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# Efficacy of herbicides in the control of *Commelina benghalensis*

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## Abstract

The alternative management to maximize the weed control spectrum without increasing the resistance is the association of different herbicides in the tank, since the isolated control of glyphosate for Commelina benghalensis has not demonstrated efficacy, since it has presented tolerance to this herbicide. Thus, the objective of this study was to evaluate the effectiveness of herbicides in association and possible sequential applications that may lead to new alternatives in the effective control of *Commelina benghalensis* in no-tillage areas. For that, a randomized block design (DBC) with ten treatments and three replications was adopted. Each experimental unit consisted of an area of 8x5m, totaling 40m². Herbicide treatments were based on the association of possible herbicides and sequential applications. The application of the herbicides was carried out with research spray maintained at constant pressure by CO², with bar containing ten model nozzles ADIA 110015 T spaced 0.50 m apart. Evaluations of herbicide efficacy were carried out at 7, 15, 22 and 30 days after application (DAA). At 60 DAA, the percentage of rebreeding of *Commelina benghalensis* was evaluated. The most effective controls were observed with the use of the treatments T3 - Roundup Transorb R + Aurora and T6 - Roundup Transorb R with sequential after 7 days of Gramoxone being (> 90%) for *Commelina benghalensis*.

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**Introduction**

Weeds can withstand unfavorable climates due to their rusticity and ability to adapt to the environment, in turn, exerting a competitive effect on the cultivable plants (Lorenzi, 2006). Therefore, it is essential to keep the cultivation areas free from interference caused by undesirable plants (Pereira, 2010).

In areas with a long fallow period, weeds have been established more frequently, increasing the number of seeds consecutively, enriching the seed bank in the soil (Costa *et al*., 2011). Among the weed species, we highlight *Commelina benghalensis,* belonging to the family Commelinaceae, with a morphology called perennial, herbaceous and prostada (covering the soil) (Karam, 2010).

*Commelina benghalensis* is of South and South-East Asian origin, which produces aerial and subterranean seeds (formed in the rhizome), favoring its dispersion (Karam, 2010). In turn, it represents extreme agronomic importance, due to the damage caused by the allelopathic effect (exudation of secondary substances/metabolites), competing for water, light and nutrients, besides being alternative hosts for diseases and pest insects (Embrapa, 2015).

During the winter, this weed senesce and, as a mechanism of survival, keeps alive the branches that remain in the soil until the moment favorable for its budding (Ronchi *et al*., 2002), which occurs at the beginning of the spring season in southwest Goiano.

Moreover, when present in the soybean crop it harms both in the development of the plants and in the mechanized harvest, interfering in the quality of harvested grains (Souza *et al*., 2004).

In addition to the mentioned characteristics, which makes it undesirable in agriculture, the chemical control of *Commelina benghalensis* has not demonstrated efficacy, since it has presented tolerance to the herbicide glyphosate, which is the main active ingredient adopted in the management of the herb (Ronchi *et al*., 2002).

Glyphosate has been the basis for the establishment of no-till areas. However, its isolated use has favored the selection of weeds considered difficult to control, such as in the case of *Commelina benghalensis*, making it necessary to diversify the mechanisms of action (Procópio *et al*., 2006; Giancotti *et al*., 2012).

However, an alternative adopted to maximize the weed control spectrum without increasing the resistance, is the association of herbicides in the tank. According to Monquero *et al.* (2001), it is essential to associate herbicides in order to control difficult-to-control species. Among these species, *Commelina benghalensis* has been prominent, due to the repetitive use of the herbicide glyphosate, making it necessary to investigate new associations with the purpose of controlling them. For Carvalho *et al.* (2003) it is important to associate active ingredients with different mechanisms of action. Another alternative that is becoming important for the management of *Commelina benghalensis* is the sequential application of herbicides (Oliveira Junior, 2006).

Thus, the objective of this research was to evaluate the effectiveness of herbicides in association and possible sequential applications that may lead to new alternatives in the effective control of *Commelina benghalensis* in no-tillage areas.

**Material and methods**

*Place of conduction of the experiment*

The research was carried out between April and July 2017 at Fazenda Alvorada located in the municipality of Jataí-GO at latitude 18º 10.153 'S and longitude 51º 52.698' W with an altitude of 827 m. fallow with high infestation of weeds, mainly of *Commelina benghalensis* (trapoeraba).

The climate of the region, according to the Köppen classification, is tropical type Aw with higher precipitation rates between October and April (Mariano & Scopel, 2001). The soil is characterized as a dystrophic Red Latosol with a clayey texture (Embrapa, 2006).

*Experimental design*

The experimental design was randomized blocks, consisting of 10 treatments and 3 replicates. The experimental units were represented by 8 meters long and 5 meters wide, totaling an area of 40m².

The herbicides adopted and their respective doses used and times of application are mentioned in Table 1. Fig. 1 shows the characterization of the experimental area, it is observed that *Commelina benghalensis* corresponds to 80% of weed infestation.

For application of the herbicides in the test, a $CO_2$ pressurized sprayer with a bar containing ten nozzles spaced 0.5 m apart was used, with ADIA 11002 T (triple fan) spraying tips at a pressure of 3.6 bar and spent of 200 L $ha^{-1}$ syrup volume.

In both applications (single and sequential) herbicides, the atmospheric conditions were recorded with the aid of a Thermo-Hygro-Digital Anemometer. Table 2 presents information on the main parameters related to herbicide applications. The evaluations after herbicide applications consisted of a percentage of control of *Commelina benghalensis* in the total area of the experimental unit at 7, 15, 22 and 30 days after application (DAA) of the herbicides by means of the percentage scale of notes, in which 0 % corresponded to no injury in weeds and 100%, to death of the plants in relation to the control without herbicide application.

At 60 DAA, the percentage of re-growth of *Commelina benghalensis* plants was determined by means of percentage of notes, where 0% corresponded to no regrowth.

*Statistical analysis*

The results were submitted to analysis of variance and the means were compared by the Scott Knott test at 5% probability by the Assistat program.

**Results and discussion**

Table 3 shows that at 7 days after application (DAA) of the herbicides the lowest percentages in the control of *Commelina benghalensis* were obtained with the use of the herbicides Roundup, Roundup + (seq.) Roundup, Roundup + DMA and Roundup + (seq.) Grammoxone.

**Table 1**. Herbicides and the respective doses used and times of applications.

| Treatments | Commercial Product | Sequential Application | Dose (L ou kg $ha^{-1}$) |
|---|---|---|---|
| T1 | Roundup[1] | | 3,0 |
| T2 | Roundup | Roundup | 1,5 - 1,5 |
| T3 | Roundup + Aurora | | 3,0 + 0,07 + 0,5 % v/v[**] |
| T4 | Roundup + DMA | | 3,0 + 1,5 |
| T5 | Roundup + Gramoxone | | 3,0 + 2,0 |
| T6 | Roundup | Gramoxone | 3,0 - 2,0 |
| T7 | Roundup +Profit | | 3,0 + 0,75 + 0,5 % v/v[**] |
| T8 | Roundup +Sumysin | | 3,0 + 0,12 + 0,5 % v/v[**] |
| T9 | Roundup +Gramocil | | 3,0 + 2,0 |
| T10 | Roundup + Aurora +DMA | | 3,0 + 0,07 + 1,5 |

[1]Roundup Transorb R; [**]Óleo Mineral Assist.

Also in Table 3, it can be noticed from the results that from the 7 days to the 30 days after the application (DAA) an increasing gradual evolution in the control of *Commelina benghalensis* was obtained for the majority of the treatments adopted.

From 22 DAA, herbicide treatments can be divided into three groups.

However, all achieved results above 80%, which is considered satisfactory according to the scale of the notes proposed by SBCPD (1995).

The first group was formed by the best results obtained at the 30 DAA, by the time of the last evaluation, which consisted of the following treatments: Roundup + Aurora and Roundup with sequential after seven days of Gramoxone. Possibly because of the intrinsic characteristic of glyphosate,

which is easily translucent from leaves to other parts of the plant such as roots, rhizomes and meristems (Galli and Montezuma, 2005). Glyphosate is not persistent in soils, usually stays for less than 60 days, being rapidly adsorbed to soil colloids and degraded by microorganisms (Marchi, 2013).

**Table 2.** Atmospheric data reported at the time of application.

| Atmosphere conditions | 1ª application | | 2ª application | |
|---|---|---|---|---|
| | initial | Last | initial | Last |
| Application Hours | 9:10 | 11:00 | 9:00 | 10:40 |
| Air temperature (°C) | 17,6 °C | 24 °C | 16,6 °C | 23 °C |
| Relative humidity (%) | 71% | 53% | 66% | 56% |
| Wind speed (km $h^{-1}$) | 3,6 | 8 | 4 | 7 |

The second group is formed by the associations of Roundup + Profit and Roundup + Gramoxone, in which they showed intermediate control effectiveness (92.33 and 93.00 respectively). For the third group, we can observe the highest number of associations of herbicides adopted. It is worth noting that although the control levels are higher than 80%, in these cases the chances of reestablishment of *Commelina benghalensis* are increased by the time of establishment of crops of agronomic interest.

**Table 3.** Summary of variance analysis: F values, coefficient of variation (CV) applied to herbicide efficiency percentages in the control of Commelina benghalensis at 7, 15, 22 and 30 days after herbicide application (DAA).

| Variable | 7 DAA | 15 DAA | 22 DAA | 30 DAA |
|---|---|---|---|---|
| F BLOCKS | 1,48$^{ns}$ | 1,43$^{ns}$ | 2,35$^{ns}$ | 4,39$^{*}$ |
| F TREATMENTS | 13,17$^{**}$ | 17,43$^{**}$ | 7,54$^{**}$ | 10,35$^{**}$ |
| Roundup[1] | 36,66 b | 64,33 b | 83,33 c | 83,66 c |
| Roundup + (seq.) Roundup | 26,66 b | 54,33 c | 83,00 c | 87,00 c |
| Roundup + Aurora | 74,33 a | 92,66 a | 96,00 a | 98,33 a |
| Roundup + DMA | 38,33 b | 56,66 c | 81,00 c | 83,33 c |
| Roundup + Gramoxone | 83,66 a | 87,33 a | 88,33 b | 87,33 c |
| Roundup + (seq.) Gramoxone | 25,33 b | 90,33 a | 94,66 a | 99,00 a |
| Roundup + Profit | 86,66 a | 81,00 a | 90,33 b | 92,33 b |
| Roundup + Sumizyn | 76,00 a | 70,66 b | 83,00 c | 84,33 c |
| Roundup + Gamocil | 76,66 a | 86,66 a | 90,33 b | 93,00 b |
| Roundup + Aurora + DMA | 79,00 a | 72,33 b | 86,00 c | 89,33 c |
| CV% | 19,90 | 7,69 | 3,74 | 3,45 |

$^{ns}$ not significant; * significant at 1% probability; ** significant at 5% probability; averages in the same column, followed by the same lowercase letters do not differ from each other; (sequential) sequence; 1Roundup Transorb R®.

*Commelina* spp. it is important to keep the remaining branches in the soil alive to recover in the area again under favorable conditions (Costa *et al*., 2011).

**Fig. 1.** Characterization of the experimental area before herbicide application.

Similarly, Ramires *et al.* (2011) observed that diffuse *Commelina* (trapoeraba) plants that survived the application of glyphosate kept the live stem, which allowed the regrowth of this species.

Santos *et al.* (2002) reported that in both *Commelina benghalensis* and *Commelina diffusa* the leaves were totally eliminated by the action of glyphosate, which suggests that both absorbed the amount of herbicide necessary for its control.

Figs 2, 3, 4 and 5 show the treatments that obtained the best results. Fig.2 shows the control images of *Commelina benghalensis* at 22 DAA, and other treatments studied in this research.

**Fig. 2.** Images of the situation of the plants of *Commelina benghalensis* at 22 days after application of the herbicide Roundup with sequential after 7 days of grammoxone.

**Fig. 3.** Images of the situation of *Commelina benghalensis* plants at 30 days after the application of the herbicide Roundup with sequential after 7 days of grammoxone.

Some associations between glyphosate and other herbicides may result in chemical incompatibilities, reducing the species control spectrum (Galli and Montezuma, 2005).

These effects are called antagonistic effects, which may also be correlated with the climate in relation to herbicide application at the target (Monquero *et al.*, 2001).

It is worth noting that the possible antagonistic effect of the 7 DAA on the association of Roundup + DMA, however, still obtained control over *Commelina benghalensis*, which comprised most of the area, leaving only the bitter grass, which was also controlled by the other associations or when sequential applications are performed. Due to the different positioning of the products, it was verified that the sequential application of Roundup and Gramoxone resulted in a better efficacy, as soon as 15 days after application, and the antagonistic effect was not observed.

**Fig. 4.** Images of the situation of *Commelina benghalensis* plants at 22 days after the application of the herbicide Roundup + Aurora.

**Fig. 5.** Images of the situation of *Commelina benghalensis* plants at 30 days after the application of the herbicide Roundup + Aurora.

Fig. 6 shows the average percentage of re-growth of *Commelina benghalensis* at 60 DAA.

It was verified that for Roundup + sequential Roundup, Roundup + Aurora, Roundup + DMA, Roundup + sequential herbicides with Gramoxone, Roundup + Aurora + DMA, there was no regrowth, proving to be efficient in the control of *Commelina benghalensis*. For the associations of Roundup + Profit, Roundup + Gramoxone and Roundup + Gramocil, sprouts were observed, losing only to Roundup in single application and Roundup + Sumizyn, in which regrowth was well known.

Possibly these species that present a minimal percentage of regrowth, as soon as restarting the next water regime there is possibility of restoring it in the area.

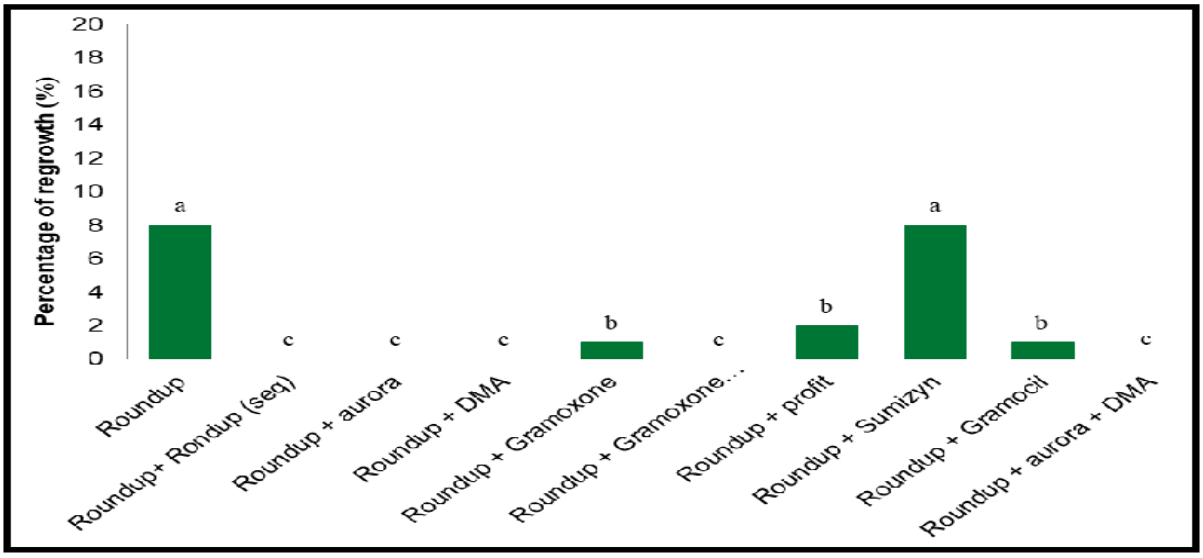


**Fig. 6.** Averages of percentages of regrowth determined at 60 days after application.

**Conclusion**

In the conditions under which the research was conducted, it can be concluded that: from 15 days after application of the herbicides all the results were satisfactory, however, the most effective controls were observed with Roundup Transorb R + Aurora and Roundup Transorb R with sequential after 7 days of Gramoxone being (> 90%) for *Commelina benghalensis*.

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