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Effects of Allelochemical of *Jatropha curcas* L. Leachate on Germination and Rooting of Four (4) Pepper (*Capsicum*) Species

Ubazi C. C[1], *Abdulkarim B. M[1], Yahaya S.A[2, 3], Sani M.H[1], Aliyu R.H[1,], Anadi A. C[1]

[1]Department of Plant Science and Biotechnology
Nasarawa State University
Keffi, Nigeria.

[2]Nigerian Institute for Oilpalm Research
(NIFOR) Benin City, Nigeria.

[3]Department of Botany,
Federal University of Technology,
Minna, Nigeria.

Email: mail2bello@gmail.com

Abstract
A study was carried out on the effect of allelochemicals of *Jatropha curcas* L. on germination and rooting of four pepper species (*Capsicum* spp) in the Department of Plant Science and Biotechnology Laboratory, Nasarawa State University Keffi, Nigeria. Data was collected on percentage inhibition and shoot length. Results generatedfrom the study showed that there were significant differences among the values of treatments (4%, 8%, 12%, 16% and 20%) and the control (0%) and within the treatments at $P \leq 0.05$ level of significance. Eventually all the test samples were said to be affected by various sort of range of concentrations of the aqueous extracts and the most obvious (i.e most significant) effect was at 12%, 16% and 20% concentrations of the extracts in all species respectively. Germination and early rooting were retarded (delayed) completely at higher concentrations in virtually all the cases when placed in comparison with the control sample. The inhibitory (retardation) effect was seen to be relyon concentration and may also be due to the presence of water soluble allelochemicals like phenols, tannins and azelaic acid.

Keywords: *Jatrpha curcas*; Allelochemicals; *Capsicum spp*; Extracts; Germination.

**Author for Correspondence*

INTRODUCTION

The inability of most crops to do well in an agro forestry system has been ascribed to allelopathic effects of tree species. Allelopathy is not restricted to a single field rather to multidisciplinary areas of research including soil science, agronomy, plant breeding, genetics, agro forestry and vegetable crops (Adnan *et al*., 2015).

Previous studies have shown that majority of the compounds having hazardous effects on neighbouring plants are phenolic in nature (Khan *et al*., 2011; Ullah *et al*., 2014 and Ferguson and Rathinasabapathi, 2003).

However, little knowledge has been acquired on the allelopathic effect of *Jatropha* on the growth and development of the intercropping plants. Several researchers have reported the release of a variety of secondary metabolites by *Jatropha* through leaching, root exudation etc, (Rejila, and Vijayakumar, 2011).

Many of the phytotoxic substances suspected of bringing about germination and growth retardation have been discovered from plant tissues and soil. A wide array of these compounds is released into the environment in appropriate quantities *via* root exudation and as leachates during litter decomposition. Most of these are phenolic compounds and are implicated in allelopathy, a process which includes the direct or indirect detrimental effect of one plant on the germination, growth and development of another plant, (Zaprometov, 1992).

An accurate answer to these questions is related to an adequate selection of starting material, an extraction method able to imitate natural conditions, and a standard method for bioactivity evaluation, able to compare between different substances and to measure effects over a wide range of targets (Macias *et al*., 2003). The selection of starting material (roots, aerial part, even flowers or fruits) is extremely important due to the different types of compounds present in every vegetable tissue. Most researches are related to aerial part or rot exudates.

The traditional extraction method of soaking is a nonselective approach and therefore scientifically unreliable. Hence as an alternative, new methods based on the imitation of natural conditions (rain simulation or root exudates recycling) offer more selectivity to find compounds related with the ecological interaction.

It is concerned with plant protection i.e. insect control, nematodes control and disease control. Commonly cited effects of allelopathy include reduced seed germination and seedling growth (Ferguson and Rathinasabapathi, 2003). Pastoralism application in agriculture have been substituted by mixed farming practise because of the tension of nutrient request, disease infiltration and reduced yield. It was detected that in mixed farming too, certain garners provide improved yield, whereas others provided lesser yield. Plants have remained establish to produce and stock various allelochemicals like., alkaloids, phenolics and others as if possible resistance compounds (Rejila and Vijayakumar, 2011).

Numerous of the phytotoxic ingredients alleged to be causing germination and growth reticence have been recognized from plants tissues and top soil. Allelochemicals have a variation of chemical arrangements and activities. Nonetheless, the special effects of these allelochemicals on biochemical and functional processes of under attack plants have not been appropriately investigated painstakingly (Hussain *et al*., 2010). So consequently, it is

paramount to check the phytotoxic paraphernalia of *J. curcas* on imperative agricultural crops before it is familiarized into the agroforestry organizationparticularly by means of the usual exercise among local farmers to syndicate trees and or shrubs with annuals or perennials plants.

In this study, attempt was made towards evaluating the allelopathic effect of *Jatropha curcas* aqueous leaf extracts on the seed germination and rooting of four (4) peppersspecies, remotely grown in Keffi Local Government Area of Nasarawa state.

MATERIALS AND METHODS

STUDY AREA

A laboratory research was carried out at the laboratory of the Department of Plant Science and Biotechnology, Nasarawa State University Keffi, Nigeria. This reputable citadel of knowledge is situated on Longitude 8.8558^{o}N and Latitude7.8694^{o}. The temperatureat this timesandwiched between 25^{o}C-30^{o}C and at about 602mm of rainfallannually. It is to be foundin the northwest of Lafia, the state capital of Nasarawa State, Nigeria(Akwa*et al*., 2007).

SAMPLE COLLECTION AND PREPARATION

Corpulent and matured leaves of *J. curcas* were collected from the Departmental botanical garden. The technique for the grounding of aqueous leaf extracts was espoused from Hassan *et al*., (2013). The leaf samples were air dehydrated under gloominess in the laboratory, powdered(2mm mesh sieve) and used for bioassay conduct extracts. Seeds of crops (Bell pepper, Cayenne pepper (*Capsicum annum*) and Bird-eye pepper, Red pepper (*Capsicum frutescens*) were obtained from the Institute for Agricultural Research Samaru, Zaria, Kaduna State, Nigeria in April 2017.

PREPARATION OF AQUEOUS LEAF EXTRACT

The dried leaves were blended to a fine powder in a mortar (2mm mesh sieve). By means of this powder, aqueous extracts were organized by the method of (Hassan *et al*., 2013). Dissimilar amounts; 100g/500ml, 80g/500ml, 60g/500ml, 40g/500ml, 20g/500ml and 0g/500ml (control) of crushed leaf sample were liquefied in autoclaved distilled water in 1000ml conical flask. These gave a proportion leaf excerpt in 100ml of water of 20%, 16%, 12%, 8%, 4%, and 0% (control) correspondingly.

BIOASSAY STUDIES

Pepper seeds were primed in distilled water for 1hour and bioassay studies were carried out following the method of Rejila and Vijayakumar, (2011). Ten(10) seeds of plant (each pepper species) were put upon Whatman No1 filter paper in petri-dishes (9cm × 2cm). Petriplates were humidified with 2ml/plate of leaf excerpt, distilled water (control) and incubated under laboratory condition. Seeds from each pepper species were exposed to the five (5) various treatments. Proportion inhibition on germinationand root length were measured red after 15 days. (Fiveplantlets were randomly harvested from each petriplate to conclude Average root length).

DATA ANALYSIS

The data wasscrutinizedby means of one way analysis of variance (ANOVA). Dissimilar means were also reflected statistical significant at $p< 0.05$.

TREATMENT AND CONCENTRATIONS USED

i. Control ($\mathbf{T_o}$) seeds supplied with autoclaved distilled water.
ii. $\mathbf{T_1}$ seeds added with 4% extracts solution.
iii. $\mathbf{T_2}$seeds added with 8% extracts solution.
iv. $\mathbf{T_3}$ seeds added with 12% extract solution.
v. $\mathbf{T_4}$ seeds added with 16% extract solution.
vi. $\mathbf{T_5}$ seeds added with 20% extract solution.

RESULTS AND DISCUSSION

The neck and neck of proportion of inhibitory effect of *Jatropha curcas* L. leaf aqueousexcerpt on germination of four different pepper species studied are presented in Table 1. The treatments (T_3-T_5) were established to record 100% inhibition in all the gears.

Effect of aqueous leaf excerpt of *Jatropha curcas* L., on the root length of Cayenne pepper (*Capsicum annum*) is shown in Table 2. Centered on the average performances of the roots per treatment, T_0 recorded 3.59mm, $T_1$0.51mm, $T_2$0.31mm while the highest inhibitory effect was recorded at higher concentrations (T_3-T_4).

Furthermore, effect of leaf aqueous extract of *Jatropha curcas* L., on the root length of Red pepper (*Capsicum frutescense* L.) is shown in Table 3. Based on the average performances of the roots per treatment, T_0 recorded 4.77mm, T_1 0.51mm, T_2 0.30mm, T_3 0.20mm and also, the highest inhibitory effect were recorded at higher concentrations (T_3-T_4).

Effect of leaf aqueous extract of *Jatrophacurcas* L., on the shoot length of Bell pepper (*Capsicum annum* L.) is shown in Table 4. Based on the average performances of the shoots per treatment, T_0 recorded 3.36mm, $T_1$0.95mm, $T_3$0.62mm while the highest inhibitory effect was recorded at higher concentrations (T_3-T_4).

Also, the effect of leaf aqueous extract of *Jatropha curcas* L., on the root length of Bird-eye pepper (*Capsicum frutescense* L.) is shown in Table 5. Based on the average performances of the roots per treatment; T_0 recorded 4.07mm, $T_1$0.52mm, $T_2$0.48mm while the highest inhibitory effect was recorded at higher concentrations (T_3-T_4).

Table 1: Percentage inhibition of *Jatropha curcas* L. leaf aqueous extract on germination of pepper.

Treatments	Bird-eye pepper	Concentration	Cayenne pepper	Red peppr Bell
T1		4	-85.79%	-89.31%
	-69.94%	-87.22%		
T2		8	-91.36%	-93.71%
	-81.55%	-88.21%		
T3		12	-100%	-96.02%
	-100%	-100%		
T4		16	-100%	-100%
	-100%	-100%		
T5		20	-100%	-100%
	-100%	-100%		

Table 2: Effect of leaf aqueous extract of *Jatropha curcas* on root length of Cayenne pepper(*Capsicum annum*).

Treatments	Concentration (%)	Average root length/treatment (mm)
T_0	-	3.59
T_1	4	0.51
T_2	8	0.31
T_3	12	-
T_4	16	-
T_5	20	-
L. S. D (0.05)		0.375

Table 3: Effects of leaf aqueous extract of *Jatropha curcas* on the root length of Red pepper (*Capsicum frutescens*).

Treatments	Concentration (%)	Average root length/treatment (mm)
T_0	-	4.77
T_1	4	0.51
T_2	8	0.30
T_3	12	-
T_4	16	-
T_5	20	-
L. S. D (0.05)		0.403

Table 4: Effect of leaf aqueous extract of *Jatropha curcas* on the root length of Bell pepper (*Capsicum annum*).

Treatments	Concentrations (%)	Average root length/treatment (mm)
T_0	-	3.36
T_1	4	0.95
T_2	8	0.62
T_3	12	-
T_4	16	-
T_5	20	-
L. S. D (0.05)		0.564

Table 5: Effect of leaf aqueous extract of *Jatropha curcas* on root of Bird-eye pepper (*Capsicum frutescens*).

Treatments	Concentrations (%)	Average root length/treatment (mm)
T_0	-	4.07
T_1	4	0.52
T_2	8	0.48
T_3	12	-
T_4	16	-
T_5	20	-
L. S. D (0.05)		1.026

The bioassay study of leaf aqueous extract of *Jatropha curcas* on the pepper species showed a gradual inhibition in seed germination and shoot length. The inhibition of the seed germination and the shoot length of pepper in all cases was found to be completely dependent on concentration. The inhibition of seed germination by leaf aqueous extract was 100% in all cases at higher concentrations except for Red (*Capsicum frutescens*) which recorded 75.00% (inhibition) at 12% concentration (Table 1) and this may be due differences in response to the treatments by the different pepper species.

The root length of *Capsicum* species was found to be greatly inhibited with increase in the concentration of leaf extract in all the cases involved, which was also supported by the findings of Ashrafi *et al*. (2008) which reported that radicle length appeared to more

sensitive to allelochemicals than hypocotyls length. Also the results revealed that highest inhibitory effect was much more pronounced at concentrations T_3-T_5 followed by $T_2$0.31mm and $T_1$0.51mm (Table 2), $T_2$0.30mm and $T_1$0.51mm (Table 3), $T_2$0.62mm and $T_1$0.95mm (Table 4), $T_2$0.48mm and $T_1$0.52mm (Table 5). The effect was more pronounced in root development than shoot development in all cases where germination occurred. This results also confirms that allelopathy is a concentration dependent phenomenon as in increase in concentration increased the extent of inhibition (Ashrafi *et al*., 2008).

Based on the inhibitory extent of leaf aqueous extract as determined, the highest inhibitory effect was recorded at concentrations T_3-T_5 in all cases and the result was in agreement with was discovered by Abugre and Sam, (2010) which reported inhibitory effect of leaf aqueous extract of *J. curcas* on crops to be concentration dependent.

Investigation on the phytochemical screening of *J. curcas* (leaves, root and stem bark) extracts revealed the presence of saponins, steroids, tannins glycosides, alkaloids and flavonoids (Igbinosa *et al*., 2009). These phenolic compounds could be responsible for this inhibition on germination, root and shoot length. Abugre and Sam, (2010), recommended that the plant part that had strong effect on germination, plumule and radicle length was the leaves. This propose that more allelochemicals can be originated at the leaves than the roots of *J. curcas* and this was maintained by the findings of (Razavi, 2011), where introductory broadcast showed that leaf extract had the strongest allelopathic consequence on seed germination, thus was designated for detailed experiments. Correspondingly, Ma *et al*. (2011) stated that bio assayed research and analysis of dissimilar extracts of leaves and roots of *J. curcas* shown the chief allelopathic substance as Azeliac acid. This compound was also testified to have inhibitory consequence on the root and shoot growth of test crops more noticeable at high concentrations.

CONCLUSION

The researchpublicized that aqueous leaf extracts of *Jatropha curcas* inhibited the germination and rootlengths of peppers (*Capsicum* spp) studied. In addition, allelopathy has been observed to be a process dependent on concentration, as concentration increased, the extent of inhibition also increases as shown. Leave aqueous extract of *Jatropha* at concentration T_3, T_4 and T_5 showed more inhibitory effect when compared to lower concentration (T_2 and T_1 respectively) in all the cases. In route with the results of this research, it is recommended that the occurrence of azelaic acid make available a reasonable advantage to *Jatropha curcas* L. as resistance mechanism thus inhibiting the growth of adjacent crops. Based on this *Jatropha curcas* L. is acclaimed as not suitable for intercropping with *Capsicum* species and this evidence is extremely valuable to pepper farming based on intercropping system. It is consequentlysuggested that supplementaryinquiries on the endogenous and inhibitory action of azelaic acid in seeds of crops be carried out.

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