Standard Scientific Research and Essays Vol2 (8): 345-349, August 2014 (ISSN: 2310-7502)
http://www.standresjournals.org/journals/SSRE

Research Article

Evaluation of allelophatic effects *calotropis procera* on sorghum and maize

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Accepted 26 August 2014

Abstract

The study was conducted to study the allelopathic effect of different concentrations (0,5,10,15 and 20%) of aqueous leaf extract of *Calotropis procera* on certain growth parameters (leaf area, plant height, fresh and dry weight and leaf number) in sorghum and maize. The experiment was conducted in a screen house (pot experiment) and was laid down in a completely randomized design (CRD). Results of the study revealed that the different concentrations (0, 5, 10, 15 and 20%) of the aqueous leaf extract had effect on growth parameters investigated. The highest inhibition in leaf area, plant height, fresh and dry weight of sorghum and maize was recorded in the 20% concentration. While the control experiment (0% concentration) had the lowest inhibition. The rate of inhibition is concentration dependent. As the concentration increases the leaf area, plant height, fresh and dry weight decreases. *C. procera* aqueous leaf extract did not have any allelopathic effect on leaf number of sorghum and maize. Therefore the study revealed that allelochemicals released from *Calotropis procera* extract had inhibitory effect on leaf area, plant height, fresh and dry weight of sorghum and maize and would have inhibitory effect when grown alongside with the test crop.

Keywords: Allelopathy, aqueous extract, inhibition, *Calotropis procera*

INTRODUCTION

Calotropis procera is an evergreen poisonous shrub and is generally known as milkweed, rubber bush, kapock tree or Sodom apple. It is a member of the family Asclepiadaceae (Parihar *et al.,* 2011) whose members are distributed throughout the world in tropical and sub-tropical regions. It is abundant in warm climate areas having dry, sandy and alkaline soils. It is mostly noted in waste and fallow lands along roads, streets, residential colony parks, sand dunes as well as in crop fields as weed (Kareem *et al.,* 2008). It is a native of North Africa, Tropical Africa, Western Asia, South Asia and Indochina. The sap contains a mix of chemicals some of which are steroidal heart poisons known as cardiac aglycones. It grows commonly around farms and agricultural areas. *Calotropis procera* has perennial growth habit with tall and erect stem having large number of branches thus assuming the shape of shrub or sometimes small tree which can grow up to 2-3 m height. Mode of propagation is mainly the seed which are transported by wind and water while asexual propagation at localized scale also occurs through suckers from the roots (Yasin *et al.,* 2012). The interference of one plant on the other by the release of biomolecules to the environment which affects and influence the growth and development of other plants and microorganisms either positively or negatively are termed allelophathy (Rice, 1984). Many plants are known to be phytotoxic in nature as they produce and release numerous allelochemicals into the environment. Chemicals that are released from plants which impose allelophathic influence on other plants are called allochemicals or allelochemics. Allellochemicals are present in many plant organs including leaves, stem, rhizome,

flowers, fruits, buds, seeds and pollen grains (Putnam, 1986; Ashrafi *et al*., 2007; Ahmad *et al*., 2011). They are released to the environment through the process of leaching, volatization, root exudation and decomposition of plant residue of dead plant particles and through seed extract (Jalageri *et al*., 2010). Different plant parts including flower, leaves, leaf litter and leaf mulch, stem, buds, roots, soil and soil leachates and their derived compounds can have allophathic effect that varies (Das, 2011). Allelochemicals have significant effect on cell division, cell differentiation, ion and water uptake, respiration. Photosynthesis, enzyme function, signal transduction as well as gene expression, inhibition of germination, reduction in growth length of plumule and radicle (Patil, 1994; Tobe and Omassa, 2000; Inderjit and Duke, 2003). The present study was conducted to evaluate the allelopathic effect of different concentrations of *Calotropis procera* aqueous leaf extract on sorghum and maize.

MATERIALS AND METHODS

Mature leaves of *C. procera*) were collected from different localities of Kano state. Kano is located in the sudan savanna Agro-ecological zone on latitude 12° 03' N and longitude 08° 31' E and altitude of 1500m above sea level (Kuwal and Knabe, 1972).

Extraction of plant material

Fresh mature leaves of the test crops were collected, dried at room temperature and pulverized into fine powder using pestle and mortar. The fine powder was sieved through 1mm mesh size / sieve. Ten gram (10g) of the powdered sample was soaked in 1000ml of sterilized distilled water for 24hrs. the suspension was filtered through a double layered muslin cloth then no 1 Whatman filter paper. Water extract was further diluted with water to get concentrations of 5,10,15 and 20% respectively, ordinary distilled water was used as control (0% concentration).

Screen house experiment

The experiment was conducted in a screen house located at the International Institute of Tropical Agriculture (IITA) Sabo Bakin Zuwo Road, Kano. Kano is situated about latitude 12° 03' N and longitude 08° 31' E. A total of six seeds/planting pot (a 4 liter plastic pot) were planted and later thinned to 2 plants/pot after germination. There were 30 pots for each treatment, each treatment was replicated six times (i.e six replications per treatment). The pots were arranged in a completely randomized design (CRD). They were watered with the extract at 2 -3 days interval and water was used as control. Data was collected on number of leaves, leaf area per plant, plant height, plant fresh weight and plant dry weight and recorded.

The leaf area /plant was estimated by measuring length and width of randomly selected leaves and applying formula as outlined by Pearce *et al.* (1975).

A = leaf area A= (L)(W)(0.75) ×2
W=width of leaf 0.75 is a constant leaf area factor for cereals
L= length of leaf

Statistical analysis

The data obtained were statistically analyzed according to the technique of analysis of variance (ANOVA). The treatment means were separated using Least significance difference (LSD) at 5% ($p<0.05$) level of significance**.** All computations and statistical analysis were performed using SAS software package (SAS, 2000).

RESULTS AND DISCUSSION

The effect of *C. procera* aqueous leaf extract on leaf area and plant height of sorghum and maize are shown in Table 1 and 2. At 3, 6 and 9 weeks after sowing (WAS)the control experiment (0% concentration recorded the highest leaf area in sorghum (50.2,170.0 and 358.0) and maize (51.8,177.0 and 360.7).while the lowest leaf area was in the 20% concentration in both sorghum (31.6, 124.3 and 308.1) and maize (30.6, 127.2 and 345.8). the highest inhibition in plant height was observed in the 20% concentration in sorghum (7.2,35.0 and 102.0) and maize (5.8,30.7 and 97.0), while the lowest inhibition was recorded in the control experiment (0% concentration. The higher the concentration of *C. procera* aqueous leaf extract the higher the reduction in leaf area and plant height of sorghum and maize. Similar results have been reported by Velu and Rajagopal (1996) and Jalageri *et al.* (2010). The result correlates with the findings of Modupe

and Joshua (2013) who reported that the leaf area of *B. pilosa* treated with extracts of maize root and rice husk was retarded with the retardation increasing with the increase in the concentration of the extracts. Similarly Dadkhah (2012) reported that foliar sprays of extracts of *Ephedra major* reduced plant height of *Circium avense*, the higher the concentration the greater the inhibition.

Tables 3 and 4 presents the effect of *C. procera* aqueous leaf extract on fresh and dry weight of sorghum and maize. At 3, 6 and 9 WAS the control experiment (0% concentration) had the highest plant fresh weight in sorghum 93.8,31.3 and 58.0) and maize (4.6,24.7 and 60.0). while the lowest inhibition was recorded in the 20% concentration in sorghum (2.6,24.6 and 50.0) and maize (3.3.,18.0 and 48.3). The 20% concentration recorded the lowest dry weight in sorghum (2.1, 24.3 and 46.7) and maize (0.9, 13.0 and 42.0). And the highest dry weight was observed in the control experiment (0% concentration) in sorghum (3.2, 26.8 and 52.6). As the concentration increases the fresh and dry weight decreases. Similar observations were made by Khan *et al* (1999) who reported that *Eucalyptus* extract reduces the fresh weight of maize seedlings. Also Khan *et al* (2008) reported that the dry weight of some weeds significantly reduces due to incorporation of aqueous extracts of *Eucalyptus camaldulensis.* This was further supported by Jalegeri *et al.* (2010) who reported that the dry matter accumulation of stem and leaf significantly reduces due to incorporation of different weed residue on some cereals, pulses and oil seed crops. The result also confirmed that allelopathy is a concentration dependent phenomenon Valthiyanathan *et al.* (2014).

The effect of *C. procera* aqueous leaf extract on plant leaf number of sorghum and maize are presented on Table 5. The aqueous leaf extract of *C. procera* did not have either inhibitory or stimulatory effect on leaf number of sorghum and maize. This result is consistent with that of Dadkhah (2012) who reported that the aqueous extract of *Ephedra major* did not have allelopathic effect on number of leaves of *C. avense*.

Table 1. Effect of *C. procera* aqueous leaf extract on the leaf area(cm) of sorghum and maize

	WAS Sorghum			maize		
Treatment (%)	3	6	9	3	6	9
0	50.2	170.0	358.0	51.8	177.0	360.7
5	42.6	140.3	355.3	36.6	161.5	357.7
10	41.5	133.0	349.7	40.2	148.4	354.3
15	41.1	128.6	344.7	35.7	131.8	351.0
20	31.6	124.3	308.1	30.6	127.2	345.8
LSD	0.081	11.16	42.7	9.79	20.6	5.5.10
SE	0.33	12.55	179.1	9.66	42.3	2.62

Key = WAS = Weeks after sowing SE= standard error

Table 2. Effect of *C. procera* aqueous leaf extract on the plant height (cm) of sorghum and maize

	WAS Sorghum			maize		
Treatment (%)	3	6	9	3	6	9
0	10.7	43.7	121.0	8.5	34.1	121.3
5	8.9	42.0	116.3	8.0	33.9	113.7
10	8.5	39.7	109.7	7.3	33.4	107.0
15	8.0	38.5	105.3	6.6	32.0	100.7
20	7.2	35.0	102.0	5.8	30.7	97.0
LSD	0.79	1.92	90.8	0.842	2.12	18.46
SE	0.063	0.37	167.8	0.071	0.45	45.85

Key = WAS = Weeks after sowing SE= standard error

Table 3. Effect of *C. procera* aqueous leaf extract on the plant fresh weight (g) of sorghum and maize.

.	WAS Sorghum			Maize		
Treatment (%)	3	6	9	3	6	9
0	3.8	31.3	58.0	4.6	24.7	60.0
5	3.5	29.3	37.0	4.5	23.9	56.0
10	3.2	29.0	54.3	3.9	22.7	55.0
15	3.0	26.7	51.7	3.9	21.0	33.3
20	2.6	24.6	50.0	3.3	18.0	48.3
LSD	0.22	2.49	2.19	0.43	2.31	2.228
SE	0.027	0.623	0.483	0.01	0.54	0.50

Key = WAS = Weeks after sowing SE= standard error

Table 4. Effect of *C. procera* aqueous leaf extract on the plant dry weight (g) of sorghum and maize

	WAS Sorghum			maize		
Treatment (%)	3	6	9	3	6	9
0	3.2	26.8	52.7	1.4	18.8	52.0
5	3.1	2.6	51.3	1.3	18.6	5040
10	2.9	28.4	50.0	1.2	16.0	96.0
15	2.5	24.6	48.0	1.0	14.0	45.0
20	2.1	24.3	46.7	0.9	13.0	42.0
LSD	0.15	0.69	1.41	0.09	6.93	3.34
SE	0.002	0..49	0.20	0.0008	4.84	0.84

Key = WAS = Weeks after sowing SE= standard error

Table 5. Effect of *C. procera* aqueous leaf extract on the leaf number of sorghum and maize

	WAP Sorghum			maize		
Treatment (%)	3	6	9	3	6	9
0	6.0	10.0	14.0	6.0	9.0	14.0
5	6.0	10.0	14.0	6.0	9..0	14.0
10	6.0	10.0	14.0	6.0	9.0	14.0
15	6.0	10.0	14.0	6.0	9.0	14.0
20	6.0	10.0	14.0	6.0	9.0	14.0
LSD	NS	NS	NS	NS	NS	NS

Key = WAS = Weeks after sowing SE= standard error NS = Not significant

CONCLUSION

The study also confirmed the findings that *C. procera* aqueous leaf extract have phytotoxic effects and inhibition in the growth of leaf area, plant height, plant fresh and dry weight of sorghum and maize. The result also confirmed that allelopathy is a concentration dependent phenomenon.

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