POSSIBLE ALLELOPATHIC EFFECTS OF SIAM WEED (*CHROMOLAENA ODORATA*) ((L) R.M. KING & ROBINSON) EXTRACTS ON THE GERMINATION AND SEEDLING GROWTH OF COWPEA (*VIGNA UNGUICULATA* L.) AND MAIZE (*ZEA MAYS* L.)

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ABSTRACT

Investigations on the possible allelopathic effects of *Chromolaena odorata* (L) R.M king & Robi son; on the germination and seedling growth of cowpea and maize were made. Dilution of 1:1, and 1:5 v/v of the original extracts were prepared by adding distilled water to the full strength (undiluted) extracts. The extracts were used in their full strength, 1:1 and 1;5 dilution and distilled water served as control. Extracts of the C. *odorata* and their dilution significantly ($P< 0.05$) reduced seed germination, plant height and root length of all the species compared with the controls. However, as the dilution of the extract increased, the percentage germination and plant growth increased. This observation was consistent in the two species investigated indicating that there was reduction in the concentration of the compound in the extract causing inhibition of germination and growth in the two species. The inhibitory effects of the seed germination and plant growth was in the order roots >leaves > stem. The result indicates that the tissues of *C. odorata* contain water-soluble compounds capable of inhibiting seed germination and plant growth,

Key words: *Chromolaena odorata*, extracts, allelopathy, seedling, maize, cowpea.

INTRODUCTION:

Allelopathy has been reported in a wide range of plant species. It however appears to be best developed in perennial; and woody species of arid environment and early successional species of more humid regions (Borner, 1960). Reviewers that have summarized information on the occurrence, chemistry and biological effects of allelo-chemicals included, Bonner (1960) and Woods (1960). Several other papers have considered the role of allelopathy in vegetational structure and dynamics (Muller, 1966, 1969, Whiltaker, 1970 and Wilson and Rice 1968). Influence of foliage of Mesquite *(Prosopis juliflora)* on germination and seedling growth of Bermuda grass *(Cynodon dactylon)* has been investigated by alHumaid and Warrag (1998), while the use of aqueous extracts of leaf, stem, root, soil and litter leachates and litter extracts have been used to test for inhibitory effects on germination and seedling growth of many crops. Joshi et.al (1992) and Thakur and Bhardwaj. (1994), used litter extracts of some tree species to test for the effects of allelopathy on seedling growth of agricultural erops, while Jadhav and Gaynar (1995) used litter leachates of

Casuarina equisetifolia to test for allelopathy on germination and seedling growth of rice and cowpea. The effects of leaf extracts of eucalyptus has been tested on the germination and seedling growth of winter crop, (Bisla et.al 1992) while Clinton and Vose, (1996), used the leaf extracts of *Rhodendron maxin* to test for allelopathy on seedling establishment of *Acer rubrum*. Similarly Hansen-Quartey et.al (1998) tested for the effects of aqueous extracts from *Artemisia afra* and soil on seed germination and early seedling development in selected plant specie.

The findings of most of the works show that substances released by the plants or the parts tested tremendously influenced the germination and seedling growth of agricultural crops. The inhibitory substances are released from producer plants in a variety of ways. Some plants release the offensive chemicals so that they pass directly into the soil from roots of living plants (Woods1960). In other cases, they may be leached from living or dead tissues of plants and be deposited either in the soil or on the surface of other plants (Borner, 1960). In a few cases, volatile compounds may pass into the air and be deposited on surfaces of other plants when dew forms (Muller and Muller, 1994). Inhibitions caused by the chemicals in these various ways are presumably important in intra-specific or inter-specific competition between the producer plants and crops for various environmental resources which lead to reduction of yield in the outwitted crops. Observation on the performances of the plants *Chromolaena odorata* leaves no doubt that it is a noxious weed (Lucas, 1989). Such performance includes the formation of a dense thicket, which hinders silvicultural activities by restricting access into the forest areas (Ivens, 1989), its potential to persist and its competitive effects on crops (Gill et.al 1986), and the presence of essential oils that account for its pungent smell. The weed has been employed in the control of yellow diseases and root rot complex of black pepper, and found to reduce the population of the nematode *Heterodera mariopi* Schmidt in the soil. (Litzenberger, and Hotong Lip; 1961). These authors also reported that crabs were repelled in a rice field when *C.odorata* was used as green manure.

The present work is aimed at testing for the possible presence of inhibitory substance in weed *C. odorata*, by investigating the effects of aqueous extracts of its leaves, stems and roots and their dilutions on the germination and seedling growth of maize and cowpea.

MATERIALS AND METHODS:

The experiment was carried out in the laboratory complex of college of Biological and physical Sciences of Michael Okpara University of Agriculture. Umudike. The cowpea *(Vigna unguiculata* L.*)* and maize *(Zea mays* L.) used in the experiment were obtained from the National Root Crops Research Institute, Umudike Abia State. The siam weed *(Chromolaena odorata)* used was collected from its natural habitat in an abandoned farm strip, near the University.

Preparation of extracts:

Chromolanena odorata plants were pulled out of the soil and the roots were washed free of adhering soil. Each plant was cut to separate leaves, stem and roots. The different parts were cut into small segments of about 0.5cm. Aqueous extracts of each part was made following a slightly modified method of Katz, et.al (1987). Cold distilled water was used in the extraction as previous experience shown that either hot or cold water could be effectively used (Hansen-Quartey et.al. 1998) Approximately 10g of material was mixed with 100ml distilled water and blended in a Moulinex mixer blender. The blended material was centrifuged for 30min at 18000 rounds per minute. The supernatant was filtered through four layers of cheese cloth (0.25ìm pore size). The filtrates obtained were considered as original undiluted extracts. Two dilutions (1:5,v/v) of the original extracts were prepared by mixing the original with distilled water.

Seed Germination Test:

The seed germination test was carried out following a slightly modified method of Hansen-Quartey et.al (1998). Treatments consisted of combinations of the three dilutions (full strength, 1:1 and 1:5) and two plant specie viz: cowpea (*Vigna unguiculata* L.) and maize (*Zea mays* L.). Distilled water was used as control on all the treatments. Five replicates of 20 seeds for each treatment were used in a completely randomized design. The seeds were placed in covered petri -dishes (12.5cm) in diameter each lined with six filter paper discs to retain enough of the liquid. The seeds were kept moist by applying about 1.5ml of the appropriate extract daily. All treatments were kept on experimental benches at laboratory room temperature. Germination (considered to have occurred when the radicle had extended to at least 1-2mm, (Hansen- Quartey et.al 1998)) was recorded at 5-day interval for 10 days. At the end of the study, the total number of seeds, which had germinated in each treatment, was expressed as a percentage of the total number of seeds.

Seedling growth test.

For the seedling growth test, the same treatments as for the germination test were used. Seedlings were grown in 10cm plastic plant pots filled with sterilized soil. Eight seeds of each plant species, (cowpea and maize) were sown in each of five pots. Soon after emergence, seedlings were thinned down to five per pot. A completely randomized design was used with five replicates. Each pot was moistened daily with 10ml of appropriate extract. The seedlings were grown in a secluded corner behind the Biology laboratory complex of Michael Okpara University of Agriculture Umudike. At the end of the growing period of 20 days after emergence, plant height and root of the seedlings in each treatment were measured; using a 50cm wooden ruler. The plant height was measured from the base of the plant to the tallest leaf (Hansen Quatery, et.al, 1998), while the root length was measured from the base of the plant to the longest root after carefully washing off adhering soil with clean tap water.

Statistical analysis:

Analysis of variance (ANOVA) was used to test for treatment differences, and mean separation was done using the least significant difference (LSD), $p<0.05$.

RESULTS:

(a) Seed germination:

The result of the effects of *Chromolaena odorata* extracts and their dilutions on the germination of cowpea and maize seeds are summarized in Table 1a and b. the analysis of variance showed significant ($P<0.05$) effects of extracts and dilutions on germination of the seeds of the two crop plants. All extracts in their full strength (undiluted), significantly reduced ($p<0.05$) seed germination in the two species to as low as 4o% compared to control (distilled water), which recorded up to 99% (Table 1). However there was a clear distinction between the seed germination percentages of the undiluted extracts and the dilutions. As the dilution of extracts increased, seed germination was increased as shown by the higher germination percentage of 69% recorded in cowpea with 1:1 dilution (Table 1a) and 86% germination recorded in maize

With 1:5dilution (Table1b). This observation indicates the presence of inhibitory compound in the *C.odorata* extracts. It also showed that the concentration or strength of the extracts was reduced with increased dilution. Roots of *C. odorata* have the most inhibitory effect on seed germination, reducing germination to as low as 4o% in cowpea and 49% in maize, followed by the leaves with as low as 51% in cowpea and49% in maize. Hence inhibition to germination by *C.odorata* extracts was in the order roots> leaves > stem. Generally *C.odorata* extracts reduced germination more in cowpea than in maize.

(b) Seedling Growth.

The result of the effects of the extracts of *C.odorata* tissues and their dilutions on plant height and root length of cowpea and maize is presented in figure 1a and b. Analysis of variance of the result showed significant differences ($p<0.05$) between the plant height and root lengths of the two species as affected by the extracts. The extracts in their full strength (undiluted) had the most inhibitory effect on plant height and root growth compared to the controls. The strength of the extracts reduced with increased dilution. The root extracts appeared to suppress growth more than the leaf and stem extracts especially in cowpea seedlings. Though the effect of the extracts did not significantly differ between the cowpea and the maize, it appeared that the maize was slightly more resistant to the inhibition than the cowpea.

DISCUSSION:

Data presented in this present paper confirmed the presence of inhibitory compound in the tissues of *C.odorata*. It also showed that concentration of the extracts was reduced with increased dilutions. The disruption of the processes of germination and hence the prevention of germination in the two species might have Had something to do with inhibition of enzymatic processes involved in germination which according to Putman (1985) is sensitive to potency of extracts. Putman (1985) and Patrick (1986) had reported that disruption of some processes can result in complete suppression of seed germination. Bare areas are always observed in the vicinity of *C.odorata* shrubs especially under the dense thicket, which the weed forms (Ivens, 1989). The bare areas could be related to failure of seeds of plants to germinate in the soil environment Hasen-Quartey et.al (1998), reported such suggestion for *Artemisia afra* shrubs.

The prevention of other plants from growing around it by disrupting their germinatio could be one of the way of avoiding competitions. However the effect of the inhibitors diminishes after germination is completed (Hansen-Quartey et.al (1998). According to Muller, (1966) plants differ in how quickly they overcome the effect of the inhibitors. The reduction in plant height and root length which could be related to yield, by the extracts demonstrates the need to be aware of the risk of poor yield on lands previously infested by *C.odorata*. However further investigation is required in this area. The fact that the maize appeared less affected by the extracts suggested that species could be screened for tolerance to allelo-chemicals from the shrub. This is confirmed by report of Materechera and Mbokodi (1997), that plants differ in their ability to grow in the soil associated with bare patches under the canopy of *Artemisia afra.* Reinhardt et.al (1994) and Meissner, et.al (1987), reported similar responses by crop species grown in soil containing organic substance released by some weed species. Another practical implication of this study is that the compounds in the extract of *C. odorata* could have a potential for use in the control of weeds in agricultural and horticultural production system. It could also have a potential for use in the control of soilborne diseases and pests. Litzenberger and Ho tong Lip (1961), had already reported a successful use of *C. odorata* in the control of yellow disease and root rot complex of black pepper and in the reduction of the nematode *Heterodera marioni* Schmidt in the soil. In other words, use of plant-derived allelochemicals could help minimize the use of chemical pesticides and others and the associated environmental contamination thereby reducing production cost and increasing yield. This area also needs further investigation.

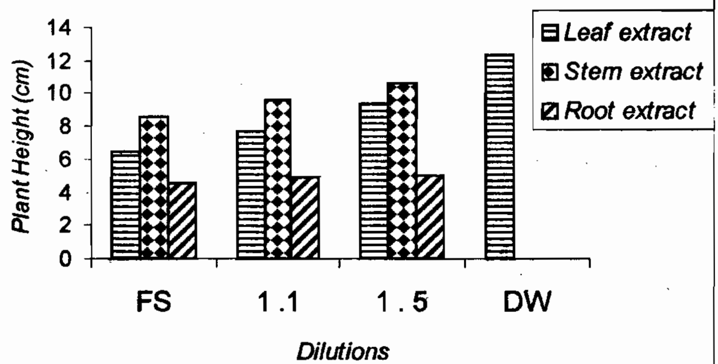

Fig 1a: Effects of C. odorata Leaf, Stem and Root extracts and their dilutions on plant height (in cm) of cowpea seedling values are means of 5 replicates

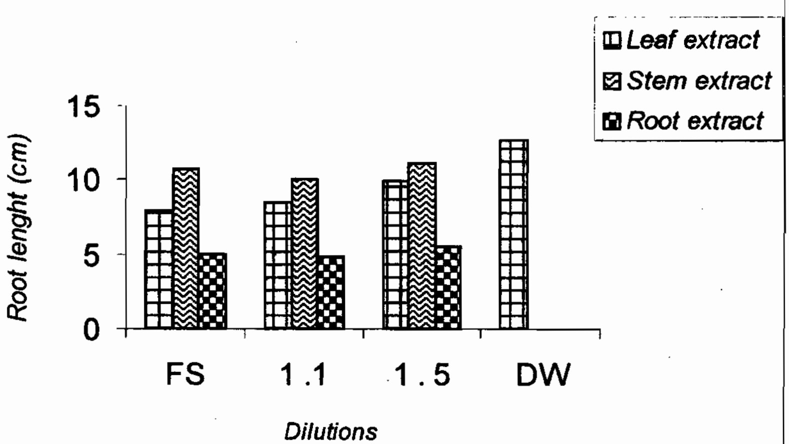

Fig. 1b: Effects of C. odorata Leaf, stem and Root extracts and their dilutions on root lenght (in cm) of cowpea seedling (values are means of 5 replicates)

FS = Full Strength: DW = Distilled water

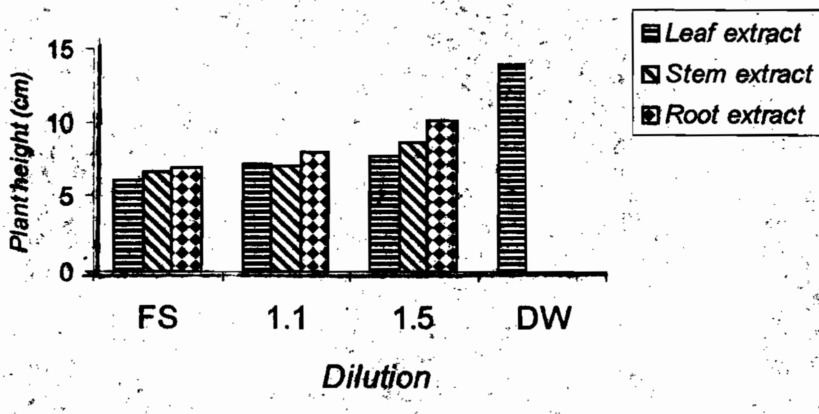

Fig. 1C: Effect of C. odorata leaf, stem and root extracts and their dilutions on Plant height (in cm) of maize seedling (values are maens of 5 replicates)

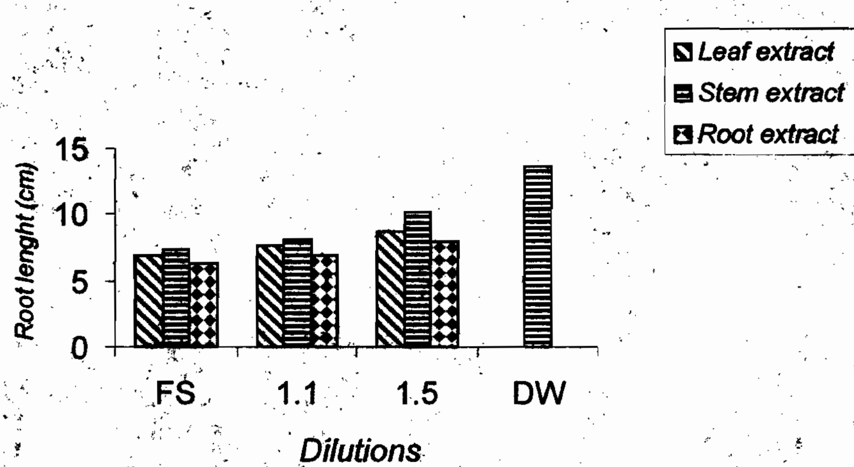

Fig. 1d: Effect of C. odorata leaf, stem and root extracts and their dilutions on the root lenght (in cm) of maize seedling (values are means of 5 replcates)

FS = Full Strength: DW = Distilled water

In conclusion; the present study has shown that the extracts from the leaves, stem and root tissues of *C. odorata* inhibited germination and seedling growth of the species studied. Since the root of the shrub had more inhibitory effect, and since the roots of the species studied were stunted, it is likely that inhibition could be expected from soil previously infested with by *C.odorata.* However, lowering the strength of the allelochemicals through dilution can reduce the inhibitory effects. Fallowing or growing less sensitive or lower value crops could do this before planting more useful crops (Hasen-Quartely et.al, 1998). It is concluded that compounds produced /released by *C.odorata* were responsible in creating the bare patches found beneath it. A possible practical application of the result of this study is that compounds derived from *C.. odorata* could be used for the control of weeds and pest in agricultural systems. This area requires further investigation

Table 1 Effect of *Chromolaena odorata* extracts from leaves, stems and roots, and their dilutions on the germination (percentage of total number of seeds sown) of cowpea and maize seeds.

	Plant spp	Dilutions	Leaf extracts	Stem extracts	Roots extracts
	Cowpea	Full strength	51	57	40
		1:1	59	66	57
		1:5	69	75	81
a		Distilled water	97	97	90
		Mean	69.00	73.75	67.00
		LSD	15.65	10.05	11.55
	Maize	CV%	31.45	22.6	32.07
B		Full strength	49	51	49
		1:1	65	61	63
		1:5	84	86	83
		Distilled water	99	95	91
		Mean	74.25	73.25	71.50
		LSD	14.14	11.70	11.04
		CV%	28.76	26.88	26.08

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