

Effect of Neem (*Azadirachta indica*) Leaf Aqueous Extract on Internode Length of Selected Cowpea Varieties Infested with *Fusarium oxysporum*

Falalu. M. I.^{1*}; Yahaya. S. M.²; Abubakar A. A.³; Aisha. W. A.⁴; Bakondi. H. H.⁵; Zainab. Y. S.⁶

^{1,3,4,5,6}Biology Department, Federal College of Education Jama'are. Bauchi

²Biology Department. Aliko Dangote University of Science and Technology Wudil

Correspondent Author: Falalu. M. I.^{1*}

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Abstract: Cowpea (*Vigna unguiculata* L.) is a major grain legume cultivated extensively in sub-Saharan Africa; however, its productivity is severely limited by soil-borne fungal pathogens, particularly *Fusarium oxysporum*. This study evaluated the effect of neem (*Azadirachta indica*) leaf aqueous extract on internode length of three cowpea varieties Sampe, Pampe 12, and a local cultivar infected with *F. oxysporum*. A pot experiment was conducted using a completely randomized design, where infected plants were treated with neem leaf aqueous extract, while untreated infected plants served as controls. Internode length was measured at defined growth stages, and data were subjected to analysis of variance. Application of neem extract significantly enhanced internode length compared with the untreated control, indicating a reduction in the deleterious effects of *Fusarium* infection. Varietal responses differed, with Pampe 12 exhibiting the greatest tolerance and growth recovery following treatment. The findings demonstrate the potential of neem leaf aqueous extract as an environmentally friendly alternative to synthetic fungicides for managing *Fusarium* wilt and improving vegetative growth in cowpea.

Keywords: *Azadirachta indica*; *Vigna Unguiculata*; *Fusarium oxysporum*; Botanical Fungicide; Internode Length; Disease Management.

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I. INTRODUCTION

Cowpea (*Vigna unguiculata* L.) plays a crucial role in food security and income generation in tropical and subtropical regions, particularly in West Africa, due to its high protein content and adaptability to marginal soils [1]. Despite its agronomic importance, cowpea production is constrained by several biotic stresses, among which fungal diseases are predominant [2]. *Fusarium oxysporum*, a soil-borne pathogen, causes vascular wilt leading to stunted growth, reduced internode elongation, and, in severe cases, plant death [3].

Conventional management of *Fusarium* wilt relies heavily on synthetic fungicides; however, their continuous use raises concerns regarding environmental pollution, pathogen resistance, and human health hazards [4]. As a result, attention has shifted toward the use of plant-derived products that are biodegradable, readily available, and safe to non-target organisms [5]. Neem (*Azadirachta indica*) is a

widely studied medicinal plant known for its antifungal, antibacterial, and insecticidal properties, attributed to bioactive compounds such as azadirachtin and nimbin [6].

Internode length is an important morphological parameter that reflects plant vigor and the extent of stress imposed by pathogenic infection [7]. Assessing changes in internode length provides insight into the effectiveness of disease management strategies on plant growth. This study therefore aimed to assess the influence of neem leaf aqueous extract on the internode length of selected cowpea varieties infected with *Fusarium oxysporum*.

II. MATERIALS AND METHODS

➤ Experimental Conditions

The experiment was conducted under screen-house conditions to minimize environmental variability. Topsoil used for the study was sterilized prior to planting to eliminate resident microorganisms.

➤ *Planting Materials:*

Seeds of three cowpea varieties Sampe, Pampe 12, and a local cultivar were obtained from institute of agricultural research Kano (IITA). Seeds were surface-sterilized using standard procedures before sowing.

➤ *Preparation of Neem Leaf Aqueous Extract*

Fresh neem leaves were collected, washed thoroughly, and air-dried under shade. The dried leaves were pulverized, and a measured quantity was soaked in distilled water for 24 hours. The mixture was filtered using muslin cloth to obtain the aqueous extract, which was subsequently diluted to the desired concentration for application [8]. Treatment levels of neem aqueous extract (0%, 25%, 50%, 75%, and 100% concentration respectively).

➤ *Isolation and Inoculation of Fusarium oxysporum*

The pathogen *Fusarium oxysporum* was isolated from diseased cowpea plants and cultured on potato dextrose agar (PDA). Seedlings were inoculated with a standardized spore suspension at the early growth stage to ensure uniform infection [9].

➤ *Experimental Design and Treatment Application*

The study was arranged in a completely randomized design (CRD) comprising neem extract-treated plants and

untreated infected controls, with adequate replications. Neem extract was applied as a soil drench around the plant base at regular intervals.

➤ *Data Collection and Analysis*

Internode length was measured in centimeters using a graduated ruler at specified growth stages. Data collected were subjected to analysis of variance (ANOVA), and treatment means were separated at the 5% probability level using an appropriate multiple comparison test.

III. RESULTS

Application of neem leaf aqueous extract significantly influenced the internode length of cowpea plants infected with *Fusarium oxysporum*. Neem-treated plants exhibited longer internodes compared with untreated infected controls. Among the varieties evaluated, Pampe 12 recorded the highest internode length following treatment, indicating greater tolerance to *Fusarium* infection, while the local variety showed comparatively lower growth response. Visual assessment also revealed a reduction in disease symptoms in neem-treated plants.

Table 4 Interaction Effect of Different Concentration of Aques Extract of Neam Leaves on Three (3) Cowpea Varieties

Varieties	Treatment	1	2	3	4	5	6	7	8	9	10
S	0.00	1.33c	2.40bc	3.40cd	5.60de	4.60d	4.61e	4.60d	4.60e	4.60d	4.60d
S	0.25	2.40a	2.33bc	4.43b	7.37b	7.37b	7.37b	7.37b	7.37b	7.36b	7.37c
S	0.50	2.23a	2.70b	5.63a	14.43a	8.43a	8.46a	8.43a	8.43a	8.43a	8.43ab
S	0.75	1.47bc	2.33bc	3.70c	6.27cd	6.27c	6.26c	6.027c	6.27c	6.28c	6.27d
S	0.00	0.50d	1.33e	2.67e	3.32f	3.37e	3.37f	3.37c	3.37f	3.38e	3.38g
P12	0.00	1.23c	2.40bc	3.5cd	5.10e	4.57d	4.40e	4.57d	4.50e	4.50d	4.10f
P12	0.25	1.33c	2.40bc	4.50b	6.23cd	7.43b	5.37d	7.37b	5.37d	7.36b	7.40c
P12	0.50	2.50a	2.83b	5.40a	14.60a	8.66a	8.67a	8.67a	8.67a	8.67a	8.67a
P12	0.75	1.40bc	2.37bc	3.53cd	6.41c	6.40c	6.40c	6.40c	6.40c	6.40c	6.40d
P12	1.00	0.67d	1.60de	2.50e	3.57f	3.56e	3.57f	3.57e	3.56f	3.57e	3.58g
Local	0.00	1.63b	2.40bc	3.23d	5.40e	4.53d	4.53c	4.53d	4.53e	4.53d	4.53e
Local	0.25	1.37bc	2.03cd	4.63b	2.37a	7.37b	7.37b	7.37b	7.39b	7.36b	7.36c
Local	0.50	2.33a	3.53a	5.47a	14.60a	8.27a	8.27a	8.27a	8.26a	8.28a	8.27ab
Local	0.75	1.30c	2.33bc	3.40cd	6.30cd	6.30c	6.30c	6.30c	6.30c	6.30c	6.3d
Local	1.00	0.77d	1.50de	2.53e	3.33f	3.33e	3.33f	3.34e	3.33f	1.33e	3.33g

Table 5 Effect of Different Concentration of Neam Leaves Aques Extract on Leave Area of three (3) Varieties of Cowpea.

Conc % Week	1	2	3	4	5	6	7	8	9	10
Conc										
0.00	2.53d	4.31c	10.40c	12.42c	10.36c	16.31c	18.30a	18.30a	18.30a	17.32c
0.25	3.83b	5.42b	11.46b	13.37b	12.33b	17.32b	17.32b	17.32b	17.32a	19.44b
0.50	4.42a	6.47a	12.50a	16.38a	13.44a	18.30a	18.30a	18.30a	18.30b	20.32a
0.75	3.51c	4.37c	9.41d	11.48d	9.37d	17.32b	17.32b	17.32b	17.32b	17.32c
1.00	2.61d	3.33d	6.46e	6.38e	6.49e	10.40d	10.40c	10.40c	10.40c	10.40d
Varieties										
SP 1	3.48a	4.78a	9.97a	11.97a	10.43a	15.86a	16.27a	16.27a	16.27a	16.97a
P12	3.40ab	4.79a	10.03a	12.08a	10.44a	15.97a	16.35a	16.35a	16.35a	16.90a
Local	3.27b	4.77a	10.13a	11.97a	10.33a	15.97a	16.37a	16.37a	16.37a	17.02a
Interaction										
Concxvar	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001

IV. DISCUSSION

This study examined the influence of neem (*Azadirachta indica*) leaf aqueous extract on the growth and yield of three cowpea (*Vigna unguiculata*) varieties (Sampe, Pampe 12, and a local variety) under infection by *Fusarium oxysporum*. Neem leaves are widely recognized for their antimicrobial and growth-regulating properties owing to the presence of bio-active compounds such as azadirachtin, nimbin, and salannin [8]. These compounds have been shown to suppress pathogen development and enhance plant defense responses [3]

The pattern observed, in which moderate concentrations (25% and 50%) outperformed both the untreated control and the higher concentrations (75% and 100%), aligns with previous reports that neem extracts exhibit dose-dependent effects [4]. Moderate concentrations appear to provide an optimal balance between antifungal activity and plant tolerance, enabling disease suppression without inducing phytotoxicity. In contrast, higher concentrations are likely to contain excessive levels of secondary metabolites that inhibit seedling vigor, root elongation, and nutrient absorption [6]. The study's findings therefore reinforce the notion that moderate neem concentrations offer the most sustainable benefits for managing *Fusarium oxysporum* a conclusion consistent with earlier research in cowpea, tomato, sweet potato, and banana systems [10]. This is similar to the present finding where the growth and yield of cowpea varieties is at moderate's concentrations of 25% and 50% of three different cowpea varieties.

V. CONCLUSION

There were significant differences among the three cowpea varieties studied, with Sampe and Pampe 12 exhibiting better growth and yield performance under *Fusarium oxysporum* infection when compared to the local variety. Neem leaf aqueous extract had a beneficial influence on disease suppression and plant performance, with moderate concentrations (50%) producing the most favorable results. Neem extract can therefore be considered a cost-effective, environmentally sustainable, and farmer-friendly bio-control alternative to synthetic fungicides in cowpea cultivation.

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