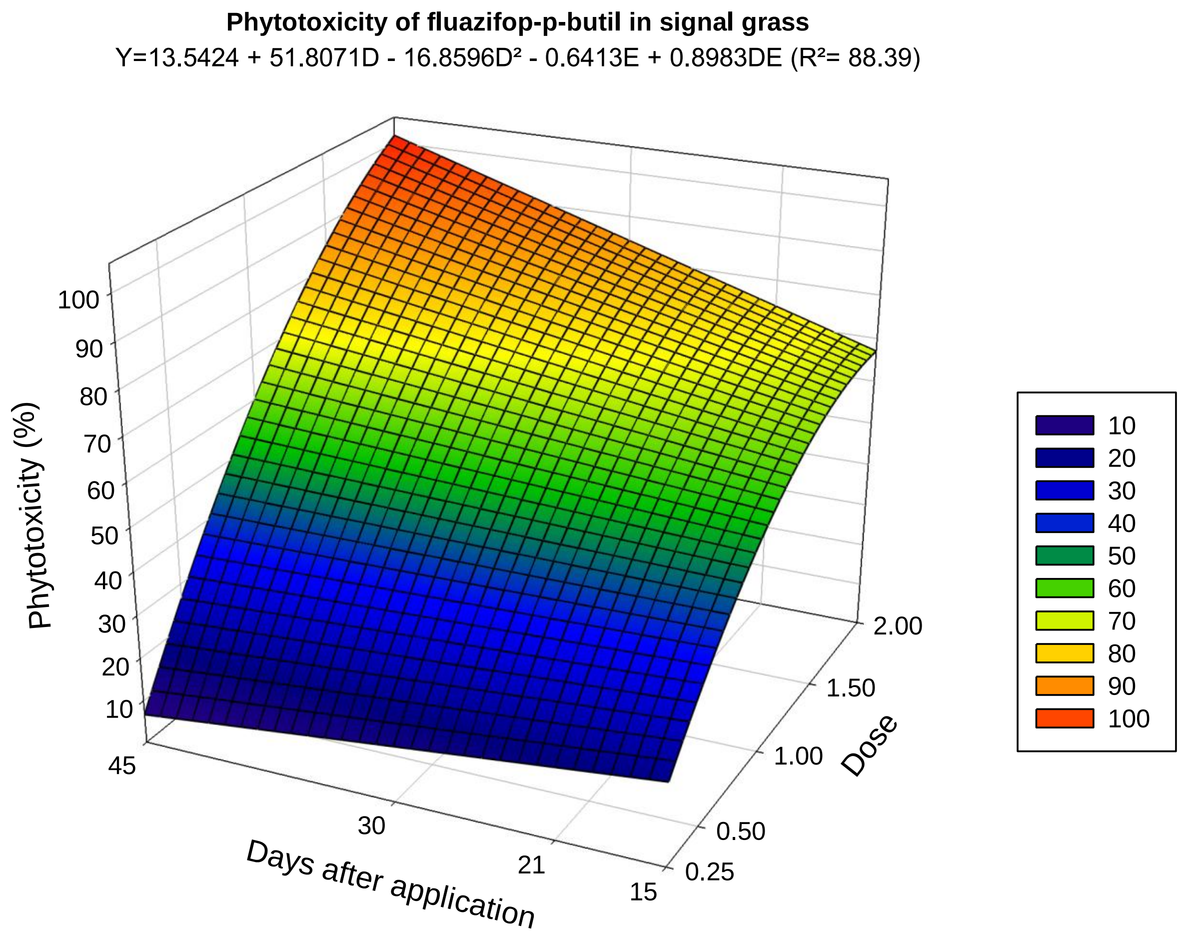

Figure 2. Intoxication of signal grass subjected to different doses of fluazifop-p-butyl at 15, 21, 30 and 45 days after herbicide application.

Glyphosate

The use of glyphosate at the doses of 0.25 and 0.50 resulted in levels of intoxication of 62 and 72% in Tanzania guinea grass plants, respectively, at 45 days after herbicide application (Figure 3), more intense than caused by the fluazifop-β-butyl herbicide (Figure 1). On the other hand, reduced doses of glyphosate were not effective in controlling signalgrass. Despite the increasing level of intoxication, they remained at 45 DAA, around 43 and 58% for the 0.25 and 0.50 doses, respectively (Figure 4). Therefore, under conditions similar to this work, the use of doses below those prescribed by the manufacturer is not recommended for the control of signalgrass.

Glyphosate at the dose 1.0 caused 75% intoxication in Tanzania guinea grass at 21 DAA, and 87% toxicity at 45 DAA. While for signalgrass, this dose generated a lower level of intoxication at 21 DAA (70%) and 80% at 45 DAA, intoxication levels already considered effective for the control of this grass (Dias et al., 2017; Santos et al., 2012; Barroso et al., 2010).

High glyphosate doses resulted in high levels of intoxication in Tanzania guinea grass during all times evaluated (96 and 100% for the doses 1.5 and 2.0, respectively). Therefore, it is not recommended to use high doses of this herbicide in areas where the grass of interest is Tanzania guinea grass

For signalgrass, the use of high doses of glyphosate resulted in approximately 82% and 90% intoxication at 15 DAA, and total control of the plants at 45 DAA, with 98% and 100% intoxication for the doses 1.5 and 2.0, respectively. This evidences that glyphosate is efficient in the control of signalgrass, similar to that found by Anésio et al. (2017), who reported that signalgrass is more susceptible to glyphosate than fluazifop-p-butyl.

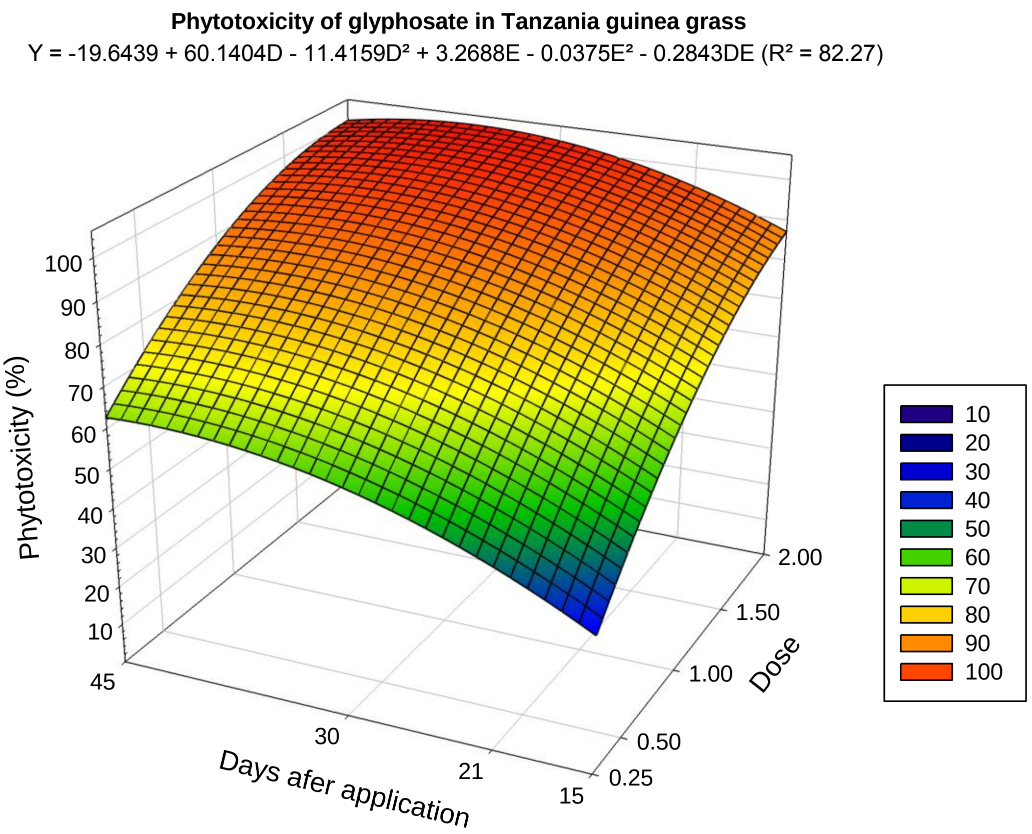

Figure 3. Intoxication of Tanzania guinea grass subjected to different doses of glyphosate at 15, 21, 30 and 45 days after herbicide application.

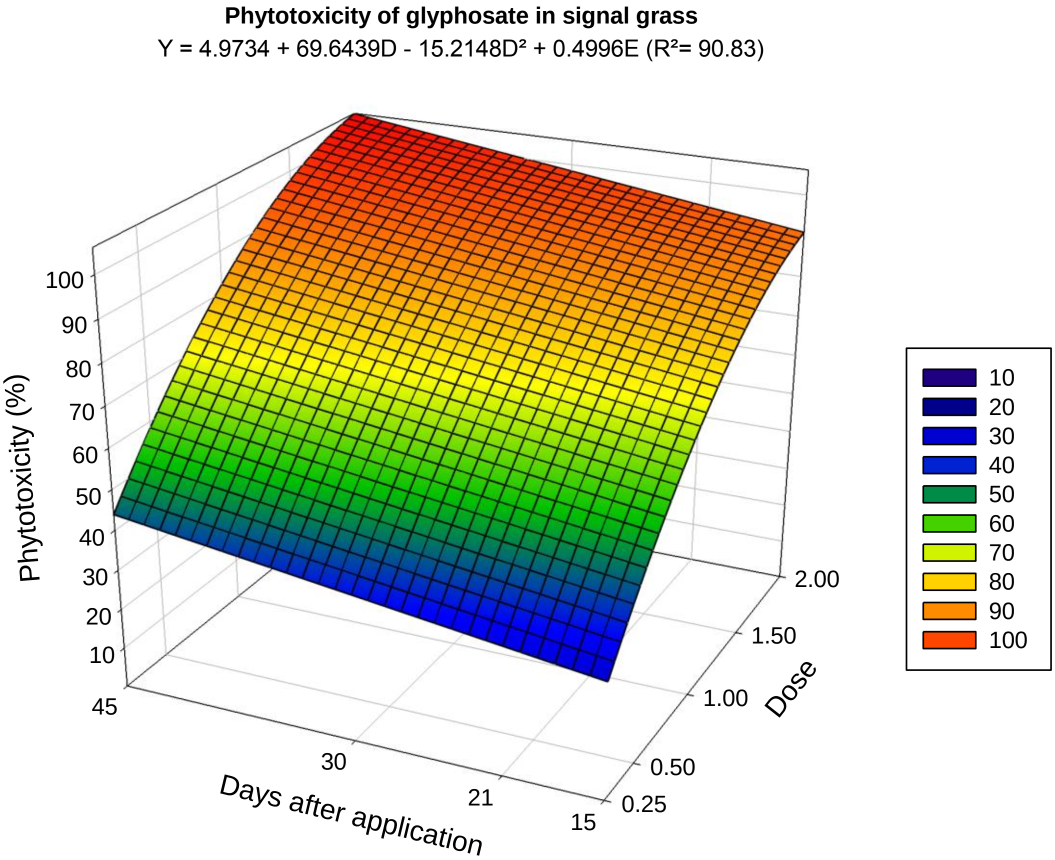

Figure 4. Intoxication of signal grass subjected to different doses of glyphosate at 15, 21, 30 and 45 days after herbicide application.

Conclusion

Low doses of fluazifop-p-butyl and glyphosate are not effective in controlling *B. decumbens*, cv. Basilisk.

Higher doses of fluazifop-p-butyl are effective in controlling *B. decumbens*, cv. Basilisk and cause strong intoxication to Tanzania guinea grass.

Fluazifop-p-butyl and glyphosate are not recommended for controlling *B. decumbens*, cv. Basilisk in pastures of *P. maximum*, cv. Tanzania in formation.

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