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The Effect of Soil in the Allelopathic Potential of *Artemisia herba-alba* and *Oudneya africana* Crude Powder on Growth of Weeds

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Abstract**—**The present study aimed to investigate the effect of two type of soil (clay and sandy soils) in the potential allelopathic effects of *Artemisia herba-alba*, *Oudneya africana* crude powder (0, 1, 3 and 6%) on some growth parameters of two weeds (*Bromus tectorum* and *Melilotus indica*) under laboratory conditions (pot experiment).

The experimental findings have reported that the donor species crude powder concentrations were suppressing to shoot length (SL), root length (RL) and the leaf number (LN)) in both soil types and caused a gradual reduction particularly when they are high. However, the reduction degree was varied and species, concentration dependent. The suppressive effect of the two donors on the two weedy species was in the following order *Melilotus indica* > *Bromus tectorum.* Generally, the growth parameters of two recipient species were significantly decreased with the increase of each of the donor species crude powder concentration levels. Concerning the type of soil stoical analyses indicated that significant difference between clay and sandy soils.

Keywords**—**Allelopathy Soil, *Artemisia herba-alba*, *Oudneya africana*, growth, weeds.

I. Introduction

THE term Allelopathy was coined by Prof. Hans Molisch in 1937, combining two Greek words “allelo” and “pathos” literally meaning “mutual suffering”. Based on that concept Rice defined allelopathy as the direct or indirect harmful or beneficial effects of one plant or another through the production of chemical compounds that escape into the environment. Allelochemicals from plants are released into the environment by exudation from roots, leaching from stems and leaves or decomposition of plant material [1]-[3].

Allelopathy includes plant-plant, plant-microorganisms, plant-virus, plant-insects, and plant-soil-plant chemical interactions. Allelopathic effects can be stimulatory or inhibitory, depending on the identity of the active compound on the static and dynamic availability, persistence and fate of organics in the environment and on the particular target species [4], [5]. In addition to the physicochemical property of the allelochemical, phytotoxic activity may be affected by many factors. These include soil and plant factors of both the donor and recipient plants, all of which are influenced by meteorological factors. Thus, it is indicated that allelopathy is a complicated phenomenon, and it is difficult to separate the allelopathic effects from other competition and/or interaction events among plants [6]-[9]. Medicinal plant had inhibitory effects, on selected weeds and its allelochemicals inhibiting weed growth was identified [10] [11]. In addition, the previous results of fujii and all [12], [13]. The interaction of plants through chemical signals 'allelopathy' has many possible agricultural and ecological applications [1], [14]. Several medicinal plants may have inhibitory effects on some weeds and its allelochemicals may causes severe reduction in weed growth [11]. A number of plants have an inhibitory effect on the growth of neighboring or successional plants by releasing allelopathic chemicals into the soil, either as exudates from the living tissues or by decomposition of plant materials [15], [16] and [17]. A successful allelochemical for weed management should inhibit germination of several weed species and not inhibit the germination of the crop [18].

The present study aimed to investigate the effect of two type of soil (clay and sandy soils) in the potential allelopathic effects of *Artemisia herba-alba*, *Oudneya africana* crude powder on some growth parameters and phytomass of two weeds (*Bromus tectorum* and *Melilotus indic*a) under laboratory conditions (pot experiment) .

II. Materials and Methods

Pot experiment was performed to test the effect of different levels of the *Artemisia herba-alba* and *Oudneya africana* (donor species) crude powder mixed (w/w) with clay and sandy soils (collected from control locations) on some growth parameters and phytomass of two weedy species; *Bromus tectorum* and *Melilotus indica.* To achieve this, soil samples (clay and sandy) were collected from the adjacent crop fields, air-dried under shade, sieved to get rid of pebbles and plant debris and stored in paper bags ready for the analysis of some physico-chemical properties.

The samples finally sterilized at (90ºC for 48h) to remove any microorganisms and weed seeds. Ten seeds of each of the recipient species were sown in plastic pots (16cm in diameter) with about 1500g of each clay and sandy soils thoroughly mixed (w/w) with 1, 3 and 6% of electrically crushed crude powder of the tow donor species (*Artemisia herba-alba* and *Oudneya africana*).

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The experiment was performed under normal laboratory conditions (23±2°C temperature, 75±2% relative humidity, and 14/10h light/dark photoperiod). One treatment was run as control with zero percent of crude powder. Treatments were arranged in a completely randomized block design with three replications. The plants were watered every two days on the average with normal tap water. The amount of water corresponding to average soil–plant evapotranspiration calculated from weight loss over a 24–hour interval. After 30 days the homogenous seedling were taken carefully from each treatment, washed with tap water to remove the adhering soil particles, and then by distilled water, gently blotted with filter paper. The data of the growth parameters are shoot length (SL) (cm), root length (RL) (cm) and the leaf number (LN).

Statistical analysis: data of the present study were subjected to standard two-way analysis of variance (ANOVA) using the COSTAT 2.00 statistical analysis software manufactured by CoHort Software Company (1986).

III. Results

A. Effect of Artemisia herba-alba Crude Powder (AHCP) on Some Growth Parameters

The demonstrated data in Table I pointed up that shoot length (SL) of *Bromus tectorum* and *Melilotus indica* was significantly affected upon applying the different concentrations of AHCP. In clay soil, there was a noticed reduction in values of SL. At control level, values of about 13.06 and 14.46cm of SL were noticed, respectively. These values were reduced to 12.86 and 14cm at 1% and at 6% AHCP concentration the values 12.33 and 13.50cm were obtained for the two recipient species respectively. Likewise, in sandy soil values of SL were about 13.03 and 13.40cm at control level respectively. These values were reduced at 6% AHCP concentration the values 15.65 and zero cm were recovered for the two recipient species respectively.

The allelopathic effect of AHCP concentration on root length (RL) of *Bromus tectorum* and *Melilotus indica* are illustrated in Table I apparently all allelopathic concentrations have significantly reduced RL. In clay soil, the control values were about 7.1 and 6.10cm for the two recipient species respectively. At 1% AHCP concentration, RL reduced to 5.73 and 5.5cm. constantly, it continues reduction till it attained values of about 3.23 and 4.75cm at 6% AHCP concentration for the two recipient species respectively. Similarly, the control values of RL in sandy soil were about 6.23 and 6.56cm respectively. At 1% concentration, the values of about 5.20 and 5.50cm were obtained and at 3% concentration, it reduced to zero cm at 6% AHCP concentration for the two recipient species.

The values of Leaf number on *Broums tectorum*. In clay soil, was obtained same value (3) at control while in sandy soil at control the value was about 2.33 on other hand, at 1, 3 and 6% AHCP concentration was about the same value (2) was recovered in clay and sandy soil, while for *Melilotus indica* the values about 5, 3 and zero were obtained at 1, 3 and6% AHCP concentration.

TABLE I
EFFECT OF *ARTEMISIA HERBA-ALBA* CRUDE POWDER (AHCP) ON SOME GROWTH PARAMETERS

Shoot length (SL)						
Species	**Type of soil**	**0%**	**1%**	**3%**	**6%**	**Tow –way ANOVA**
Bromus tectorum	**CS**	13.06	12.86	12.43	12.33	Treatment : **
	SS	13.03	12.53	12.33	0.00	Soil type: **
Melilotus indica	**CS**	14.46	14.00	13.75	13.50	Treatment : **
	SS	13.40	16.50	15.75	0.00	Soil type: NS
Root length (RL)						
Species	**Type of soil**	**0%**	**1%**	**3%**	**6%**	**Tow –way ANOVA**
Bromus tectorum	**CS**	7.10	5.73	3.60	3.23	Treatment : **
	SS	6.23	5.20	5.16	0.00	Soil type: **
Melilotus indica	**CS**	6.10	5.50	5.00	4.75	Treatment : **
	SS	6.56	5.50	4.75	0.00	Soil type: *
Leaf number (LN)						
Species	**Type of soil**	**0%**	**1%**	**3%**	**6%**	**Tow –way ANOVA**
Bromus tectorum	**CS**	3.00	2.00	2.00	2.00	Treatment : NS
	SS	2.33	2.00	2.00	0.00	Soil type: NS
Melilotus indica	**CS**	3.33	2.00	2.00	2.00	Treatment : NS
	SS	2.00	5.00	3.00	0.00	Soil type: NS

CS: clay soil, SS: sandy soil, **:Significant at 0.01, NS: not significant .

B. Effect of Oudneya africana Crude Powder (OACP) on Some Growth Parameters

Data in Table II pointed up that shoot length (SL) of *Bromus tectorum* and *Melilotus indica* was significantly affected upon applying the different concentrations of OACP. In clay soil, there was a noticed reduction in values of SL. At control level, values of about 13.06 and 14.46 cm of SL were observed respectively. These values were reduced to 12.53 and 14.25cm at 1% and at 6% OACP concentration the values 12.1 and zero cm were obtained for the two recipient species respectively. Similarly, in sandy soil values of SL were about 13.03 and 13.40cm at control level respectively. At 1 and 3%

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OACP was obtained 11.90 and 11.83cm these values were reduced to zero cm at 6% OACP concentrations for *Bromus tectorum* compared to *Melilotus indica* the value about to zero cm was observed.

The allelopathic effects of OACP concentration on root length (RL) of *Bromus tectorum* and *Melilotus indica* are illustrated in Table II Generally, all allelopathic concentrations have significantly reduced RL. In clay soil, the control values were about 7.10 and 6.10cm for the two recipient species respectively. At 1% OACP concentration, RL reduced to 5.43 and 5.69cm and 4.26 and 5.50 at 3% level. Constantly, it continues reduction till it attained values of about 3.8 and 4.30cm at 6% OACP concentration for the two recipient species respectively. Correspondingly, the control values of RL in sandy soil were about 6.23 and 6.56 cm respectively. It reduced zero at 6% OACP concentration for *Bromus tectorum*. While for *Melilotus indica*, the value it reduced to zero at 1, 3 and6% OACP concentration.

Generally, leaf number (LN) of *Bromus tectorum* and *Melilotus indica* was not significant affected by the increase in OACP concentration. In clay soil, the control values of LN were about 3 and 3.33, respectively. At 6% OACP concentration the values of about 2 leaves were attained for the two recipient species respectively. Similarly, in sandy soil, the control values of LN were about 2.33 and 2 respectively. At 6% OACP concentration, values of about zero were obtained for the two recipient species respectively.

TABLE II
EFFECT OF *OUDNEYA AFRICANA* CRUDE POWDER (OACP) ON SOME GROWTH PARAMETERS

Shoot length (SL)						
Species	**Type of soil**	**0%**	**1%**	**3%**	**6%**	**Tow –way ANOVA**
Bromus tectorum	**CS**	13.06	12.53	12.43	11.86	Treatment : **
	SS	13.03	11.90	11.83	0.00	Soil type: **
Melilotus indica	**CS**	14.46	14.25	14.25	13.75	Treatment : **
	SS	13.40	0.00	0.00	0.00	Soil type: **
Root length (RL)						
Species	**Type of soil**	**0%**	**1%**	**3%**	**6%**	**Tow –way ANOVA**
Bromus tectorum	**CS**	7.10	5.43	4.26	3.80	Treatment : **
	SS	6.23	6.60	6.06	0.00	Soil type: **
Melilotus indica	**CS**	6.10	5.69	5.50	4.30	Treatment : **
	SS	6.56	0.00	0.00	0.00	Soil type:**
Leaf number (LN)						
Species	**Type of soil**	**0%**	**1%**	**3%**	**6%**	**Tow –way ANOVA**
Bromus tectorum	**CS**	3.00	2.00	2.00	2.00	Treatment : NS
	SS	2.33	1.66	1.33	0.00	Soil type: NS
Melilotus indica	**CS**	3.33	2.50	2.00	2.00	Treatment : NS
	SS	2.00	0.00	0.00	0.00	Soil type: **

CS: clay Soil, SS: sandy soil, **: Significant at 0.01, NS: not significant.

IV. DISCUSSION

The test the effect crude powder mixed (w/w) with clay and sandy soils (collected from control locations) on some growth parameters of two species (two weeds) were considered as target or recipient species.

The crude powder of *Artemisia herba-alba* and *Oudneya africana* (donor plants) mixed (w/w) with clay and sandy soils (collected from control locations) affect some growth parameters like shoot length, root length, number of leaves of *Bromus tectorum* and *Melilotus indica*. The effect was, in general, more severe on the tow weedy plant. Among the different donor plants, effect depending on the type of donor species and on the extract concentration. Generally, under the present study, the growth parameters of all the two recipient species were significantly decreased with the increase of the donor species crude powder concentration levels regardless soil type. On the other hand, shoot (SL) and root length (RL) of the two recipients species were significantly decreased with the increase in treatment concentrations under clay and sandy soil.

In clay soil *Artemisia herba-alba* and *Oudneya africana* crude powder had the same allelopathic potential effect on *Bromus tectorum* and *Melilotus indica* while, in sandy soil *Oudneya africana* crude powder had the greatest allelopathic compared to *Artemisia herba-alba* crud powder on *Melilotus indica*. This reduction may be attributed to the presence of allelochemicals in the crude powder.

In the present study, the inhibitory effects of the allelopathic treatments on shoot and root length as well as leaf number were almost alike in the two recipient species and may be related to the inhibition of cell division and/or cell expansion [19], And These phenolics inhibit the germination and seedling growth of same plant species or others by their effects on metabolic processes of germination and growth [20]. In many studies, it was found that root growth was more inhibited than shoot growth [21].

In general, plant growth inhibition have been attributed to inhibitory chemicals released from decomposing residues which was compatible with results reported by other researchers [22] or by leaching of toxic materials from the residue to the soil . Kuiters and Denneman reported similar

findings for phenolic compounds in sandy and clay soils [23]. They discovered that higher amounts of allelochemicals were extractable from sandy soils than from clay soils. Oleszek, and Jurzysta concluded that heavy soils adsorb more allelochemicals than sandy soils, and In the present investigated species, growth parameters was obviously higher illustrating better results in sandy soil than the clay soil [24].

Experimental findings have reported that donor species crude powder concentrations were suppressing to length (SL), root length (RL and the leaf number (LN)) in both soil types and caused a gradual reduction particularly when they are high however, the reduction degree was varied and species, concentration dependent. The suppressive effect of two donors on the two weedy species was in the following order *Melilotus indica* > *Bromus tectorum*. The distinction between dicotyledonous and monocotyledonous species was less clear in shoot and root tests than in germination tests. Significant reductions in growth of the roots and shoots were observed as the extract concentration increased. The results are in agreement with previous investigations in that the activity of either water-extracts or weed residues was directly related to the concentration of the residue rates [25],[26]and [27] .

Based on the results of this study: The species with the strongest allelopathic potential such as *Artemisia herba-alba* and *Oudneya africana*, must be examined for their selective action on other specific plants including weeds and crops under field conditions, their allelopathic activity will be much more detailed. Analysis of possible allelochemicals in these plants is also required. The isolation and characterization of growth inhibitors, which might be responsible for the strong allelopathic potential of these species is needed. There is possibility to use these allelochemicals directly or as structural leads for the discovery and development of environment friendly herbicides to control weeds.

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