

Allelopathic Effect of Extracts of Pomegranate (*Punica granatum*), Eucalyptus (*Eucalyptus spp.*) and Noni (*Morinda citrifolia*) on Germination and Development of Lettuce Seeds (*Lactuca sativa*), Tomato (*Solanum lycopersicum*) and Pepper (*Capsicum baccatum*)

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Abstract

The germination tests were carried out in the presence of extracts of the fruit of pomegranate (*Punica granatum*), noni (*Morinda citrifolia*) and leaves of eucalyptus (*Eucalyptus spp.*), with commercial seeds of lettuce (*Lactuca sativa*), tomato (*Solanum lycopersicum*) and pepper (*Capsicum baccatum*). The extracts were extracted and applied inside the Petri plates with filter paper base with the seeds already distributed in the plates. The seeds of all the germinated crops in the presence of the extract of the Noni fruit caused an accelerated germination and a greater development compared to the control. As the extracts of pomegranate and eucalyptus retracted the germination and delayed its development compared to Noni extract, all followed by a water check.

Keywords: Productive performance; Vegetables; Inhibitory effect

Introduction

Allelopathy is defined as the inhibitory or beneficial effect, direct or indirect of one plant on the other [1]. This phenomenon occurs in natural plant communities [2]. These substances can be produced by any part of the plant, such as root and shoot exudates, seeds in full germination process, and also in the residues of certain plants during the process of straw decomposition [3]. The Eucalyptus (*Eucalyptus spp.*) belongs to the family Myrtaceae, has its origin in Australia. From the leaves, essential oils used in cleaning products, foodstuffs, perfumes, and medicines are extracted [4], the stem is used for the extraction of cellulose, to be used in the paper industry [5]. Several species of Eucalyptus are cultivated in several parts of the world and exploited on a large scale for many years, and in Brazil, it is found in all regions [5,6] Pomegranate (*Punica granatum L.*) belongs to the family Punicaceae, native to the region from Iran to the Himalayas, northwest of India. It is a species of multiple uses, its fruits being harvested from the bark and the pulp, for pharmaceutical and commercial purposes [7]. In addition, it has been used in the treatment of various health problems such as gastrointestinal problems, relief of intestinal pain, dyspepsia, dysentery, pharyngitis, and others. Noni (*Morinda citrifolia*) belongs to the Rubiaceae family and is a fruit from Southeast Asia that was recently introduced in Brazil as a raw material with strong commercial appeal due to all the beneficial characteristics attributed to it and the benefits related to its consumption. The fruit of the noni is ovoid, juicy and has several triangular seeds of red coloring. Nowadays noni juice made with grapes is widely used and studies show that it has anti-inflammatory properties, helps in fighting cancer, increases the immune system among others [8]. The lettuce (*Lactuca sativa*) belongs to the family Asteraceae is an herbaceous plant, belonging to the family of Cichoriaceae [9,10]. Typical vegetable salad, considered as a plant with tranquilizing properties and which, due to the fact of being consumed raw, retains all its nutritional properties. According to Maroto-Borrego [11] and Camargo [12] it is an excellent source of vitamin A, with vitamins B1, B2, B5, and C, as well as Ca, Fe, Mg, P, K and Na minerals. according to the cultivar [13]. Tomato (*Solanum lycopersicum*) belongs to the Solanaceae family, the fruit is fleshy and succulent berry type, with a variable aspect, depending on the cultivar. Most are red when ripe,

with the exception of Japanese salad-type cultivars with pink fruits. The average unit weight of the fruit varies from less than 25 g (cherry type) to more than 300 g, in large fruit cultivars, type salad [14,15]. The Pepper (*Capsicum baccatum*) belongs to the family Solanaceae, originating in the Americas adapts very well to the hot climates. It is sensitive to low temperatures and does not tolerate frost. It is described as a functional food based on its antioxidant, anti-inflammatory, antimutagenic and chemopreventive properties of capsaicin. The diversity of beneficial properties present in peppers and their great application in cooking, food industry, pharmacology, dentistry and medicine, among others, indicate the great socioeconomic importance of the cultivation of this vegetable for the agribusiness [16]. The objective of this study was to evaluate the allelopathic effects of pomegranate (*Punica granatum*), noni (*Morinda citrifolia*) and *Eucalyptus spp.* Leaves on lettuce (*Lactuca sativa*), tomato (*Solanum lycopersicum*) and pepper (*Capsicum baccatum*), in different concentrations of extracts for each culture, analyzing the germination time at room temperature, percentage of germination and aerial and root development in size.

Materials and Methods

The present work was carried out in the Center of Didactic Laboratories of the University Center of the North Paulista (Unorp), in São José do Rio Preto - SP, from February to April 2018. Eucalyptus leaves, lettuce seeds, pepper, noni and pome fruits in the municipality of Adolfo and Catanduva/SP. The fruits of pomegranate (*Punica*

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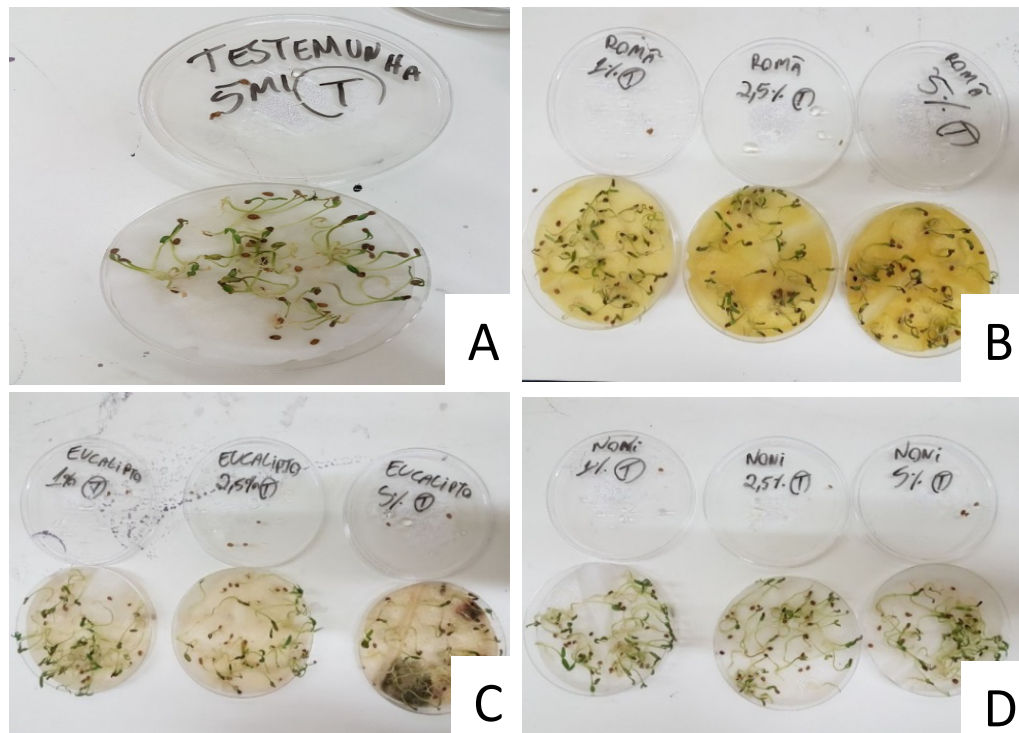


Figure 1: Tomato germination (*Solanum lycopersicum*) on the twentieth day after application of extracts and Witness. A-Witness; B-Pomegranate extracts; C-Eucalyptus extracts and D-Noni extracts.

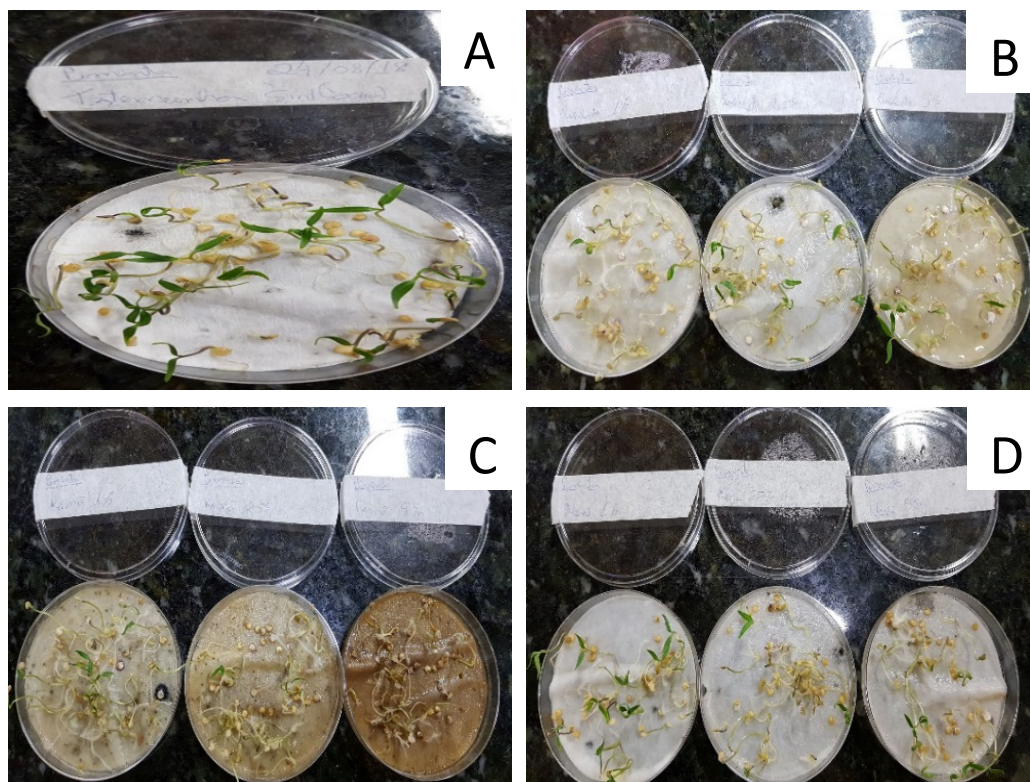


Figure 2: Pepper germination (*Capsicum baccatum*) on the twentieth day after application of extracts and Witness. A-Witness; B-Eucalyptus extracts; C-Pomegranate extracts and D-Noni extracts.

granatum), noni (*Morinda citrifolia*) and eucalyptus (*Eucalyptus spp.*) Were harvested on the same day of processing to extract the extract. In the laboratory, the leaves of eucalyptus, noni fruit, and pomegranate fruit were weighed 10g portions each, were macerated separately with the aid of a mortar and pestle, and 50 mL of distilled water was added to the extract of 20.0%, the residues were eliminated with a sieve, leaving only the extract. Fifty seeds of *L. sativa*, *S. lycopersicum* and *C. baccatum* were distributed. In Petri plate lined with filter paper. The seeds were arranged so that there was room for them to develop. Two replicates of each culture were made for each extract. 1.0% 0.25 mL of extract was added to 4.75 mL of water, while the concentration of 2.5% was added 0.63 mL of extract to 4.37 mL, at the concentration of 5.0% added - if 1.25 mL of extract to 3.75 mL of distilled water, placing, therefore, 5.0 mL of each extract per plate, with the aid of a Pasteur pipette. After the extracts were added into the Petri plate, they were closed and identified according to the culture and percentage

of extracts (Table 1) for cultivation at room temperature and a photoperiod of 12 hours/day for 20 days. Distilled water was used daily to maintain moisture inside the Petri plate. After the period of the administration of the extracts, the germinated seed counts were carried out. The seedlings were removed from the plate to make all size measurements of the aerial part and the root system with the aid of a ruler. At the end of the Petri plate culture, the test was carried out in germination trays for seedlings with the substrate. It was used seeds of lettuce (*Lactuca sativa*), tomato (*Solanum lycopersicum*) and pepper (*Capsicum baccatum*), and applying the same extracts, pomegranate (*Punica granatum*), noni (*Morinda citrifolia*) and *Eucalyptus spp.* But in only one concentration only the concentration of 5.0%. Since they were not immersed, they were only pulverized, it was decided to use the highest concentration being 5.0%. The cells of the trays were divided for each culture type of a control for each extract, the base for culture was the substrate moistened with the extracts and sprayed twice a day

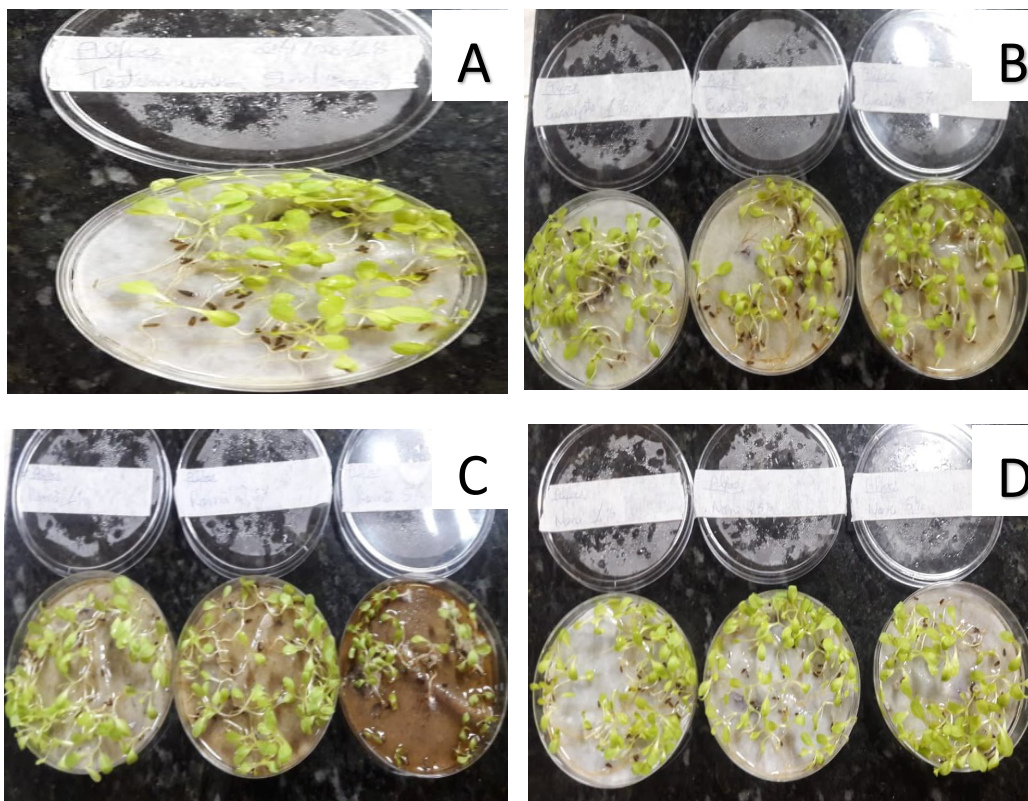


Figure 3: Germination of lettuce (*Capsicum baccatum*) on the twentieth day after application of extracts and Witness. A-Witness; B-Eucalyptus extracts; C-Pomegranate extracts and D-Noni extracts.



Figure 4: Germination trays of lettuce (*Lactuca sativa*), tomato (*Solanum lycopersicum*) and pepper (*Capsicum baccatum*) after 30 days of administration of pomegranate (*Punica granatum*), noni (*Morinda citrifolia*) and *Eucalyptus spp.*

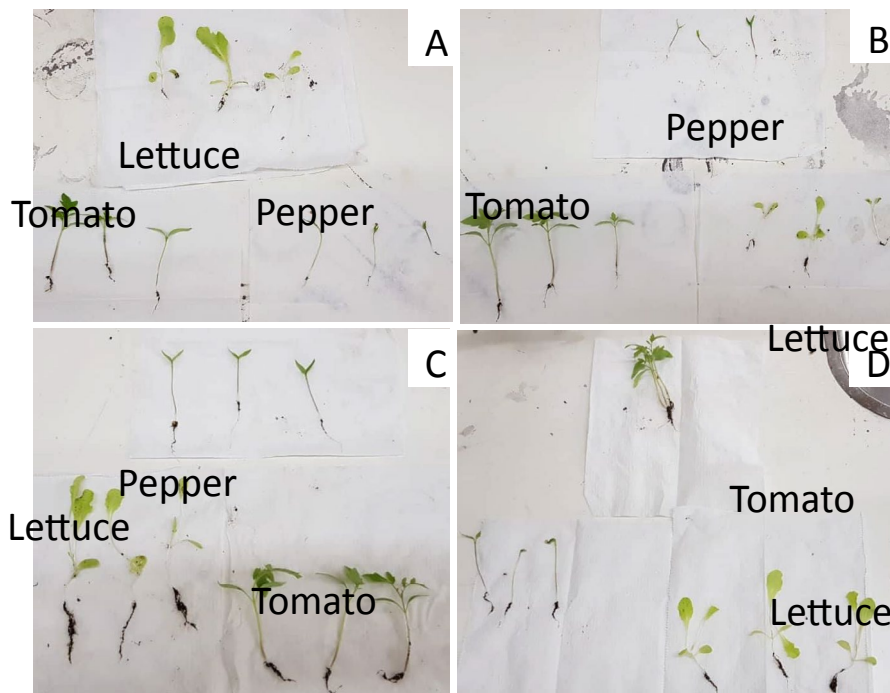


Figure 5: Comparison of seedlings of lettuce (*Lactuca sativa*), tomato (*Solanum lycopersicum*) and pepper (*Capsicum baccatum*) after 30 days of exposure to the extracts in relation to Witness. A-Extract of pomegranate (*Punica granatum*). B-Eucalyptus extract (*Eucalyptus spp.*). C-Noni extract (*Morinda citrifolia*). D-Witness.

Lettuce	Tomato	Pepper
Witness	Witness	Witness
Noni 1.0%	Noni 1.0%	Noni 1.0%
Noni 2.5%	Noni 2.5%	Noni 2.5%
Noni 5.0%	Noni 5.0%	Noni 5.0%
Eucalyptus 1.0%	Eucalyptus 1.0%	Eucalyptus 1.0%
Eucalyptus 2.5%	Eucalyptus 2.5%	Eucalyptus 2.5%
Eucalyptus 5.0%	Eucalyptus 5.0%	Eucalyptus 5.0%
Pomegranate 1.0%	Pomegranate 1.0%	Pomegranate 1.0%
Pomegranate 2.5%	Pomegranate 2.5%	Pomegranate 2.5%
Pomegranate 5.0%	Pomegranate 5.0%	Pomegranate 5.0%

Table 1: Treatments used in the experiment.

Extract	0.0%	1.0%	2.5%	5.0%
Pomegranate	34	34	33	36
Eucalyptus	34	33	31	30
Noni	34	33	37	42

Table 2: Count of lettuce (*Lactuca sativa*) seedlings germinated on the twentieth day, after sowing in petri plate, containing fifty seeds on each plate.

Extract	0.0%	1.0%	2.5%	5.0%
Pomegranate	36	40	34	36
Eucalyptus	36	28	37	35
Noni	36	39	40	39

Table 3: Count of tomato (*Solanum lycopersicum*) seedlings germinated on the twentieth day, after sowing in petri plate.

Extract	0.0%	1.0%	2.5%	5.0%
Pomegranate	25	16	18	19
Eucalyptus	25	33	30	18
Noni	25	20	18	19

Table 4: Count of pepper seedlings (*Capsicum baccatum*) germinated on the twentieth day, after sowing in petri plate. Containing fifty seeds on each plate.

Concentration	Pomegranate		Eucalyptus		Noni	
	AAD	RMD	AAD	RMD	AAD	RMD
0.0%	16.4	11.8	16.4	11.8	16.4	11.8
1.0%	13.8	7.8	16.2	12.0	21.8	22.4
2.5%	15.2	12.0	17.2	12.6	22.2	16.0
5.0%	14.2	11.0	17.8	14.8	19.6	17.2

Table 5: Average aerial development (AAD) and root mean development (RMD) of lettuce (*Lactuca sativa*) culture.

Concentration	Pomegranate		Eucalyptus		Noni	
	AAD	RMD	AAD	RMD	AAD	RMD
0.0%	17.4	3.6	17.4	3.6	17.4	3.6
1.0%	23.1	8.8	24.6	11.8	29.2	14.2
2.5%	24.4	6.6	19.8	8.8	28.2	11.4
5.0%	20.6	6.0	26.2	6.4	30.6	14.2

Table 6: Average aerial development (AAD) and root mean development (RMD) of Tomato culture (*Solanum lycopersicum*).

Concentration	Pomegranate		Eucalyptus		Noni	
	AAD	RMD	AAD	RMD	AAD	RMD
0.0%	22.4	4.8	22.4	4.8	22.4	4.8
1.0%	14.2	10.0	18.6	3.6	16.2	6.2
2.5%	16.2	9.8	18.8	4.8	20.4	9.8
5.0%	15.4	9.8	15.6	3.2	19.8	8.8

Table 7: Average aerial development (AAD) and root mean development (RMD) of pepper culture (*Capsicum baccatum*).

for 30 days, after the 30 days were analyzed aerial part and root system of crops, with the aid of a ruler.

Results and Discussion

It was observed in the experiment with lettuce, that in the concentrations of 2.5% of noni and 5.0% of noni and pomegranate,

the number of germinated seeds was higher when compared to the control (Figures 1-5 and Table 2). For tomato at concentrations of 1.0% pomegranate and noni, 2.5% noni and 5.0% noni, the number of germinated seeds was higher when compared to the control (Table 3). For pepper at concentrations of 1.0% and 2.5% of eucalyptus, the number of seeds germinated was higher when compared to the control (Table 4). It was observed in the lettuce experiment that at the concentrations of 1.0%, 2.5% and 5.0% of noni, the shoot and root system development were larger when compared to the control (Table 5). In the tomato experiment, it was observed that in all concentrations of all the extracts an increase was observed when compared to the control (Table 6). In the experiment with pepper it can be observed that in the concentrations of 1.0%, 2.5% and 5.0% of pomegranate and noni, only the root system increased, compared to the control (Table 7). In a study carried out by Gonsalves et al., [17] the occurrence of allelopathic effects in all fruit extracts and leaves of (*Morinda citrifolia* L.) (Noni), inhibiting the germination of *Senna occidentalis* and *Senna obtusifolia*. In a study carried out by Pereira et al., [18], eucalyptus foliar extracts were used in the germination of lettuce seeds, the allelopathic effects had great germination intensity, differing mainly in smaller concentrations where they had lower germination index seeds of lettuce. These results are similar to those found by Azevedo et al., [19] for the germination of lettuce seeds in treatments with eucalyptus leaves, with eucalyptus inhibiting germination and development. The use of pomegranate extract (*Punica granatum*), second is a medicinal plant and has broad support from the World Health Organization, encouraging scientific research.

Conclusion

In view of this work, it is concluded that the extracts of pomegranate and eucalyptus tend to cause a delay in the germination and development of the tested seeds of lettuce and tomato, however, the pepper culture underwent an inversion the eucalyptus extract had a greater germination compared to noni and pomegranate. Being that the noni extract totally accelerated the time of germination and development in size with the seeds of lettuce and tomato.

Conflict of Interests

There is no conflict of interest between authors.

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