

Abstract

This work aimed to evaluate the response to toxicity of different sub-doses of glyphosate in young plants of varjão (*Parkia multijuga*, Benth.). The experiment was installed in the experimental area of UNEMAT – State University of Mato Grosso, in Alta Floresta – Mato Grosso state. The treatments tested were three sublethal rates of glyphosate (T1-6%, T2-12%, T3-24% of the recommended dose of 3.0 L ha⁻¹) and T4-control (without application). After 7, 14, 21, 28 days and 6 months of the application of the herbicide, it was performed measurements of the height and diameter of the cervix of plants and given the notes of phytotoxicity. After 6 months of the application of the herbicide, it was found that the increasing doses of glyphosate caused injuries in the leaves and reduction of growth in height in plants of *Parkia multijuga*, there was low index of mortality, however, it was verified a significant improvement in all treatments.

Key words: phytotoxicity; herbicide; native species

Introduction

One of the problems found for the recovery of the degraded area is the control of invasive species in the beginning of the process of artificial regeneration. One of the alternatives to perform this control is the use of herbicides which do not harm the development of the planted seedlings, but which are efficient in the control of the invasive species. One of the main herbicides used to this type of control is glyphosate, since it has a low cost and high efficiency.

Glyphosate is a post emergent herbicide, which belongs to the chemical group of the glycine substitution, classified as non-selective and of systemic action. It presents a wide action spectrum, which allows an excellent control of annual or perennial weeds, either with broad or narrow leaves (GALLI and MONTEZUMA, 2005). The quick translocation of the glyphosate of the leaves of the plants treated to the roots, rhizomes and the meristems is one of the most important characteristics of this herbicide. This systemic property results in the total destruction of perennial invasive species, hard to control (YAMADA e CASTRO, 2004).

Despite the great use of this herbicide in agriculture, it is still incipient the knowledge of the

Drift of sub-doses of glyphosate in young plants of Varjão (*Parkia multijuga*, Benth.)

Rubens Marques Rondon Neto¹, Kleiber Moura de Oliveira², Oscar Mitsuo Yamashita³

After 6 months of the application of the herbicide, it was found that the increasing doses of glyphosate caused injuries in the leaves and reduction of growth in height in plants of *Parkia multijuga*, there was low index of mortality, however, it was verified a significant improvement in all treatments.

effects in the native forest species. Therefore, it of major importance the knowledge of the phytotoxic effects of the glyphosate mainly in native species aiming to help in the control of invasive plants in degraded areas in the process of recovery.

Among the several native forest species of the region of the Brazilian Amazon with potential to be used in the programs of recovery of degraded areas, there is varjão (*Parkia multijuga* Benth.). According to CARVALHO (2009), it is a species which occurs naturally in the Amazon biome, it is classified according to the ecological group as initial secondary, and it may present quick growth and be planted in mixed stands and at full sun.

Thus, the present work aimed to evaluate the susceptibility of the phytotoxicity of different sub-doses of glyphosate in young plants of *Parkia multijuga* Benth.

Material and methods

The experiment was installed in the area of the university campus of Alta Floresta, which belongs to UNEMAT – Universidade do Estado de Mato Grosso (University of the State of Mato Grosso). It is located on the northernmost of the state of Mato

Received on: 13 feb. 2010. Accepted for publication on: 06. jun 2010.

1 Professor of the Department of Forest Engineering of the UNEMAT – Universidade do Estado de Mato Grosso (State University of Mato Grosso), Campus of Alta Floresta. Av. Rogério Silva, s/n – Jd. Flamboyant, CEP: 78580-000, Alta Floresta/MT. E-mail: rubensrondon@yahoo.com.br;

2 Student of Forest Engineering of the UNEMAT – Universidade do Estado de Mato Grosso (State University of Mato Grosso), Campus of Alta Floresta. E-mail: kleiber_moura@hotmail.com;

3 Professor of the Department of Agronomy of UNEMAT – Universidade do Estado de Mato Grosso (State University of Mato Grosso), Campus of Alta Floresta. E-mail: yama@unemat.br.

Grosso, between the geographic coordinates of 56° 04' 08" W and 284 m of altitude. The experiment was conducted between the period of May 2009 and June 2010.

According to the classification of Köppen, the region presents climate of the type Aw, being tropical rainy with distinct dry season of two months. The annual average temperature ranges between 20 and 38 °C, having as a mean 26 °C. The rainfall is high, ranging between 2,500 and 2,750 mm, with maximum intensity between the months of January and March (FERREIRA, 2001). The soil of the region is classified as Latossolo Vermelho Amarelo Distrófico a Moderado¹, with medium texture with gravel/clay and slightly undulating relief (MOREIRA and VASCONCELOS, 2007).

The experimental area was occupied by landscape of brachiaria (*Brachiaria brizantha*), which was eliminated during the soil preparation, through the performance of four harrowing in the depth of approximately 20 cm. The varjão seedlings (*Parkia multijuga*), used to the planting were produced in tubes of 50 cm³, being planted in field when they presented in average 20 cm of height.

The seedling was done in the spacing 1 x 1 m, in holes of 20 x 20 x 20 cm opened with exactitude, where it was applied 0.3 liters of hydrogel solution, prepared in the proportion of 3.0 g L⁻¹ of water. During the dry period of the region (May to September), the seedlings were irrigated fortnightly with 2.0 liters of water each. The control of the invasive species was performed manually with aid of a hoe, carpentering the surroundings of the plants

(crowning).

The experiment was installed in the random block design with four replications, in which each experimental unit was formed by four plants. One year after the sowing, the seedlings were treated with sub-doses of glyphosate, which constituted the tested treatments, being: T1 – 6%, T2 – 12%, T3 – 24% of the recommended dose of 3.0 L ha⁻¹ and T4 – control (without application). The herbicide used was Gliz 480 SL, with composition of glyphosate and isopropylamine salt (480 g L⁻¹ of the equivalent acid).

The application of the sub-doses of the herbicide was performed using backpack sprayers with constant pressure maintained by compressed CO₂, and bar containing flat spray nozzle type XR TEEJET 110.02. The pressure flow was calibrated to 2 kgf cm⁻² and water volume to L ha⁻¹. In the moment of the application, the room temperature was 28 °C, relative air humidity of approximately 80% and absence of wind.

After the application of the herbicide it was performed the evaluations at the 7, 14, 21 and 28 days and 6 months, being evaluated the following characteristics: phytotoxicity visual grading (Table 1); plant height and stem diameter. The last two data were transformed in $\sqrt{x + 0.5}$, which were submitted to analysis of variance and the averages compared among themselves by the Tukey test at the level of 5% probability, with aid of the program SISVAR (FERREIRA, 2003).

Results and discussion

When evaluating the levels of phytotoxicity caused by the sub-doses of glyphosate in the plants

¹ Brazilian Soil Classification

Table 1. Grading scale given to the visual evaluation of the level of phytotoxicity of varjão plants (*Parkia multijuga*), submitted to increasing sub-doses of glyphosate.

Grade	Characteristics
0	No damages. No effects over the culture.
1	Light damages or reduction of growth with fast recovery. Effects insufficient to promote reduction of productivity.
2	Moderate damages or reduction of growth with slow recovery or definitive. Effects intense enough to promote small reduction of productivity.
3	Severe damages or reduction in the growth not recoverable or reduction of stand. Effects intense enough to promote drastic reduction of productivity.
4	Complete destruction of the crop of only some plants alive

Source: SBCPD (1995).

of *Parkia multijuga*, it was found that 7 days after the application, T1 (6% of the recommended dose), caused in 100% of the individuals significant levels of damage (grade 1) (Figure 1). Therefore, few days after the contact with the glyphosate the plants of *Parkia multijuga* showed that they are sensible to the herbicide. At the 14, 21 and 28 days, the damages were aggravated in 25% of the individuals, which presented moderated damages (grade 2), however, most of them (75%) remained only with light damages. At 6 months, it was noted a recovery of the phytotoxic effects, caused by the application of the sub-dose of the herbicide in T1, considering that 75% of the individuals had no apparent damage (grade 0). The other 25% presented sever damages (grade 3).

Concerning the behavior of the plants of

Parkia multijuga in the T2 (12% of the recommended dose), it was verified that at 7, 14, 21 and 28 days after the application of the herbicide, 50% of the individuals presented damages classified as light (grade 1). However, other 50% of the individuals presented moderated damage (grade 2); thus, the plants were initially more sensible to the herbicide in relation to T1. On the other hand, 6 months after the application of the herbicide it was verified a significant recover of the sintoms of the phytotoxicity, since 50% of the individuals did not present any signs of damage (grade 0), mantaning the other individuals with light damages (grade 1).

Differently from the other three treatments, T3 (24% of the recommended dose) caused a great variation in relation to the phytotoxicity, obtained at

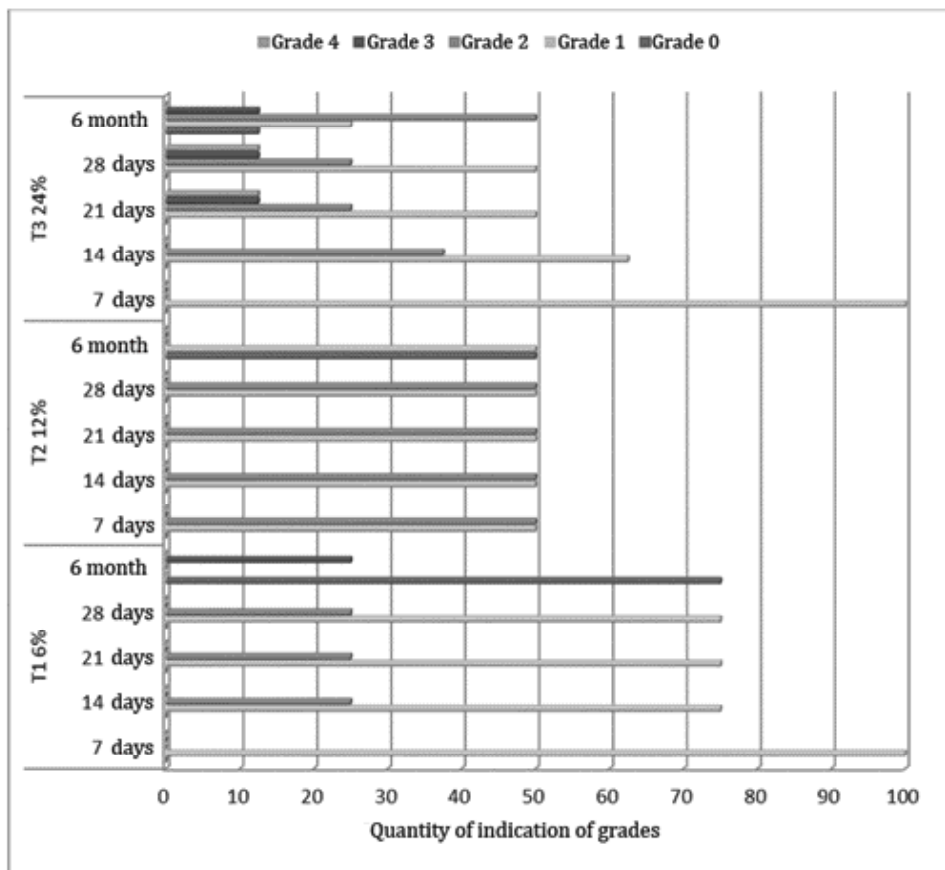


Figure 1. Percentage of the number of indication of grading phytotoxicity leves existent in plants of varjão (*Parkia multijuga*) at the 7, 14, 21, 28 days and 6 months after being submitted to application of sub-doses of glyphosate.

7 days after the application 100% of the individuals presenting light damages (grade 1). Similar results were also observed by YAMASHITE et al. (2009), at 7 days after the application of 360 g ha⁻¹ of glyphosate in plants of *Ceiba pentandra*. Sequentially, 14 days after the application (T3) the damages worsened, when 37.5% of the individuals presented moderated damages with reduction of the growth (grade 2), the remaining 62.5% still presented light damages (grade 1).

In the 21 and 28 later days, it was observed that the phytotoxicity worsened in 12.5% of the individuals in the T3, having mortality of some individuals (grade 4), in the same proportion of individuals there were still symptoms of several damages (grade 3). Other 25% and 50% of the individuals had moderated damages (grade 2) and light damages (grade 1), respectively. Ending T3, 6 months after the application of the herbicide, it was observed an alteration of the phytotoxic effects of the herbicide, since 12.5% of the individuals recovered and presented no damages (grade 0). However, there was still 25% of the individuals with light damages (grade 1), 50% with moderated damages (grade 2) and th eother 12.5% of the individuals were found with severe damages (grade 3).

It could be seen that 6 months after the application of the sub-doses of the herbicide, the plants of *Parkia multijuga* were sensible to glyphosate, prevailing the occurrence of light and moderate symptoms of phytotoxicity and having no mortality in T1 and T2. In T3 it was observed significant degree of mortality due to the increase of the sub-doses of glyphosate.

The appearance of severe damages and mortality of some individuals suggest inviability concerning the application of doses higher than 24% of the recommended dose in plantations of *Parkia*

multijuga, since in case it happens involuntary drift of the herbicide, possibly the plants would not resist to the phytotoxic effects. According to YAMADA and CASTRO (2004), the phytotoxic effects of the herbicides may be disastrous if there is no care about their dosage, even if they are not applied directly in the plants of interest, however, it may occur by accidental drift.

Concerning the effect of the sub-doses of glyphosate in the increases in the height of the plants of *Parkia multijuga*, it was observed a significant inhibition of the increment. It can be noted that in the treatments T1, T2 and T3 there were increments in height (89.7%, 88.4%, 83.2%, respectively) lower than the one observed in the control (Table 2). The differences of the increase in height between the treatments submitted to the sub-doses of glyphosate were small, and did not differed statistically, however, all of them presented statistic differences from T4. Differentially, CARBONARI et al. (2007) verified that the sub-dose of 3.6 g ha⁻¹ stimulated the growth in height of eucaliptus (*Eucaliptus grandis*), providing a larger number of lateral branches.

Regarding the diametric increase of the trunk of the individuals of *Parkia multijuga* after the application of sub-doses of glyphosate, it was found that there was no statistic difference between the treatments tested. The differences between the treatments submitted to the application of the glyphosate were small and almost insignificant, however the increase in diameter (50.6%, 47% and 27%, respectively) was more satisfactory in the absence of the herbicide. According to TUFFI SANTOS et al. (2006), all the species of eucaliptus submitted to 346 g ha⁻¹ of glyphosate presented a diamter smaller that the one observed between the tested doses 45 days after the application.

The increase in diameter of the individuals of

Table 2. Increases in total height and plant diameters of varjão (*Parkia multijuga*) 6 months after the application of sub-doses of glyphosate.

Treatment	Increase in height (cm)	Increase in diameter (cm)
T1 (Subdose of 6%)	4.0 a	0.42 a
T2 (Subdose of 12%)	4.5 a	0.45 a
T3 (Subdose of 24%)	6.6 a	0.62 a
T4 (Control)	38.7 b	0.85 a
Coefficient of variation (%)	35.4	15.5

Obs.: In the columns averages followed by the same letters did not differ statistically by the Tukey test at 5% of probability.

Parkia multijuga even having a lowermost increase, was ascending, independent on the increasing application of glyphosate, not being apparent the negative or positive effects of the herbicide. Another aspect to be considered is the occurrence of damages that led to the reduction of the growth of the leaves which justified the reduction of the increases in height and diameter of the plants exposed to the highest doses. Therefore, the application of glyphosate must be done in a directed form, aiming to avoid as much as possible its contact with the plants of *Parkia multijuga*, which is also in accordance with the recommendations of PEREIRA et al. (2010) to

Eucalyptus grandis.

Conclusion

With the performance of the present work it was concluded that the plants of *Parkia multijuga* are sensible to the application of the glyphosate, having significant phytotoxic effect in the plants, causing damage and even death in some individuals, and great negative influence in the increase of plant height in the plants submitted to the application of the herbicide in relation to the control.

References

- CARBONARI, C.A.; MESCHÉDE, D.K.; VELINI, E.D.; GUERRINI, I.A. Acúmulo de fósforo em plantas de eucalipto de diferentes doses de glyphosate. In: I SIMPÓSIO INTERNACIONAL SOBRE GLYPHOSATE, Botucatu. 2007. **Anais...** Botucatu. v.1. p.76-78.
- CARVALHO, P.E.R. **Faveira-benguê (Parkia multijuga)**. Colombo: Embrapa Florestas, 2009. 6p. (Comunicado Técnico, 227).
- FERREIRA, D.F. **SISVAR - Sistema para análise de variância de dados balanceados**: versão 4.3. Lavras: DEX/UFLA. 2003.
- FERREIRA, JCV. **Mato Grosso e seus Municípios**. Editora Buriti: Cuiabá, 2001.
- GALLI, A.J.B.; MONTEZUMA, M.C. **Alguns aspectos da utilização do herbicida glifosato na agricultura**. São Paulo: Monsanto do Brasil/Acadcom, 2005. 66p.
- MOREIRA, M.L.C.; VASCONCELOS, T.N.N. **Mato Grosso: solos e paisagens**. Cuiabá: Secretaria de planejamento e coordenação geral-SEPLAN/MT, 2007, 272p.
- PEREIRA, M.R.R.; RODRIGUES, A.C.P.; COSTA, N.V.; MARTINS, D.; KLAR, A.E.; SILVA, M.R. Efeito da deriva de glyphosate sobre algumas características fisiológicas em plantas de eucalipto. **Interciência**, Caracas, v. 35, n. 4, p. 279-283, 2010.
- SBCPD – SOCIEDADE BRASILEIRA DA CIÊNCIA DAS PLANTAS DANINHAS. **Procedimentos para instalação, avaliação e análise de experimentos com herbicidas**. Londrina: SBCPD, 1995. 42p.
- TUFFI SANTOS, L.D.; FERREIRA, F.A.; FERREIRA, L.R.; DUARTE, W.M.; TIBURCIO, R.A.S.; SANTOS, M.V. Intoxicação de espécies de eucalipto submetidas à deriva do glyphosate. **Planta Daninha**, Viçosa, v. 24, n. 2, p. 359-364, 2006.
- YAMADA, T.; CASTRO, P. R. C. Glifosato, herbicida com singular modo de ação: efeitos secundários e implicações fisiológicas e agronômicas. In: I SIMPÓSIO SOBRE SISTEMA AGRÍCOLA SUSTENTÁVEL EM COLHEITA ECONÔMICA MÁXIMA - SASCEM, São Pedro, 2004. **Anais...** São Pedro, p.01-45.
- YAMASHITA, O.M.; BETONI, J.R.; GUIMARÃES, S.C.; ESPINOSA M.M. Influência do glyphosate e 2,4-D sobre o desenvolvimento inicial de espécies florestais. **Scientia Forestalis**, Piracicaba, v. 37, n. 84, p. 359-366, 2009.

