

Full Length Research Paper

## Allelopathic effect of irrigation with different concentrations of leaf extracts of *Jatropha curcas* L. on growth *Brassica oleracea*

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Received 23 July, 2013; Accepted 18 September, 2015

The competition for sunlight, nutrients or space makes many plants from releasing toxins that can harm the growth and development of competing plants. This work aims to measure the allelopathic effect of the physic nut leaf extract on the cabbage plantation growth. The experiment was conducted in the Missal city, state of Parana, Brazil. It was used 6 different concentrations of extract *Jatropha. curcas* L., as follow: 0, 5, 10, 20, 40, 80%. After 30 days of cultivation it was performed analysis of the following parameters of the crop development: Stalk diameter, stalk length, leaf area, root length, fresh and dry matter of root, fresh and dry matter of air portion, and the evaluated parameters varied in accordance with different levels of *J. curcas* extract.

**Key words:** Purging nut, allelochemicals, allelopathy, foliar extracts, irrigation.

### INTRODUCTION

Allelopathy term was used for the first time in 1937 by Hans Molisch, and it was defined as a malefic or benefic influence of a chemical substance released by plants or microorganisms named allelochemicals. The most part of them come from a secondary metabolism of the plant working against microorganisms, virus, insects and other pathogens and predators action in order to inhibit them or to stimulate the growth or development of plants, and they can be released from leaves, root or by the decomposition of plant remains (Ferreira and Aquila, 2000).

The competition between one plant and another usually happens by a contest for limited resources as light, water and nutrients. Regarding to allelopathy it can be considered a strategy in an ecological competition because it concerns of a toxic effect of substances produced by other plants. Through this mechanism, a plant may interfere in the growth of another. However, the allelopathy is also known as an alternative to use of agrochemicals (Moreira et al., 2011).

Regarding to cabbage (*Brassica oleracea capitata* var.) it is *Brassica oleracea* subspecies, Capitata group that is

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composed by the most used vegetables in human feed. It is a biannual and herbaceous plant that belongs to the Brassicaceae family. It has rounded and waxy leaves, and they create a compact "head". With time, it was obtained adapted cultivars in different temperatures leading to an increase in the plantation and harvest period (Figueira, 2007).

The cabbage cultivation, as others herbaceous, requires a high nitrogen fertilizer level in its cycle that is in a short period. After the harvest, a few crop residue remains at cultivation local, leaving the soil with a lower amount of nutrients available, and it forces the producers to use nitrogen fertilizers, which has a high cost, and leave the producer depending on the industry (Zotarelli, 2000).

Physic nut (*Jatropha curcas* L.) is a plant that belongs to the Euphorbia family. This specie is well known by its high oil productivity that may be used to produce biodiesel. It is native from South America, but it is being explored in Central America, India and Africa too. The physic nut cultivation may produce about 2 tons of oil per hectare in regions of sandy and not very fertile soils where the weather is unfavorable for the most part of the plantations, and it is considered an excellent option to familiar agriculture (Saturnino, 2005).

Silva et al. (2012) reported that the aqueous extract of *J. curcas* root generates a allelopathic effect on some crops, showing the presence of chemical substances that may influence the growth and development of certain plants, and it may cause some positive or negative effects on the germination time and average speed and the maximum length of the root, and it can be observed a phytotoxicity of its residues on soil, and the most part of the residues come from the decomposition of leaf tissue (Wang et al., 2009).

As a function of what have been told, the main purpose of this work is to evaluate the allelopathic effect of the leaf tissue of *J. curcas* on the growth and development of *B. oleracea* capitata variety crop, and to analyze the following parameters: Stalk diameter, stalk length, leaf area, root length, fresh and dry matter of root and fresh and dry matter of air portion.

## MATERIALS AND METHODS

The present study was performed in the Missal city, state of Parana, at 25°05'29" of latitude south and 54°14'52" of longitude west and 317 m of altitude. The date of the study was April 28 to May 27 of 2013. The weather is mesothermal humid subtropical. Summer is hot with a tendency of concentrated rainfall and the average temperature is 22°C. Winter has not frequent frost and its average temperature is 18°C. There is not a completely dry season. The annual average precipitation index is 1.788 mm (KAEFER, 2007).

The plantation was performed in an expanded polystyrene tray, specific to the vegetables seedlings production, being composed by a total of 200 cells, with a system of 10 × 20 cells, each one with a area of 14 cm<sup>2</sup> and a depth of 5.5 cm. The study was conducted in a greenhouse. The soil type is Red Hapludox.

The sowing in the tray was performed at a depth of 5 mm from the surface of soil. The treatment with substratum was performed starting at the first day of sowing, in randomized blocks. It was evaluated 6 different levels of physic nut leaf extract in concentrations of 0, 5, 10, 20, 40 and 80%. The sprinkling was performed with a manual sprinkler in three equal parts per day using a volume of 5 ml per cell, totalizing 100 ml per day for the period of 30 days till the harvest.

To obtain the leaf extract it was performed a crush of 200 g of leaf tissue of physic nut from the experimental field of the University, Cascavel campus, in 1 L of distilled water using a blender, and then filtering the material using a 40 mesh sieve that results in the crude extract. This was diluted again in distilled water to obtain different concentration ranges: 0, 5, 10, 20, 40 and 80%. The stock solution extract was stored in recipient 2 L, and refrigerated at 5°C.

To perform the analysis, it was withdrawn the most representative plants of each treatment and the analysis was carried out right after the plant harvest, in order to preserve its characteristics. The analyzed parameters were: Stalk diameter, stalk length, root length, leaf area, fresh and dry matter of root, fresh and dry matter of air portion.

A caliper rule was used to measure the stalk diameter, stalk length and root length. The leaf area was estimated using graph paper. To measure the fresh matter of the root and of air portion it was used analytical balance with a precision of 0,0001 g. To analyze the dry matter of the root and of the air portion, they were placed in a industrial oven at 65°C and they were keep in there till they do not change their weight. Then it was measured again its weight in an analytical balance to obtain the dry matter mass.

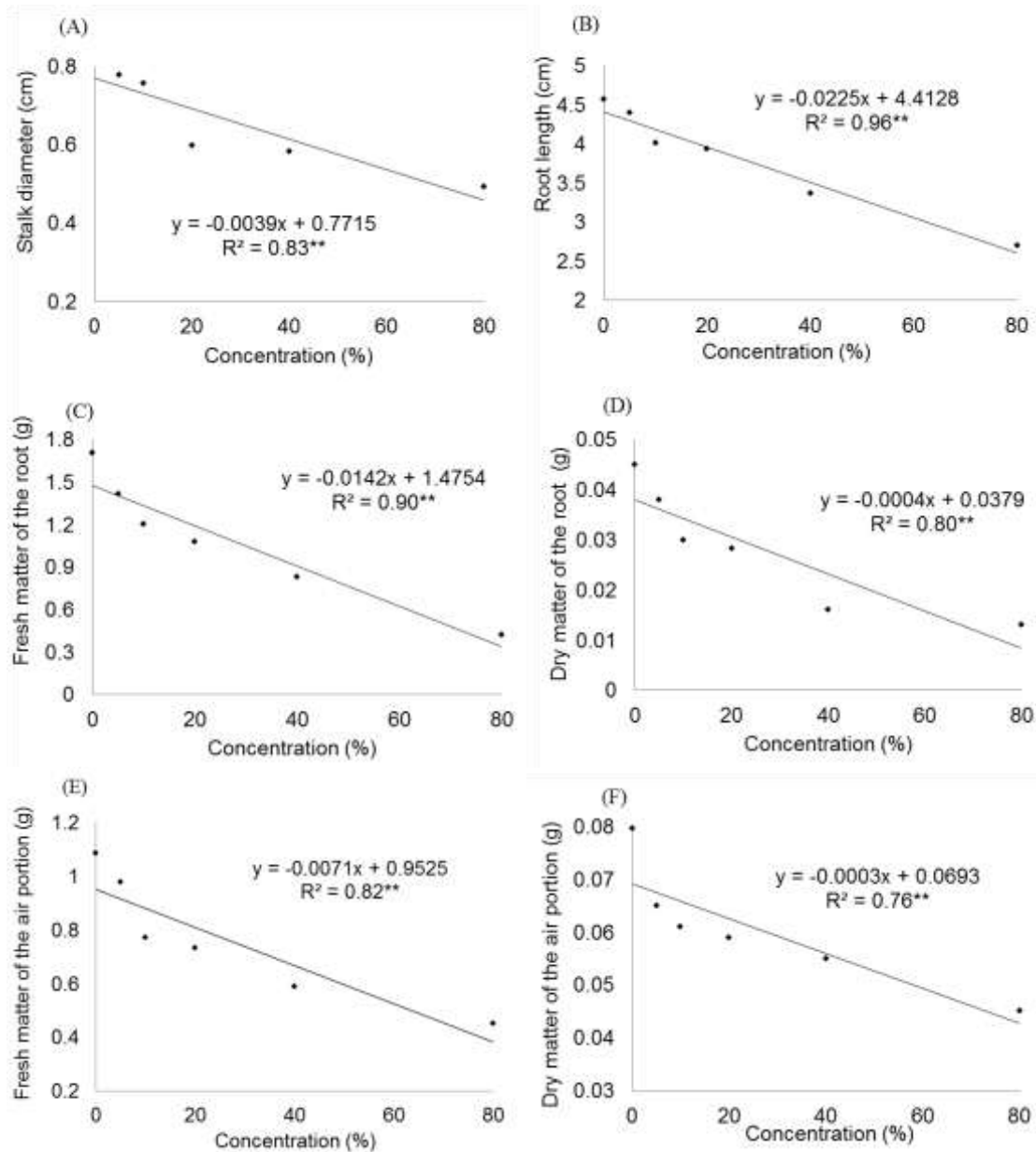
The statistical analysis of data (ANOVA) was performed using the software ASSISTAT version 7.6 beta. It was verified the representativeness of the data, it was calculated the average, the variation coefficient and regression at 5% of probability.

## RESULTS AND DISCUSSION

It can be observed in Figure 1 that the increase of the aqueous extract of *J. curcas* concentration influenced significantly ( $p < 0.01$ ) the stalk diameter, the root length, the stalk length, the leaf area, the dry and fresh matter of the root and the dry and fresh matter of the seedling area, in a linear decreasing way.

It can be observed that the stalk diameter (Figure 1A) adjusted linearly in a decreasing way, indicating a negative effect of the extract of *J. curcas*. The root length (Figure 1B) also decreased as function of the concentration. Similar results were found by Lemos et al. (2009), in a work carried out with aqueous extract of *J. curcas*. The authors verified that the concentration inhibited the root development in lettuce seedlings, with morphologic changes in the root. In a study carried out by Pillati and Boiago (2012) using root extract of *J. curcas* it can be also observed a negative allelopathic effect to the root growth *Brassic napus* L. However, contradictory results were observed by Sanderson et al. (2013) in lettuce, but with lower concentrations (0, 1, 5, 10 and 15%) than in this study.

Reichel et al. (2013) verified that aqueous extract of *J. curcas* in concentrations of 20, 25, 30 and 35% stimulated the root growth in the wheat plantation. Abugre and Sam (2010) observed an inhibition of the



**Figure 1.** Stalk diameter (A); Root length (B); Fresh matter of the root (C); Dry matter of the root (D); Fresh matter of the air portion (E); Dry matter of the air portion (F). \*\* = significant at 1% of probability.

seedlings growth of *Z. mays* when they were submitted to high temperatures of *J. curcas* root extract. Bonamigo et al. (2009) reported an allelopathic effect of root aqueous extract on the early development of the soybean and canola. Abugre and Sam (2011) in a research with aqueous extract of *J. curcas* observed that the *J. curcas* specie was the one that most inhibited the okra seed germination (*Abelmoschus esculentus* (L.) Moench).

The fresh and dry matter of the seedling root (Figure 1C and D) suffered negative interference as a function of the concentrations. Rejila and Vijayakumar (2011) in a study performed with leaf extract of *J. curcas* on the

*Capsicum annum* L. crop verified a significant reduction on the root development. Wang et al. (2009) reported in their studies an allelopathic effect of the *J. curcas* leaves on the *Tagetes erecta* L. seedlings development.

Regarding to the fresh and dry matter of the seedling air portion (Figure 1E and F) it can be observed that the *J. curcas* concentrations lead to an allelopathic effect. Similar effects were observed by Abugre and Sam (2010) with aqueous extract of root and leaves of the physic nut on the *Phaseolus vulgaris* crop. Reichel et al. (2013) observed in a study with extract of physic nut leaves (*J. curcas*) on the early development of wheat (*Triticum*

*aestivum* L.), with concentrations of (5, 10, 15, 20, 25, 30 and 35%), an allelopathic inhibition.

## Conclusion

The application of aqueous extract of *J. curcas* leaf tissue showed a negative effect on the cabbage crop, with a reduction in the root length, stalk diameter, fresh and dry matter of the air portion and fresh and dry matter of the root as a function of the concentrations.

## Conflict of Interest

The authors have not declared any conflict of interest.

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