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Evaluation of Allelopathic Potential of Lantana Camara and Tithonia Diversifolia on Seed Germination Attributes Of Cowpea [Vigna Unguiculata (L) Walp]

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Abstract: *Some weeds that have been reported to have allelopathic potentials are always found in association with field crops. This association might be inhibitory or stimulatory; some of these weeds however have the potentials of becoming invasive under certain cropping system and environmental situations. The objective of this study was to assess the effect of aqueous extract of some selected weed species on seed germination of cowpea. An in vivo, experiment was conducted to study the effect of water extract of leaves, shoots and roots of Lantana camara and Tithonia diversifolia on the germination of cowpea, in factorial experiment of 2 (weeds) × 3 (concentrations) in a completely randomized design (CRD) with three replicate. Three concentrations (10%, 20% and 40%) of each ground plant parts were studied with distilled water used as control. The aqueous extracts of the plant parts and control were used to germinate seeds of Cowpea (Ife-brown) in petri-dish with 5ml of extracts administered to each petri dish. Data were collected on number of germinated seeds daily, from 3 days after sowing (DAS) to 8DAS. Also length of plumules and radicles were measured and recorded at 8 DAS on five randomly selected germinated seeds. Data were anlysized by ANOVA and the means separated using the Duncan's Multiple Range Test (DMRT). Results showed that germination percentage, radicles and plumules length decreased with increase in concentration, Reduction in length was more pronounced in the extracts derived from L. camara than those from T. diversifolia significantly when compared with control at 5% level.*

Key words: *Lantana camara, allelopathy, germination, inhibition and Tithonia diversifolia.*

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I. Introduction

Generally, plants interact with others in natural environment; sometimes an individual plant can have a depressive effect on its neighbors. Muller, (1969) described the adverse effect of a neighboring plant in association with others and defined it as interference. Interference is the association between two organisms in which one or both suffer(s) some set back; this includes Competition, Parasitism and allelopathy. According to Szczepanski, (1977) the potential causes of interference include; Allelospoly (competition) the depletion of one or more resources required for growth while Allelopathy is the addition of chemical toxins by one or more species in association. The term "allelopathy" was proposed for expressing the harmful, stimulatory, enhanced and beneficial effects that one plant species has on another through the formation of chemical retardants escaping into the environment (Molisch, 1937). The International Allelopathy Society (IAS,1996) defined allelopathy as any process involving secondary metabolites produced by plants, micro-organisms, viruses, and fungi that influence the growth and development of agricultural and biological systems, including positive and negative effects. Chemicals released from plants that impose allelopathic influences are termed allelochemicals or allelochemics or allelotoxins (Einhellig, 1987). These chemicals are present in different parts of plants like stem, leaves, roots, flowers, inflorescence, fruits and seeds (Putnam, 1985). These allelochemicals are released from the plants by volatilization, leaching, exudation and decomposition of plant residues (Rice, 1984).

T. diversifolia (Mexican sunflower), an aggressive weed with high invasive capacity, is a native of Mexico and Central America and has been introduced to West Africa as an ornamental plant and possibly with imported grains (Akobundu and Agyakwa 1998; Ayeni et al., 1997). T. diversifolia as reported by Taiwo and Makinde, (2005) has both stimulatory and phytotoxic plant inhibitory attributes. However, Tongma et al., (1997) investigated the allelopathic effect of T. diversifolia; and they found out that there was a decrease in shoot and root growth of the test plant species when grown in soil previously planted with T. diversifolia though seed germination was not affected. Lantana camara, one of the world's 10 worst weeds was introduced in the Indian subcontinent during the early part of the nineteenth century (Bansal, 1998). The weed is aggressively growing in forest, tea garden and wastelands of the country (Ahmed, 2007). This obnoxious weed poses a serious problem

to flora and fauna because of its toxic substance and it contains certain allelopathic compounds (Jain et al., 1989). Although several researches have so far worked on the invasion and allelopathic effects of Lantana on various agricultural crops (Bansal, 1998).

II. Materials And Methods

Receptor crops

The cowpea seeds variety Ife-brown was the test crop and was collected from Institute of Agricultural Research and Training (IAR&T) Ibadan.

Donor plant

In the experiment, *L. camara* and *Tithonia diversifolia* as the donor plants, while stem, leaf and root aqueous extracts were used as the allelochemical.

Preparation and application of aqueous extracts

The aqueous extracts were prepared following Edrisi et al. (2011) method with modifications. The collected plant materials were sorted into three parts (root, stem and leaf) and air dried in the laboratory at 25oC for twenty one days. The air dried plant materials were then ground with Thomas, bench top milling machine and stored away in well labeled envelopes. The ground plant materials were weighed 10g, 20g and 40g then soaked separately in distilled water made up to 100 ml in beakers to have 10%, 20% and 40% (w/v) concentrations respectively. The beakers were covered with aluminium foil and extraction was kept on at room temperature (25oC) for 24 hours, when extracts were obtained by filtering with a muslin cloth. The filtrates were stored in an incubator at 15oC. The study was a 2 x 3 factorial experiment of two weed plants and three concentrations laid out in a Completely Randomized Design (CRD), with the control treatment being distilled water. The 7 treatments were replicated three times. The allelopathy was separately compared by plant parts. Ten (10) seeds of each test crops were placed in petri-dishes lined with Whatman No 1 filter paper and replicated three times; 5 ml (milliliter) of each treatment was applied to each petridish using a syringe. The seeds were observed for germination, by the protrusion of radicle and plumule. Germination was observed on daily basis for eight days. On 8 DAS the number of seeds that germinated was counted in each of the treatments for all the test crops. Also, at 8 DAS the length of plumules and radicles was measured (using meter rule). Five germinating seeds were randomly picked in each petridish for the latter measurements.

III. Results And Discussion

Germination of cowpea seeds exposed to varying concentrations of leaf, stem and root aqueous extracts two weed species

Leaf Extract: Germination of cowpea seeds exposed to varying concentrations of plant part aqueous extracts, comparing leaf extract to control (distilled water), germination decreased with increasing concentration of aqueous extract in each weed species. The germination inhibition varied among the weed species. Germination varied from 56.7% in *L.camara* to 86.7% in *T. diversifolia* at 10% leaf concentration, but varied from 6.7% *in L. camara* to 56.7% in *T. diversifolia* at 40% concentration (Table 1).

Stem Extracts: Less inhibition was recorded in stem aqueous extract. Mean germination varied from 73.3% in *L. camara* to 100% in *T. diversifolia* at 10% concentration. However, at 40% concentrations mean germination varied from 46.7% in *L. camara* to 56.7% in *T. diversifolia* (Table 1).

Root Extracts: At 10% concentration of the root extracts, germination varied from 73.3% in *L. camara* to 93.3% in *T. diversifolia*, while at 40% concentration germination varied from 46.7% in *L. camara* to 60.0% in *T. diversifolia* (Table 1).

Table 1: Germination percentage of cowpea seeds treated with varying concentration of stem, root and leaf extracts of two weed species at 8 DAS

	GERMINATION (%)		
TREATMENT	LEAF EXTRACTS	STEM EXTRACTS	ROOT EXTRACTS
Control	100a	100a	100a
T. diversifolia 10%	86.7abc	100a	93.3ab
T. diversifolia 20%	66.7cd	70.0def	70.0cdef
T. diversifolia 40%	56.7d	56.7fg	53.3efg
L. camara 10%	56.7d	73.3cde	73.3cde
L. camara 20%	26.7e	60.0efg	60.0defg
L. camara 40%	6.7f	46.7g	46.7g

Percentage values with the same letters under a column are not significantly different according to Duncan's Multiple Range Test (DMRT), at 5%level.

EFFECTS OF AQUEOUS EXTRACT OF PLANT PARTS ON RADICLE LENGTH (cm) AT 8 DAS

Comparing the aqueous extracts of plant parts with control (distilled water) showed that the treated Cowpea seeds at different concentrations of aqueous extracts have significant difference on the radicle length.

Leaf Extract: The radicle length of the germinated seeds of cowpea varied among the different vegetative parts extracts, recording 6.33±0.44 cm leaf extract of *L. camara* to 8.50±0.88 cm in *T. diversifolia* at 10% (Table 2), but varied from 4.83±0.44 cm in *L. camara to* 7.00±0.88 cm *T. diversifolia* at 40% concentration.

Stem Extracts: Less reduction in length was recorded in stem aqueous extracts. The mean values varied from 7.83±0.60 cm in *L. camara* to 10.60±0.57 cm in *T. diversifolia*, at 10% concentration. However, at 40% concentrations mean length varied from 5.33±0.44 cm in *L. camara* to 10.33±0.88 cm in *T. diversifolia* (Table 2).

Root Extracts: At 10% concentration of the root extracts, radicle length varied from 7.50±0.28 cm in *L. camara* to 9.00±0.57 cm *T. diversifolia*, while at 40% concentration germination varied from 5.17±0.44 cm in *L. camara* to 6.83±0.60 cm in *T. diversifolia* (Table 2). Reduction in radicles length increased with the increase in the concentrations of the extracts thus suggesting that the effect of the extracts is concentration-dependent.

Table 2: Mean radicle length of germinating cowpea seeds treated with varying concentrations of leaf, stem and root aqueous extracts of six weeds species at 8 DAS

		RADICLE LENGTH	(cm)
TREATMENT	LEAF EXTRACTS	STEM EXTRACTS	ROOT EXTRACTS
Control	12.67a±0.00	12.00a±0.00	11.67a±0.00
T.diversifolia 10%	8.50b±0.88	10.60b±0.57	9.00b±0.57
T.diversifolia 20%	7.33bcd±0.88	10.47b±0.88	6.50de±0.28
T.diversifolia 40%	7.00bcd±0.88	10.33b±0.88	6.83cde±0.60
L.camara 10%	6.33cde±0.44	7.83cd±0.60	7.50bcd±0.28
L.camara 20%	5.67de±0.44	5.00ef±0.50	6.17de±0.44
L.camara 40%	4.83e±0.44	5.33ef±0.44	5.17e±0.44
CV (%)	13.60	14.67	13.71

Values with the same letters under a column are not significantly different according to Duncan's Multiple Range Test (DMRT), at 5%level.
CV= Coefficient of variation.

EFFECTS OF AQUEOUS EXTRACT OF PLANT PARTS ON PLUMULE LENGTH (cm) AT 8 DAS

Leaf Extract: The plumule length of the germinated seeds of cowpea varied among the leaf extract concentrations, recording 4.67±0.33 cm in *L. camara* to 5.67.00±0.66 cm in *T. diversifolia* at 10% (Table 3). However the length varied from 3.00±0.33 cm in *L. camara to* 4.67±0.88 cm *T. diversifolia* at 40% concentration.

Stem Extracts: Less reduction in length was recorded in stem aqueous extract. Mean plumule length varied from 5.00±0.33 cm in *L. camara* to 5.67±0.33 cm in *T. diversifolia* at 10% concentration. However, at 40% concentrations mean length varied from 3.33±0.33 cm in *L. camara* to 5.33±0.60 cm in *T. diversifolia* (Table 3).

Root Extracts: At 10% concentration of the root extracts, plumule length varied from 4.67±0.57 cm in *L. camara* to 5.67±1.10 cm in *T. diversifolia*, while at 40% concentration germination varied from 3.00±0.33 cm in *L. camara* to 4.67±1.01 cm in *T. diversifolia* (Table 3).

Table 3: Mean plumule length of germinating cowpea seeds treated with varying concentrations of leaf, stem and root aqueous extracts of two weeds species at 8 DAS

	PLUMULE LENGTH	(cm)	
TREATMENT	LEAF EXTRACTS	STEM EXTRACTS	ROOT EXTRACTS
Control	7.77a±0.00	7.33a±0.00	8.00a±0.00
T. diversifolia 10%	5.67bcd±0.66	5.67b±0.33	5.67bc±1.10
T. diversifolia 20g%	5.33bcd±0.28	5.67b±0.33	3.67fgh±1.20
T. diversifolia 40%	4.67cdef±0.88	5.33b±0.60	4.67cdef±1.01
L. camara 10%	4.67cdef±0.00	5.00bc±0.33	4.67cdef±0.33
L. camara 20%	3.67fgh±0.88	3.67cd±0.00	3.67fgh±0.33
L. camara 40%	3.00h±0.33	3.33d±0.33	3.00h±0.33
CV (%)	11.41	9.04	11.16

Values with the same letters under a column are not significantly different according to Duncan's Multiple Range Test (DMRT), at 5%level.
CV= Coefficient of variation.

IV. Conclusion

Many plants and their root residues have been reported to have allelopathic effect on agricultural crops (Whitaker and Feeny, 1970). Studies have been carried out on the effects of allelochemicals released by root, leaves, stem, fruits and other parts (Rice, 1984). The present study revealed that aqueous extracts of the selected weed species L. camara and T. diversifolia contained water soluble allelochemicals which cause inhibitory effects on germination and on germination attributes. The aqueous leaf extracts showed higher inhibitory effect on the seed germination with increase in concentration. Effects of leaf extracts could be due to the large amount of allelochemicals present in the leaf (Madrid, 1974). Inhibitory effects increased with increase in concentrations, whereas lower concentrations in T. diversifolia showed stimulatory effect on the cowpea germination. This study on leaf extracts of L. camara showed significant inhibition of cowpea seed compared to the control treatment at all concentrations. This is a confirmation of observation of Ahmed et al (2007) on allelopathic effects of L.camara on some agricultural crops.

At low concentration T. diversifolia showed stimulatory effect on seed germination, with results not significantly different from the control. Results obtained from this work are similar to that of other researchers, in relation to inhibitory effects of leaf extracts of Ageratum conyzoids on seed germination of rice Malla, (2003; Poudel, 2004). Eze and Gill (1992) reported that Chromolaena odorata allelochemicals inhibit the growth of many plants in nurseries and plantations. Otusanya et al. (2007) have demonstrated that aqueous extracts of leaf and shoot extract of T. diversifolia was inhibitory to the germination and growth of Amaranthus cruentus. T. diversifolia at low concentration confirmed the report by Taiwo and Makinde (2005) who asserted that the plant has both stimulatory and phytotoxic inhibitory attributes. However, results suggest that reduction in radicle length was more pronounced in the extracts derived from L. camara than T. diversifolia extracts. T. diversifolia produced least reduction in radicle length, in the stem and root aqueous extracts. Similar observations were made by Aziz et al. (2008) on wheat.

Based on the result obtained from this research on the allelopathic potential of the two selected weeds species, Lantana camara showed higher allelopathic potency, even at low concentrations and should be carefully removed during land preparation and cultivation, to avoid high deposit of residues of various vegetative parts. Considering the stimulatory effect of Tithonia diversifolia at low concentrations, they could be used in soil amendment to enhance performance of crops. Further study should be carried out on effect of the aqueous extracts on the performance of the seedling.

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