ALLELOPATHIC EFFECT OF MINTWEED (*Hyptis suaveolens (L.*) Poit) GREEN AND BROWN LEAVES AQUEOUS EXTRACT ON SEED GERMINATION AND SEEDLING GROWTH OF COWPEA

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ABSTRACT
Hyptis suaveolens is an invasive weed that has negative effects on native plant communities and impedes the growth of vulnerable or threatened species growing near it. This study revealed the allelopathic effect of the aqueous extract of the green and brown leaves of *Hyptis suaveolens* on seed germination and seedling growth of cowpea at different concentration (0 %, 2.5 %, 5 %, 7.5 % and 10 %) in a laboratory – based experiment. The treatments were arranged as a 2 x 5 factorial in a Completely Randomized Design (CRD) in four replications. Results revealed that irrespective of the leaf type, there was no significant difference in the allelopathic potential on the seed germination and seedling growth of cowpea. In contrast, the concentration of the extracts had a significant allelopathic effect on cowpea seed germination and seedling growth, such that the inhibition was concentration dependent. The inhibition of the seed germination and seedling growth increased with the increase in the concentration from 0 to 10 %. The highest concentration (10%) of *H. suaveolens* leaf extract significantly reduced the germination percentage, germination index, mean germination time, radicle and plumule lengths by 61.5 %, 63.9 %, 61.7 %, 54.2 % and 62.5 %, respectively. It was apparent that the 10% concentration had more inhibitory (-61.5%) effect on the germination and seedling growth of cowpea relative to the control. This weed must therefore be controlled in the cowpea field at their initial growth.
Keywords: Allelopathy, Germination, Seedling growth, Concentration and Cowpea

INTRODUCTION

Hyptis suaveolens (L.) Poit, which is commonly known as Mintweed, is an important invader of the tropical and sub-tropical regions of the world (Afreen *et al.*, 2017). *Hyptis* possesses several characteristics common to other invasive species, such as allelochemicals that help in its survival and spread. This species has wide ecological amplitude, high plasticity and reproductive capacity because it is able to grow on a variety of soil types, land uses and land cover type (Padalia *et al.*, 2013). *Hyptis* possesses faster growth rate, massive seed production, high proliferation rate, dual mode of reproduction (from perennating root-stocks as well as seed). Higher resistance against pathogens due to allelochemicals and essential oil (Raizada, 2006).

The growth and establishment of other plant species near the clumps of *H.suaveolens* is quite restricted (Raizada *et al*., 2006) but the specific reasons that lead to the dominance of *H. suaveolens* still remain unclear. One of the plausible reasons for such interference could be due to the presence of allelochemicals in this plant. Allelochemical activities of aqueous methanol extract of *H. suaveolens* on the germination and seedling growth of several weeds and crop species have been reported by Momimul-Islam *et al.* (2013) and Daniya *et al.* (2014).

Allelopathy refers to the effect of one plant species on another through the release of chemical compounds known as allelochemicals into the environment (Weih *et al*., 2008), which may either be promoting (synergistic) or inhibiting (antagonistic) depending on the compounds released and target plants. The potential use of allelopathy as a natural means for weed suppression in Agro ecosystems has attracted the interest of researchers for a long time (Yongqing *et al.,* 2014).

Cowpea (*Vigna unguiculata* (L.) Walp) is an important pulse crop widely cultivated in the tropics. The pods are highly nutritive and are a good source of digestible protein, dietary fiber and vitamin A and C. In addition to these the pods also contain Ca, P, Na, K, Mg, Fe, Zn, Mn and Cu (Gerrano *et al*., 2017). However, it is sensitive to weed competition especially at the early stage of crop development and the period from 14 to 40 days after sowing (DAS) has been considered critical for the weed competition (Osipitan *et al.,* 2016). Weed infestation has been reported to be more severe during the rainy season and causes severe yield reduction (Gupta *et al.,* 2016). The impact of weed interference on cowpea yield depends on the duration and stage at which the crop-weed interference takes place. The season-long competition has resulted in 53 to 76 percent yield reduction in cowpea (Gupta *et al.,* 2016).

The aim of the study was to assess the allelopathic effect of aqueous extracts of green and brown leaves of *H. suaveolens* at varying concentrations on germination and seedling growth of cowpea.

MATERIALS AND METHODS

A set of experiments was carried out to assess the allelopathic effect of *H. suaveolens* on germination and seedling growth of cowpea in a laboratory at Department of Crop Production, Federal University of Technology, Minna, Niger State. Green and Brown leaves of *H. suaveolens* were collected at flowering stage from farmlands within the Federal University of Technology Gidan Kwano Campus, Minna, Niger State during the rainy season of 2022. The two leaves were

separated, air dried under the shade for four weeks and later oven dried at 70^{o}C to a constant weight. The powder of each plant part was soaked in distilled water for 24 hours in a ratio of 1:20 (w/v) at room temperature. The water extracts of each plant part were filtered through a Whatman No. 1 filter paper to obtain the pure aqueous extracts without impurities. The extracts prepared in this manner were used as stock solutions with concentration of 10 % (w/v), and further dilutions to 2.5 % (w/v) of extracts of green and brown leaves of *H. suaveolens* were made by adding distilled water to the stock solution for carrying out the experiment at varying concentrations: - 0%, 2.5% (1:40 w/v), 5% (1:20 w/v), 7.5% (1: 15 w/v) and 10% (1: 10 w/v) against cowpea in a laboratory condition. Ten cowpea seeds were placed on a filter paper in 9 cm diameter petri dishes, separately. In each petri dish, 10 ml of green or brown leave aqueous extracts at 2.5%, 5%, 7.5% and 10% and distilled water was poured as per the treatments. Distilled water was used as control for comparison. The temperature during the growing period of cowpea ranged from 29.0 to 31.8^{o}c. The experiment was observed for 16 days. Petri dishes were kept moistened during the whole period of study. The number of seeds germinated was counted on a daily basis. Germination percentage, germination index, mean germination time and germination energy were determined using the formulae shown below: -

(a) Germination percentage (GP)

GP= $\frac{Germinated\ seeds}{Total\ seeds}$ x 100 as described by the Association of Official Seed Analysts (AOSA, 1990).

(b) Mean germination time (MGT)

MGT=$\frac{\sum Dn}{N}$ Ellis Roberts as described by Safder *et al*. (2021)

Where n = number of germinated/emerged seeds on day `D` and `D` equal days of count

(c) Germination Index (GI)

GI= $\frac{No\ of germinated\ seeds}{Days\ of\ first\ count}$ + $\frac{No\ of\ germinated\ seeds}{Days\ of\ first\ count}$ as described by AOSA (1990)

(d) Radicle and Plumule length: This were measured using a centimetre rule.

(e) Percentage Inhibition/Stimulation: -

Inhibition (-) or Stimulation (+) = $\frac{Germinated\ seeds\ in\ extracts}{Germinated\ seeds\ in\ control} - Germinated\ seed\ in\ control$ x 100

The data collected were subjected to the analysis of variance (ANOVA) using the Statistical Analysis System (SAS) software package version 9.0. Differences between the treatments means were separated by the Least Significant Difference (LSD) at 5% level of probability.

RESULTS AND DISCUSSION

Germination Indices of Cowpea

The allelopathic effect of green and brown leaves extracts of *H. suaveolens* on germination indices of cowpea are hown in Table 1. The germination percentage, germination index and mean germination time was not significantly affected by either green or brown leaves of *H. suaveolens* (Table 1). In contrast, the germination indices were significantly reduced by the concentrations of the aqueous extract of the leaves (Table 1). Furthermore, the germination percentage, germination index and mean germination time were significantly reduced as the concentration of the extract was increased from 0 % to 10 %. The highest concentration of 10 % consistently and significantly reduced the germination percentage, germination index and mean germination time compared to the control. The allelopathic inhibition of germination in cowpea could be attributed to the presence of allelochemicals at varying concentrations in the water extracts of the *H. suaveolens* leaves. Oraon and Mondal (2021) demonstrated that *H. suaveolens* inhibited the seed germination, though in rice. Furthermore, Oraon and Mondal (2021) substantiated that allelopathic activity depends on the concentration and varies from species to species.

Seedling Growth of Cowpea

The allelopathic effect of extracts of *H. suaveolens* on seedling growth of cowpea is shown in Table 2. The radicle and plumule lengths were not significantly affected by either green or brown leaves of *H. suaveolens*. In contrast, the radicle and plumule length were significantly reduced by the concentrations of the aqueous extract of the *H. suaveolens* (Table 2). Both radicle and plumule lengths were significantly reduced as the concentration of the extract was increased from 0 % to 10 %. Maximum reduction in radicle and plumule lengths were recorded with the highest concentration (10 %) in this study. Increasing the concentrations of aqueous leaf extracts increased the inhibitory effect of the radicle and plumule lengths of cowpea. Oraon and Mondal (2021) also reported that the germination and seedling growth of several crops are affected by the allelopathic influence of *H. suaveolens.*

CONCLUSION

It can be concluded in this study that irrespective of the type of leaves of *H. suaveolens*, the aqueous extract of the leaves had a strong allelopathic potential to fully inhibit the germination and seedling growth of cowpea. The 10 % concentration of aqueous extract of the *H. suaveolens* leaves strongly inhibited the germination and seedling growth of cowpea.

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Table 1: Allelopathic effect of water extract of green and brown leaves of *Hyptis suaveolens* at varying concentration on germination indices of cowpea

Treatment	Germination Percentage	Germination Index	Mean Germination Time

Leaf type (L)			
Green	54.0a	2.4a	5.4a
Brown	63.0a	2.7a	6.3a
LSD (0.05)	11.6	0.5	1.2
Concentration(C) (%)			
0	81.3a	3.6a	8.1a
2.5	70.0ab	3.1ab	7.0ab
5.0	58.8bc	2.6bc	5.9bc
7.5	51.3c	2.2cd	5.1c
10	31.3d	1.3d	3.1d
LSD (0.05)	18.3	0.8	1.8
Interaction			
L x C	NS	NS	NS

Means with different letters from each other differ significantly at $p \leq 0.05$: NS = Not significant.

Table 2: Allelopathic effect of water extract of green and brown leaves of *Hyptis suaveolens* at varying concentration on radicle length, plumule length, stimulation and inhibition of cowpea

Treatment	Radicle length (cm)	Plumule length (cm)	Stimulation and inhibition (%)
Leaf (L)			
Green	2.8a	6.7a	-28.8a
Brown	3.1a	7.6a	-25.6a
LSD (0.05)	0.5	1.0	16.0
Concentration (C)			
0	3.5a	9.6a	0.0a
2.5	3.5a	8.0b	-12.7ab
5.0	3.0a	7.3b	-26.6b
7.5	3.0a	7.0b	-35.2b
10	1.6b	3.6c	-61.5c
LSD (0.05)	0.8	1.5	25.27
Interaction			
L x C	NS	NS	NS

Means with different letters from each other differ significantly at $p \leq 0.05$: NS = Not significant: negative values represent inhibition