ajfand SCHOLARLY, PEER REVIEWED
AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT
Volume 21 No. 7
August 2021
PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST
ISSN 1684 5374

Afr. J. Food Agric. Nutr. Dev. 2021; 21(7): 18404-18413 https://doi.org/10.18697/ajfand.102.19695

SHORT COMMUNICATION

EFFECTS OF FRESH SHOOT BIOMASS OF SIAM WEED *Chromolaena odorata* (L.) King and H. Robinson ON THE GERMINATION AND GROWTH OF OKRA *Abelmoschus esculentus* (L.) Moench

Ajewole TO[1]*, Ayesa AS[2], Popoola KM[1], Ajiboye MD[1], Oluwole BR[1] and OS Kolawole[3]

Tolulope Ajewole

*Corresponding author email: tolulope.ajewole@fuoye.edu.ng

[1]Federal University Oye Ekiti, Ekiti State, Nigeria

[2]Chrisland University, Abeokuta, Ogun State, Nigeria

[3]Federal University Kashere, Gombe State

ajfand SCHOLARLY, PEER REVIEWED AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT Volume 21 No. 7 August 2021 PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST ISSN 1684 5374

ABSTRACT

This study was carried out in the Department of Plant Science and Biotechnology, Federal University Oye Ekiti, Ekiti State. Investigation was carried out on the effects of Fresh Shoot Biomass of *Chromolaena odorata* on okra *Abelmoschus esculentus*. For the laboratory experiment, about 5g, 10g, 15g and 20g each of *Chromolaena odorata* was weighed into plastic bottles each containing 250ml of distilled water for 24 hours. Two millilitres of the leachate was used to water the seeds of okra that was placed in Petri dishes. Each treatment had five replicates that contained four seeds of okra (*Abelmoschus esculentus*). For the screening experiment, loamy top soil, fresh shoot, stems and leaves of *Chromolaena odorata* were collected within Federal University Oye Ekiti environment and crushed into smaller bits using mortar and pestle. Three seeds, each of okra that was planted in all the pots. The growth variables considered include radicle length, plumule length, number of roots, for the green house experiment the plant height, leaf area, stem girth, and pod weight were also observed. The leachate of *Chromolaena odorata* resulted to a reduction in radicle length, plumule length and number of roots. The radicle length of okra treated with leachates of 15g/250ml were adversely affected, while the plumule length of 5g/250ml, 15g/250ml and 20g/250ml greatly decreased compared to the control. The highest decrease in number of roots was noticed in the 15g/250ml concentration. The control plant had the highest plant height increased in a concentration dependent manner with exception of those treated with 200g, the leaf area of the control plant was observed to be lower than all the treatment plants, but it increased in a concentration dependent manner. Also, there was a concentration dependent increase in the steam girth of *A. esculentus.* The pod weight of the treated plants were lower than the control. The plant treated with 50g highest moisture content, the fat content was higher in the control and plant treated with 50g than the other treated plant. The protein content of the treatment plants was observed to be significantly higher when compared to the control plant. Crude fiber content of the treatment plant was significantly higher than the treatment plants. The ash content of the control was significantly lower than the treated plants, the carbohydrate content of the control plant increased significantly compared to the treatment plant with the lowest at 150g treated plant. The study concluded that the leachate and FSB affected the seed germination, growth and the food content of *Abelmoschus esculentus.*

Key words: Shoot, Biomass, *Chromolaena odorata, Abelmoschus esculentus,* germination, leachates, growth, Okra

https://doi.org/10.18697/ajfand.102.19695

ajfand SCHOLARLY, PEER REVIEWED
AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT
Volume 21 No. 7
August 2021
PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST
ISSN 1684 5374

INTRODUCTION

Okra (*Abelmoschus esculentus*)
Okra is the only vegetable crop of significance in the Malvaceae family and is very popular in the Indo-Pak subcontinent. It is one of the oldest cultivated crops presently grown in many countries and is widely distributed in Africa to Asia, southern Europe and America.

According to Lamount [1], okra has an estimated average chemical composition of OBF (*Abelmoschus esculentus* variety): 67.5 % a-cellulose,15.4 % hemicelluloses, 7.1 % lignin, 3.4 % pectic matter,3.9 % fatty and waxy matter and 2.7 % aqueous extract.

***Chromolaena odorata* (Siam weed)**
Chromolaena odorata (Siam weed) belongs to the family *Asteraceae*. Its common names include "Awolowo", in Igbo language," Obiraohu" in Bumaji-Boki, siam weed, triffi weed in Hausa, bitter bush or jack in the bush [2]. It has been introduced into the tropical regions of Asia, Africa and the Pacific, and parts of Australia, Central and Western Africa, tropical America, India, Philippines, southern China, South Africa, eastern Indonesia, and Australia where it is an invasive weed [3]. *Chromolaena odorata* is considered an invasive weed of field in its early stage and has been reported to be the most problematic invasive species within protected rainforests in Africa [4]. It forms dense stands that prevent the establishment of other plant species. It is an aggressive competitor and may have allelopathic effects. It is also a nuisance weed in agricultural land and commercial plantations. It contains carcinogenic-pyrrolizidine alkaloids [5]. It can suppress crops and other plants by competing for nutrients and water, over-shading and allelopathy [6]. *Chromolaena odorata* leaves, especially the young ones are toxic due to high levels of nitrate [7].

The general aim of this study was to investigate the effects of *Chromolaena odorata* on the morphological and food quality and yield of okra *Abelmoschus esculentus.*

MATERIALS AND METHODS

This experiment was carried out in the laboratory of the Department of Plant Science and Biotechnology, Faculty of Science, Federal University Oye Ekiti, Nigeria. Materials used for this study include: fresh shoot of *Chromolaena odorata*, okra seed, weighing balance, mortar, distilled water, conical flask, measuring cylinder, paper tape, cleaned and dried petri dishes, Whattman No 1 filter paper, syringe, and measuring bottles. Fresh shoot of *Chromolaena odorata* was collected within the University environment. The fresh leaves were blended in mortar without adding water.
About 5g, 10g, 15g and 20g each of *Chromolaena odorata* were weighed into plastic bottles each containing 250ml of distilled water and left for 24 hours. Thereafter, each sample was filtered. Exact 2ml of the leachate was used to water the seeds of okra that were placed in petri dishes containing double layered Whatman No 1 filter paper. Each treatment had five replicates that contained four seeds of okra (*Abelmoschus esculentus*). Control experiment was set up by using distilled water and all the experiments were kept at room temperature. The radicle length, plumule length, and the

number of secondary roots were observed. Also, the germination percentage was calculated based on the number of germinating seedlings.

SCREEN HOUSE EXPERIMENT

Seeds of okra (*Abelmoschus esculentus*), shoot (stems and leaves) of Siam weed, nylon pots, weighing balance, 2mm sieve, 50cl measuring cup, loamy soil, mortar and pistil, white plastic spoons, permanent marker tape rule, and a weighing balance were the materials used for the screen house experiment. Loamy top soil was collected within the Federal University, Oye Ekiti environment where Siam weed had not grown, so as not to interfere with the calculated result of the experiment. Fresh shoot, stems and leaves of *Chromolaena odorata* were collected within the university environment crushed into smaller bits. Samples of 50g, 100g, 150g and 200g of crushed Chromolaena were incorporated into four planting pots containing 15kg of loamy top soil, respectively, then a control experiment (0g *Chromolaena odorata*) was set up. The set-up was wet using tap water from the screen house and allowed to sit for about 24 hours after which three seeds each of okra were planted in all the pots. After two weeks, two weaker plants were removed from each pot, leaving the plant with more vigour. The plant height, stem girth, leaf area, number of fruits and pod weight were taken at eight weeks after planting, after which they were air dried and blended separately for proximate analysis.

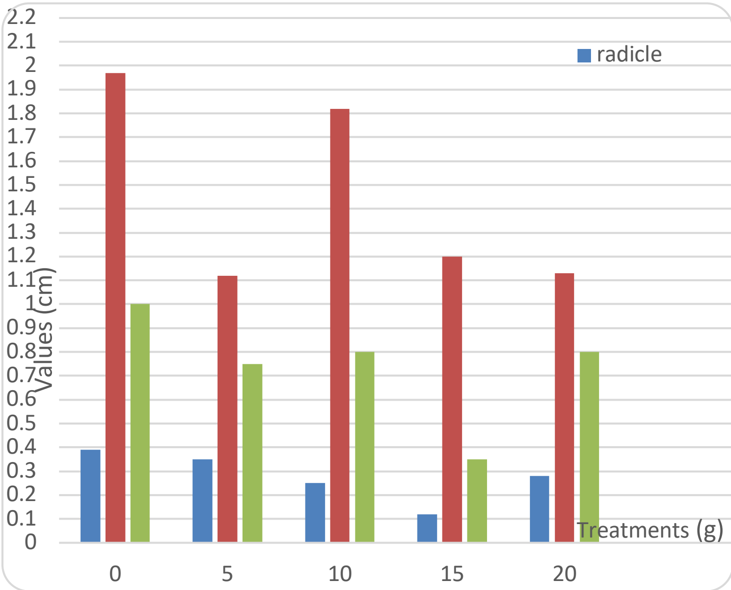
DETERMINATION OF PROXIMATE COMPOSITION OF THE SEEDS

The proximate parameters such as moisture, ash, crude fiber protein and carbohydrate contents of the samples were carried out following the procedure elaborated by AOAC [8].

ajfand SCHOLARLY, PEER REVIEWED
AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT
Volume 21 No. 7
August 2021
PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST
ISSN 1684 5374

RESULTS AND DISCUSSION

Figure 1.1: The effects of varying concentrations of leachates of *Chromolaena odorata* on radicle length, plumule length and number of roots of *Abelmoschus esculentus*



From the result shown above (Figure 1.1), it was observed that the radicle length of the control plants was higher than the plant treated with different concentrations 5g/250ml, 10g/250ml and 20g/250 of leachates obtained from *Chromolaena odorata*. The plant treated with 15g/250ml of *C. odorata* leachate had the lowest radicle length. Also, the plumule length was significantly higher in the control and the plants treated with 10g/250ml. Plants treated with 5g/250ml, 15g/250ml, 20g/250ml of *Chromolaena odorata* were negatively affected, the control had the highest plumule length.
The leachate of *Chromolaena odorata* had the highest negative effect on the root of plants treated with 15g/250ml, while it had a uniform effect on 5g/250ml and 20g/250ml. The control had the highest number of roots followed by plants with 10g/250ml.

In the same way, there was a concentration dependent increase in the stem girth of *Abelmoschus esculentus* after treatment with fresh shoot of biomass of *C. odorata*. However, there was no significant difference in the stem girth of the control and the treated plants. The control plants had the lowest value. It was observed from the result that the pod weight of plant treated with *C. odorata* fresh shoot biomass was lower than the control (with no treatment). The pod weight of the treatment plants is also concentration dependent. It was observed from this study that the moisture content of the control plant was significantly ($p < 0.05$) higher than the plant treated with different concentrations (100 g/ml, 150g/ml and 200 g/ml) of *Chromolaena odorata* fresh shoot biomass. The plant treated with 50 g/ml had the highest moisture content.

ajfand SCHOLARLY, PEER REVIEWED
AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT
Volume 21 No. 7
August 2021
PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST
ISSN 1684 5374

There was no significant difference between the fat content of the control and the plants that were treated with 50 g/ml. However, the fat content of the control was significantly higher than the plants treated with 100 g/ml, 150g/ml and 200 g/ml of *Chromolaena odorata* fresh shoot biomass.

The protein content of the treated plants was observed to be significantly ($p < 0.05$) higher when compared with the control plants. The plants that received 150 g/ml treatment had the highest protein content. The crude fibre content of control plant significantly ($p < 0.05$) increased when compared to the treatment plants. There was no significant difference in the crude fibre content of the plants treated with 100 g/ml, 150g/ml and 200g/ml of *Chromolaena odorata* fresh shoot biomass.

The ash content of treatment plants were significantly lower than the control. The plant treated with 100 g/ml of *Chromolaena odorata* fresh shoot biomass had the lowest ash content. There was no significant difference in the ash contents of plants treated with 50 g/ml, 150g/ml and 200 g/ml of *Chromolaena odorata* fresh shoot biomass.

The carbohydrate content of the control plant increased significantly when compared with the treatment plants. The plant treated with 150 g/ml of *Chromolaena odorata* fresh shoot biomass had the lowest carbohydrate content.

In this study it was observed that the radicle, plumule and number of roots were lower in the treatment plants compared to the control plants with highest effect on the treatment with 15g/250ml. Phytotoxic suppressive action of water extract of *Chromolaena odorata* on germination and seedling growth of rice and barn yard grass was also noticed in the work of Suwal *et al.* [10].

The minimal seed germination may also be as a result of available enzyme inside the seed and acid phosphate that delays seed germination, which leads to reduced ATP production [11,12]. The leachate showed a reduction in radical length, plumule length and number of root. The radical length of concentration 15g/250ml was greatly affected, while the plumule length of 5g/ml, 15g/ml and 20g/ml greatly decreased compared to the control. The highest decrease in number of roots was noticed in the 15g/250ml concentration in line with Suwal *et al.* [10], who also noticed phytotoxic suppressive action of water extract of *Chromolaena odorata* on germination and seedling growth of rice and barnyard grass. Therefore, deviation of plant from normal structure in photosynthesis may result in the reduction of plant growth or biomass [12, 13].

Crude fiber content of the treatment plant was significantly higher than the control plants. The ash content of the control was significantly lower than the treated plants, the carbohydrate content of the control plant increased significantly compared to the treatment plant with the lowest at 150g/ml treated plant. The study concluded that the leachate and FSB affected the seed germination, growth and the food content of *Abelmoschus esculentus.* According to Inderjit [14], allelopathy is an interference mechanism, in which live or dead plant materials release chemical substances, which inhibit or stimulate the associated plant growth.

ajfand SCHOLARLY, PEER REVIEWED
AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT
Volume 21 No. 7
August 2021
PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST
ISSN 1684 5374

The increase in protein, fat and ash contents of okra with the increase in concentration of FSB of *C. odorata* observed in this study is of great importance to human nutrition [15]. Proteins represent less than 1% of the fresh mass of fruit and vegetable tissues. The proteins of fruits and vegetables are built from amino acids, but other related simple nitrogenous compounds also occur. Fruits, vegetables and legumes account for 1.2%, 5.5% and 6.1%.

Also, the high presence of carbohydrate in the okra used in this study makes it important for the human diet, as described by Ariel *et al.* [16]. After water, carbohydrates are the most abundant constituents in fruits and vegetables, representing 50% to 80% of the total dry weight. Carbohydrate functions include, among others, the storage of energy reserves and the make-up of much of the structural framework of cells. Simple carbohydrates, which are also the immediate products of photosynthesis, are important components of sensorial quality attributes. Carbohydrates, like proteins, yield 4 kcal g^{-1}, while fats yield 9 kcal g^{-1}.

ajfand SCHOLARLY, PEER REVIEWED
AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT
Volume 21 No. 7
August 2021
PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST
ISSN 1684 5374

Table 1: Effect of concentrations of Fresh Shoot Biomass of *Chromolaena odorata* on different parts of *Abelmoschus esculentus*

Concentration (g/ml)	Plant Height	Leaf Area	Stem Girth	Pod Weight
0	7.53 ± 0.78^{a}	11.77 ± 0.89^{a}	0.80 ± 0.06^{a}	25.81 ± 5.56^{a}
50	7.77 ± 0.37^{a}	15.12 ± 2.05^{ab}	0.87 ± 0.09^{a}	20.06 ± 3.47^{a}
100	8.43 ± 0.26^{a}	16.44 ± 2.22^{ab}	1.00 ± 0.06^{a}	20.08 ± 3.03^{a}
150	8.97 ± 0.79^{a}	16.97 ± 1.54^{ab}	1.00 ± 0.06^{a}	20.94 ± 1.35^{a}
200	7.73 ± 1.27^{a}	19.63 ± 1.61^{b}	1.00 ± 0.10^{a}	22.19 ± 1.72^{a}

Table 2: Effect of concentrations of fresh shoot biomass of *C. odorata* on the proximate analysis of *Abelmoschus esculentus* dried fruit

Concentration (g/ml)	Moisture Content	Fat Content	Protein Content	Crude fibre Content	Ash Content	Carbohydrate Content
0	12.08 ± 0.02^{d}	6.19 ± 0.02^{a}	15.72 ± 0.09^{a}	11.16 ± 0.06^{a}	6.27 ± 0.06^{a}	48.59 ± 0.05^{a}
50	13.07 ± 0.05^{e}	6.11 ± 0.01^{a}	16.72 ± 0.22^{b}	10.84 ± 0.14^{b}	6.12 ± 0.02^{b}	47.14 ± 0.12^{c}
100	10.77 ± 0.17^{b}	5.21 ± 0.01^{b}	20.27 ± 0.09^{c}	9.64 ± 0.04^{c}	5.93 ± 0.03^{c}	48.19 ± 0.14^{b}
150	11.15 ± 0.05^{c}	5.51 ± 0.09^{c}	23.28 ± 0.16^{e}	9.69 ± 0.04^{c}	6.09 ± 0.03^{b}	44.29 ± 0.03^{d}
200	9.81 ± 0.06^{a}	5.74 ± 0.09^{d5}	21.46 ± 0.15^{d}	9.46 ± 0.04^{c}	6.13 ± 0.02^{b}	47.42 ± 0.07^{c}

https://doi.org/10.18697/ajfand.102.19695

REFERENCES

1. **Lamont W** Okra, a versatile vegetable crop. *Hort. Technol.* 1999;**9**: 179-184.

2. **Okon PB and UC Amalu** Using weed to fight weed. LEISA MAGAZINE.

3. **Raimundo RLG, Fonseca RL, Schachetti-Pereira R, Peterson AT and Thomas Michael Lewinsohn**: Native and Exotic Distributions of Siamweed (*Chromolaena odorata*) Modeled Using the Genetic Algorithm for Rule-Set Production, *Weed Science*, 2007; **55 (1):** 41–48.

4. **Struhsaker TT, Struhsaker PJ and KS Siex** "Conserving Africa's rain forests: problems in protected areas and possible solutions" (PDF). *Biological Conservation,* 2005; **123 (1)**: 45–54.

5. **Fu PP, Yang YC, Xia Q, Chou MC, Cui YY and G Lin** "Pyrrolizidine alkaloids-tumorigenic components in Chinese herbal medicines and dietary supplements", *Journal of Food and Drug Analysis*, 2002; **10(4)**: 198-211.

6. **Wilson D** Deletion of the high-affinity cAMP phosphodiesterase encoded by PDE2 affects stress responses and virulence in Candida albicans. *MolMicrobiol* 2007**; 65(4)**:841-56.

7. **Orapa W and I Bofeng** Mass production, establishment and impact of Cecidocharesconnexa on chromolaena in Papua New Guinea. In: Proceedings of the Sixth International Workshop on Biological Control and Management of Chromolaena, ed. M. D. Day and R. E. McFadyen. ACIAR Technical Reports 55. Canberra, Australia: ACIAR, 2004; pp. 30–35.

8. **AOAC**. Official Methods of Analysis. 18th edn. Association of Official Analytical Chemists; Arlington, VA, USA: 2006

9. **AOAC**. Official Methods of Analysis. 18th edn. Association of Official Analytical Chemists; Arlington, VA, USA: 1990.

10. **Suwal MM, Anjana D and HD Lekhak** Allelopathic effects of *Chromolaena odorata* on seed germination and seedlings growth of paddy and barnyard grass. Scientific world 2010; vol. 8, No. 8.

11. **Simiri M, Chaoui A and E EI Ferjani** Respiratory metabolism in the embryonic axis of germinating pea seed exposes to cadmium. *J. Plant Physiol*., 2009; **166(3)**: 259-269.

12. **Ayesa AS, Chukwuka KS and OO Odeyemi** Tolerance of *Tithonia diversifolia* and *Chromolaena odorata* in heavy metal contaminated soils. Journal of Toxicology Reports (Elsevier) 2018; **5** ;1134-1139. https://doi.org/10.1016/j.toxrep.2018.11.007

13. **Żurek G, Pogrzeba M, Rybka K, Krzyżak J and K Prokopiuk** The Effect of Heavy Metal Contaminated Soil on Growth and Development of Perennial Grasses E3SWeb of Conferences: published by EDP Sciences, 2013; 201 / 301130 **1** conf e3s 06 13006.

14. **Inderjit** Soil environment effects on allelochemical activity *Agron. J.,* 2001; **93**:79-84.

15. **Hiza HAB and L Bente** Nutrient content of the U.S. food supply, 1909–2004: A summary report. Home Economics Research Report Number 57. U.S. Department of Agriculture, Center for Nutrition Policy and Promotion, Washington, DC, USA 2007.

16. **Ariel V, George M, Gabriel OS and HC Carlos** Nutritional Quality of fruits and vegetables Chapter 5 Postharvest Handling (A systems approach) 2009.