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Original Article

ALLELOPATHIC POTENTIAL OF *Vernonia amygdalina* AND *Moringa oleifera* LEAF EXTRACTS ON SEED GERMINATION AND SEEDLING GROWTH OF *Sesamum indicum* L.

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ABSTRACT

The allelopathic effect of *Vernonia amygdalina* and *Moringa oleifera* leaf extracts on seed germination and seedling characteristics of sesame (*Sesamum indicum* L.) Var. 01M was analyzed in this study. The seeds were treated with different extract concentrations (i.e. 25%, 50%, 75%, and 100%) of *Vernonia amygdalina* and *Moringa oleifera*. The allelopathic study of *Vernonia amygdalina* and *Moringa oleifera* was carried out based on percentage seed germination on the 5th and 10th days, shoot length, root length and shoot/root ratio at 10 days after sowing. Seedling characteristics like number of leaves, height of plant, stem girth, leaf length, leaf breadth and leaf area all at 8 Weeks after Planting (8WAP) were also investigated for different concentrations. All data pooled were subjected to Analysis of Variance (ANOVA) and means with significance difference were separated using Duncan Multiple Range Test (DMRT). Results showed that eight (shoot length, root length, number of leaves, plant height, stem girdth, leaf length, leaf breath and area of leaves at 8 WAP) out of the ten quantitative attributes studied on sesame (*Sesamum indicum*) showed significant differences in relation to the different concentrations of *Vernonia amygdalina* leaf extracts while only three (shoot length, number of leaves, and plant height at 8 WAP) out of ten attributes studied on the effects of *Moringa oleifera* leaf extracts showed significant difference. Therefore, there is sufficient evidence in this study to conclude that *Vernonia amygdalina* had more allelopathic effects on seedling establishment and growth of sesame (*Sesamum indicum*) than *Moringa oleifera*.

Key words: Allelopathic, *Vernonia amygdalina*, *Moringa oleivera*, allelochemicals, *Sesamum indicum*, extracts.

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INTRODUCTION

Sesame (*Sesamum indicum* L.) according to Alege *et al.* (2014) is one of the World's important oil seed crops. Its primary marketable products are the whole seeds and seed oil (Bharathi *et al.*, 2015). The high protein content of sesame seed meal makes it a very good feed for chicken and livestock. In aquaculture production, sesame meal have similar protein content to soybean meal and are successfully used as fishmeal protein substitute without negatively affecting the growth of carnivorous fish (Nang-Thu *et al.*, 2011; Jahanbakhshi and Shabani, 2013).

Allelopathy, according to Singh *et al.* (2001), is a phenomenon involving either beneficial or adverse effects of a plant (including microorganisms) on another plant through the release of chemicals into the environment. Rahaman and Acharia (1998) reported that all concentrations of aqueous inflorescence and stem extracts of *Parthenium hysterophorus* had inhibitory effect on seed germination and seedling growth of *Cassia occidentale.* Allelochemicals according to Maharjan *et al.* (2007) are present in different parts of plants like stem, leaves, roots, flowers, inflorescence, fruits and seeds. Koche *et al.* (2010) and Rahaman and Acharia (1998) reported that leaves seem to be the most consistent producers of these allelochemicals. Baeshen (2014) reported that information on plants and their allelopathic effects on other plants could help to design the best crop-rotation system. Allelochemicals are mostly released from the plants by volatilization, leaching, exudation and decomposition from plant residues (Maharjan *et al.,* 2007).

Sesame (*Sesamum indicum* L.) is an oil producing crop commonly grown in Anyigba and its environs. Sesame farmers in this region have been complaining of poor seed germination and seedling establishment which automatically have negative effects on their annual production. This challenge may be attributed to allelochemicals released by plants on the farm plots. Koche *et al.* (2010) reported that leaves seem to be the most consistent producers of alleolochemicals in plants. It is observed that *Moringa oleifera* and *Vernonia amygdalina* grow in abundance on most farms in Anyigba and its environs. It is, therefore, imperative to investigate the effects of the leaf extracts of these two plants (*Moringa oleifera* and *Vernonia amygdalina*) on seed germination and seedling growth of sesame (*Sesamum indicum* L.). The main aim of this study is to assess the allelopathic potentials of *Moringa oleifera* and *Vernonia amygdalina* leaf extracts on seed germination and seedling growth parameters in *Sesamum indicum.*

MATERIALS AND METHODS

Sample Collections and Identification

Improved sesame (*Sesamum indicum*) variety with accession code 01M obtained from National Cereal Research Institute (NCRI), Badeggi, Nigeria was considered for this study. Bitter leaf (*Vernonia amygdalina*) and Moringa leaf (*Moringa oleifera*) were obtained from a farm at the Faculty of Agriculture, Kogi State University, Anyigba. These plants were identified at the Biological Sciences Department, Kogi State University, Anyigba.

Preparation of Test Extracts from the Plant Samples

The preparation of plant extracts were carried out according to the method

described by Mousavi *et al.* (2013) with some slight modifications. The leaves were harvested from the plants, washed and air-dried at Biological Sciences Department laboratory. The dried leaf samples were then ground to powder using pestle and mortar, and sieved through an 8.0mm aperture size wire mesh net. 200g of the ground leaves were separately dispensed into 1litre of water and then are kept in the refrigerator for 24hours. Thereafter, the solutions were centrifuged at 1,200rpm, filtered into 100ml beaker using whatman number 2 filter paper and the filtrates used for further study. The raw undiluted filtrates served as 100% concentration while distilled water serves as control for the study. Serial dilutions of the two extracts (*Vernonia amygadalina* and *Moringa oleifera*) were prepared in relation to distilled water to obtain 25%, 50% and 75% concentrations. The methods outlined by Alam and Azimi (1991) were employed for the seed germination and seedling growth study. The treatment at each extracts level was arranged using Complete Randomized Design (CRD) with five replicates. Sesame seeds were soaked in each concentration for three hours before considered for further study.

Seed Viability test

The floatation method was used for seed viability test. Seeds were steeped into distilled water in a beaker; viable seeds sank while those that floated were regarded as non-viable. The former were considered for the study.

Seed Germination Test and Shoot/Root lengths

Fifty (50) healthy sesame seeds each were put in petri dishes and the different concentrations of *Vernonia amygdalina* and *Moringa oleifera* extracts were applied to each individual petri dishes while distilled water served as control for the study. The numbers of germinated seeds were counted everyday for ten days while the lengths of the plumule (shoot) and radicle (root) were measured for five germinating seeds from each treatment 7 Days After Germination (7 DAG) in petri dishes.

Quantitative traits of the Seedlings

This study was conducted at the plant house of Biological Science Department, Kogi State University, Anyigba. Top soils (0-5cm deep) were collected at the Research House of Biological Sciences Department, properly mixed and sterilized by autoclaving twice at 120^{o}C for 30 minutes according to the method described by Shuab *et al.* (2014). The sterilized soils were thereafter distributed into polythene bags. Each treatment was replicated five times while Complete Randomized design (CRD) was adopted for this study. The soils were watered with their corresponding extract concentrations and three sesame seeds were sown per bag. Thereafter, growing sesame plants were watered every three days. Some quantitative traits were considered for sesame (*Sesamum indicum*) grown from seeds treated with different concentrations of *Vernonia amygdalina* and *Moringa oleifera* at 8 Weeks after Planting (8WAP). These quantitative traits are number of leaves per plant, plant height, stem girth, leaf length, and leaf breadth and leaf area.

Data Analysis

The shoot and root ratios were calculated for every concentrations of leaf extracts. Data collected on each trait were subjected to Analysis of Variance (ANOVA), while Duncan Multiple Range Test (DMRT) was used to separate

significant means. All analyses were carried out using SPSS version 16 software package.

RESULTS

Eight (8) out of the Ten (10) quantitative traits analyzed for the effects of *Vernonia amygdalina* leaf extracts on germination of seeds and establishment of seedling of *Sesamum indicum,* showed statistical significant differences. These results are presented in Table 1. All the 20 sesame seeds tested in this study germinated at 10 Days After Planting (DAP) with 12 seeds germinated in control and 25% concentration of *Vernonia amygdalina* at 10 Days After Planting (DAP). The shoot-root ratio was 1.08 in control but the least ratio of 0.50 was recorded in 25% *Vernonia amygdalina.* The highest number of leaves (11.6) and tallest plants (17.64 cm) were recorded on 50% concentration of *Vernonia amygdalina* while the least number of leaves (6.4) and shortest plants recorded from control plants (10.7cm). The longest, widest and largest leaves at 8 WAP were recorded on 75% concentration of *Vernonia amygdalina* while at 8 WAP control produced plants with the least values of leaf length, breadth and area with 5.7cm, 3.3cm an 18.85cm^2, respectively.

Three (3) out of the ten (10) quantitative traits analyzed for the effects of leaf extracts of *Moringa oleifera* on the germination of seeds and seedling growth of *Sesamum indicum,* showed statistical significant difference (Table 2). All the 20 sesame seeds studied germinated at 10 Days After Planting (DAP) in control and 50% concentration of *Moringa oleifera* while 14 seeds germinated when sesame seeds were treated with 25% and 75% concentration of *Moringa oleifera* at 10 Days After Planting (DAP). The shoot-root ratio was 1.08 in control but reduced when treated with *Moringa oleifera.* The highest number of leaves (11.7) and tallest plants (17.61 cm) were recorded on 25% and 50% concentrations of *Moringa oleifera* while the least number of leaves (6.51) and shortest plants recorded from control plants (10.7cm).

Table 1: Effects of *Vernonia amygdalina* Leaf Extract on Quantitative Traits of *Sesamum indicum* Var. 01M.

Conc.	NOG 1-5 days	NOG 6-10 days	Total No of germinated seeds	Shoot length (cm) 10DAG	Root length (cm) 10DAG	Shoot/ root ratio	No. of leaves 8WAP	Height of plants (cm) 8WAP	Stem girth (cm) 8WAP	Leaf length(cm) 8WAP	Leaf breadth (cm) 8WAP	Leaf area (cm^2) 8WAP
Control	4	8	12	0.57^{bc}	0.53^{a}	1.08	8.00^{a}	10.7^{a}	1.20^{ab}	5.70^{a}	3.30^{a}	18.85^{a}
25%	4	8	12	0.10^{a}	0.20^{a}	0.50	11.60^{b}	14.64^{b}	1.34^{c}	6.38^{ab}	3.82^{ab}	23.76^{ab}
50%	9	8	17	0.47^{ab}	0.53^{a}	0.89	11.60^{b}	17.64^{c}	1.02^{ab}	7.08^{b}	4.44^{bc}	28.11^{ab}
75%	8	8	16	0.47^{ab}	0.70^{ab}	0.67	6.40^{a}	14.38^{b}	1.12^{ab}	7.08^{b}	4.48^{c}	34.71^{b}
100%	8	10	18	0.97^{c}	1.07^{b}	0.91	7.60^{a}	13.38^{b}	0.84^{a}	6.30^{ab}	3.92^{ab}	25.75^{ab}
LSD value	NS	NS	NA	0.18	0.22	NA	1.07	1.32	0.20	0.52	0.37	4.95

Means with the same alphabets in the same column are not significantly different at $P<0.05$
Key
NS= Not significantly different
NA= Not analyzed
NOG=Number of germination
DAG=weeks after planting
WAP=weeks after planting.

Table 2: Effects of Leaf Extracts of *Moringa oleifera* of Quantitative traits on *Sesamum indicum* Var. 01M.

Conc.	NOG 1-5 days	NOG 6-10 days	Total No of germinated seeds	Shoot length (cm) 10DAG	Root length (cm) 10DAG	Shoot / Root ratio	No. of leaves 8WAP	Height of plants 8WAP	Stem girth 8WAP	Leaf length 8WAP	Leaf breadth 8WAP	Leaf area 8WAP
Control	4	10	14	0.57^{b}	0.53	1.08	8.00^{a}	10.70^{a}	1.20	5.70	3.30	18.85
25%	8	6	14	0.37^{ab}	0.60	0.62	11.70^{b}	14.35^{b}	1.44	5.10	3.26	16.66
50%	10	10	20	0.23^{a}	0.40	0.58	11.30^{b}	17.61^{c}	1.54	5.34	3.24	18.17
75%	10	4	14	0.20^{a}	0.33	0.61	6.51^{a}	14.16^{b}	1.30	5.06	3.40	17.56
100%	6	10	16	0.30^{a}	0.50	0.60	7.30^{a}	13.86^{b}	1.43	4.88	3.20	15.67
LSD value	NS	NS	NA	0.10	NS	NA	1.03	1.32	NS	NS	NS	NS

Means with the same alphabets in the same column are not significantly different at $P<0.05$
Key
NS= Not significantly different
NA= Not Analyzed
NOG=Number of germination
DAG=weeks after planting
WAP=weeks after planting

Plate I. Photograph of Germinating Sesame Seeds, 7 Days after Germination (7 DAG) using *Vernonia amygdalina* Leaf Extract.

Plate II. Photograph of Germinating sesame Seeds 7 Days after Germination (7 DAG) using *Moringa olefeira* Leaf Extract.

Plate III: Photograph of Sesame plants grown with *Vernonia amygdalina* Leaf Extract.

Plate IV: Photograph of Sesame plants grown with *Moringa olefeira* Leaf Extract.
KEY

A: Control, B: 25% *Vernonia amygdalina,* C: 50% *Vernonia amygdalina,* D: 75% *Vernonia amygdalina,* E: 100% *Vernonia amygdalina,* F: 25% *Moringa olefeira,* G: 50% *Moringa olefeira,* H: 75% *Moring aolefeira,* I: 100% *Moringa olefeira*

DISCUSSION

Alleolopathy, according to Iduh and Oghale (2013), is the inhibitory or stimulatory reciprocal biochemical interactions among plants. Aladejimokun *et al.* (2014) opined that allelopathy is a process whereby remains of dead or living plants release chemicals that interfere with the metabolism of other plants. Alam and Azimi (1991) proposed two modes of action for allelopathy; firstly, the synergistic effect between competition and allelopathy may give the producers of phytotoxins an advantage over its competing species. The second mechanism is "self-balancing negative feed-back" whereby stressed plants produce more allelochemicals to suppress the growth of immediate vegetation thereby providing enough reduction in competing populations in the community.

The results obtained on effect of *Vernonia amygdalina* leaf extracts on quantitative traits in sesame revealed that the extract significantly affects shoot length, root length, shoot/root ratio, numbers of leaves, height of plants, stem girth, leaf length, leaf breadth and leaf area in the plant with each organ showing significant development at different extract concentrations. This indicates that *Vernonia amygdalina* extracts has significant allelopathic effect on seedling growth and establishment of sesame (*Sesamum indicum*). It could also be deduce from above findings that each trait in (*Sesamum indicum*) requires different treatment for genetic expression. Therefore expressions of these traits in *Sesamum indicum* are concentration dependent. Similar finding was reported by Iduh and Oghale (2013) on the effect of *Ageratum conyzoides* leaf and flower extracts on seedling growth of sesame (*Sesamum indicum*).

The close shoot/root length ratio observed between control and 100% concentration of *Vernonia amygdalina* leaf extract in this study indicates that the extracts had the highest potency to enhance growth in the shoot and root apices at a very high concentration. This suggests that *Vernonia amygdalina* leaf extract has stimulatory (positive) allelopathic ability on shoot and root growth at this concentration. This enhanced growth may be linked to the production of more auxin at 100% concentration of the extract. Zhung *et al.* (2005) gave similar report on the effect of Lantana (*Lantana camera* L.) on water hyancinth (*Eichornia crasspes*). In the opinion of Aladejimokun *et al.* (2014), stimulation of growth by plant extracts can be accounted for by the breakdown of functional allelochemicals in the extracts and their subsequent transformation to plant nutrients required for growth.

The observed significantly higher performance of sesame for traits like height of plants, leaf number, leaf breadth, leaf length and area of leaves at 50% and 75% concentrations further confirmed the earlier report that the allelopathic effect of *Vernonia amygdalina* on sesame growth is concentration-dependent. Therefore, enhance growth will be obtained in sesame only if the best concentration is maintained. This finding lends credence to the report of Zhung *et al.* (2005) that allelochemicals can inhibit growth of plants at certain concentrations

but may stimulate growth at same other concentrations.

The effects of *Moringa oleifera* leaf extracts on quantitative traits of sesame revealed very little allelopathic interaction. Only the shoot length, number of leaves and height of plants responded significantly to different concentrations of the extracts. This indicates that *Moringa oleifera* extracts has little allelopathic potential on seedling establishment and seedling growth of sesame. This finding therefore suggests that the genes controlling shoot length, number of leaves and plant height in sesame may be easily affected by external environment. Alege *et al.* (2011) reported that genes controlling some morphological traits in sesame can easily be affected by environmental factors. In contrast to the finding on *Vernonia amygdalina* on shoot/root ratio in sesame seedling*, Moringa oleifera* leaf extracts did not produce allelopathic effects on shoot/root ratio which strongly suggest that *Moringa oleifera* leaf extracts may not enhance auxin production in sesame. Also, the distribution of this growth hormone in the two apices is more toward the root than the shoot.

CONCLUSION

There is sufficient evidence in this study to support that *Vernonia amygdalina* had more allelopathic potentials on seedling establishment and growth of sesame than *Moringa oleifera.* Also, the stimulatory effect of *Vernonia amygdalina* is concentration-dependent and when properly utilized it could lead to increase in growth of sesame (*Sesamum indicum*). It is, therefore, recommended that farmers should plant *Vernonia amygdalina* around their farms because the allelochemicals produced by the plant could enhance growth in the crops (sesame). Further study is, therefore, recommended to identify the exact allelochemicals in the plant that promote crop growth in sesame (*Sesamum indicum*).

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