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ALLELOPATHIC EFFECT OF *JATROPHA CURCAS* (LIN) LEACHATE ON GERMINATION AND EARLY SEEDLING GROWTH OF FIVE (5) AGRICULTURAL CROPS IN KANO, NIGERIA

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ABSTRACT
Allelopathy refers to the chemical inhibition of one species by another. Decline in crop yields in cropping and agroforestry system in recent years has been attributed to allelopathy effects.Laboratory studies were conducted at Research Centre for Tissue Culture, Kazaure, Jigawa state (Longitude08° 41 ′ N and Latitude12° 65 ′ E). The aim of this study is to investigate the allelopathic potentials of aqueous leaf extract of Jatropha curcason seed germination and early seedling growth of five (5) crops. J. curcas aqueous leaf extract was prepared by 100g, 50g, 20g powder dissolved in 500ml double distilled water and were tested for their allelopathic effect on some growth parameters of maize, millet, guinea corn, cowpea and ground nut. The effect of the different concentrations was compared with that of distilled water (control). Healthy seeds were sought and surface sterilized with 1% sodium hypochloride for 20 minutes. Laboratory study was conducted using sterilized petri dishes with double layer of Whatman filter paper at averagely 27°C and 70% humidity. An interval of 24, 48, 76 and 92 hours were recorded on germination studies while radicle and shoot lengths at 92nhours respectively. Decreased in germination percentage, shoot and radicle lengths of the crops studied were observed to be concentration dependent.All the concentration of the different extracts had inhibitory effect on the germination of all the crops compared to control. Phytochemical screening of the J. curcas leaf extract was also determined.
Keywords: Allelopathy, Jatropha, Germination, Phytochemicals, Extract.

INTRODUCTION

Allelopathy is an interference mechanism in which live or dead plant material release chemical substances which inhibit or stimulate the associated plant growth (May and Ash, 1990). Allelopathy is all direct positive or negative effect of a plant on another or on microorganism by the liberation of biochemical (allelochemicals) into the environment (Elroy, 1984). Allelopathic chemicals can be present in any part of the plant. They can be found in the leaves, flower, roots, fruits or stems. They can also be found in the surrounding soil. These toxins affect target species in many different ways. Allelopathy also plays an important role in suppressing the growth of weed plants (Florentine and Fox, 2003).

Jatrophacurcas is a perennial poisonous shrub belonging to the family *Euphorbeaceae*. The plant originates from Central America to tropical and subtropical countries and mainly grown in Asia and Africa. Common names includes Barbados nut, purge nut, physics nut, black vomit nut, Curcas bean, the Hausa people of northern Nigeria called it 'Bini-da-zugu'. Recently, Cheema and Ali (2003) have advocated commercial utilization of sorghum water extract for weeds management in wheat. Khan *et al*., (2004) reported that *Prosopis, Eucalyptus* and *Acacia* retarded the growth and development of several weeds.The failure of most crops in an agroforestry system has been attributed to allelopathic effect of the tree species. This phenomenon is as a result of phytochemical exuded by trees. These chemicals are largely classified as secondary metabolites (such as alkaloids, isoprenoids, phenolics, flavonoids, terpanoids&gluconolatese.t.c (Nazir*et al*., 2007). Combining trees with annual or perennial crops is a common practice among the local farmers. In many tree species leaf leachates had been reported to have varying degrees of inhibitory and stimulating effects on germination percentage. It has been argued that detailed study of allelopathy can reduce reliance on herbicides.

MATERIALS AND METHODS

Study area

Laboratory studies were conducted at Research Centre for Tissue Culture, Kazaure, Jigawa State on Longitude 08 ^{o} 41' N and Latitude 12^{o} 65' E.

Preparation of the aqueous leaf extract

Fresh and manure leaf samples of *J. curcas* were collected randomly at vegetative stage in early 2010 from Old-site, Bayero University Kano. The leaves were shade dried and grounded using mortar and pestle then passed through 2mm mesh sieve. Different amounts; 100g/500ml, 50g/500ml, 20g/500ml and 0g/500ml (control) of the ground materials were dissolved in sterilized distilled water in a 1000ml conical flask. These gave the percentage leaf extract in 100ml of water 20%, 10%, 4% and 0% (control).

The mixture was then shaken intermittently and allowed to stand for 24 hours at room temperature. Thereafter the suspensions were filtered using layers of muslin cloth and then passed through No. 1 Whatman filter paper (Knox *et al*., 2010).

Collection and sterilization of seeds

Five (5) agricultural crops seeds were obtained from Kano Agricultural and Rural Development Authority (KNARDA). They includes Zeamay (ACR- 97; maize), *Panicummiliaceum* (Millet), *Sorghum sudanense* (SAMSORG 14 – KSV8; sorghum), *Vignaunguiculata* (277- 2; cowpea) and *Arachis hypogea* (SAMNUT- 23; ground nut). The grains were surface sterilized with 20% sodium hypochlorite for 15 minutes then rinsed severally with distilled water to remove the excess of the chemical. The seeds were presoaked in distilled water for two (2) hours and then soaked in different concentration of the aqueous leaf extracts for three (3) hours (Sazada*et al*., 2009). Ten (10) seeds of each crop were germinated inside germination chamber on double layer of No. 1 Whatman filter paper in petri dishes with the different leachate concentrations and laid in Completely Randomized Design (CRD) with three replications. The petri dishes were clearly labeled. Germination and early seedling experiment was terminated after 5 days. Data was recorded on rate of germination at 24, 48,72 and 96 hours intervals while shoot and root lengths were measured using thread and metre rule at the final stage of the experiment.

Phytochemical screening

About 30g of the powdered leaves were placed in a round bottom flask containing 200 cm^3 of methanol and mixed. The round bottom flask was placed in a flask shaker and agitated for four (4) hours and left to stand overnight. The extract was then filtered and the filtered extracts were subjected to phytochemical tests for the identification of the bioactive components(Bukar and Mudi, 2011; Malviya*et al*. 2011; Sofowora, 1993; Kumar *et al*., 2009).

Statistical analysis

Statistical analysis was performed employing one way analysis of variance (ANOVA) test using Microsoft Excel Window 2007. To detect the significance differences between means, least significant test was used at 5%. All values are expressed as mean ± standard deviation.

RESULTS AND DISCUSSION

The results in Table 1 showed the allelopathic effect of *J.curcas* aqueous leaf extract on millet, maize, guinea corn, cowpea and ground nut. Maximum germination percentage of the seeds were observed in all the control treatments with 100% germination attained within 76 hours after sowing in millet and maize, 48 hours in guinea corn and cowpea and 92 hours in ground nut. It was observed that the rate of germination decreased with increase in concentration of the leaf extract. However at 92 hours in the highest concentration (20%) percentage germination decreased from 100% to 90%, 80%, 93.3% and 40% in millet, maize, guinea corn and ground nut respectively. High germination reduction was recorded at 20% concentration in maize and millet while highest inhibitory effect was obtained in ground nut where germination did not occur at 24 hours in all the treatments and only 10% and 23.3% were recorded at 48 and 76 hours.

Highest shoot length was obtained in the control treatments while the lowest shoot length was recorded in the highest concentration (20%) with the exception of guinea corn where the minimum shoot length 4.5cm was obtained in the 10% concentration. However the differences in the shoot lengths were not significantly different ($p < 0.05$) in all the crops treated with *J.curcas* extract. Root length was significantly ($p < 0.05$) reduced in millet seeds by all concentrations of the extract. The highest root length (11.5cm) was observed in the control of millet and this decreased with increase in the concentration of the treatments to 6.5cm in 20% treatment (Table 2). Phytochemical screening of leaf extracts of *J.curcas* indicate the presence of carbohydrate, tannin, flavonoid, glycoside, resin, saponin, steroids and fatty acids while Anthraquinones and alkaloid were not observed (Table 3).

Allelopathy is considered as both harmful and beneficial interaction between the plants. The result obtained from laboratory study showed that the leaf extract of *J. curcas* exhibited varying degree of allelopathy by inhibiting the germination and growth of the tested crops. In the laboratory, maximum percentage seed germination was shown in the control treatments where no extract was used whereas the lowest seed germination was obtained in the highest concentration (20%). All the concentration of the different extracts had inhibitory effect on the germination of all the crops compared to control. These observations are consistent with findings on related plant species. Alam and Islam (2002) reported that plant produce chemicals which interfere with other plants and affect seed germination and seedling growth. Jadhar and Gayanar (1992) reported that percentage of germination, plumule and radicle length of rice and cowpea were decreased with increasing concentration of *Acacia auriculiformis* leaf leachate. Bhardwaj (1992) reported that leachates from *E. globulus* leaves significantly reduced maize germination but were ineffective on wheat germination. It was also observed (from the study) that the allelopathic potential of the *J.curcas* leaf extract is more pronounced in the germination study.Root length was strongly inhibited by the aqueous leaf extract of *Jatropha* in all the tested crops. A similar reduction of shoot length was also observed. It was also noticed that the decrease in root and shoot lengths seemed to increase with increase in concentrations of the extract.

Table 1: The effect of different concentrations (g/ml) of *Jatropha curcas* aqueous leaf extract on germination percentage of millet, maize, guinea corn, cowpea and ground nut.

Crop type and Time (hr)	Concentration of *J. curcas* leaf Extracts				LSD 5%
Millet	**Control**	**20g/500ml**	**50g/500ml**	**100g/500ml**	
24	40.0±6.15	23.3±3.21	23.3±3.21	10.0±0.0	16.30
48	80.0±7.36	56.6±5.10	40.0±4.64	30.0±4.64	25.49
76	100.0±0.0	90.0±4.64	70.0±4.64	60.0±4.64	16.3
92	100.0±0.0	100.0±0.0	100.0±0.0	90.0±4.64	NS
Maize					
24	53.3±3.21	30.0±4.64	20.0±0.0	10.0±4.64	14.37
48	90.0±0.0	70.0±4.64	70.0±4.64	60.0±4.64	16.30
76	100.0±0.0	100.0±0.0	90.0±4.64	80.0±4.64	13.30
92	100.0±0.0	100.0±0.0	96.6±3.21	80.0±4.64	10.87
Guinea corn					
24	60.0±4.64	30.0±0.0	30.0±4.64	20.0±4.64	16.30
48	100.0±0.0	90.0±0.0	76.6±6.15	70.0±4.64	17.18
76	100.0±0.0	100.0±0.0	80.0±7.36	80.0±4.64	NS
92	100.0±0.0	100.0±0.0	93.3±3.21	93.3±3.21	NS
Cowpea					
24	70.0±7.31	70.0±4.64	60.0±0.0	50.0±7.31	NS
48	100.0±0.0	100.0±0.0	100.0±0.0	100.0±0.0	NS
76	100.0±0.0	100.0±0.0	100.0±0.0	100.0±0.0	NS
92	100.0±0.0	100.0±0.0	100.0±0.0	100.0±0.0	NS
Ground nut					
24	30.0±4.64	0.0	0.0	0.0	9.41
48	73.3±6.15	23.3±3.21	20.0±4.64	10.0±4.64	20.3
76	90.0±4.64	50.0±4.64	30.0±4.64	23.3±3.21	17.18
92	100.0±0.0	70.0±4.64	50.0±4.64	40.0±4.64	16.30

Values are expressed as Mean ±standard deviation. NS = not significant, LSD= Least significant difference.

Table 2: The effect of different concentrations (g/ml) of *Jatropha curcas* leaf extracts on shoot and root lengths (cm) of millet, maize, guinea corn, cowpea and ground nut seedlings.

Crop type	Concentration of leaf extracts				
Shoot length	**Control**	**20g/500ml**	**50g/500ml**	**100g/500ml**	**LSD 5%**
Millet	6.0±1.50	5.8±1.21	5.6±0.45	5.6±0.45	NS
Maize	3.4±0.96	2.9±0.75	3.7±0.91	2.9±0.75	NS
Guinea corn	6.7±0.80	5.2±0.75	4.5±1.87	6.4±0.91	NS
Cowpea	4.2±1.20	3.5±1.10	3.8±1.81	3.3±1.56	NS
Ground nut	0.0	0.0	0.0	0.0	
Root length					
Millet	11.5±2.27	9.6±2.16	7.1±1.05	6.5±1.05	3.55
Maize	9.5±1.70	7.8±2.02	7.8±1.20	7.2±3.30	NS
Guinea corn	10.3±1.13	8.5±1.30	7.8±1.53	7.8±2.56	NS
Cowpea	4.6±1.51	5.8±2.50	6.2±1.50	3.6±1.68	NS
Ground nut	1.8±1.37	1.83±0.73	1.8±0.60	2.1±1.08	NS

Values are expressed asMean ±standard deviation. NS = not significant, LSD= Least significant difference.

Table 3: Phytochemical screening of *J. curcas* leaf extract using water and methanol as extract solvent.

Test	A	B
1. Carbohydrate	+	+
2. Alkaloid	-	-
3. Tannin	+	+
4. Flavonoids	+	+
5. Glycosides	+	+
6. Resins	+	+
7. Steroids	+	+
8. Saponin	+	+
9. Anthraquinone	_	_
10. Fatty acids	+	+

Key: A = water solvent, B = methanol solvent, (+) present, (-) absent.

CONCLUSION

Conclusively, from the results obtained it showed that the aqueous leaf extract of *J. curcas* at all the concentrations inhibited germination, root and shoot lengths of cowpea, ground nut, maize, millet and guinea corn. Aqueous leaf extract of *J. curcas* can be a good candidate for future field experiment and use as natural herbicide.

Recommendations

i. Farmers should avoid intercropping, demarcating or fencing their farm land with *J.curcas* as this may affect their farm produce.
ii. Further studies are suggested to investigate on molecular, genetic and physiological mechanisms of the observed allelopathy.

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