Response of *Cajanus Cajan* L. Millsp Seed to Allelopathic Effects of Cashew Leaf and Stem Bark Extracts

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Abstracts
The experiment was conducted to observe the inhibitory effects of the leaves and stem-bark extract derived from Anacardium occidentale (cashew) from the National Root Crops Research Institute Umuahia, Umudike in Abia State on the germination of Cajanus cajan (pigeon pea). The experiments were set on sterilized Petri dishes stuffed with cotton wool. Different concentrations of the aqueous extracts of cashew leaves and stem bark i.e. 30%, 50% and 70% were prepared and administered to the seeds while distilled water was used as the control (0%) of the experiment .The aqueous extracts of both the cashew leaves and stem bark caused inhibitory effects on the germination percentage and germination rate of pigeon pea and increased with increase in the concentrations of the extracts. In the cashew leaves extracts the highest inhibition percentage was recorded in 70% which had 80.00%, 50% had 86.66%, 30% had 90.00% while the lowest inhibition was in control which had 96.66%. Also, in the cashew stem bark extracts the highest inhibition percentage was recorded in 70% which had 86.66%, 50% had 90.00%, 30% had 93.33% while the lowest inhibition was in control which had 96.00%. These findings showed that certain phytochemicals in the tissues of A. occidentale caused significant phytotoxic effects on the germination of C. cajan seeds. Also, the cashew leaf aqueous extract had more effects on the germination of C. cajan than the cashew bark extract.

Keywords: *Allelopathy, extract, leaves, stem bark, germination*

Introduction

Allelopathy refers to the mechanism to achieve a competitive edge among the plant species growing in close proximity to another (Tuan *et al*., 2011). It is the influence of one plant upon another plant growing in its vicinity by the release of certain metabolic toxic products in the environment Arpana, 2015). Allelopathy can be separated from other mechanisms of plant interference because detrimental effect is exerted through release of chemical inhibitors (allelochemicals) by the donor species (Tuan *et al*., 2011). Allelopathy is the influence of one plant upon another plant growing in its vicinity by the release of certain metabolic toxic products in the environment. It covers biochemicals interactions, both beneficial and harmful, between plant species including fungi and bacteria (Arpana, 2015). Allelochemicals are the subsets of secondary metabolites (Stamp, 2003). It includes terpenoids, phenolic compounds, alkaloids, fatty acids, steroids and polyacetylenes (Kohli, 1990). Allelopathic substances are present in any part of the plant i.e. leaves, bark, roots, fruits, stems. Allelochemicals (inhibitors) are produced by plants as end products, by-products and metabolites and are contained in the stem, leaves, roots, flowers, inflorescence, fruits and seeds of the plants. Of these plant parts, leaves seem to be the most consistent producers of these allelochemicals (Sisodia and Siddiqui, 2010). This

study was therefore aimed at evaluating the inhibitory effects of Cashew leaves and stem-bark extracts on the germination of *Cajanus cajan* (pigeon pea).

Materials and Method

This study was carried out in the laboratory of Department of Plant Science and Biotechnology, Michael Okpara University of Agriculture, Umudike, Nigeria. The seeds of pigeon pea (*Cajanus cajan*) were collected from National Root Crop Research Institute (NRCRI), Umudike, Nigeria while the extracts were derived from cashew leaves and stem-barks collected from the cashew farm of Michael Okpara University of Agriculture, Umudike, Nigeria. Viability of the seeds was carried out using the floatation technique (Osuagwu and Iwuoha, 2014). The experiment was a completely randomized design with each treatment replicated three times. The cashew leaves and stem barks were oven-dried at 55^{o}C in National Root Crop Research Institute (NRCRI), Umudike Central Services Laboratory for 12 hours and grounded into fine powder after which it was stored for later use. Cold water extraction was used in obtaining the extracts. 20 grams of each sample were weighed and soaked overnight in 150mls of water in a beaker and allowed to stand. The mixture was filtered using a muslin cloth was spread over a beaker. The filtrate was collected for the experiment while the chaff was discarded (Nwokeocha and Ezumah, 2014). The stock solution (100%) of both extracts was diluted into concentrations of 30%, 50% and 70% by measuring out 30ml, 50ml and 70ml and made up to 100ml with distilled water. Three different concentrations of cashew leaves and stem bark extracts, 30%, 50%, 70% and distilled water were used as control (0%) for the experiment. Thirty seeds of *C. cajan* were placed in Petri dishes containing cotton wools moistened with different concentrations of either cashew leaves extracts or cashew stem bark extracts and distilled water as the control. The seeds were allowed to germinate with twice a day wetting of the dishes to avoid drying out (Nwokeocha and Ezumah, 2014). The seeds were allowed for five days to germinate. The seeds were regarded germinated with the emergence of radicle and plumule. The parameters determined were germination percentage and germination rate. Germination percentage was calculated using the formular:

Germination percentage (%) = $\frac{Number\ of\ seeds\ germinated}{Number\ of\ seeds\ planted}\ x\ \frac{100}{1}$ (Nwokeocha and Ezumah, 2014).

While the germination rate was calculated using the formular:

$$\text{Germination rate} = \frac{Number\ of\ seeds\ germinated}{Number\ of\ days\ of\ germination}$$

The difference between the number planted and the number that germinated under different treatments was tested and compared using paired t –test (Ogbeibu, 2005).

Results

The results for number of seeds planted, number of germinations, percentage germination and germination rate are presented in Tables 1 and 2. The study showed that as the concentration of cashew leaves extracts increased from 0% (control) to 70%, the percentage germinations decreased from 96.66% to 80.00% while germination rate decreased from 5.8 to 4.8 (Table 1 and Fig. 1). The maximum inhibition was recorded at 70% concentration while the minimum was recorded 0% (control) concentration. Also, as the concentration of cashew stem bark extracts increased from 0% to 70%, the percentage germinations decreased from 96.00% to 86.66% while germination rate decreased from 5.8 to 5.2 (Table 2 and Fig. 2). The maximum inhibition was recorded at 70% concentration while the minimum was recorded 0% (control) concentration. The effect of both extracts followed the same trend. Paired t-test analysis showed that there was

significant difference ($p < 0.05$) between the number of seeds planted and the number that germinated (since t Stat > t Critical two-tail) in both extracts. This difference is attributed to the inhibitory effect of the extracts.

Table 1: Effects of cashew leaf extract on the germination of pigeon pea

Treatment	Total number of seeds planted	Number of days of germination	Number of seeds germinated	Germination percentage	Germination rate
0%	30	5	29	96.66%	5.8
30%	30	5	27	90.00%	5.4
50%	30	5	26	86.66%	5.2
70%	30	5	24	80.00%	4.8

Table 2: Effects of cashew stem bark extract on the germination of pigeon pea

Treatment	Total number of seeds planted	Number of days of germination	Number of seeds germinated	Germination percentage	Germination rate
0%	30	5	29	96.00%	5.8
30%	30	5	28	93.33%	5.6
50%	30	5	27	90.00%	5.4
70%	30	5	26	86.66%	5.2

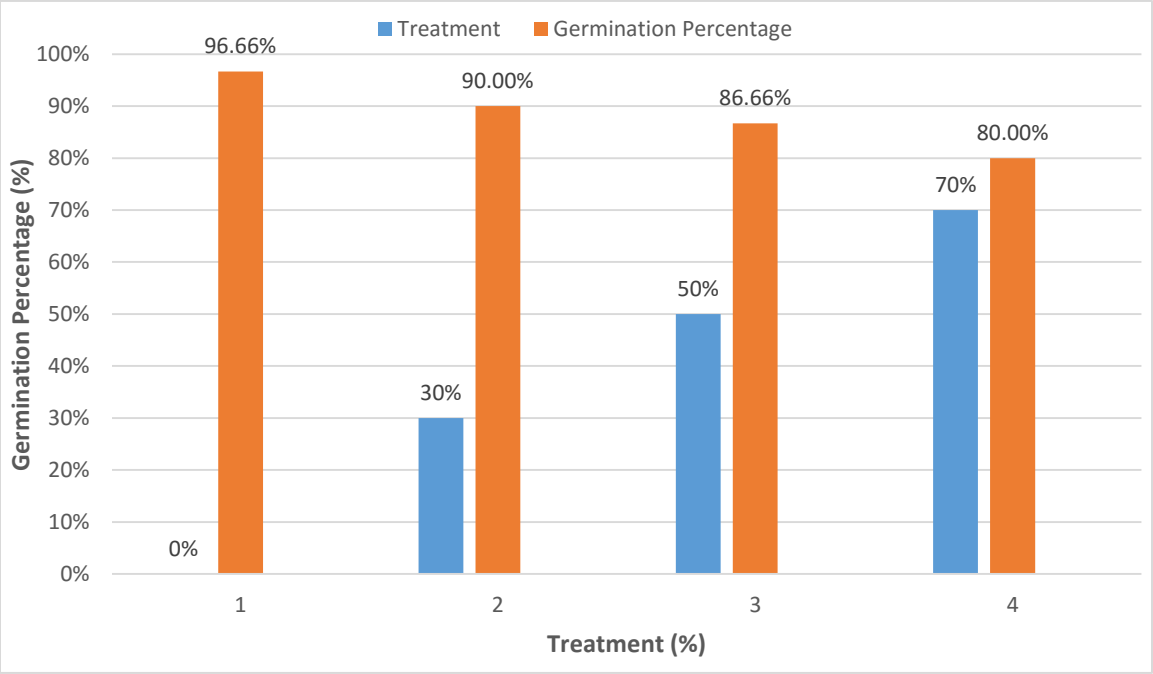

Fig. 1: Relationship between the treatment and percentage germination of the cashew leaves extracts.

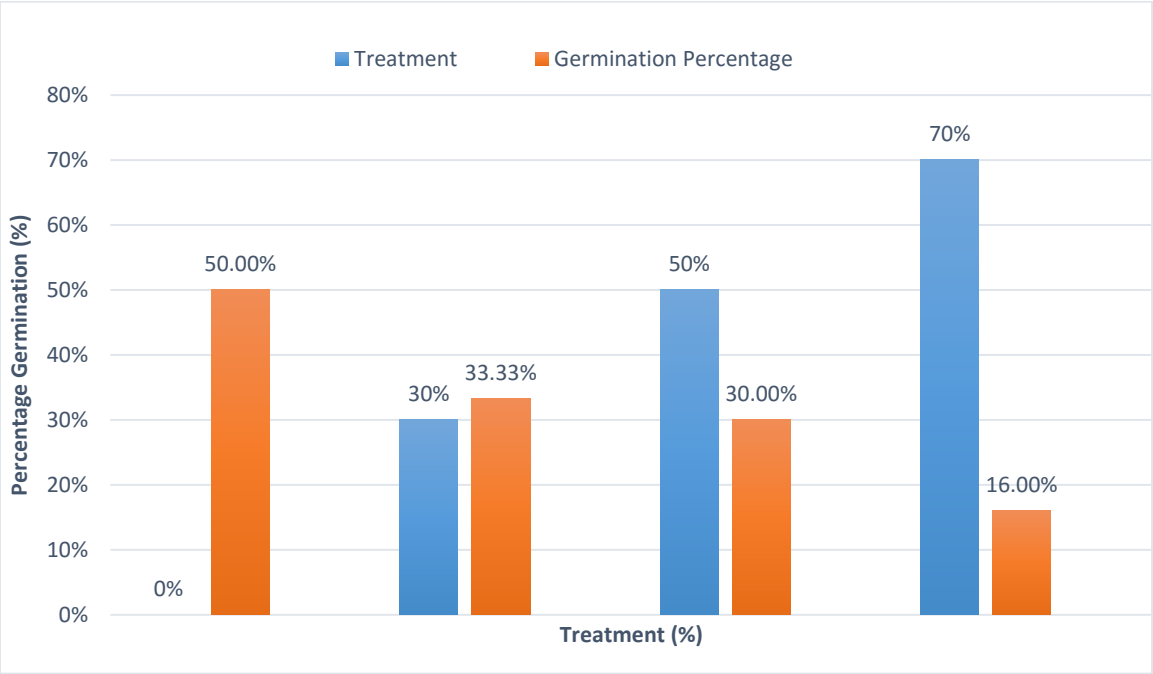

Fig. 2: Relationship between the treatment and percentage germination of the cashew bark extracts.

Discussion

In this study, it was discovered that cashew contained some phytochemicals in there tissues that had phytotoxic effects on the seed germination of pigeon pea. Previous researches revealed that various concentrations of *Anacardium occidentale* leaves and stem bark extracts decreased the seed germination of *Zea mays* (Nwokeocha and Ezumah, 2014). The inhibitory effects also have been reported in aqueous extracts of all parts of *Lantana camara* on the germination of *Pennisetum americanum*, *Lactucasativa* (L.) and *Setaria italica* (L.) (Hussain *et al.*, 2011). Various phenolic compounds inhibited cell division (Arpana, 2015). It is also possible that cell elongation was affected by extracts of cashew. Regulation of the concentration of hormones, such as auxins and gibberellins, is also important for normal plant cell growth and morphogenesis (Arpana, 2015). The inhibitory effect on plant height might be due to checking or inhibition of biosynthesis of gibberellins, which are responsible for cell elongation and plant height (Arpana, 2015). It was observed that cashew leaves and stem bark extracts had different inhibitory effects on the germination of pigeon pea seeds. The different effects between leaf aqueous extracts and root extracts were perhaps contributed by different allelochemical quantities and entities presence in plant tissues (Tuan *et al.*, 2011). Vijay and Jain (2010), noted that the extracts of roots, stem and leaf of *L. camara* have significant effect on seed germination. The process of germination decreased as the concentration in the medium increased. Also the leaf extract of *A. occidentale* had greater inhibition on the germination of *C. cajan* as compared to stem bark. The same observation was made by (Vijay and Jain, 2010) which showed that the leaf extract of *Lantana camara* had greater inhibition on the germination of *Phaseolus mungo* as compared to the extracts of stem and root. According to Tomaszewski and Thimann (1966), plants also appear to vary in their production of allelopathic chemicals depending upon the

environment in which they are grown due to their response to various stresses that they encountered. Parayil and Honey (2013), reported that high concentrations of *A. occidentale* leaf-extract reduced the percentage germination of *Vigna unguiculata.*

Conclusion

With the result of this finding in view, it will be concluded that *Anacardium occidentale* has shown significant inhibition on the germination of *Cajanus cajan*. Seed germination is one of the critical stage in the life history of any individual plant species. The gene makeup and aggressive capacity of plant species determines there survival in the natural environment. Seeds of *C. cajan* soaked in aqueous extracts of leaves and stem bark of *A. occidentale* showed inhibition in seed germination. The evidence from the data showed that allelochemicals present in *A. occidentale* might inhibit the germination of seed.

Competing Interests

Authors have declared that no competing interests exist.

References

Arpana, M. (2015). Allelopathic properties of *Lantana camara. International Research Journal of Basic and Clinical Studies,* 3(1):13-18

Hussain, F., Ghulam, S., Sher, Z. and Ahmad, B. (2011). Allelopathy by *Lantana camara. Pakistan Journal Botany,* 43(5): 2373-2378.

Ismail, B. S. and Kumar, T. (1996). Effects of aqueous extracts and residue decomposition of *Mikania micrantha* H.B.K on selected crops. *Allelopathy journal*, 3:195-206.

Kohli, R. K. (1990). Allelopathic Potential of Eucalyptus. Project Report MAB-DOEn. Project, India.

Nwokeocha, O.W. and Ezumah, B. S. (2015). Effects of cashew leaves and stem-bark extracts on the germination of maize. International Journal of Plant and Soil Science **4(**5**):**494-498.

Ogbeibu, A. E. (2005). *Biostatistics – A practical approach to research and data handling*. Mindex Publishing Company Limited, Benin City, Nigeria. pp. 175 – 176.

Parayil, S. P. and Honey, A. E. S. (2013). Study on the effect of aqueous leaf extract of *Anacardium occidentale* on seed germination and seedling growth of *Vigna unguiculata*. Asia Pacific *Journal of enviroment, ecology and sustainable development,* 1:10-14.

Sisodia, S. and Siddiqui, M. B. (2010). Allelopathic effect of *Lantana camara* on *Bidens pilosa*. VEGTOS. 20(1): 29-32.

Sisodia. S. and Siddiqui, M. B. (2010). Allelopathic effect by aqueous extracts of different parts of *Croton bonplandianum* Baill. On some crop and weed plants. *Journal of Agricultural Extension and Rural Development,* 2(1):022-028,

Stamp, N. (2003) Out of the Quagmire of Plant Defense Hypothesis. The Quarterly Review of Biology. **78**:23-55

Tomaszewski, M. and Thimann, K. V. (1966). Interaction of phenolic acids, metallic ions and cheating agents on auxin induced growth. Plant Physiology, 41:1443-1454.

Tuan, N. T. K., Nashriyah, M., Hasbullah, M., Raja, D. R. I. and Muhamad, A. A. W. (2011). Allelopathic effects of *Anacardium occidentale* linn of Terengganu and kelantan on growth of maize and cucumber. *International Research Journal of Applied and Basic Sciences*.2 (5):175-180.

Vijay B. and Jain, B. K. (2010). Allelopathic effects of *L. camara* L. on in vitro seed germination

of *Phaseolus mungo. International Journal of Plant Science, 5*(1):43- 45.