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# IN VIVO EVALUATION OF SOME PLANT EXTRACTS ON THE CONTROL OF CERCOSPORA LEAF SPOT (*Cercospora sesami*) ON FOUR SESAME VARIETIES IN TARABA, NIGERIA

[1]Tunwari, B. A. & [2]Nahunnaro, H.
[1]Department of Crop Production and Protection,Federal University Wukari, Katsina - Ala Road, P.M.B. 1020, Wukari, Taraba State, Nigeria.
[2]Department of Crop Protection Modibbo Adama University of Technology, P.M.B. 2076, Yola, Adamawa State, Nigeria
[1]Corresponding Author's e-mail address: adamubilkoya@gmail.com

**ABSTRACT**
Cercospora leaf spot is one of the most important foliage diseases in Nigeria. An in vivo study on the disease was carried using five plant extracts (*Azadirachta indica*, *Jatropha curcas* Linn., *Alium sativum*, *Ocimum gratissimum* (L., *Chromolaena odorata*) and a synthetic fungicide Benlate on four sesame varieties (Yandev 55, NCRIBEN 01M, E8 and NCRIBEN-03L) in a completely randomized design and replicated four times. The combined mean results revealed that severity was reduced from 45.46% to 38.30% when *Ocimum gratissimum* plant extract or Benlate was used as foliar spray. Furthermore, variety E8 was found to be resistant to Cercospora leaf spot. Similarly, interaction mean severity pooled for the years 2011 and 2012 indicated that E8 variety treated with plant extract from *Ocimum gratissimum* gave the lowest reduction of disease from 49.29% to 34.64% compared with the highest disease obtained from unsprayed plants of Yandev 55 variety. This had resulted in highest increase of 1000-seed weight from 2.37 to 3.37 g and seed yield per plant from 5.45 to 8.26 g.

**KEY WORDS:** *Cercospora sesami*, sesame varieties, plant extracts, severity, yield parameters.

## INTRODUCTION

Since antiquity Sesame (Beniseed) has been used as a valued oil crop. The Sesame belongs to the family Pedaliaceae and of the genus Sesamum. Sesame (*Sesamum indicum* L.) is an important food and cash crop in Nigeria. Average yield of the crop in the country is about the lowest in the world arising from what may be termed as sustained neglect of the crop in terms of research, extension and policy initiatives. Most of the main Beniseed experimental stations in Mokwa, Osara, Yandev, Beli, Lafia and Kwali dated back to 1959 have been closed down or work de-emphasized (Kalu and Adeyemo, 1998). It is also worthy of note that Sesame is an orphan crop internationally because it is not represented by any international research institute, though here in Nigeria it is covered by two research institutes *i.e*. National Cereal Research Institute (NCRI) Badeggi and Institute for Agricultural Research (IAR) Zaria. Research and extension efforts have not only been very marginal but have also been on a progressive decline in recent years. In Nigeria leaf spot is one of the most serious damaging diseases of sesame (Poswal and Misari, 1994). Worldwide losses as high as 20% of the seed yield due to *Cercospora sesami* have been reported (Naresh and Sangwan, 2010). Reduction of initial inoculum is achieved through cultural measures such as crop rotation, removal of volunteer plants, and burial of sesame residue (Shokes and Culbreath 1997). Spraying with fungicides is required to achieve optimal yields during most years, but have been noted to pose serious environmental threat to man and animals (Bailey *et al*., 1994). In addition, low to moderate resistance is present in some released cultivars and much effort has been directed at developing cultivars with high levels of leaf spot resistance. This paper reports the results of an experiment to identify plant extracts and variety of sesame that will record the lowest severity of *Cercospora* leaf spot of sesame in Taraba State under screen house condition.

## MATERIALS & METHODS

### Pathogen isolation and purification

A typical leaves with symptoms of *Cercospora* leaf spot were carefully transferred unto humid chambers made up of petri dishes that were under laid with filter papers at both covers with the aid of forceps flamed and cooled in methylated spirit and wetted thoroughly (Eman, 2011). The lesions on leaf materials were, therefore, incubated in these humid chambers at room temperature for 72 hours, and examined for sporulation under Trinocular Microscope. After 72 hours pieces of leaves around the spot areas were cut using sterile needles and transferred unto glass slides containing cotton blue stain. The slides were then covered with lids, pressed tightly with fingers to eliminate air bubbles and mounted on a trinocular microscope. Observed conidia from separate conidiophores were picked using glass needle (that was previously flamed and cooled in methylated spirit) and transferred aseptically in to six different plates containing V8 agar using single spore technique as part of the culture purification process (Hashem and Farrag, 2005; Eman, 2011). The process was carried out under sterile condition. The plates were placed in an incubator for 7 days. After

that the plates were removed and kept on the bench in a previously fumigated clean room where they could access sunlight at room temperature for 2 -3 months where morphological characteristics of the fungus were observed daily during the growth period until the cultures had fully sporulated. Detailed microscopic examinations were carried out during the growing stages to reveal the organism. In each case, temporary slides were prepared and viewed under x 45 objective lens of a trinocular microscope.

**Identification of *Cercospora sesami***

Morphological examination was made on host material for *Cercospora* sp. at Crop Protection Laboratory of Department of Crop Protection, Modibbo Adama University of Technology Yola and confirmed at IAR ABU, Zaria Mycology Laboratory according to Hashen and Farag (2005) and Barnett and Hunter (2006). Naturally infected sesame leaves were washed several times with sterilized distilled water, and then placed in a humid chamber at room temperature for 48 hours. After that, pieces of leaves around visible spots were cut and placed on glass slides and macerated in drops of cotton blue and tightly covered with lids to avoid air bubbles and observed using Trinocular Microscope. Spore size measurement was done using an ocular (eye piece) micrometer previously calibrated with a stage micrometer. In all, 25 spores were selected randomly and measured for the length, width and type of septation to obtain the size of the spores. The minimum length of conidia was 42.50 µm while the maximum length was 85.60 µm with a mean length of 68.50 µm. The minimum width of conidia was 3.30 µm while the maximum was 5.50 µm with a mean width of 4.38 µm (Table 1). Under this microscopic examination it was observed that the conidiophores are dark, simple, arising in small fascicle or clusters of 2-5, olivaceous brown, slightly paler and nodulase thickened towards the apex, multi-septate with 7-10 septa, rarely branched, straight, mildly geniculate. Conidia are hyaline, cylindrical, straight to curved, indistinctly multi-septate (3 – 6 septate). On the basis of these characters the pathogen was identified as *Cercospora* sp. according to Ellis (1976), Larone (1995) and Aptroot (2006). From the present results, there appears to be considerable difference or variation in size of conidia. This is probably due to environmental factors, and perhaps the existence of several races of the pathogen.

**TABLE 1.** Dimension of Conidiospores and number of septation of *Cercospora sesami* from specimens obtained from a surveyed field

| S/No | Conidial length (µm) | Conidial width (µm) | No of septae |
|---|---|---|---|
| 1. | 78.50 | 3.30 | 6 |
| 2. | 42.50 | 4.40 | 4 |
| 3. | 66.50 | 4.50 | 5 |
| 4. | 77.50 | 4.60 | 6 |
| 5. | 55.00 | 3.75 | 4 |
| 6. | 75.60 | 5.50 | 5 |
| 7. | 71.50 | 4.25 | 6 |
| 8. | 77.00 | 5.75 | 4 |
| 9. | 66.00 | 3.75 | 6 |
| 10. | 60.50 | 3.60 | 3 |
| 11. | 55.00 | 3.75 | 4 |
| 12. | 45.50 | 3.50 | 3 |
| 13. | 47.50 | 4.50 | 4 |
| 14. | 85.60 | 5.00 | 6 |
| 15. | 82.00 | 5.00 | 6 |
| 16. | 57.50 | 4.60 | 4 |
| 17. | 63.60 | 4.50 | 5 |
| 18. | 72.00 | 5.00 | 5 |
| 19. | 78.00 | 4.60 | 6 |
| 20. | 76.60 | 3.75 | 5 |
| 21. | 74.50 | 4.00 | 4 |
| 22. | 67.00 | 3.60 | 5 |
| 23. | 77.00 | 4.60 | 4 |
| 24. | 82.50 | 5.00 | 6 |
| 25. | 77.50 | 4.75 | 6 |
| Mean | 68.50 | 4.38 | |
| SED | 2.44 | 0.13 | |

***Pathogenicity test***

Pathogenicity study was conducted on sesame plants using cv. Yandev 55 variety according to Dunkle and Levy (2000), Okori *et al*. (2003) and Eman, (2011). Seedlings were raised by sowing seeds in 25 cm diameter plastic buckets (10 seedlings /bucket) and later thinned to 5 seedlings/bucket. After 3 weeks of good establishment, the seedlings were sprayed with spore suspension of $1x10^4$ spores/ml in distilled water of the pathogen. Such inoculated plants were then covered with perforated transparent polythene sheets to build relative humidity and maintained for 24 hours. At the end of 24 hours, the pots were kept in screen house under natural humidity. The plants were watered regularly and observations were made

for the appearance and development of symptoms. Symptoms of Cercospora leaf spot were observed as from 4 weeks after planting. The fungus was re-isolated from the leaves that exhibited symptoms and the cultures obtained were compared with the original to confirm the identity according to Kock's postulates. This confirmation was done before inoculation of the isolated pathogen for the screenhouse experiments.

**Collection of plant materials and preparation of extracts**

Plant extracts from leaves of *Azadirachta indica* A. Juss, *Jatropha curcas* Linn., *Alium sativum* L. (bulbs), *Ocimum gratissimum*(L.), and *Chromolaena odorata* R.M. King and Robinson obtained from within and around Modibbo Adama University of Technology, Yola were used for the field trials. These plants were selected because they were associated with pest management and disease control practices in several parts of Africa (Enikuomehin and Peters, 2002; Essien and Akpan, 2004; Ogbebor and Adekunle, 2008; Adesegun, *et al*., 2012).

The crude extracts were obtained by sterilizing the leaves in 10% Sodium hypochlorite (NaOCl) for 1 minute, washed 5 times in distilled water, air dried and later oven dried at 70$^{o}$C for 20 minutes according to Akinbode and Ikotun (2008). Thereafter, the plant leaf materials were ground using mortar and pestle and sieved in a 40 mm sieve into a fine powder. To obtain extracts, 100 g of the grounded powder (packaged according to plant species) were weighed in to a conical flask. After that, 100 mls distilled water was added to form a ratio of 1:1 w/v (weight over volume). This was then corked with rubber brine and shaken well for 20 minutes to mix and allowed to stand overnight (24 hours) at room temperature and the content filtered using a muslin cloth. To obtain 10% concentration for spray, 100 mls of the filtered plant extract suspension was added to 900 mls of sterile water to make up to 1 litre. This was then kept in glass bottles until needed.

**Experimental design and randomization of treatments**

The design used was a completely randomized design (CRD) with four (4) replicates using combination of Four (4) sesame varieties and Seven (7) treatments of plants extracts and a recommended fungicide giving a total of 28 treatments and were replicated 4 times. The experiment consisted of 112 pots.

**Pot preparation and planting**

Seeds of sesame varieties sown in 25 cm diameter pots containing 10 kg previously steam-sterilized loam soil under screenhouse condition in 2011 and 2012. Ten seeds were sown at a depth of 3 cm in each pot. Planting was done according to treatment combinations, and watering was done at any other day to provide the require moisture and to build relative humidity. At two weeks of planting the seedling density was reduced (thinned) to 5 plants /pot. The pots were arranged according to completely randomized Design (CRD) and replicated four times.

**Inoculation procedures and application of plant extracts**

The pots in the screenhouse were inoculated with spore suspension of 1 x $10^4$ conidial/ml for even distribution of the pathogen at 3 WAS. This was to ensure adequate contact between the pathogen and the sesame plants.

**Application of plants extracts and fungicide**

The plant extracts (10%) were sprayed using pressurized hand sprayer from 4 weeks after sowing (WAS) and repeated at 6, 8 and 10 WAS. The synthetic fungicide, Benlate was sprayed at the recommended rate of 2 kgha$^{-1}$ at 4 WAS and 8 WAS, while the control was left unsprayed.

**Disease Assessment**

Severity was estimated by assessing 5 plants per pot and determining overall score according to percentage area covered using a scale of 1-7 at 4, 6, 8, 10 and 12 WAS. This helped to determine the extent of establishment of the disease. The following formula was used in determining the severity of infections:

$\sum$ nx /N (7) (Chaube and Pundhir, 2005),

Where x = grade per leaf;

n = number of leaves per given grade,

N = total number of leaves examined/pot;

7 = the maximum disease grade.

Determinations of yield parameters were done using the five plants that were maintained per pot. The parameters included:

**Number of capsules per plant (CPP)**

This was achieved by counting number of capsules on each of the 5 plants and finding average per plant.

**Number of seeds per capsule (SPC)**

The number of seeds per capsule was achieved by randomly selecting twenty capsules from the five plants per pot and put in small envelops. Seeds were counted from the individually selected and threshed capsules and their means worked out to determine number of seeds per capsule.

**1000-seed weight (OTSW)**

This was estimated by counting 1000-seeds at random from each plot five times and weighed using a sensitive balance.

**Seed yield per plant (SYPP)**

This was achieved by harvesting the five plants in each pot of the screenhouse experiment, put in an envelope and dried naturally. Their seeds were added to their respective seeds of the twenty capsules earlier used to determine number of seeds per capsule and weighed.

The data collected were subjected to analysis of variance (ANOVA) based on completely randomized design (CRD) and the difference between means was determined using Duncan's Multiple Range Test (DMRT) as described by Gomez and Gomez (1984).

## RESULTS

**Cercospora leaf spot (CLS) Disease severity**

The results obtained in 2011 and 2012 showed various levels of significance of varieties and plant extracts on CLS severity at 4 -12 WAS. It was observed that CLS severity progressed steadily from 4 to 12 WAS. Results (Table 2) on the severity of CLS revealed significant difference amongst varieties at 4 – 12 WAS for 2011 and 2012 combined analysis. Sesame variety E8 recorded significantly (P= 0.05) lowest severity of 36.32%, while Yandev 55 gave highest mean value of 43.72% at 12 WAS. The pattern of result with respect to efficacy of plant extracts indicated that Ocimum, which was at par with Chromolaena and Benlate gave the lowest combined

mean severity value of 38.30%, compared to unsprayed control with the highest value of 45.46% at 12 WAS under screenhouse condition. There were highly significant interactions between varieties and plant extracts on CLS severity at 12 WAS from data obtained in 2011 and 2012 (Table 3). The combined means of the two-year screenhouse results confirmed the efficacy of E8 x Benlate treated plants, though statistically at par with E8 x Ocimum and E8 x Chromolaena, which resulted in the lowest severity value of 34.64% as compared to the highest value of 49.29% obtained from unsprayed plants of Yandev 55.

**TABLE 2**. Combined mean severity (%) of CLS at 4-12 WAS in a screenhouse in Ardo-kola, Taraba State, Nigeria in 2011 and 2012.

| Treatment | Cersev4 | Cersev6 | Cersev8 | Cersev10 | Cersev12 |
|---|---|---|---|---|---|
| Variety(V) | | | | | |
| Yandev 55 | 23.37$^{a}$ | 25.87$^{a}$ | 30.71$^{a}$ | 38.22$^{a}$ | 43.72$^{a}$ |
| NCRIBEN01M | 21.98$^{b}$ | 22.70$^{b}$ | 27.89$^{b}$ | 31.31$^{c}$ | 38.09$^{c}$ |
| E8 | 21.48$^{b}$ | 22.04$^{b}$ | 26.73$^{b}$ | 30.50$^{c}$ | 36.32$^{d}$ |
| NCRIBEN03L | 23.21$^{a}$ | 26.27$^{a}$ | 31.54$^{a}$ | 34.16$^{b}$ | 41.35$^{b}$ |
| SE | 0.83 | 3.15 | 2.97 | 2.87 | 0.73 |
| Plant extracts(F) | | | | | |
| Neem | 22.59$^{a}$ | 24.60$^{b}$ | 29.28$^{b}$ | 33.60$^{b}$ | 40.25$^{b}$ |
| Jatropha | 22.95$^{a}$ | 24.33$^{b}$ | 29.28$^{b}$ | 33.43$^{b}$ | 39.77$^{b}$ |
| Garlic | 22.32$^{a}$ | 23.56$^{c}$ | 28.26$^{c}$ | 32.26$^{c}$ | 38.57$^{c}$ |
| Ocimum | 22.32$^{a}$ | 24.01$^{b}$ | 28.63$^{c}$ | 32.02$^{c}$ | 38.30$^{c}$ |
| Chromolaena | 22.23$^{a}$ | 23.58$^{c}$ | 28.12$^{c}$ | 31.98$^{c}$ | 38.35$^{c}$ |
| Benlate | 22.32$^{a}$ | 23.17$^{c}$ | 27.01$^{d}$ | 31.00$^{d}$ | 38.39$^{c}$ |
| Control | 22.76$^{a}$ | 26.64$^{a}$ | 33.93$^{a}$ | 39.84$^{a}$ | 45.46$^{a}$ |
| Mean | 22.50 | 24.22 | 29.22 | 33.44 | 39.87 |
| SE | 0.83 | 3.15 | 2.97 | 2.87 | 0.73 |
| V x F | NS | NS | NS | NS | * |

Means in the same column followed by the same superscript(s) are not significantly different (0.05) using Duncan's Multiple Range Test. WAS = Weeks after sowing. Cersev 4, 6, 8, 10 and 12 = cercopora leaf spot severity at 4, 6, 8, 10 and 12 WAS

**TABLE 3.** Combined mean interactions between varieties and plant extracts on severity of CLS of sesame in a screenhouse experiment at Ardo-kola, Taraba state, Nigeria in 2011 and 2012

| | Sesame varieties | | | | |
|---|---|---|---|---|---|
| Plant extracts | Yandev 55 | NCRIBEN-01M | E8 | NCRIBEN-03L | Mean |
| Neem | 44.11$^{b}$ | 38.57$^{f}$ | 36.91$^{g}$ | 41.41$^{d}$ | 40.25 |
| Jatropha | 43.39$^{b}$ | 38.21$^{f}$ | 36.43$^{g}$ | 41.06$^{d}$ | 39.77 |
| Garlic | 42.32$^{c}$ | 36.96$^{g}$ | 35.36$^{h}$ | 39.64$^{e}$ | 38.57 |
| Ocimum | 42.32$^{c}$ | 36.43$^{g}$ | 35.00$^{hi}$ | 39.64$^{e}$ | 38.30 |
| Chromolaena | 42.32$^{c}$ | 36.43$^{g}$ | 34.82$^{i}$ | 39.64$^{e}$ | 38.35 |
| Benlate | 42.32$^{c}$ | 36.78$^{g}$ | 34.64$^{i}$ | 39.82$^{e}$ | 38.39 |
| Control | 49.29$^{a}$ | 43.23$^{bc}$ | 41.09$^{d}$ | 48.22$^{a}$ | 45.46 |
| Mean | 43.72 | 38.09 | 36.32 | 41.35 | 39.87 |

SE(±) common to all treatment combinations = 0.73

Means with the same superscript(s) are not significantly different at 5% level using DMRT

**Effects of varieties on capsules per plant and number of seeds per capsule**

Number of capsules per plant (CPP) and number of seeds per capsule (SPC) were highly significantly (Table 4) influenced by varieties. Results on capsules per plant (CPP) showed that E8 gave the highest value of 188 in 2011and 2012 combined means, while the lowest capsules per plant value of 163 were obtained in pots planted with Yandev 55. Results presented in Table 4 also gave a highly varietal significant on number of seeds per capsule (SPC) with sesame variety E8 producing highest number of seeds per capsule value of 66.72, while the lowest value (61.70) of seeds per capsule was obtained from plants of NCRIBEN-03L under screenhouse.

Effects of plant extracts on the manifestation of CLS disease infection showed highly significant results (Table 4). Ocimum extract consistently produced the highest capsules per plant value of 191.13, while unsprayed sesame plants indicated the lowest value of 145.00. The consistency of Ocimum extract sprayed sesame plants was maintained in the combined means of seeds per capsule (SPC) with highest value of 66, though statistically at par with Benlate and Chromolaena extract, compared to the unsprayed control value of 57.72.

**Effects of varieties on 1000-seed weight and seed yield per plant**

Table 4 also presented highly significant effect with respect to 1000 - seed weight and seed yield per plant. The results indicated that E8 gave the highest 1000 - seed weight value of 3.05 g, while the lowest combined mean value of 2.72 g was observed in Yandev 55. It was further observed that E8 produced the highest seed yield per plant

value of 7.93 g than Yandev 55 with lowest seed yield per plant value of 6.39 g under screenhouse condition in 2011 and 2012. The result in Table 4 further showed that the synthetic fungicide Benlate, which is significantly at par in performance with sesame plants sprayed with extracts of Ocimum and Chromolaena, produced the highest 1000 - seed weight combined mean value of 3.15 g, while unsprayed sesame plants significantly produced the lowest value of 2.56 g. Results also revealed that Benlate and Chromolaena, which are statistically similar to Ocimum extract, influenced the highest seed yield per plant (SYPP) value 7.46 g, compared to unsprayed plants value of 6.39 g in the 2011 and 2012 combined analysis.

**TABLE 4.**Combined effects of CLS on Yield attributes of sesame as influenced by varieties and plant extracts following screenhouse experiments at Ardo-kola, Taraba, Nigeria in 2011 and 2012

| Treatment | CPP | SPC | OTSW | SYPP |
|---|---|---|---|---|
| Variety (V) | | | | |
| Yandev 55 | 163.48$^{c}$ | 62.78$^{c}$ | 2.72$^{c}$ | |
| NCRIBEN01M | 183.36$^{a}$ | 64.66$^{b}$ | 3.00$^{b}$ | 6.39$^{d}$ |
| E8 | 188.38$^{a}$ | 66.72$^{a}$ | 3.05$^{a}$ | 7.38$^{b}$ |
| NCRIBEN03L | 175.75$^{b}$ | 61.70$^{d}$ | 2.99$^{b}$ | 7.93$^{a}$ |
| SE | 9.55 | 1.19 | 0.071 | 6.93$^{c}$ |
| Plant extracts (F) | | | | 0.15 |
| Neem | 170.06$^{b}$ | 62.66$^{b}$ | 2.79$^{c}$ | |
| Jatropha | 170.97$^{b}$ | 62.48$^{b}$ | 2.83$^{c}$ | 6.88$^{b}$ |
| Garlic | 186.75$^{a}$ | 65.91$^{a}$ | 3.05$^{b}$ | 6.98$^{b}$ |
| Ocimum | 191.13$^{a}$ | 66.21$^{a}$ | 3.11$^{a}$ | 7.36$^{a}$ |
| Chromolaena | 189.63$^{a}$ | 66.41$^{a}$ | 3.13$^{a}$ | 7.45$^{a}$ |
| Benlate | 190.66$^{a}$ | 66.38$^{a}$ | 3.15$^{a}$ | 7.46$^{a}$ |
| Control | 145.00$^{c}$ | 57.72$^{c}$ | 2.56$^{d}$ | 7.43$^{a}$ |
| Mean | 177.74 | 63.97 | 2.95 | 6.39$^{c}$ |
| SE | 9.85 | 1.19 | 0.071 | 7.14 |
| V x F | NS | NS | * | 0.15 |
| | | | | * |

Means in the same column followed by the same superscript(s) are not significantly different (0.05) using Duncan's Multiple Range Test. CPP = Capsules plant$^{-1}$; SPC = Seeds capsule$^{-1}$; OTSW = One thousand seed weight (g); SYPP = seeds yield per plant (g)

**Interactions between varieties and plant extracts on 1000-seed weight and seed yield per plant**

Tables 5 and 6 show the mean interaction performance of the effects of varieties and plant extracts evaluated for control of CLS as related to yield parameters under screenhouse conditions in 2011 and 2012 at Ardo-kola. Combined mean analysis of the two years screen house experiments proved that E8 plants treated with Ocimum extract or Benlate, which showed statistical resemblance with E8 same variety sprayed with extract of Chromolaena, produced the highest 1000-seeds weight (OTSW) values of 3.37 g, while the lowest value of 2.37 g was got from unsprayed plants of Yandev 55 (Table 5).

There were also highly significant interactions between varieties and plant extracts on seed yield per plant in 2011 and 2012 combined analysis (Table 6). The results showed that E8 x Benlate combination, which is statistically the same with E8 x Ocimum and E8 x Chromolaena, gave the highest seed yield per plant value of 8.26 g, compared to the lowest value of 5.43 g from unsprayed plants of Yandev 55.

**TABLE 5.** Combined mean interactions between varieties and extracts on 1000-seed weight following screenhouse experiments to control CLS disease of sesame at Ardo-kola, Taraba, Nigeria in 2011 and 2012.

| | Sesame varieties | | | | |
|---|---|---|---|---|---|
| Plant extracts | Yandev 55 | NCRIBEN-01M | E8 | NCRIBEN-03L | Mean |
| Neem | 2.58$^{mn}$ | 2.93$^{fg}$ | 2.79$^{j}$ | 2.85$^{hi}$ | 2.79 |
| Jatropha | 2.65$^{kl}$ | 2.98$^{f}$ | 2.81$^{ij}$ | 2.89$^{gh}$ | 2.83 |
| Garlic | 2.84$^{h-j}$ | 3.09$^{e}$ | 3.18$^{b-d}$ | 3.08$^{e}$ | 3.05 |
| Ocimum | 2.85$^{hi}$ | 3.12$^{c-e}$ | 3.35$^{a}$ | 3.12$^{c-e}$ | 3.11 |
| Chromolaena | 2.89$^{gh}$ | 3.11$^{de}$ | 3.33$^{a}$ | 3.19$^{bc}$ | 3.13 |
| Benlate | 2.87$^{hi}$ | 3.13$^{c-e}$ | 3.37$^{a}$ | 3.23$^{ab}$ | 3.15 |
| Control | 2.37$^{o}$ | 2.70$^{k}$ | 2.55$^{n}$ | 2.62$^{lm}$ | 2.56 |
| Mean | 2.72 | 3.00 | 3.05 | 2.99 | 2.95 |

SE(±) common to all treatment combinations = 0.071

Means with the same superscript(s) are not significantly different at 5% level using DMRT

**TABLE 6.** Combined mean interactions between varieties and extracts on seed yield per plant following screen house experiments to control CLS disease of sesame at Ardo-kola, Taraba, Nigeria in 2011 and 2012.

| | Sesame varieties | | | | |
|---|---|---|---|---|---|
| Plant extracts | Yandev 55 | NCRIBEN-01M | E8 | NCRIBEN-03L | Mean |
| Neem | 6.08$^{k}$ | 7.09$^{f}$ | 7.69$^{bc}$ | 6.66$^{h}$ | 6.88 |
| Jatropha | 6.23$^{j}$ | 7.23$^{e}$ | 7.74$^{b}$ | 6.73$^{gh}$ | 6.98 |
| Garlic | 6.74$^{gh}$ | 7.57$^{c}$ | 8.03$^{a}$ | 7.12$^{ef}$ | 7.36 |
| Ocimum | 6.78$^{g}$ | 7.64$^{bc}$ | 8.19$^{a}$ | 7.18$^{ef}$ | 7.45 |
| Chromolaena | 6.80$^{g}$ | 7.64$^{bc}$ | 8.19$^{a}$ | 7.20$^{ef}$ | 7.46 |
| Benlate | 6.66$^{h}$ | 7.58$^{bc}$ | 8.26$^{a}$ | 7.23$^{e}$ | 7.43 |
| Control | 5.43$^{l}$ | 6.37$^{i}$ | 7.40$^{d}$ | 6.37$^{i}$ | 6.39 |
| Mean | 6.39 | 7.38 | 7.93 | 6.93 | 7.14 |

SE (±) common to all treatment combinations = 0.15

Means with the same superscript(s) are not significantly different at 5% level using DMRT

## DISCUSSION

The experiments set in place to assess the behavior of different varieties and plant extracts including a synthetic fungicide against the sesame Cercospora leaf spot under screenhouse conditions of infection. The severity of *Cercospora* leaf spots also varied among the four sesame varieties at 4 to 12 weeks after sowing. This progression of the disease with time could probably be due to systematic epidemic build up in a polycyclic process being apparently aided by massive conidial production and spread within the cropping season. This inference is in agreement with Krantz (1964) concept of infection sequence i.e. infections, sporulation and dispersal of pathogen. Disease severity was significantly lower in variety E8 than the other varieties, probably due its inherent resistance to attack by the pathogens than the other varieties. This result agrees with Izge *et al*. (2007) who in a study to determine the level of variability of crop to *Cercospora* leaf spot concluded that variability existed among varieties in all characters, probably due their inherent level of resistance to attack by the pathogens. Iwo *et al*., (1998) earlier reported various level of susceptibility to *Cercospora* leaf spot by sesame genotypes.

The effects of plant extracts and a synthetic fungicide Benlate on the development of of Cercospora leaf spot on sesame were monitored as from 4 to 12 WAS IN 2011 and 2012 under screenhouse conditions. Sesame plants sprayed with extracts of Ocimum, which is at par with Chromolaena and Benlate in efficacy, had less severity, as compared with unsprayed sesame plants. These results agree with the findings of Amuchi (1999) who reported that application *Ocimum gratissimum* was effective in reducing the radial growth of *Rhizopus spp*. This agrees with earlier reports of Udo *et al.* (2001) on the inhibition of growth and sporulation of fungal pathogens on *Ipomea batatas and Dioscorea sp*, by garlic extract; Okigbo and Nmeka, (2005) on the use of *Xylopia aethiopica and Zingiber officinade* to control yam tuber rot caused by *F. oxysporum, A. niger and A.flavus* and Amienyo *et al.*, (2007) on the use of *Z. officinale, Annona muricata, gacinia cola, Alchorniea cordifolia, Allium sativum* to control wet rot on sweet potato caused rot fungal pathogen, Abdullaziz and younes, (2010) on the use of *Cinnamomum verum*, arise (*Pimpinella anisum L.*), black seed (*Nigella sativa L.*) and clove (*Syzygium aromaticum L. Merr and perry*) against pea (*Pisum sativum L.*) root-rot fungus (*Rhizoctonia solani*) and Ebele, (2011) on the use of *Carica papaya, Chronolaena odorota and Acalypha ciliate* on the control of pawpaw fruit rot fungi. The use of biocides from plant origin in crop protection is an important means of promoting biopesticides in crop production. In this screenhouse studies, attempts were made to control CLS disease of sesame using plant extracts treatments and host resistance of four sesame varieties. From this study it was observed that synergistic effect of plant extracts and host resistance had strong capacity to reduce the spread of CLS on sesame plants compared to control treatments under screenhouse in 2011 and 2012. It was therefore, noted that interactions of E8 x Ocimum extract, which is statistically the same with E8 x Chromolaena and E8 x Benlate, effectively reduced severity of infection. This confirmed the work of Ambang *et al*. (2011) that integrating host resistance (Bafia variety) and methanolic extracts of yellow oleander (*Thevetia peruviana*) seeds (METPS) efficiently protects groundnut against CLS than groundnut variety 55-437 treated with METPS. Plant extracts and variety also produced significant effect on capsules per plant, seeds per capsule, 1000 – seed weight and seed yield per plant of sesame in 2011 and 2012 combined analysis under screenhouse conditions. The yield parameters significantly ($P<0.05$) increased due to spraying of Ocimum, Chromolaena extracts or Benlate on sesame variety E8 or NCRIBEN-01M. The number was generally lower in the unsprayed sesame plants. This could be due to the lower disease severity recorded as a result of application of plant extracts compared to the untreated control. In Nigeria, Salako (1985) investigated the application of a range of fungicides for Cercospora leaf spot disease control in groundnuts and reported a yield increase of 132 – 286% over unsprayed control plots depending on the fungicide used. In conclusion, this study has shown that the *Ocimum gratissimum* and *Chromolaena odorata* extracts used have the potentials in the protection of sesame plant against Cercospora leaf spot fungus. From this study it could be seen that the performance of the plant extracts is comparable to the synthetic fungicide Benlate, and therefore this has given the farmers ample opportunities to try many alternatives that are user friendly. Therefore, plant extracts and crop varieties can be used as a potential tool in plant disease management, particularly Cercospora leaf spot of sesame, as sustainable and ecofriendly botanical fungicides that are economically and

environmentally rewarding for sesame and other crop producers.

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