International Journal of Agriculture and Environmental Research

ISSN: 2455-6939

Volume:03, Issue:01

BIOASSAY TO EVALUATE THE ALLELOPATHIC POTENTIAL OF LEAVES of *Siparuna guianensis* MART. & ZUCC.

Vanessa Damasceno Gonçalves[1], Elisangela Clarete Camili[1], Maria de Fatima Barbosa Coelho[1], Ludmila Silveira Piton[1], Rodrigo Aleixo Brito de Azevedo[2] , Carla Maria Abido Valentini[3]

[1]Universidade Federal de Mato Grosso, Programa de Pós-Graduação em Agricultura Tropical, Av. Fernando Correa da Costa, nº 2367 – Cidade Universitária - 78060-900 – Cuiabá – MT, Brasil , Telefone/Fax +55(65) 36158618

[2]Universidade da Integração Internacional da Lusofonia Afro-brasileira, Instituto de Desenvolvimento Rural Avenida da Abolição, 7. Redenção, CE, 62790-000

[3]Instituto Federal de Mato Grosso, Campus Cuiabá - Bela Vista, Avenida Juliano Costa Marques, s/n, Bela Vista, 78050-560 - Cuiabá, MT.

ABSTRACT

Medicinal plants such as *Siparuna guianensis*, have secondary metabolites that may have allelopathic properties with potential for use as natural herbicides. The aim of this study was to evaluate the allelopathic potential of *Siparuna guianensis* leaves on the germination and growth of *Lactuca sativa* L. The extract was obtained by 50 g leaves in 500 mL of distilled water in a blender. From this extract was obtained by diluting in water in concentrations of 0 (control), 25, 50, 75 and 100%. The bioassay was conducted in completely randomized design with five treatments and four replicates of 50 seeds of *L. sativa*. There was no significant difference between the extracts for germination ranging from 97.5 to 100%. The germination rate and seedling root length decreased proportionally with increasing concentration. The allelopathic potential was verified in developmental characteristics of lettuce seedlings and there was no effect on the germination percentage.

Keywords: Negramina, Seed germination, Lettuce.

INTRODUCTION

Siparuna guianensis Aublet belongs to Siparunaceae family and occurs from Nicaragua, throughout northern South America to Paraguay in high primary and secondary forests plains, with heights of 1200 meters, rarely 1,400 meters (Renner and Hausner, 2005). In many countries of America, the decoction of leaves of *S. guianensis* is used as a drink against stomach disorders and leaves are also used in compresses against headache and rheumatism (Valentini et al., 2010).

ISSN: 2455-6939

Volume:03, Issue:01

According Bezerra et al. (2011) in the leaves of *S. guianensis* occur saponins, alkaloids, flavones, flavanonóis and xanthones, tannins and phenols, catechins, depsides, depsidonas and coumarins and steroids, triterpenoids and azulenes that are promising for pharmacological studies and support for public policies to promote the therapeutic indications of plants widely used in folk medicine.

Allelopathy can be defined as positive or negative interference of secondary metabolic compounds produced by a plant (allelochemicals) and released in the middle. Interference on the growth of another plant can be indirect, by transforming these substances into the soil by microorganism activity (Inderjit et al., 2011).

In recent years, emphasis has been especially search tree species, in order to verify allelopathic effects with potential species to compose and agroforestry silvipastoral systems (Zhang, 1993; Inderjit et al., 2011). This study may be useful in the search for natural phytotoxins and synthetic derivatives to be used as natural herbicides because they can be more specific in their action and less harmful to the environment (Chou, 1999; Inderjit et al., 2011), minimizing environmental impact without compromising the quality of resources, wildlife and the quality of food used in the human diet.

The objective of this study was to evaluate the allelopathic potential *Siparuna guianensis* leaves on the germination and seedling development of *Lactuca sativa* L.

MATERIAL AND METHODS

The experiment was conducted in Seed Laboratory the Faculty of Agronomy and Animal Science (FAMEVZ) of the Federal University of Mato Grosso (UFMT) Campus Cuiabá. Leaves *Siparuna guianensis* were collected from adults in Chapada dos Guimarães (MT) between the geographic coordinates 15º10'-15º30' South latitude and 55º40'-56º00 West longitude. The climate is Aw (savanna climate) according to Köppen classification.

The leaves were placed for 5 min in containers containing 10 mL of sodium hypochlorite diluted in 500 mL of distilled water so that they were cleaned, then rinsed in tap water and dried with a paper towel. The leavess were ground in a blender at a ratio of 50g leaves/500mL of distilled water. The extract was filtered on filter paper and stored in glass ballon.

For bioassay of germination was used completely randomized design with five treatments consist of the concentrations of the leaf extract obtained by diluting in distilled water (0 - control, 25, 50, 75 and 100%), with four replications of 50 lettuce seeds.

ISSN: 2455-6939

Volume:03, Issue:01

The pH determination was made pH meter and the electrical conductivity (EC) were measured by conductivity. From the EC values determined the osmotic potential (OP) according to the formula proposed by Ayers and Westcot (1999): osmotic potential in the atmosphere (ATM) = -0.36 * CE. The data were transformed to ATM (MPa).

The seeds were placed in transparent plastic boxes gerbox (11x11x3 cm) on two sheets of blotting paper moistened with their treatment, in the amount of 2.5 times the mass of the substrate. The boxes were covered and sealed with plastic wrap and kept in BOD incubator at 30 °C during the day and 20 °C overnight in a photoperiod of 12 hours for seven days.

Every 24 hours was noted the number of germinated seeds. The criterion to assess the germination of the seeds was based on the physiological germination concept cited by Marcos Filho (2015), which describes the beginning of germination to seed soaking and its end with the protrusion of the radicle. Seven days after treatment application, lettuce seeds were evaluated as to the length of the shoot: root transition region to the insertion of the cotyledons and root length: transition region of the shoot to the apex of the root. The fresh weight was obtained in semianalitica balance and the dry weight was obtained after drying the seedlings in a greenhouse at 80 °C for 24h to give the amount in grams in semianalítica scale (ISTA, 2006).

The seedlings were classified as normal or abnormal according to the specifications of Brasil, (2009). Were considered abnormal those who have shown potential to continue its development, and normal seedlings with minor defects as limited or minor damage, growth retardation in the root system. So were considered abnormal, the seedlings with root systems or rotten air, absent totally atrophied.

The germination rate was determined according to Maguire (1962) calculated by the expression: IVG = (G1/N1) + (G2/N2) + ... + (Gn/Nn), where: G1 = number of germinated seeds in the first count N1 = number of days until the first count, G2 = number of seeds germinated in the second count, N2 = number of days until the second count n = last count.

The allelopathic effect index suggested by Williamson and Richardson was calculated according to the formula: RI = 1 - C/T ($T \geq C$) or RI = T/C - 1 ($T < C$) Where: C = speed of germination control (0%), T = speed of germination treatment (Gao et al., 2009).

The variables were subjected to analysis of variance and regression when significant models were selected with higher R^2.

ISSN: 2455-6939

Volume:03, Issue:01

RESULTS AND DISCUSSION

The physicochemical characteristics presented by the extracts of leaves *Siparuna guianensis* in different concentrations are shown in Table 1. It is observed pH range compared to the control, with acidity in the extracts, but remained within acceptable standards for germination and seedling growth allelopathic tests.

Table 1. Physical and chemical characteristics of aqueous extracts of leaves of *Siparuna guianensis*. UFMT, Cuiabá, MT. 2015.

Extract concentration	pH	Osmotic potential (MPa)
0%	7.60	-0.0002918
25%	5.27	-0.0107234
50%	5.29	-0.0205714
75%	5.28	-0.0299453
100%	5.37	-0.0386626

Results in the literature indicate that both the germination and growth of seedlings are affected when the pH is extremely alkaline or extremely acid with deleterious effects observed in pH conditions below 4 and greater than 10 (Eberlein, 1987), for Mayeux and Scifres (1978), pH testing allelopathic effects are caused by pH below 3 and above 11.

As for the osmotic potential, the values were lower than -0.2 MPa and therefore not responsible for possible changes in germination behavior of lettuce, for according Gatti et al. (2004), osmotic potential values must not exceed -0.2 MPa in allelopathic tests.

It is important to analyze the pH and the osmotic potential of the extracts, as these may contain solutes such as sugars, amino acids and organic acids which can mask the allelopathic effect and being osmotically active (Ferreira and Aquila, 2000).

There was no difference in the percentage of lettuce germination ranging from 98.6 to 100%, but other characteristics were affected by extract concentrations (Figure 1). According to Ferreira and Borghetti (2004), often the allelopathic effect does not occur by reducing the germination (final germination percentage), but on the germination rate.

ISSN: 2455-6939

Volume:03, Issue:01

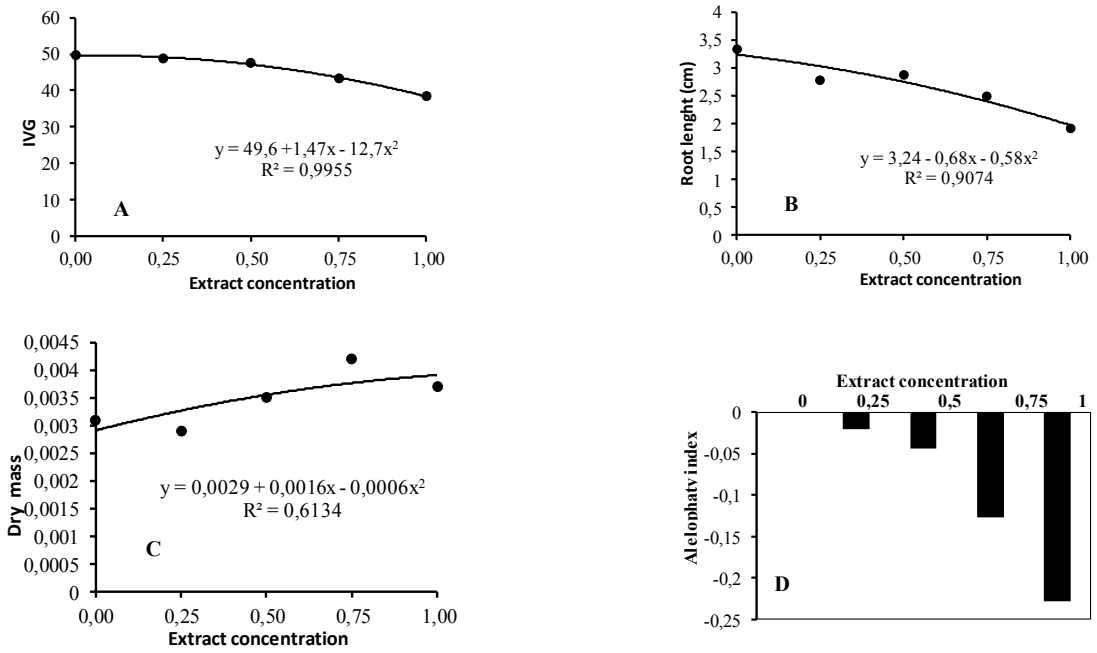

Figure 1. Germination Speed Index (A), root length (B), dry mass of seedlings (C) and allelopathic index (D) of lettuce in different concentrations of *Siparuna guianensis* extract. UFMT, Cuiabá, MT. 2015.

The variation in the germination rate (Figure 1A) and root length (Figure 1B) of the seedlings can be explained by polynomial models of second-degree regression with R^2 above 90%. The values decreased proportionally with increasing concentration.

Results similar to those observed in IVG were found by other authors. Candido et al. (2010) evaluated the allelopathic potential of *Senna occidentalis* (L.) and observed significant reduction in germination rate (IVG) on seeds of lettuce and tomato when it increased the concentration of the extract. Tur et al. (2010) found a significant reduction IVG with increasing concentration of the extract of fresh and dried leaves of *Duranta repens* L. on lettuce.

Borella et al. (2011a) tested the allelopathic effect of nightshade (*Solanum americanum* Mill.) On radish seed germination (*Raphanus sativus* L.) and found that all the aqueous extracts of nightshade reduced the average number of seeds germinated a day. Reducing the speed of germination index shows reduction of seed vigor of expression, due to the toxic effect of the extract.

ISSN: 2455-6939

Volume:03, Issue:01

As the dry mass of the seedling (Figure 1C) it was favorable effect of the extracts and the highest concentrations dry mass was higher than the control. Similar results were obtained by Pelegrini and Cruz-Silva (2012), where the extracts obtained by infusion of leaves of *Coleus barbatus* (A.) Benth. stimulated the growth of the aerial part of lettuce. Since the allelopathic effect index (Figure 1 E), which indicates the interference on the speed of germination, had negative values in proportion to the increase in the extract concentration.

The allelopathic effect index (RI) indicates stimulus when it presents positive values in the control and negative values indicate inhibition. In the data presented (Figure 1D) may be noted that the negative allelopathic effect was proportional to the concentration of the extract, the higher the concentration inhibition. Borella et al. (2011b) found that *Schinus* extracts caused inhibitory effects on germination of radish proportional to concentration.

CONCLUSIONS

The pH and osmotic potential remained within acceptable standards for the germination and initial growth of lettuce, suggesting that the presence of compounds in the extracts have caused the observed effects. The leaf extract *Siparuna guianensis* at different concentrations did not affect the lettuce seed germination and the allelopathic potential was seen in developmental characteristics of lettuce seedlings as the germination rate, dry mass and root length.

REFERENCES

Ayers, R.S.; Westcot, D.W. (1999). *Water quality for agriculture*. Roma: FAO, 97p. (FAO. Irrigation and Drainage Peper, 29).

Bach, F.T.; Silva, C.A.T. (2010). Efeito alelopático de extrato aquoso de boldo e picão-preto sobre a germinação e desenvolvimento de plântulas de alface. *Revista Cultivando o Sab***er**, v.3, n.2, p.190-198.

Beserra, F.P.; Carvalho, R.H.A.; Campos, S.L.; Borges, J.C.M.; Fagundes, R.; Pereira, M.A.B.; Bessa, N.G.F. (2011). Prospecção fitoquímica das folhas de *Siparuna guianensis* Aublet. (Siparunaceae) de uso popular medicinal em reassentamento rural, Tocantins. *Cadernos de Agroecologia,* v.6, n.2, p.1-5.

Borella, J.; Martinazzo, E.G.; Aumonde, T.Z. (2011a) Atividade alelopática de extratos de folhas de *Schinus molle* L. sobre a germinação e o crescimento inicial do rabanete. *Revista Brasileira de Biociencias,* v.9, n.3, p.398-404.

ISSN: 2455-6939

Volume:03, Issue:01

Borella, J.; Wandscheer, A.C.D.; Pastorini, L.H. (2011b). Potencial alelopático de extratos aquosos de frutos de *Solanum americanum* Mill. sobre as sementes de rabanete. *Revista Brasileira de Ciências Agrárias,* v.6, n.2, p.309-313.

Brasil. Ministério da Agricultura e Reforma Agrária. (2009). *Regras Para Análise de Sementes,* Brasília: SNAD/CLAV, 395p.

Candido, A.C.S.; Schmidt, V.; Laura, V.A.; Faccenda, O.; Hess, S.C.; Simionatto, E.; Peres, M.T.L.P. (2010). Potencial alelopático da parte aérea de *Senna occidentalis* (L.) Link (Fabaceae, Caesalpinioideae): bioensaios em laboratório. *Acta Botânica Brasílica,* v.24, n.1, p.235-242.

CHOU, C.H. (1999). Roles of allelopathy in plant biodiversity and sustainable agriculture. *Critical Reviews in Plant Sciences,* v.18, n.5, p.609-630.

Duarte, T.G. (2001). *Um estudo etnoecológico sobre o uso de recursos vegetais em Nova Xavantina, Mato Grosso*. 135p. Dissertação (Mestrado - Área de Concentração Ecologia e Conservação da Biodiversidade) - Departamento de Botânica e Ecologia, Universidade Federal de Mato Grosso, Cuiabá.

Eberlein, C.V. (1987). Germination of *Sorghum almum* seeds and longevity in soil. **Weed Science**, v.35, n.6, p.796-801.

Ferreira, A.G.; Aquila, M.E.A. (2000). Alelopatia: uma área emergente da ecofisiologia. *Revista Brasileira de Fisiologia Vegetal*, v.12, n. Edição Especial, p.175-204.

Ferreira, A.G.; Borghetti, F. (2005). *Germinação: do básico ao aplicado*. Porto Alegre: Artmed, 323p.

Gao, X.; Li, M.; Gao, Z.; Li, C.; Sun, Z. (2009). Allelopathic effects of Hemistepta lyrata on the germination and growth of wheat, sorghum, cucumber, rape, and radish seeds. *Weed Biology and Management,* v.9, n.3, p.243-249.

Gatti, A.B.; Perez, S. C. J. G.; Lima, M.I.S. (2004). Efeito alelopático de *Aristolochia esperanzae* O. Kuntze na germinação e no crescimento de *Lactuca sativa* L. e *Raphanus sativus* L. *Acta Botânica Brasílica,* v.8, p.459-472.

Gobbo-Neto, L.; Lopes, N.P. (2007). Plantas medicinais: fatores de influência no conteúdo de metabólitos secundários. *Química Nova,* v.30, n.2, p.374-381.

ISSN: 2455-6939

Volume:03, Issue:01

Inderjit, K.; Wardle, D.A.; Karban, R.; Callaway, R.M. (2011). The ecosystem and evolutionary contexts of allelopathy. *Trends Ecology & Evolution*, v.1442, p.1-8.

ISTA - International Seed Testing Association. (2006). International rules for testing seeds. *Seed Science and Technology,* v.32, p.403.

Maguire, J.A. (1962). Speed of germination: aid in selection and evaluation for seedling emergence and vigor. *Crop Science*, v.2, p. 176-177.

Marcos Filho, J. (2015). *Fisiologia de sementes de plantas cultivadas*. Londrina: ABRATES, 659p.

Mayeux, H.S.; Scifres, C.J. (1978). Germination of goldenweed seed. *Journal of Range Management,* v.31, n.5, p.371-374.

Pasa, M.C. (1999). *A utilização dos recursos vegetais no Vale do Aricá, Mato Grosso: um estudo etnoecológico.* 150p. Dissertação (Mestrado - Área de Concentração Ecologia e Conservação da Biodiversidade) – Departamento de Botânica e Ecologia, Universidade Federal de Mato Grosso, Cuiabá.

Pelegrini, L.L.; Cruz-Silva, C.T.A. (2012). Variação sazonal na alelopatia de extratos aquosos de *Coleus barbatus* (A.) Benth. sobre a germinação e o desenvolvimento de *Lactuca sativa* L. *Revista Brasileira de Plantas Medicinais,* v.14, n.2, p.376-382.

Renner, S.S.; Hausner, G. (2005). *Monograph of Siparunaceae*, Flora Neotropica, v.95, 256p.

Tur, C.M.; Borella, J.; Pastorini, L.H. (2010). Alelopatia de extratos aquosos de *Duranta repens* sobre a germinação e crescimento inicial de *Lactuca sativa* e *Lycopersicum esculentum*. *Revista Biotemas,* v.2, n.23, p.13-22.

Valentini, C.M.A.; Rodríguez-Ortíz, C.E.; Coelho, M.F.B. (2010). *Siparuna guianensis* Aublet (negramina): uma revisão. *Revista Brasileira de Plantas Medicinais*, v.12, n.1, p.96-104.

Zhang, Q. (1993). Potential role of allelopathy in the soil and the decomposition root of chinese-fir replant woodland. *Plant and Soil,* v.151, n.2, p.205-209.

