SHORT COMMUNICATION

EFFICACY OF PLANT EXTRACTS ON CONTROL OF OKRA ANTHRACNOSE (*Colletotrichum gloeosporiodes*) IN THE SUDAN SAVANNAH ECOLOGY OF NIGERIA.

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SUMMARY

A field experiment was conducted at the Research Farm of the Department of Crop Protection, University of Maiduguri during the 2017 cropping season to evaluate the efficacy of five plant extracts (Neem seed, Garlic clove, Ginger rhizome, Bitter leaf, Balanite), and synthetic fungicide (Ridomil) on the control of okra anthracnose. The field trial was laid out in a randomized complete block design (RCBD) and replicated three times. Data was collected on disease incidence and severity, as well as average fruit yield, average fruit weight, average plant height and plant establishment count were also determined. Result showed that plant sprayed with the plant extracts had significant (p = 0.05) lower disease incidence and severity compared to the untreated plots. Plots treated with Neem seed and ginger rhizome extracts recorded significant reduction in disease incidence (19.96 and 18.53% respectively) at 3WAP, compared to the untreated plot (29.30%). Growth and yield parameters in treated plots for Neem seed, Garlic clove and synthetic fungicide were rated higher (589.53kg/ha, 588.50kg/ha and 606.90kg/ha) respectively compared to plots treated with other plant extracts as well as the check. The study has therefore shown that the plant extracts has great potential as fungicidal materials for control of anthracnose disease of okra.

Keywords*:* Anthracnose disease, plant extracts, okra, incidence, severity.

OKRA (*Abelmoschus esculentus*) *L.* Moench, also known as Lady's finger, is grown on about 2 million hectares annually in Nigeria [11]. It is a flowering plant valued for its edible green fruit, okra is an erect annual crop, some species growing up to 2m in height with long and broad leaves and with 5 to 7 petals. The fruit is a capsule 5-20 cm long and broad, containing numerous seeds. The crop is known locally as "bhendi" in Malaysia, "quiabairo" in Portuguese, and "bamiya" in Arabic. In Nigeria, its local names are "ila", "okwuru" and "kubewa" in Yoruba, Igbo and Hausa, respectively [12]. Okra supplies unsaturated fatty acids, protein, folic acid, calcium, vitamin C and potassium among other nutrients; hence plays a vital role in human diet [8]. There are several reasons for low yield of okra such as soil type and preparation, time and sowing method, seed quality e.t.c which all plays important roles but insect and disease are the most important biotic constraint [3].

Anthracnose is one of the fungal diseases found infecting okra plants and other vegetables, evergreen trees and shrubs. It is easily disseminated by water, and can out-winter in infected debris but does not spread under dry conditions [9]. Symptoms vary with host plants, weather and time of the year infection occurred. In Okra plant, infected leaves develop brown to black or tar-like spots, which appear on infected leaves of the host plant. Young infected leaves are curled and distorted with only a portion of each leaf dying. Heavily infected leaves fall prematurely throughout the growing season. Anthracnose of okra can cause 50% yield loss and above especially in susceptible genotype [5]. Management of anthracnose disease of okra could be achieved by use of resistance varieties, cultural methods such as wide plant spacing, raking and disposal of fallen leaves during growing season and use of synthetic fungicides. Due to residual effects of synthetic fungicides, plant extracts for control of plant disease and pest are emerging and widely acceptable for their eco-friendly nature. Different plant tissues, such as roots, leaves, shoots, seeds, bark of plants and flower possess inhibitory properties against bacteria, fungi and insects [2].

MATERIALS AND METHODS

The total area for the experiment was 720 m^2 with each plot measuring 8m x 8m. There were seven rows per replication, five seeds were sown per hole with 60cm x 45 cm plant spacing. Each plot contained 32 plants with 1m x 1m inter and intra row spacing. The field was planted on 12th, July 2017 at the Teaching and Research Farm of the Department of crop Protection, Faculty of Agriculture, Chukwuemeka Ojukwu University, Anambra State.

Experimental design and treatment

The trial was laid out in a Randomized Complete Block Design and replicated three times. The experiment consisted of five treatments and a control, as well as, standard check. The treatments were Neem seeds (*Azadirachta indica*) T1, Garlic clove (*Allium sativum*) T2, Ginger rhizome (*Zingiber officinale)* T3, Bitter leaf (*Vernomia amygdalina*) T4, Balanite seeds (*Balanite aegyptiaca*) T5, Ridomil (active ingredient metalaxyl + tebuconazole) T6 and Control (T7).

Preparation and application of aqueous extracts

The aqueous extracts were prepared following the procedures described by Edrisi and Farahbakhsh [4] with modifications. The collected plant materials were sorted into three parts (seed, stem and leaf) and air-dried in the laboratory at 25^{o}C for twenty one days. The air-dried plant materials were then, ground with bench top milling machine and stored in well labeled envelopes. For each powdered plant material, 200g was weighed, soaked separately in 1000ml distilled water for 24 hours at room temperature (27±2 ^{o}C) and covered with aluminum foil. Extracts were obtained by filtering with a muslin cloth and applied three times at 2 days interval using a hand sprayer, starting from 2 weeks after planting (WAP). Ridomil was prepared according to manufacturer's instructions (2.5kg/ha in formulation of wettable powder for vegetables).

Data collection and analysis

Disease incidence

The plants were examined at 5-day intervals and quantitative assessment (number of plants/leaves infected) was done from two randomly selected quadrats (1m x 1m) per plot. The total number of plants and number of infected plants in the quadrat were counted and the percentage disease incidence was calculated. Number of leaves infected was obtained from five randomly selected plants per plot and was expressed as percentage of total number of leaves.

Disease severity

The disease severity assessment score scale ranging from 1-9 was used. In the scale,

1 = no symptoms or presence of lesions

2 = 1-5 % leaf area covered with lesions

3 = 6-10 % leaf area covered with lesions

4 = 11-20 % leaf area covered with lesions

5 = 21-30 % leaf area covered with lesions

6 = 31-40 % leaf area covered with lesions

7 = 41-50 % leaf area cover with lesions
8 = 51-75 % leaf area covered with lesions
9 = more than 75 % leaf area cover with lesions
The disease severity was calculated using the formula:

$$\text{Disease Severity} = \frac{\sum n}{N \times 9} \times 100$$

Where, N = Total number of plants assessed; 9 = Highest score on severity scale, and ∑n= Summation of individual ratings.

Growth parameters
A random sample of five plants per plot was used for assessing growth parameters such as plant establishment (%), plant height (cm), and fruit yield (kg/ha).
Data collected were subjected to statistical analysis using Analysis of Variance (ANOVA), whereas means were separated using the Duncan multiple range test (DMRT).

RESULTS AND DISCUSSION

At 3 WAP disease incidence was lower in metalaxyl and ginger treated plots (17.03% and 18.53%, respectively) with bitter leaf and balanite plots showing high disease incidence at 21.93% and 22.90%, respectively. The disease incidence was significantly higher in the untreated plot and significantly lower in metalaxyl-treated plots when compared with the plant extracts. This might be connected with the fungicidal potency of the synthetic product. At 6 WAP, there was no significant difference among all the plots treated with plant extracts. Rather the synthetic fungicide showed significant variation. At 9 and 11 WAP results showed that the difference among all the treatments was not significant, except the check plot in Table 1. The various reactions among plant extracts (especially, *Zingiber officinale*) to disease incidence explained varying fungicidal potency of active ingredient in the extracts as reported by Nair, N and Arora [6].

Table 1: Effect of plant extracts on disease incidence of okra anthracnose at different weekly intervals after planting (WAP).

Treatment	3 WAP	6 WAP	9 WAP	11 WAP
Neem Seed	19.96b	36.60^{b}	36.83^{b}	38.90^{b}
Garlic clove	20.96b	37.80^{b}	38.96^{b}	40.05^{b}
Metalaxyl	17.03c	30.93^{c}	33.53^{b}	36.90^{b}
Ginger rhizome	18.53b	37.83^{b}	38.26^{b}	37.61^{b}
Bitter leaf	21.93^{b}	36.53^{b}	39.26^{b}	37.63^{b}
Balanite seed	22.90^{b}	36.23^{b}	40.03^{b}	38.06^{b}
control	29.30^{a}	42.23^{a}	44.53^{a}	48.86^{a}
SE±	3.66	2.90	3.54	6.06

Values with the same letters under a column are not significantly different according to Duncan's Multiple Range Test (DMRT) at 5% level of probability; SE±= Standard error.

The results in Table 2 showed that at 3 WAP there were differences in severity rates among the treated plants. Plots treated with metalaxyl had the lowest disease severity (18.63%) followed by neem extract (19.96%), but not statistically different except, when compared with the untreated plot (control). The low severity recorded in some plant extracts is dependent on the fungicidal potency of those extracts (Neem and Garlic). Garlic contains phytotoxic substance "allicin" [13] and the neem plant extracts contain an active ingredient known as "Azardirachtin", which is active against many pests and pathogens [1]. From 3 WAP to 11WAP, there was no significant difference in all the treatments, but the results showed that the inhibitory potential of the plant extracts is comparable with the synthetic fungicide.

Table 2: Effect of plant extracts on disease severity of okra anthracnose.

Treatment	Disease Severity (%)			
	3WAP	6WAP	9WAP	11WAP
Neem Seed	19.96^{b}	24.60^{b}	23.76^{b}	22.16^{b}
Garlic clove	21.50^{b}	26.00^{b}	24.56^{b}	23.63^{b}
Metalaxyl	18.63^{b}	22.30^{b}	21.93^{b}	20.83^{b}
Ginger rhizome	23.56^{b}	27.80^{b}	27.13^{b}	26.70^{b}
Bitter leaf	24.66^{b}	27.80^{b}	28.20^{b}	29.56^{b}
Balanite seed	26.46^{b}	27.16^{b}	28.86^{b}	29.80^{b}
Control	38.46^{a}	48.53^{a}	46.86^{a}	51.86^{a}
SE±	6.04	4.13	6.06	7.04

Values with the same letters under a column are not significantly different according to Duncan's Multiple Range Test (DMRT) at 5% level of probability; SE± =Standard error.

Table 3 showed the effect of plant extracts on yield parameters, i.e. number of fruits per plant and fruit weight. Statistically there was no significant difference among treated plot both for number of fruits per plant and fruit weight. Neem, Garlic clove and Ginger treated plots yield was significantly higher compared to untreated plots. The inhibition effect of the plant extract on hypha growth and spore germination as reported by Obagwu *et al*. [7] aided plant tolerance to disease incidence, flowering, fruiting and maturity.

Table 3: Effect of plant extracts on fruit yield of okra as affected by anthracnose disease at harvest (from 9 to 11 weeks after planting).

Treatment	Number of fruits/plant	Fruit weight (kg/ha)
Neem Seed	5.80^{a}	589.53^{a}
Garlic clove	5.70^{a}	588.50^{a}
Metalaxyl	5.93^{a}	606.90^{a}
Ginger rhizome	5.70^{a}	578.80^{a}
Bitter leaf	5.66^{a}	575.83^{a}
Balanite seed	5.53^{a}	562.97^{a}
Control	3.23^{b}	450.87^{b}
SE±	0.54	28.72

Values with the same letters under a column are not significantly different according to Duncan's Multiple Range Test (DMRT), at 5%level. SE± = Standard error.

Table 4 shows results on plant growth parameters at 3 WAP. There was no significant difference among treated plots except, when compared with check plot. Neem and metalaxyl treated plots showed highest plant establishment records (96.16%) and the least percentage establishment was recorded in the control plot (77.60%). The highest plant height was recorded in metalaxyl-treated plot (61cm) and the shortest plants were observed in the control plot (43 cm). Taiwo and Makinde [10] reported that the extract of *Tithonia diversifolia* had both stimulatory and phytotoxic inhibitory attributes.

Table 4: Effect of plant extracts on growth parameters of okra as affected by anthracnose disease.

Treatment at 11WAP	Plant establishment (%) at 3WAP	Plant height (cm)
Neem seed	96.16[a]	59.29[a]
Garlic clove	90.16[b]	59.40[a]
Metalaxyl	96.06[a]	61.13[a]
Ginger rhizome	90.20[b]	56.56[a]
Bitter leaf	83.53[b]	55.16[a]
Balanite seed	81.66[b]	54.80[a]
Control	77.60[c]	43.96[b]
SE±	5.11	3.52

Values with the same letters under a column are not significantly different according to Duncan's Multiple Range Test (DMRT), at 5%level. SE± = Standard error

CONCLUSION

The five botanical extracts had control effects on okra anthracnose at different rates. However, the incidence and severity of anthracnose was significantly lower in the plots treated with neem, ginger rhizome, garlic clove (extracts) and Ridomil at 3 WAP, 6 WAP, 9 WAP and 11 WAP. The highest disease incidence and severity (48.86% and 51.86%, respectively) were recorded on control plots at 11 WAP, followed by the balanite treated plots (40.06% and 29.80%, respectively). The yield parameters such as fruit weight and number of fruits harvested were also affected by the application of the plant extracts. Plots treated with Neem seed extract, Garlic clove extract and Metalaxyl had higher yields (589.53, 588.50 and 606.90 kg/ha, respectively), while the untreated plots had the lowest yield (450 kg/ ha). The study has therefore, shown that the plant extracts have great potentials as fungicidal materials for the control of anthracnose disease of okra. The Neem seed and garlic clove extracts offer greater prospects in the management of this fungal pathogen in field condition, especially in our region where costs of synthetic pesticides are beyond the reach of resource-poor farmers.

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