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Research Paper

ALLELOPATHIC ACTIVITY OF *Caesalpinia ferrea* MART. LEAF EXTRACT

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Abstract

The study aimed to evaluate the allelopathic potential of *Caesalpinia ferrea* Mart leaves. on growth and early development of corn (*Zea mays* L.), melon (*Cucumismelo* L.) and cowpea (*Vigna unguiculata*Walp.). The experiment was conducted at the Seed Analysis Laboratory, UFERSA from November 2011 to June 2012. The crude extract dilutions were the treatments (1.0%, 0.5%, 0.25%, 0.125% and 0% control) in a randomized design with four replications of twenty seeds. The possible allelopathic effects were observed in the percentage of features and emergency speed index, percentage of normal and abnormal seedlings, dry weight, shoot length and root. The melon was the most sensitive culture to the activity of the leaf extract of *Caesalpinia ferrea*, while corn appeared indifferent to the activity of this extract in all traits.

Key words: Allelopathy, *Caesalpinia ferrea* Mart. *Zea mays*, *Cucumismelo*, *Vigna unguiculata*.

INTRODUCTION

Allelopathy is a science that studies the processes arising from substances released by plants and microorganisms responsible for the impaired growth and development of the biological system of the target species [1]. Studies of secondary metabolites of the plants were initiated by organic chemists of the nineteenth and early twentieth century, interested in these substances for their importance as medicinal drugs, poisons, flavoring, industrial materials and ecological functions [2].

The allelopathic effects are seen by researchers as a promising alternative, both in the economic as ecological, such as contributing to the search for new pesticides, understand the antagonism of intercropping or crop rotation, continually reduce the use of synthetic herbicides, replacing them with natural herbicides [3].

For this reason, scholars have aroused his attention, increasingly, in the search for new species that express this feature, as its importance to the successful implementation of agrosilvipastoris systems [4] as well as its use in the synthesis new bioenseticidas, vegetable compounds that arise as a promising, efficient and environmentally safe strategy to reduce the pest population [5].

There is evidence in the literature inhibitory potential of savanna species on the germination, growth and development of seedlings tests: [4] tested aqueous extract of *Croton sonderianus*

Mull Arg. and *Mimosa tenuiflora*Willd., [6] studied the allelopathic effects of different organs of *Erythrinavelutina*Willd., [7] studied the effects of aqueous extracts of different organs of *Amburanacearenses*; [8] evaluated the allelopathic activity of *Ziziphusjoazeiro* Mart. seed extracts.

Caesalpinia ferrea Mart ex Tul. belongs to the Fabaceae-Caesalpinoidae family, is easily recognizable because of the presence of light spots on the trunk, small leaflets, yellow flowers, vegetables smooth, hard and aromatics [9]. It has great medicinal and ornamental potential, and its wood is used in construction and carpentry [10].

The effect of different organ extracts of *Caesalpinia ferrea* was studied on the germination of lettuce and concluded that leaf extracts, bark and mature pods had allelopathic activity on the development of seedlings of the test species [11].

This result served as inspiration for the research focus that aimed to evaluate the allelopathic potential *Caesalpinia ferrea* leaves on growth and early development of corn (*Zea mays* L.), melon (*Cucumismelo* L.) and cowpea (*Vigna unguiculata*Walp.).

MATERIALS AND METHODS

The experiment was conducted in the Department of Plant Sciences of the Seed Analysis Laboratory, Federal Rural University of the Semi-Arid (UFERSA) in Mossoro, from November 2011 to June 2012. The material used as test species were seed hybrid maize (*Zea mays* L.), melon (*Cucumismelo* L.) and beans (*Vigna unguiculata* L.). In the production of extracts used up leaves of *Caesalpinia ferrea* collected from adult trees in the city of Mossoro.

Initially a 70% concentration was prepared (70% ethanol and 30% distilled water) with 115g leaves of *Caesalpinia ferrea*. The sheets underwent four extractions. Each extraction, the material was filtered, the liquid part being placed for evaporation, resulting in a slurry. To prepare the crude extract weighed 15g and the slurry was added 1500 ml of water resulting in a concentration of 1%.

After that, the extracts were taken to the soil laboratory (UFERSA), which was determined its pH, electrical conductivity (CE-MS) and was later determined from the EC values, the osmotic potential of the extracts by the formula proposed by [12]. After that, the crude extracts were stored in the refrigerator until the time of installation of bioassays.

It is known that different concentration levels produce different responses in the morphology and physiology of plants. For this reason, the research in question sought in the literature methods to present the closest the natural conditions dosages. Hence it selected five concentrations (1%, 0.5%, 0.25 %%, 0.125% and 0% (control)), and the dilutions were derived from the higher concentration.

The experimental design was completely randomized with four replications with 20 seeds. The leaf extracts of *Caesalpinia ferrea* in five concentrations (1%, 0.5%, 0.25%, 0.125% and 0%) was an experiment where it was tested the possible allelopathic thereof in the growth and development of target species (corn, melons and beans). Therefore, the work consisted of three experiments (E_1, E_2, E_3*Caesalpinia ferrea* leaves-extracts on corn, melons and beans respectively) in five concentrations. Each plot was made up of plastic box (depth 17 cm, width 9.5 cm and height 4.3 cm), sterilized with alcohol, containing 400g of washed and sterilized sand. Each experimental unit was moistened with 50 ml of extract, made up circular holes (1 cm) deep (6.5 cm), which evenly distributed the 20 seeds. The plastic boxes were placed in germination at 25 ° C and a photoperiod of 24 h for eight days.

It is considered the emergency start of seedlings with the issuance coleoptile (corn) and cotyledons (beans and melon). The counting of emerged seeds was daily. Evaluations of seedlings occurred on the eighth day after sowing, classifying them into normal or abnormal, according to criteria described in [13]. To determine dry weight of normal seedlings, was used air circulation oven forced under an average temperature of 65 °C for a period of 24h. The variables included emergence percentage, percentage of normal and abnormal seedlings, root length and shoot. The emergence speed index (GSI) was calculated according to [14] by the formula $IVG = G_1/G_2 + N_1/N_2 + ... + G_n/N_n$; wherein: G_1, G_2, G_n= number of germinated seeds

computed in the first, second and last count; and N_1, N_2, N_n = number of days from sowing to first, second and last count.
Analysis of variance was performed by the statistical program SISVAR [15] and the averages compared by Tukey test at 5% probability.

RESULTS AND DISCUSSION

The different types of statements are within the normal osmotic potential (0 to -0.09) and pH (4.7 to 6.7) and therefore not these factors account for possible changes in the germinative behavior lettuce (Table 1).
Under normal conditions, the pH should be between four and seven and osmotic potential (MPa) below -0.2 [16]. The osmotic potential extracts involving germination values not exceeding 0.2 MPa, for the extracts can present certain solutes which alter the property of water, resulting in an osmotic pressure different from zero in the solution [17].

Table 1. Physical and chemical characteristics of aqueous leaf extract (*Caesalpinia ferrea* Mart). PO (osmotic potential).

Concentration (%)	pH	PO (Mpa)
1	4.66	- 0.03866
0.5	4.77	- 0.02043
0.25	4.77	- 0.01131
0.125	5.7	-0.00657
0	5.11	0

The speed of germination rate and percentage of emergence of corn, melons and beans were not affected by the extracts, affecting more intensely the other characteristics of maize (Table 2). The length of the shoots of beans was lower in concentration of 0.25%. [18] observed a reduction in the percentage of germination of beans when evaluating the allelopathic effect of the extract of *Eucalyptus grandis* leaves. [19]achieved the same kind of response when evaluating the allelopathic effects of plant extracts of millet pine leaves and velvet bean on germination and early growth of corn and beans.

Table 2. Average of emergency percentage (PE), emergency speed index (IVE), abnormal (PAN), dry matter (DM), shoot length (CPA), length root (CR) of corn (*Zea mays* L.), melon (*Cucumesmelo* L.) and beans (*Vigna unguiculata* (L) Walp) submitted to aqueous extract leaves of *Caesalpinia ferrea* Mart. at different concentrations. Mossoró, RN, Brazil. 2013.

Concentraction (%)	PE	IVE	PAN	DM (g)	CPA (cm)	CR (cm)
			Maiz			
1	92.50 a	4.38 a	1.25(0.80)[1]a	1.83 a	12.34 a	16.11 a
0.5	97.50 a	4.74 a	2.50(0.82) a	1.92 a	12.10 a	17.37 a
0.25	96.25 a	4.86 a	0.00(0.79) a	1.84 a	12.13 a	17.77 a
0.125	95.00 a	4.86 a	0.00(0.79) a	1.93a	13.48 a	18.27 a
0	97.50 a	4.94 a	0.00(0.79) a	1.98 a	12.96 a	18.14 a
LSD[2]	7.85	0.61	(0.04)	0.46	1.46	2.41
			Melon			
1	100.00 a	4.10 a	11.25(0.91)[1]a	0.48 a	14.78 a	12.42 ab
0.5	97.50 a	4.14 a	13.75(0.93) a	0.447 a	12.92 b	13.13 ab
0.25	98. 75 a	4.41 a	8.75(0.88) a	0.48 a	11.28 c	12.28 b
0.125	97. 50 a	4.11 a	10.00(0.89) a	0. 41 a	11.93 c	12.21 b
0	98.75 a	4.18 a	5.00(0.84) a	0.45 a	13.47 b	13.94 a
LSD[2]	5.28	0.36	(0.14)	0.2	0.98	1.58

			Bean			
1	93.75 a	2.88 a	15.00(0.94)[1] a	1.11 a	23.42 a	15.55 a
0.5	95.00 a	2.80 a	17.50(0.97) a	1.18a	23.42 a	15.93 a
0.25	97. 50 a	3.23 a	8.75(0.88) a	1.30 a	20.51 b	15.66 a
0.125	93. 75 a	3.08 a	8.75(0.88) a	1.25 a	21.66 ab	16.38 a
0	91.25 a	3.06 a	7.50(0.87) a	1.21 a	22.29 ab	16.55 a
LSD[2]	12.99	0.52	(0.19)	0.4	2.02	2.37

Means followed by the same letter in the columns do not differ by Tukey test at 5% significance level. [1]The figures in brackets in the PAN column correspond to the averages of the original data transformed into arcsin $\sqrt{(x/100)+0.5}$. LSD = least significant difference.

The percentage of abnormal seedlings was very low in maize, melon and beans but had values above 10% at the highest concentrations of leaf extracts of *Caesalpinia ferrea*. These seedlings showed the absence of the absorbent at the root, root necrosis, darkening and hardening of the root apex and deformed roots.

The hardening and darkening of the root tips are evidence of morphological and anatomical changes caused by phytotoxins [20]. Several authors also noted these effects in lettuce seeds, such as, [6] with velutina*Erytrinavelutina* extracts, [21] with aqueous extracts of *Ziziphusjoazeiro* seeds, [22] with aqueous extracts of *Mimosa tenuiflora* seeds and [23] with *Mimosa tenuiflora* extracts of bark.

As in other studies, the research in question found a more pronounced allelopathic effect on the early development of seedlings than on germination [24]. In trials with soybean germination and other crops on aqueous wheat and oat extracts effect did not cause interference in the germination of the species tested, but provided a reduction in root length and shoot seedling possibly due to the allelopathic effects [25].

CONCLUSION

The extract of leaves of *Caesalpinia ferrea* the highest concentrations affected the development of shoots melon and beans. Corn appeared indifferent to the activity of this extract in all traits.

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