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# STUDIES OF DISEASE INCIDENCE AND SEVERITY CAUSED BY CERCOSPORA LEAF SPOT ON DIFFERENT COWPEA (*Vigna unguigulata* L.Walp.) VARIETIES IN YOLA, ADAMAWA STATE, NIGERIA

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## ABSTRACT

Cercospora Leaf Spot (CLS) caused by *Cercospora canscense* of cowpea (*Vigna unguigulata* L.Walp) is a major constraint against cowpea cultivation. In the wake of rising cost of chemical control studied in Modibbo Adama University, Yola. The main objective of the study was to determine the effectiveness of neem and pawpaw leaves extract for the control of CLS disease of cowpea while the varieties used include SAMPEA-1, SAMPEA-2, SAMPEA-3, SAMPEA-4, SAMPEA-5, SAMPEA-6, SAMPEA-7, SAMPEA-8, SAMPEA-9 and SAMPEA-10. The study comprised laboratory studies, green house and field experiments. The field experiment employed a factorial experiment consisting of 20 treatments laid out in a Randomised Complete Block Design replicated three times with plant extract placed on the main plot while varieties placed on the sub-plot during 2019 and 2020 seasons. The results revealed that all the varieties were infected by cercospora leaf spot disease at varying levels. Control plants had significantly highest disease severity throughout 2019 and 2020, in 2019 at 7WAS control recorded the mean value of 24.63 followed by neem with 24.01 while the least of 18.90 was obtained from pawpaw leave extract. SAMPEA 8 had the highest disease severity of 30.29 followed by SAMPEA 9 with 29.91 while the least of 10.14 was obtained from SAMPEA 5. Therefore, adoption of neem and pawpaw leave extract as alternatives and better remedies to CLS disease control is recommended.

**Keywords:** Cowpea, Plant Extract, Cercospora, Disease Severity, Disease Incidence

## INTRODUCTION

Cowpea (*Vigna unguiculata* (L.) Walp) is a dicotyledonous plant that belongs to the legume family Leguminoseae and sub-family Papillinoadea, order Fabaceae and genus Vigna (Sanginga *et al.,* 2002). It is an annual herb with strong principal root and many spreading lateral roots in surface soil. It is one of the most important legume crops grown throughout the tropical belt covering Asia, the East Africa, southern Europe, Central and Southern America, the Southern United States of America. It is the major source of protein in human diet and fodder to livestock as well as improving soil fertility. It is a tropical legume of African origin especially West and Central Africa (WCA). Approximately 90% of world's cowpea is grown in sub-Saharan Africa, mostly in Nigeria and Niger. According to FAOSTAT (2017), cowpea was grown on about 12.3 million ha of land globally and 6.9million tons of grain was produced. Nigeria, the largest cowpea producer in the world accounts for about 3 million tons of the world production from a cultivated land area of 3.5 million ha. Currently more than 70% of the world production is concentrated

in three countries, namely, Nigeria, Brazil and Niger. Nigeria is the leading country with 0.9 million tons annually on 0.4 hectares of land most of which comes from four northern states of Adamawa, Borno, Kano and Sokoto (Anonymous, 2000).

Cowpea is a higher drought tolerant crop than many other crops. It grows in areas with average annual rainfall less than 500 mm. It is best grown in areas with annual rainfall between 750-1,100mm (Udensi *et al.,* 2007). One of the most remarkable things about cowpea is that it thrives in dry environment; available cultivars produce a crop with as little as 300 mm rainfall. Cowpea also has a great tolerance to water logging. Well distributed rainfall is important for normal growth and development of cowpeas (Udensi *et al.,* 2007). Yield loss attributed to Cercospora leaf spot in susceptible cowpea genotypes varies between 36% and 42% ((Booker and Pathamanathan, 2007). Out of 75 cowpea varieties evaluated in 1999 and 2000, about 40% of the germplasm were found susceptible to Cercospora leaf spot disease (Ajibade and Amusa, 2001), with Ife brown, a widely adopted and cultivated cowpea cultivar in Nigeria having 80% Cercospora incidence on the field. Field observation revealed crop loss of over 40% in Cercospora endemic field (Ajibade and Amusa, 2001). This study was therefore carried out to isolate and identify Cercospora leaf spot pathogen associated with different cowpea genotypes in Yola North Local Government Areas in Adamawa State. Similarly, field investigation was carried out by planting some selected cowpea cultivars.

## MATERIALS AND METHODS

### Experimental Site

This study was carried out in the Research Farm of Faculty of Agriculture, Moddibbo Adama University of Technology, Yola in 2019 and 2020 rainy seasons.

### Sources of Cowpea Used

Cowpea seeds, *Vigna unguiculata* (L.) WALP was used for this study and was procured from Institute of Agricultural Research (IAR), Zaria. SAMPEA 1, 2, 3,4,5,6,7,8,9 and 10 was used.

### Field Experiment

The field was cleared into fine tilt and chemical like Round up was sprayed to kill all the weeds then the field was ploughed and harrowed twice to a fine tilt. Beds were prepared and arranged in a Randomized Complete Block Design (RCBD) with three replications. Each plot had an area of 3x2 meters ($6m^2$). The space between plots was 0.5 m and the space between replication was 1 m. TVX-3236- a cowpea variety susceptible to *Cercospora* leaf spot was planted two weeks before planting the test varieties and the pathogen was isolated from the plant and it inoculum was use to infect the test varieties.

The seeds were treated with Apron plus at the rate of 10 g/kg to protect the seed and were later planted at about 3cm depth.

Sowing was carried out manually using hoe on the prepared beds. The seeds were sown on an inter-row spacing of 70cm and intra-row of spacing 30cm at the rate of 3 seeds per hill which was thinned to two per stand at 2 weeks after planting.

Fertilizer application was done in small quantity of 15 kg/ha nitrogen after 5 weeks as a starter dose and phosphorus at the rate of 30 kg for good crop, and phosphorus in single phosphate at the rate of 30kg/ha recommended for cowpea production (Dugje *et al*., 2009.

The weeds was controlled by hand weeding using a hoe at 2 weeks after planting, and second at 4 weeks after planting to ensure clean field as recommended by (Dugje *et a*l.,2009).

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**Preparation of Plant Extracts**

This was done adopting the method by Ganiyu *et al* (2018) where fresh matured leaves from Azadiracta indica and Carica papaya were collected from plants within the university premises. In the laboratory, the leaves (1 kg of each species) were thoroughly rinsed in running tap water, air-dried at room temperature, blended in 15 L of sterile distilled water in an electric blender (Master Chef—®, China) and left for 24 hrs.

**Application of Plant Extracts**

The pathogens were controlled by application of neem and pawpaw leaves extract on the cowpea plants. The sprayed field was inoculated with spore suspension of 5x $10^4$ conidial/ml for even distribution of the pathogen at 4WAS. Thereafter, the plants extract (10%) was sprayed as from 5WAS using ULV sprayer and repeated at two weeks' interval until 10WAS. The unsprayed fields was not inoculated but was sprayed with distilled water only and were compared with the sprayed field to know the effect of the pathogen on the cowpea plant also to know the efficacy of the plant extract in controlling the Cercospora leaf spot disease of cowpea.

**Disease Incidence (%)**

Disease incidence was calculated by counting the number of diseased plants and expressed as the percentage of the total plants sampled from each plot. This will be carried out starting from the first appearance of the visible disease symptoms to when the sampled plants expressed 100% symptoms. The formula is expressed thus:

$$\text{Disease Incidence} = \frac{\text{Number of Diseased Plant}}{\text{Total Number of Plants Assessed}} X\ 100 \quad \text{.....1}$$

**Disease Severity (%)**

Disease severity was carried out using the modified visual severity scale of Park 1987 using the formula.

$$\text{Disease severity} = \frac{\text{sum of individual ratings}}{\text{No. of plants assessed x 6}} X\ 100 \quad \text{.....2}$$

**Data Analysis**

Data collected was analyze using Statistical Analysis System (SAS) appropriate for Randomized Completely Block Design (RCBD) and means separation was carried out using Ducans Multiple Range Test (DRMT).

## RESULTS AND DISCUSSION

**Effects of plant extracts and cowpea varieties on Disease Severity**

The result of the effects of plant extracts and varieties of cowpea on disease severity of cowpea in 2019 and 2020 seasons is presented in Table 1 and 2. The result indicated highly significant difference ($p \leq 0.05$) in both the extracts and varieties on disease incidence at 7, 8, 9, 10, 11 and 12 Weeks after Storage (WAS) in both 2019 and 2020.

In 2019, at 7WAS control recorded the highest mean value of 24.63 followed by neem extracts with 24.01 while the least of 18.90 was obtained from the pawpaw extract, at 8WAS the same trend was also observed control recorded the highest mean value of 30.91 followed by neem extracts with 30.04 while the least of 26.50 was obtained from the pawpaw, similarly at 9WAS the same trend was observed control recorded the highest mean value of 37.84 followed by neem extracts with 37.17 while the least of 37.02 was obtained from the pawpaw, at 10WAS control also recorded the highest mean value of 46.81 followed by neem extracts with 45.42 while the least of 40.03 was obtained from the pawpaw, at 11WAS neem extract recorded the highest mean value of 54.43 followed by control

with 54.28 while the least of 44.25 was obtained from the pawpaw, at 12WAS control recorded the highest mean value of 64.25 followed by neem extracts with 61.73 while the least of 47.81 was obtained from the pawpaw extract.

In 2020, at 7WAS pawpaw recorded the highest mean value of 21.90 followed by neem extracts with 19.91 while the least of 19.03 was obtained from the control treatment, at 8WAS control had the highest mean value of 27.57 followed 25.80 obtained from neem and the least of 25.79 was obtained from pawpaw extracts although not significantly difference (P>0.05) from the neem extract, at 9WAS control had the highest mean value of 37.20 followed 33.89 obtained from pawpaw and the least of 33.35 was obtained from neem extracts although not significantly difference (P>0.05) from the pawpaw, at 10WAS control recorded the highest mean value of 39.91 followed by neem extracts with 36.52 while the least of 36.50 was obtained from the pawpaw extract, similar trend was also observed at 11WAS control recorded the highest mean value of 45.99 followed by neem extracts with 43.76 while the least of 43.44 was obtained from the pawpaw extract, the trend also continue at 12WAS, control recorded the highest mean value of 54.45 followed by pawpaw extracts with 53.27 while the least of 53.36 was obtained from the neem extract although not significantly difference (P>0.05) from the pawpaw extract.

In 2019 at 7WAS, SAMPEA 8 recorded the highest equal mean value of 30.29 followed by 27.91 obtained from SAMPEA 9 while the least of 10.14 was obtained from SAMPEA 5, at 8WAS SAMPEA 8 had the highest mean value of 34.95 followed by 31.73 obtained from SAMPEA 9 while the least of 21.15 was obtained from SAMPEA 5, at 9WAS SAMPEA 7 recorded the highest mean value of 44.71 followed by 43.00 obtained from SAMPEA 8 while the least of 29.04 was obtained from SAMPEA 5, at 10WAS SAMPEA 10 recorded the highest mean value of 48.53 followed by 49.93 obtained from SAMPEA 8 while the least of 39.77 was obtained from SAMPEA 3, at 11WAS the same SAMPEA 10 recorded the highest mean value of 59.29 followed by 58.53 obtained from SAMPEA 8 while the least of 44.21 was obtained from SAMPEA 1, almost similar trend was observed at 12WAS SAMPEA 10 recorded the highest mean value of 69.59 followed by 67.53 obtained from SAMPEA 8 while the least of 47.22 was obtained from SAMPEA 1.

In 2020 at 7WAS SAMPEA 2 recorded the highest mean value of 37.56 followed by 19.25 obtained from SAMPEA 1 while the least of 10.16 was obtained from SAMPEA 3, at 8WAS the highest of 31.11 was observed from SAMPEA 1 followed by 30.31 obtained from SAMPEA 10 while the least was obtained from SAMPEA 3 with mean value of 24.07, at 9WAS SAMPEA 5 recorded the highest mean value of 39.20 followed by SAMPEA 10 with 37.50 while the least of 32.23 was obtained from SAMPEA 1, at 10WAS SAMPEA the same 5 recorded the highest mean value of 39.63 followed by 39.25 obtained from SAMPEA 1 while the least of 35.55 was obtained from SAMPEA 9, at 11WAS SAMPEA 4 recorded the highest mean value of 46.70 followed by 45.70 obtained from SAMPEA 5 and 8 while the least of 40.10 was obtained from SAMPEA 1, at 12WAS SAMPEA 8 recorded the highest mean value of 61.76 followed by 61.71 obtained from SAMPEA 8 while the least of 43.96 was obtained from SAMPEA 1.

There was also significant difference ($p \leq 0.05$) among years, 2019 had the highest disease incidence of 22.52, 29.15, 36.90, 44.08, 50.99 and 57.94 while the least of 18.94, 26.39, 34.64, 37.64, 44.50 and 53.67 was recorded in 2020 at 7WAS, 8WAS, 9WAS, 10WAS, 11WAS and 12WAS respectively. There was significant interaction ($P \leq 0.05$) between treatments-

varieties year-treatment, year-varieties and year-treatment-varieties in both 2019 and 2020 but year-treatments, year-treatments-varieties both in 2019 and 2020.

There was also highly significant difference (P≤ 0.05) in both treatments and varieties of the combined analysis at 7WAS, 8WAS and 9WAS, 10WAS, 11WAS and 12WAS. At 7WAS, the highest disease severity of 21.83 was obtained from control followed by 20.40 obtained from pawpaw while the least of 19.96 was obtained from the neem, at 8WAS the highest mean value of 29.24 was obtained from control followed by 27.92 obtained from neem while the least of 26.15 was obtained from pawpaw, similar trend was observed at 9WAS, the highest mean value of 37.52 was obtained from control followed by neem with 35.26 while the least of 34.53 was observed from pawpaw, similar trend was also observed at 10WAS, the highest mean value of 43.36 was obtained from control followed by neem with 40.97 while the least of 38.26 was observed from pawpaw, similar trend was observed at 11WAS, the highest mean value of 50.14 was obtained from control followed by neem with 49.10 while the least of 44.00 was observed from pawpaw, the same trend was also observed at 12WAS, the highest mean value of 59.36 was obtained from control followed by neem with 57.50 while the least of 50.54 was observed from pawpaw.

On the other hand, at 7WAS SAMPEA 2 gave the highest disease incidence of 29.30, followed by 23.45 obtained from SAMPEA 8 while the least of 13.95 was obtained from SAMPEA 5, at 8WAS the same SAMPEA 2 also recorded the highest mean value of 30.97 followed by SAMPEA 10 with 30.49 while the least was obtained from SAMPEA 3 with mean value of 25.54, at 9WAS SAMPEA 10 recorded the highest mean value of 39.76 followed by SAMPEA 8 with 39.10 while the least of 31.64 was obtained from 3, almost similar trend was observed at 10WAS the same SAMPEA 10 also recorded the highest mean value of 43.70 followed by SAMPEA 8 with 42.66 while the least of 38.62 was obtained from 3, at 11WAS SAMPEA 10 recorded the highest mean value of 52.43 followed by SAMPEA 8 with 52.11 while the least of 42.16 was obtained from 1, at 12 WAS SAMPEA 8 recorded the highest mean value of 64.62 followed by SAMPEA 10 with 62.58 while the least of 45.59 was obtained from 1.

**Table 1:** Effects of Plant Extracts and Varieties on Disease Severity in Yola in 2019 and 2020 Seasons

| | **Disease Severity 2019** | | | **Disease Severity 2020** | | |
|---|---|---|---|---|---|---|
| **Treatments** | 7WAS | 8WAS | 9WAS | 7WAS | 8WAS | 9WAS |
| Neem | 24.01$^{b}$ | 30.04$^{b}$ | 37.17$^{c}$ | 19.91$^{b}$ | 25.80$^{b}$ | 33.35$^{b}$ |
| Pawpaw | 18.90$^{c}$ | 26.50$^{c}$ | 37.68$^{b}$ | 21.90$^{a}$ | 25.79$^{b}$ | 33.89$^{b}$ |
| Control | 24.63$^{a}$ | 30.91$^{a}$ | 37.84$^{a}$ | 19.03$^{c}$ | 27.57$^{a}$ | 37.20$^{a}$ |
| P<F | <.0001 | <.0001 | <.0001 | <.0001 | <.0001 | <.0001 |
| **Varieties** | | | | | | |
| SAMPEA 1 | 29.09$^{f}$ | 27.04$^{f}$ | 33.40$^{h}$ | 19.25$^{b}$ | 25.18$^{f}$ | 32.23$^{f}$ |
| SAMPEA 2 | 29.04$^{f}$ | 30.83$^{c}$ | 35.42$^{f}$ | 37.56$^{a}$ | 31.11$^{a}$ | 35.17$^{c}$ |
| SAMPEA 3 | 22.46$^{e}$ | 27.02$^{f}$ | 31.55$^{i}$ | 10.16$^{j}$ | 24.07$^{g}$ | 31.72$^{f}$ |
| SAMPEA 4 | 20.26$^{g}$ | 28.18$^{c}$ | 34.64$^{g}$ | 15.53$^{i}$ | 29.96$^{c}$ | 33.30$^{e}$ |
| SAMPEA 5 | 10.14$^{h}$ | 21.15$^{g}$ | 29.04$^{j}$ | 17.76$^{e}$ | 28.88$^{d}$ | 39.20$^{a}$ |
| SAMPEA 6 | 23.17$^{d}$ | 29.55$^{d}$ | 38.98$^{d}$ | 17.17$^{g}$ | 25.57$^{e}$ | 35.51$^{c}$ |
| SAMPEA 7 | 25.80$^{c}$ | 30.41$^{c}$ | 44.71$^{a}$ | 19.21$^{c}$ | 22.20$^{i}$ | 32.33$^{f}$ |
| SAMPEA 8 | 30.29$^{a}$ | 34.95$^{a}$ | 43.00$^{b}$ | 16.62$^{h}$ | 23.32$^{h}$ | 35.20$^{c}$ |
| SAMPEA 9 | 27.91$^{b}$ | 31.73$^{b}$ | 36.22$^{e}$ | 17.37$^{f}$ | 23.30$^{h}$ | 34.29$^{d}$ |
| SAMPEA 10 | 22.96$^{d}$ | 30.66$^{c}$ | 42.01$^{c}$ | 18.85$^{d}$ | 30.31$^{b}$ | 37.50$^{b}$ |
| P<F | <.0001 | <.0001 | <.0001 | <.0001 | <.0001 | <.0001 |
| **Year** | 22.51$^{a}$ | 29.15$^{a}$ | 36.90$^{a}$ | 18.94$^{b}$ | 26.39$^{b}$ | 34.64$^{b}$ |

| | | | | | | |
|---|---|---|---|---|---|---|
| P<F | <.0001 | <.0001 | <.0001 | | | |
| **Interaction** | | | | | | |
| Treatment X Variety | ** | ** | ** | ** | ** | ** |
| Year X Treatment | ** | ** | ** | ** | ** | ** |
| Year X Variety | ** | ** | ** | ** | ** | ** |
| Year X Treatment X Variety | ** | ** | ** | ** | ** | ** |

**Table 2:** Effects of Plant Extracts and Varieties on Disease Severity in Yola in 2019 and 2020 Seasons

| | **Disease Severity 2019** | | | **Disease Severity 2020** | | |
|---|---|---|---|---|---|---|
| **Treatments** | 10WAS | 11WAS | 12WAS | 10WAS | 11WAS | 12WAS |
| Neem | 45.42$^{b}$ | 54.43$^{a}$ | 61.73$^{b}$ | 36.52$^{b}$ | 43.76$^{b}$ | 53.26$^{b}$ |
| Pawpaw | 40.03$^{c}$ | 44.25$^{c}$ | 47.81$^{c}$ | 36.50$^{c}$ | 43.44$^{c}$ | 53.27$^{b}$ |
| Control | 46.81$^{a}$ | 54.28$^{b}$ | 64.25$^{a}$ | 39.91$^{a}$ | 45.99$^{a}$ | 54.48$^{a}$ |
| P<F | <.0001 | <.0001 | <.0001 | <.0001 | <.0001 | <.0001 |
| **Varieties** | | | | | | |
| SAMPEA 1 | 41.66$^{g}$ | 44.21$^{j}$ | 47.22$^{j}$ | 39.25b | 40.10$^{h}$ | 43.96$^{g}$ |
| SAMPEA 2 | 42.66$^{e}$ | 46.35$^{i}$ | 48.79$^{i}$ | 37.75$^{e}$ | 44.57$^{d}$ | 51.10$^{e}$ |
| SAMPEA 3 | 39.77$^{h}$ | 46.70$^{h}$ | 51.52$^{h}$ | 37.48$^{f}$ | 45.57$^{c}$ | 53.33$^{d}$ |
| SAMPEA 4 | 44.14$^{c}$ | 47.98$^{g}$ | 53.17$^{g}$ | 38.20$^{d}$ | 46.70$^{a}$ | 57.10$^{b}$ |
| SAMPEA 5 | 42.91$^{d}$ | 49.53$^{e}$ | 55.60$^{f}$ | 39.63$^{a}$ | 45.70$^{b}$ | 47.77$^{f}$ |
| SAMPEA 6 | 42.04$^{f}$ | 48.23$^{f}$ | 56.65$^{e}$ | 37.74$^{e}$ | 43.26$^{g}$ | 51.11$^{e}$ |
| SAMPEA 7 | 48.71a | 56.50$^{c}$ | 61.81$^{d}$ | 34.55$^{i}$ | 43.87$^{f}$ | 61.71$^{a}$ |
| SAMPEA 8 | 47.93$^{b}$ | 58.53$^{b}$ | 67.53$^{b}$ | 37.39$^{g}$ | 45.70$^{b}$ | 61.76$^{a}$ |
| SAMPEA 9 | 42.51$^{e}$ | 52.59$^{d}$ | 67.45$^{c}$ | 35.55$^{h}$ | 44.12$^{e}$ | 53.28$^{d}$ |
| SAMPEA 10 | 48.53$^{a}$ | 59.29$^{a}$ | 69.59$^{a}$ | 38.87$^{c}$ | 45.56$^{c}$ | 55.58$^{c}$ |
| P<F | <.0001 | <.0001 | <.0001 | <.0001 | <.0001 | <.0001 |
| **Year** | 44.08$^{a}$ | 50.99$^{a}$ | 57.94$^{a}$ | 37.64$^{b}$ | 44.50$^{b}$ | 53.67$^{b}$ |
| P<F | <.0001 | <.0001 | <.0001 | | | |
| **Interaction** | | | | | | |
| Treatment X Variety | ** | ** | ** | ** | ** | ** |
| Year X Treatment | ** | ** | ** | ** | ** | ** |
| Year X Variety | ** | ** | ** | ** | ** | ** |
| Year X Treatment X Variety | ** | ** | ** | ** | ** | ** |

**Effects of plant extracts and cowpea varieties on Disease Incidence**

The result of the effects of plant extracts and varieties of cowpea on disease incidence of cowpea in 2019 and 2020 seasons is presented in Table 3. The result indicated highly significant difference ($p \leq 0.05$) in both the extracts and varieties on disease incidence at 7, 8 and 9 Weeks after Storage (WAS) in both 2019 and 2020. In 2019, at 7WAS control recorded the highest mean value of 24.74 followed by neem extracts with 21.32 while the least of 17.97 was obtained from the pawpaw extract, at 8WAS pawpaw had the highest mean value of 64.39 followed 45.31 obtained from control and the least of 38.37 was obtained from neem extracts, at 9WAS the trend continue exactly the same way, pawpaw extract recorded the highest mean value of 80.33 followed by control with mean value of 72.79 while the least of 65.00 was obtained from neem extract. In 2020, at 7WAS control recorded the highest mean value of 19.77 followed by neem extracts with 12.88 while the least of 12.57 was obtained from the pawpaw extract although not significantly difference ($P>0.05$) from the neem extract, the same trend also observed at 8WAS control had the highest mean value of 64.33 followed 53.57 obtained from neem and the least of 52.00 was obtained from pawpaw extracts, at 9WAS control also recorded the highest mean value of 86.00 followed by neem with mean value of

72.75 while the least of 72.73 was obtained from pawpaw although not significantly difference (P>0.05) from the neem extract.

In 2019 at 7WAS, SAMPEA 7 and 10, recorded the highest equal mean value of 29.99 followed by 23.22 obtained from SAMPEA 4 while the least of 14.11 was obtained from SAMPEA 3, at 8WAS SAMPEA 10 had the highest mean value of 57.88 followed by 57.00 that was obtained from SAMPEA 7, at 9WAS the same SAMPEA 10 recorded the highest mean value of 85.44 followed by 83.00 obtained from SAMPEA 7 while the least of 38.88 was obtained from SAMPEA 3. In 2020 at 7WAS SAMPEA 6 recorded the highest mean value of 20.00 followed by 19.13 obtained from SAMPEA 7 while the least of 10.07 was obtained from SAMPEA 1, at 8WAS the highest of 64.46 was obtained from SAMPEA 4 followed by 63.35 obtained from SAMPEA 5 while the least was obtained from SAMPEA 3 with mean value of 50.00, at 9WAS the same SAMPEA 10 recorded the highest mean value of 85.51 followed by SAMPEA 7 with 77.13 while the least of 74.45 was obtained from SAMPEA 2. There was also significant difference (p≤ 0.05) among years, at 7WAS 2019 had the highest disease incidence of 21.34 while the least of 15.08 was recorded in 2020, at 8WAS and 9WAS respectively 2020 had the highest mean values of disease incidence of 56.63 and 77.17 while the least of 49.22 and 71.71. There was significant interaction (P≤ 0.05) between treatments-varieties year-treatment, year-varieties and year-treatment-varieties in both 2019 and 2020 but year-treatments, year-treatments-varieties both in 2019 and 2020.

There was also significant difference (P≤ 0.05) in both treatments and varieties of the combined analysis at 7WAS, 8WAS and 9WAS. At 7WAS, the highest disease incidence of 22.25 was obtained from control followed by 17.10 obtained from neem while the least of 15.27 was obtained from the pawpaw, at 8WAS the highest mean value of 57.70 was obtained from pawpaw followed by 54.82 obtained from control while the least of 45.97, at 9WAS, the highest mean value of 79.40 was obtained from control followed by pawpaw with 76.53 while the least of 68.87. On the other hand, at 7WAS SAMPEA 7 gave the highest disease incidence of 24.56, followed by 21.58 obtained from SAMPEA 6, at 8WAS SAMPEA 10 recorded the highest mean value of 59.82 followed by SAMPEA 4 with 57.84 while the least was obtained from SAMPEA 1 with mean value of 46.11, at 9WAS SAMPEA 10 recorded the highest mean value of 85.48 followed by SAMPEA 6 with 78.81 while the least of 69.3.

**Table 3:** Effects of Plant Extracts and Varieties on Disease Incidence in Yola in 2019 and 2020 Seasons

| | **Disease Incidence 2019** | | | **Disease Incidence 2020** | | |
|---|---|---|---|---|---|---|
| **Treatments** | 7WAS | 8WAS | 9WAS | 7WAS | 8WAS | 9WAS |
| Neem | 21.32$^{b}$ | 38.37$^{c}$ | 65.00$^{c}$ | 12.88$^{b}$ | 53.57$^{b}$ | 72.75$^{b}$ |
| Pawpaw | 17.97$^{c}$ | 64.39$^{a}$ | 80.33$^{a}$ | 12.57$^{b}$ | 52.00$^{c}$ | 72.73$^{c}$ |
| Control | 24.74$^{a}$ | 45.31$^{b}$ | 45.31$^{b}$ | 19.77$^{a}$ | 64.33$^{a}$ | 86.00$^{a}$ |
| P<F | <.0001 | <.0001 | <.0001 | <.0001 | <.0001 | <.0001 |
| **Varieties** | | | | | | |
| SAMPEA 1 | 15.15$^{g}$ | 38.88$^{i}$ | 62.22$^{h}$ | 10.07$^{h}$ | 53.34$^{f}$ | 76.53$^{d}$ |
| SAMPEA 2 | 20.87$^{d}$ | 44.44$^{h}$ | 73.32$^{d}$ | 15.59$^{de}$ | 50.00$^{g}$ | 74.45$^{f}$ |
| SAMPEA 3 | 14.11$^{h}$ | 38.88$^{i}$ | 68.88$^{f}$ | 17.81$^{bc}$ | 50.00$^{g}$ | 76.68$^{c}$ |
| SAMPEA 4 | 23.22$^{b}$ | 51.22$^{e}$ | 72.00$^{e}$ | 14.32$^{ef}$ | 64.46$^{a}$ | 76.68$^{c}$ |
| SAMPEA 5 | 16.33$^{f}$ | 49.78$^{f}$ | 77.55$^{c}$ | 16.64$^{cd}$ | 63.35$^{b}$ | 76.66$^{c}$ |
| SAMPEA 6 | 23.16$^{c}$ | 55.13$^{c}$ | 83.00$^{b}$ | 20.00$^{a}$ | 56.67$^{d}$ | 74.33$^{e}$ |
| SAMPEA 7 | 29.99$^{a}$ | 57.00$^{b}$ | 71.58$^{e}$ | 19.13$^{ab}$ | 55.10$^{e}$ | 77.13$^{b}$ |
| SAMPEA 8 | 23.17$^{c}$ | 51.44$^{e}$ | 66.65$^{g}$ | 12.77$^{fg}$ | 55.00$^{e}$ | 76.66$^{c}$ |

| | | | | | | |
|---|---|---|---|---|---|---|
| SAMPEA 9 | 17.45$^{e}$ | 45.54$^{g}$ | 66.44$^{g}$ | 11.11$^{gh}$ | 56.67$^{d}$ | 76.65$^{c}$ |
| SAMPEA 10 | 29.99$^{a}$ | 57.89$^{a}$ | 85.44$^{a}$ | 13.32$^{f}$ | 61.76$^{c}$ | 85.51$^{a}$ |
| P<F | <.0001 | <.0001 | <.0001 | <.0001 | <.0001 | <.0001 |
| **Year** | 21.34$^{a}$ | 49.22$^{b}$ | 72.71$^{b}$ | 15.08$^{b}$ | 56.63$^{a}$ | 77.16$^{a}$ |
| P<F | <.0001 | <.0001 | <.0001 | | | |
| **Interaction** | | | | | | |
| Treatment X Variety | ** | ** | ** | ** | ** | ** |
| Year X Treatment | ** | ** | ** | ** | ** | ** |
| Year X Variety | ** | ** | ** | ** | ** | ** |
| Year X Treatment X Variety | ** | ** | ** | ** | ** | ** |

In 2019 cropping seasons, there was a significant difference in disease incidence with plants treated with neem and pawpaw leaves extract better than the control. Similarly, in 2020 cropping season, plants treated with neem and pawpaw leaves extract reduced disease incidence, the performances of neem and pawpaw leaves extract were outstanding as compared to control. Consequently, decreased in disease incidence in plants treated with neem and pawpaw leaves extract could be due to the antifungal properties of the extracts. This is in accordance with Ambang (2011) who observed that an increase in concentration of *T. peruviana* seed extracts resulted in a decrease in rate of spread of Cercospora Leaf Spot of cowpea. This also confirmed the findings that neem leaf extract reduced the growth of *Curvularia lunata* and succeeded in resisting fruit rotting in Cucurbitaceae caused by *Fusarrium equisitifolium* and *F. semitectum* (Al-Hamza, 2013). The assertion that neem leaves extract demonstrated a strong ability against the development of many disease causing fungi is true (Tewari and Nayak, 1991; Locke, 1995). Miah *et al*. (1990); Ahmed (1985) also reported that neem extract had potential for controlling *Cercospora* leaf spot in mungbean. It has been observed that neem leaves extract resulted significant reduction of *Cercospora* leaf spot of mungbean over untreated (control).

Early leaf spot severity caused by *Cercospora canscense* greatly reduced with the application of plant extracts as compared to the negative control across the two cropping seasons 2019 and 2020 respectively. This observed reduction in early leaf spot severity with the application of neem and pawpaw leaves extracts is due to their fungicidal effects, which lowered the spread of the early leaf spot pathogen (*Cercospora canscense*). This agrees with Hossain and Hossain (2013) and Sudiono *et al* (2020) report that aqueous neem seed and leaves extracts gave a considerable reduction in disease incidence, spot number per leaf, defoliation per plant and number of infected leaf per plant by 35.45 -60.07 and 42.06-72.20 % respectively. The papaya leaf extract also inhibits *C. gloeosporioides* fungal colony growth at 2 up to 7 days after inoculation, but it does not inhibit spore density and germination. The papaya leaf extract also inhibits anthracnose disease occurrence at papaya fruit in 5 and 6 days after application. Carica papaya leaves contain alkaloids which are important elements in plant defense system against plant pathogens (Azarkan *et al.,* 2004). Also, latex constituent in papaya leaves contains chitinase enzymes, which have been shown to have strong antifungal activity against biochemical processes in fungi.. Ganiyu *et al* (2018) also reported that, application of 6.67% concentration of *Azadirachta indica, Acalypha wilkisiana* and *Carica papaya* either singly or in combination resulted in low incidence of anthracnose on cowpea plant compared with untreated plots.

The SAMPEA 7 and 10 in 2019 and 2020 respectively recorded the highest value of disease incidence in all treatments. It has been observed that they have been very susceptible to Cercospora leaf spots, which is the reason they have the highest value of disease incidence. The 10 varieties reacted

differently to the disease incidence of *Cercospora Canescens*, which indicated that varieties have different level of resistance to the disease. This could be due to the inherent genetic make-up of the varieties to resist the disease at different levels (Allerd *et al.,* 1992; Sinsiri *et al*., 2006). This may be as a result of effect of *Cercospora* Leaf spot on the performance of the variety coupled with the ability of varieties to accumulate assimilates under the disease condition.

## CONCLUSION

*Cercospora l*eaf spot is a serious disease of cowpea in Nigeria. It may be considered as one of the major limiting factors to grow cowpea which is widely distributed all over the country wherever the crop is cultivated. In the present study, application of botanical extracts against *Cercospora* leaf spot was studied under greenhouse and field experiment. It is evident that both of the treatments showed significant effect leaf spot and plant disease incidence (% infected plant). It has been observed that neem and pawpaw leaves extract resulted in significant reduction of *Cercospora* leaf spot of cowpea over untreated (control). It is evident that the treatments (neem and pawpaw leave extracts) showed significant effect in respect of disease incidence and severity at 7WAS, 8WAS, 9WAS, 10WAS, 11WAS and 12WAS.

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