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INVESTIGATION OF ALLELOPATHIC POTENTIAL OF ACACIA NILOTICA L.

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Abstract:-
Acacia nilotica. L commonly known as babul, kikar or Indian gum Arabic tree, has been recognized worldwide as a multipurpose tree. Set of experiments were conducted for evaluation of the allopathic effects of water extracts of different parts (park, leaves and pods) of A. nilotica as well as soil extracts under canopy on seed germination and seedling development of receptor specie (Cucumus sativus L.) under different concentration (1%, 5% and 10%). Inhibitory effect of the different donor plant parts water extracts was ranked as follows: pod > leaf > bark. Soil extracts at different distances from trunk had stimulatory effect at 2m and 5 m distance while at the edge showed inhibitory effects on seed germination and seedling development of both C. sativus L.

Keyword:-*Acacia nilotica. L, allelopathy, seed germination, seedling growth, Cucumus sativus L.*

INTRODUCTION

Allelopathy is a natural phenomenon in which plant interaction plays a significant part in the groforestry system (38). Defined allelopathy as the effects of one plant (including microorganisms) on anther plant via the release of chemicals into the environment (22). Plant allelochemicals are known to be the secondary plant metabolite that may be released to the environment from plants by way of four processes: root exudation, volatilization, Leaching and decomposition of plant residues in soil (6). Many plants allelochemicalsrecoreded in plants such as phenolics, terpenoids, alkaloids, fatty acid, steroids, and polyacetylenes are known to act as an important role in allopathy, which includes positive and negative effects on the plants (15). The multiple effects resulting from allelochemicals include a decrease in plant development, absorption of water, mineral nutrients, ion uptake, leaf water potential, shoot turgor pressure, osmotic potential, dry matter production, leaf area expansion, stomatal aperture size, stomata diffusive conductance, and photosynthesis (5). Most research on allopathy has focused on the essence of interaction between weed species, weed crops and crop species (41). Understanding allelopathic effects of forest trees on potential crops is vital for successful agroforestry systems (21). Acacia species contains secondary metabolites including amines and alkaloids, cyanogenic glycosides, cyclitols, fatty acids and seed oils, fluoroacetate, gums, nonprotein amino acids, terpenes (including essential oils, diterpenes, phytosterol and triterpenegenins and saponins), hydrolyzable tannins, flavonoids and condensed tannins (40). *A.nilotica* in Libya confined to sauterne part particularly in: Sokna, Sebha, Germa, Tajirhi, Wegh, Ghat El Birkit, Gebel Uweinat, Ghat and Kufra(17). Acacias have been shown as very important economic plants since early times as a source of tannins, gums, timber, fuel and fresh fish. They have significant pharmacological and toxicological effects In Africa and the Indian subcontinent; A. nilotica is extensively used as a browse, timber and firewood species (14; 23; .30)

Materials and method

Plant material:

Seeds of (*Cucumisativus)* L. were obtained from the local grocery store.

Preparation of extracts: Fresh barks, leaves pods of *Acacia nilotica* and soil were collected from El kufra area in south west part of Libya (Mimosaceae) family. During March 2013 the materials were thoroughly rinsed with tap water followed by washing with sterilized water and oven dried at 50°C. The dried material was crushed in a pestle and mortar and soaked in distilled water the water extracts of different parts of plants were prepared as per method of Narwal, (29). (1, 5 and 10%) g of powdered plant material was dissolved in 100ml water to prepared extract of (1,5and 10%) concentration. The mouth of the flask containing the extract was covered with aluminum foil and kept for 24 hours. After shaking well the extract was first filtered through a muslin cloth and again filtered through Whatman filter paper No.1 for complete separation of suspended particles. The extracts of different concentration were stored in the refrigerator during the experimental period as per requirement.

The soil was collected 400 g from under the crown of the tree, immersed in 400 ml of distilled water 24 hours, after shaking in an electric shaker for 30 min, and were passed through Whatman No. 1 filter paper. (33).

Germination test: Seeds were purified and selected of similar size.

They were sterilized with 3% sodium hypo chloride (chlorox) and were thoroughly washed with distilled water many times. Petri dishes (9cm in diameter) were cleaned, lined with single layer of filter paper. Four replicates were used per treatment (concentration), each contains ten seed five ml of distilled water and tested concentrations (from Bark, leaves pods and soil) were added. All Petri dishes were incubated in (WTB bind) incubator at 20 ºC.

Distilled water and tested solutions were added whenever were needed. Seeds were allowed to germinate for five days. Daily and final germination percentages of seeds under different extracts solutions. Were counted using the following formula: Germination percentages (%) = Number of germination seeds/Total number of seeds ×100. Seedling test: After five days the plant were harvested and measures of the total fresh and dry weight of root and shoot of each seedling were taken.

1Length of shoots and roots (cm) by using a ruler

2Fresh weight by using four decimals balance (AB54-SMettler Toledo) 3 Roots and shoots were covered with aluminum foil and then placed in an oven at 60-80 C for one day. Base and shoot dry mass were recorded one by one.

Statistical analysis: Two way ANOVA and One way ANOVA with Tukeyposthoc test and T test wear conducted initial length and fresh Dry weight of shoot and root. Repeated measures analysis was employed to investigate the patterns of change in development over time among treatment.

Result and Discussion

It is obvious that low concentration of water extract of *Acacianilotica* bark (1%) stimulated the germination and seedling growth of *Cucumissativus*, but high extract concentration (5 and 10%) significantly reduced the germination and seedling growth of the species as compared with distilled water(tabla1) .Which suggests that the stimulatory or inhibitory effect is a function of the concentration (39). Similarly, Reigosa et al., (37) concluded that certain allelochemicals have a stimulatory effect or no action on various plant species at lower concentrations. These results are in agreement with those obtains by Khan et al., (20) who found that the bark extract had stimulatory effect on germination percentage of *Asphodelustenuifolius*. In contrast These our results not in agreement with those obtains by Mehmood et al., (26) who found Aqueous bark extract of *A. nilotica* at different concentrations significantly enhanced germination, shoot and root length except 20% concentration which significantly reduced shoot and root length.

The results regarding the effects of leaf extract of *Acacia nilotica*at 1, 5 and 10% showed inhibition in germination and seedling growth of the test specie (table2). These result are in agreement with those obtains by El-Khawas and Shehata (19) who reported that the leaf leachates of Acacia nilotica inhibited the germination and growth of Zea mays and

phaseolus vulgaris. On the other hand these results are in agreement with those obtained by Duhhan and Lakshinarayana (10) who found that the growth of *Cyamopsistetragonoloba* and *Pennisetum* growing at distance of 1-2 and 7.5m from trunk of *Acacia nilotica* was inhibited. meanwhile the obtained results are not in agreement with those obtained by Tripathi et al., (44) who found that the allelopathic activity of the leaf extracts of *Acacia nilotica* at low concentrations had stimulatory effect on germination, growth, chlorophyll, protein, carbohydrates and proline contents of soybean, but in the higher concentrations, there was a decreasing trend of all the parameters in the soybean. The aqueous extract of leaves was proved more inhibitory on seed germination and seedling growth of test plant than bark of *Acacia nilotica* These results are not in agreement with those obtains by Swaminatha et al., (43) who found that the inhibition effect of bark extract was greater than leaf extract on eight arable crops .

Pod extracts had inhibitory effect at all concentration on both seed germination and seedling growth of *Cucumissativus* and effect was increased with increase in the concentration. The water extract of pod was proved inhibitorier on seed germination and seedling growth of test plant than any other part of *Acacia nilotica*. These result are in agreement with those obtains by Dhana et al., (7) who was observed the maximum inhibitory effect among the various parts of *Acacia nilotica* for pod extract on wheat (*Triticumaestivum*)than bark leaves extract.
The data reported in this study revealed that bark, leaves and pod had inhibitory effect at all used concentrations on both seed germination and seedling growth of *C .sativus*, the effect was increased with increase in the concentration, which is agreed with Singh et al., (42) who reported that biological activities of receiver plants to allelochemicals are known to be concentration dependent on a response threshold is characteristically inhibition as the concentration increases.

The data also revealed that at all concentrations of different parts of Acacia *nilotica* root length was more sensitive to water extracts for both species than shoot length where all the employed extract concentrations significantly suppressed root length. The root system became brownish and formation of root hairs and death of cells was evident except for bark extract at 1% concentration had stimulatory effect on root growth and branching of roots. This result is in agreement with Al-Shahid et al., (2) who reported that plant roots exposed to allelochemicals became brownish and root hairs formation. This might be due to the rapid inhibiting effect on the respiration of root tips which ultimately reduced elongation. Also Bais et al., (3) reported that catechin a putative phytotoxin inhibits plant growth due to sever oxidative burst in root tips, resulting in cell death.
Since roots are the first to absorb chemical compounds from the environment, so exhibit abnormal growth in response to chemicals present in the extracts, resulting in suppressive growth (Javaid and Shah, 18). The extract of *A. nilotica* is known to contain gallic acid,
M-digallic acid, catechin, chlorogenic acid, gallolyated flaven-3, 4-diol and rabidandiol (24). These compounds are allelopathic of *Acacia nilotica* present in the different parts extracts might be responsible for the retardation of germination and other growth parameters of and *C.sativus*, in the present study. Further Phenolics are widely recognized for their allelopathic potential in plants and can be found in a variety of plant tissues (8).. The effects of allelochemicals have been studied mostly on seed germination and the suggested mechanisms for its inhibition are the disruption of mitochondrial respiration (1) through the influence of allelochemicals on glycolysis, the Krebs cycle, electron transport and oxidative phosphorylation (27), and the mitochondrial membrane.

The data concerning the assay of soil under canopy indicated that the water extract of soil at 2 and 5 m distance from tree trunk caused stimulatory effect in germination and seedling growth of the test plant (table 3,4). But soil extract at the edge had inhibitory effect. This result is not in agreement with Duhhan and Lakshinarayana (10) who found that the growth of *Cyamopsistetragonoloba* and *Pennisetum* growing at distance of 1-2 and 7.5m from tree trunk of *Acacia nilotica* was inhibited. This result is in agreement with (Pandey et al., 35, Nair 28 Palm 34) who reported that the tree of *A. nilotica* improves soil fertility under its canopy by reducing proportion of sand with simultaneous increase in clay particles, mainly due to protection of soil from the impact of raindrops. Higher nutrient concentration under canopy compared to canopy gap is mainly a consequence of increased above and belowground organic matter input, nutrient cycling through leaf litter and protection of soil from erosion. The decrease in nutrient concentration towards the canopy edge compared to mid canopy position is mainly due to relatively low inputs of leaf litter as the canopy of *A. nilotica* is thin towards canopy edge (.36)

Also *A. nilotica* is reported to be well nodulated with Rhizobium species (9).This nodulation behaviour help in biological nitrogen fixation which help to meet the nitrogen requirement in nutrient-poor soils. In addition, this species form symbiotic associations with naturally occurring soil fungi called vesicular arbuscularmycorrhizae (VAM) (19). This association assists the roots to exploit more soil volume and to gain improved access to available nutrients especially phosphorus under stress and also makes the unavailable forms of nutrients into utilizable forms (4). On other hand. The presence of allelopathic substances in the soil is often determined by a number of important factors. These include the density at which the leaves fall, the rate at which this material decomposes, the distance from other plants, and, finally, the quantity and distribution of the annual rainfall (, 25;12;32). The decomposition of plant material is then dependent on leaf tissue quality (C: N and C:P ratios), temperature, rainfall and the presence of certain micro-organisms (13;31;16). Soil type and its pH are also important (39) in determining whether or not allelopathic substances are present in the soil and if they are in sufficiently high enough concentrations to affect other plants.

Table. 1. Effect of different concentrations of water extracts of *Acacia nilotica* L. on seed germination percentages of *Cucumissativus*L.

Extract concentration	Day 1	Day 2	Day 3	Day 4	Day 5
Control	94.0±2.45	100.0±0.0	100.0±0.0	100.0±0.0	100.0±0.0
Bark					
1	86.0±2.45	94.0±2.45	96.0±2.45	96.0±2.45	96.0±2.45
5	92.0±3.74	98.0±0.200	98.0±0.200	98.0±0.200	98.0±0.200
10	84.0±24.5	94.0±2.45	96.0±2.45	96.0±2.45	98.0±2.45
Leaves					
1	82.0±0.200	96.0±2.45	96.0±2.45	96.0±2.45	96.0±2.45
5	62.0±3.74	94.0±0.400	94.0±0.400	94.0±0.400	94.0±0.400
10	66.0±0.400	92.0±0.200	92.0±0.200	92.0±0.200	92.0±0.200
Pod					
1	90.0±0.0	96.0±0.245	98.0±0.200	98.0±0.200	98.0±0.200
5	50.0±0.632	68.0±0.548	76.0±0.678	76.0±0.678	76.0±0.678
10	42.0±0.374	80.0±0.632	86.0±0.400	86.0±0.400	86.0±0.400

Table. 2. Effect of different concentrations of water extracts of *Acacia nilotica*L. On some growth parameters of *Cucumissativus* L.(Cucumber) seedlings in Petri dish.

Treatment	Conc.%	SL	RL	SFW	SDW
	control	3.100±0.2950	5.247±0.3263	0.64467±0.58012	0.11767±0.002333
Bark					
	1	2.853±0.5504	4.427±0.3398	0.67900±0.029000	0.11500±0.00493
	5	2.080±0.2680	1.813±0.3017	0.50967±0.44 281	0.10933±0.00233
	10	1.893±0.1067	0.713±0.1341	0.36067±0.009701	0.9800±0.00100
Leaves					
	1	1.913±0.0792	2.880±0.3410	0.46733±0.066195	0.07933±0.02333
	5	00.0±0.0	00.0±0.0	00.0±0.0	00.0±0.0
	10	00.0±0.0	00.0±0.0	00.0±0.0	00.0±0.0
Pod					
	1	1.413±0.1059	1.320±0.1964	0.43400±0.022030	0.04033±0.004096
	5	00.0±0.0	00.0±0.0	00.0±0.0	00.0±0.0
	10	00.0±0.0	00.0±0.0	00.0±0.0	00.0±0.0

Table.3. Effect of different concentrations of soil extracts of *Acacia nilotica* L. on seed germination percentages of*Cucumissativus* L. five days after treatment

Soil extracts	Day1	Day2	Day3	Day4	Day5
Control	70.0±0.316	84.0±0.245	98.0±0.200	98.0±0.200	98.0±0.200
2M	58.0±0.374	74.0±0.510	90.0±0.316	100.0±0.00	100.0±0.00
5M	62.0±0.374	84.0±0.245	94.0±0.00	100.0±0.00	100.0±0.00
EC	44.0±0.510	54.0±0.812	86.0±0.583	86.0±1.772	86.0±1.772

Table.4. Effect of soil extracts under canopy of *Acacia nilotica* L. On seedlings of *Cucumissativus L*.

Treatment	distances	SL	RL	SFW	SDW
	Control	2.660±0.2968	4.800±0.05019	0.68533±0.068533	0.062733±0.0255524
soil					
	2M	3.933±0.4020	7.087±0.05520	1.051067±0.01472197	0.101400±0.0076166
	5M	4.900±0.03525	11.400±0.07007	1.072167±0.1122507	0.089433±0.0020464
	CE	2.793±0.02643	4.933±0.03990	0.900767±0.0663109	0.1017833±0.0058156

5M=5Mater 2M=2Mater CE= Canopy edge

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