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Field Management of Cercospora Leaf Spot induced by Cercospora sesami Zimm. Using Plant Extracts And A Synthetic Fungicide As A Method Of Reducing The Effects On Agronomic Traits Associated With Yield Of Sesame (*Sesamum indicum* L.)

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Abstract: *The field experiment was conducted to investigate the effect of plant extracts and the synthetic fungicide (Benlate) on Cercospora leaf spot on sesame agronomic traits associated with yield at Ardokola and Gassol in 2011. The results of the field trials showed that the synthetic fungicide (Benlate) and all the plant extracts (Azadirachta indica, Jatropha curcas Linn., Alium sativum, Ocimum gratissimum(L.), Chromolaena odorata) reduced the amount of disease by 7.1% to 8.64% compared to unsprayed control (with severity range of 55 to 58%). Similarly, plant extracts and benomyl gave 3.52 to 6.8% increase in plant height (compared to control of 136.94 to 149 70cm), 12.58 to 16.57 % more branches plant^{-1} (compared to control of 3.0 to 3.0), 32.10 to 36.82% more branches plant^{-1} (compared to control of 108.45 to 162.78) and 40.71 and 38.22% increase in yield over the unsprayed plots (548.66 and 551.04kg/ha) for Ardokola and Gassol respectively.*

Keywords: *Ceacospora leaf spot (CLS), Synthetic Fungicide (benlate), plant extracts, disease intensity, disease progress curves, agronomic traits, yield and sesame*

I. Introduction

Sesame (*Sesamum indicum* L.) is an oil seed crop generally cultivated on small holdings by poor – resource farmers in the tropics. The traditional agro-ecological zone of sesame cultivation is between latitudes 6 and 10^0N (Olowe, 2007; Agboola, 1979), which falls within the guinea savannah where the rainfall is usually below 1000mm. It is an erect, branch, stout, aromatic, annual herb of about 0.5 to 2.0m tall with well developed tap root system of up to 90cm long. Sesame exhibits a very high degree of genetic variability. Leaves shape, size and arrangement differ between varieties and even on some plants. Stems also differ in degree of pubescence – smooth, hairy or very hairy (Weiss, 1984).

Most of the shoot characteristics such as plant height, length and type of branches; length of the first capsule, pod production efficiency (Ep), seed production efficiency (Es), internodes length and number of nodes have been reported to be largely variety – specific and their contribution to grain yield quantified (Weiss, 1984; Ogunbodede and Ogunremi, 1986; Ogunremi and Ogunbodede, 1986; Olowe and Busari, 1998). However, there is little information on the effects of some management practices like pests and diseases control on the expression of these characteristics that can enhance grain yields. Cercospora leaf spot (CLS) is considered to be one of the most prevalent diseases of sesame that could lead to about 22 to 53% reduction in yield (Enikuomehin *et al*., 2002). Therefore, these experiments were conducted to evaluate the effects of synthetic fungicide (Benlate) and some selected plant extracts on CLS disease on the expression of some shoot characteristics of sesame with a view to identify the ultimate effects, if any, of those agronomic practices (effective disease management) in sesame production.

II. Materials And Methods

The trials were laid on flat land at two locations in Taraba State. The first location was a the Farm centre, ATC-Kofi, Ardokola (Northern Guinea Savannah in Latitude 8^0 89''N and Longitude 11^0 37''E), while the second location was at Koromu Farm centre Mararraban Gassol (Southern Guinea Savannah in Latitude 8^0 39′N and Longitude 10^0 47′E) in July 27 and August 5, 2011 respectively. The land was ploughed and harrowed and, compound fertilizer (15:15:15 NPK) was broadcasted over the areas at the rate of 400kg/ha during land preparation.

A plot was eight rows with 5 m x 4 m dimension and inter-row spacing of 50 cm. planting was done at an intra-row spacing of 10cm. A Randomized Complete Block Design (RCBD) was used in assigning the treatments to the plots. The treatments were replicated four times.

III. Inoculation Procedures

The two fields were inoculated with spore suspension of 5 x 10^4 conidial/ml for even distribution of the pathogen at 3WAS. Thereafter, plant extracts (10%) were sprayed as from 4WAS using ULV sprayer and repeated at two weeks intervals until 10WAS.

IV. Field Disease Assessment

Severity was estimated by assessing 10 randomly tagged plants per plot and determining overall score according to percentage area covered using a modified scale of 1-7 as adopted by Enikuomehin (2005) at 4, 6, 8, 10 and 12WAS. This was intended to show the progress of the disease in each treatment.

Determinations of agronomic traits were done using the ten tag plants that were used for disease severity score. The parameters measured included:

* Plant height (cm) at 4, 6, 8, 10, 12 weeks after sowing (WAS) and at harvest were done by measuring distance from ground level to the tip of all the 10 tagged plants and finding average for one plant.
* Number of fruits was achieved by counting number of capsules on the 10 tagged plants and finding average per plant.
* Number of branches were determined by counting number of branches at 4, 6, 8, 10, 12 weeks after sowing (WAS) and at harvest on the 10 tagged plants and finding the average per plant.

V. Results

The Effects of Plant Extracts Treatment on the Intensity of CLS

Analysed results on the activities of plant extracts and a synthetic fungicide and their antifungal effects on CLS as its affects some agronomic traits of sesame are presented in Table 1. Results shows that the plant extracts tested varied in the control of CLS in each of the locations. In general, all treated plants had significantly lower CLS intensity than the untreated check. In Ardokola, plants treated with *Azadirachta indica*, *Jatropha curcas* Linn., *Alium sativum*, *Ocimum gratissimum Chromlaena odorata* and benomyl (Benlate) had significantly lower disease intensity than unsprayed ones. In Gassol, plants sprayed with Chromolaena, Benlate, Garlic, Ocumum and Jatropha also had significantly lower disease intensity than those treated with control and Neem, while the unsprayed control had the highest CLS intensity. Plant extracts gave about 12.32 to 14.29% reduction in disease intensity compared to untreated checks (with severities of 57.94 and 55.44% in Ardokola and Gassol respectively). During the one year of experimentation in the two locations, the disease was observed in all the treatments. Severity was low at 4 Weeks after sowing in all treatments. There after the disease progressed steadily (Figures 1 and 2). A close examination of disease progress curves showed that in each location, the disease progressed slowly in growth between 4 and 10 weeks after sowing. Beyond 10 weeks after sowing, there was a sharp growth in both locations.

Effects of plant extracts on Agronomic traits.

The effect of plant extracts and benlate on plant height was not significant in Gassol research centre, but results obtained at Ardo-Kola Farm centre showed highly significant (P=0.01) effect at harvest in 2011 (Table 1). It was found that seedlings treated with Neem, Jatropha, Garlic, Ocimum, Chromolaena extracts and Benlate produced taller plant at harvest than unsprayed control.

The effect of plant extracts on branches per plant were significantly different at 8, 10, 12WAS and at harvest for Ardokola field trial, and also at 6, 10, 12 WAS and at harvest for Gassol farm centre in 2011 (Figures 3 and 4). In both locations seedlings treated with plant extracts and Benlate produced more branches per plant than the unsprayed control.

The effect of plant extracts on pods per plant presented a highly significant (P=0.01) differences for the two locations. Seedlings treated with plant extracts and benlate produced more pods per plant over unsprayed control at both locations in 2011, though Garlic extracts proved statistically better than the other treatments in Gassol location.

Seedling treated with Chomolaena, Garlic, Ocimum, Jatropha and Benlate gave significantly higher yields than the other treatments in both Ardokola and Gassol locations in 2011.In general, plants treated with extracts and benlate (benomyl) significantly had 40.71% and 38.22% higher yields (Table 1) than unsprayed plots (548,66 kgha^{-1} and 551.04 kgha^{-1}) for Ardokola and Gassol respectively.

It is generally observed that plant extracts and benomyl gave 3.52 to 6.8% increase in plant height (compared to control of 136.94 to 149 70cm), 12.58 to 16.57 % more branches plant^{-1} (compared to control of 3.0 to 3.0), 32.10 to 36.82% more pods plant^{-1} (compared to control of 108.45 to 162.78) and 40.71 and 38.22% increase in yield over the unsprayed plots (548.66 kgha^{-1} and 551.04kgha^{-1}) for Ardokola and Gassol respectively.

Table 2 is the weather data (rainfall, relative humidity and temperature) observed during the critical stage at which the plants are vulnerable to attack by cercospora leaf spot pathogen.

Table 1: Effects of some selected plant extracts and a synthetic fungicide on intensity of CLS as it affects some Agronomic characteristics of sesame in Ardokola and Gassol in Taraba state, Nigeria, 2011

	*Intensity of CLS (%)		[1]Plant height (cm)		[1]Branches per plant		[1]Capsules per plant		[1] Seed Yield in kgha^{-1}	
Treatments	Ardokola	Gassol	Ardokola	Gassol	Ardokola	Gassol	Ardokola	Gassol	Ardokola	Gassol
Neem	49.998b	47.52b	163.92a	140.69a	3.63ab	3.05a	151.47a	213.90b	818.31b	773.95c
Jatropha	50.27b	46.80bc	162.48a	142.06a	3.53b	3.06a	137.52a	209.10b	837.91b	787.24bc
Garlic	50.80b	45.09d	163.66a	140.79a	3.75a	2.96a	159.33a	258.44a	925.38a	843.19abc
Ocimum	48.75b	45.14cd	161.19a	141.27a	3.54b	2.96a	152.88a	214.19b	782.97b	797.38bc
Chromoleana	49.28b	44.30d	164.22a	139.24a	3.61ab	3.11a	145.47a	224.44ab	849.13ab	871.41ab
Benlate	49.998b	44.67d	167.083a	140.94a	3.50b	3.03a	155.52a	209.25b	863.47ab	891.91a
Control	57.94a	55.44a	149.70b	136.94a	2.92c	2.71b	108.45b	162.78c	548.66c	551.04d
Mean	51.0059	46.99	161.75	140.27	3.49	2.98	144.38	213.16	803.69	788.02
S.E.	3.13	2.60	9.88	7.56	0.27	0.32	28.10	49.51	107.39	113.17
p-value	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001

Means in the same column followed by the same letter(s) are not significantly different (0.05) using Duncan's Multiple Range Test.
*Percentage leaf area diseased estimated at 12WAS
[1]parameters determined at harvest

Table 2: Weather data for some selected periods starting from date of planting (27th July and 5th August) at Jalingo and Gassol respectively in 2011

	Total rainfall (mm) in 2011		Average daily R.H. in 2011		Average daily Temperature (^{0}C)	
Period	Ardokola	Gassol	Ardokola	Gassol	Ardokola	Gassol
4 WAS	157.3	579.98	NA	81	NA	27.5
6 WAS	119.10	218.54	NA	83	NA	27.3
8 WAS	117	176.65	NA	85	NA	28.0
10 WAS	114.7	117.5	NA	81	NA	29.3
12 WAS	106.1	58.39	NA	81	NA	28.5

WAS = weeks after sowing
Source: TADP and NIMET weather data at Jalingo and Gassol
NA = Data not available

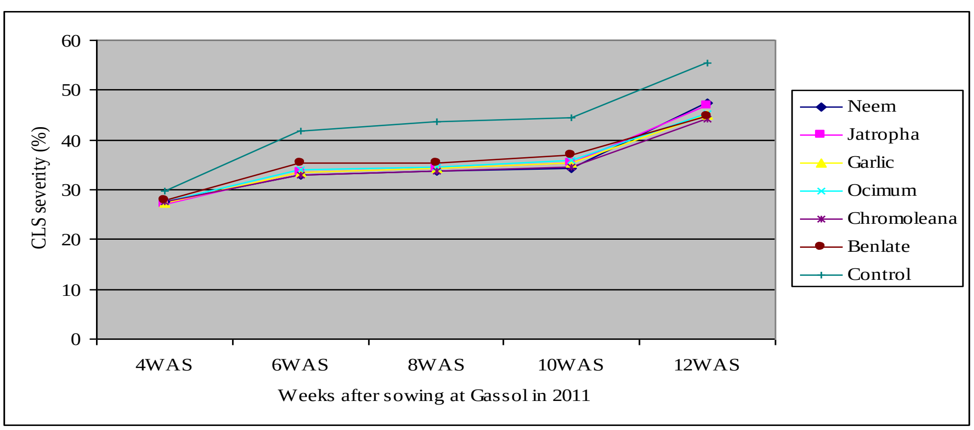

Figure 1: Effects of some plants extracts on the severity of CLS of sesame in field trial at Ardokola, Taraba state, Nigeria in 2011

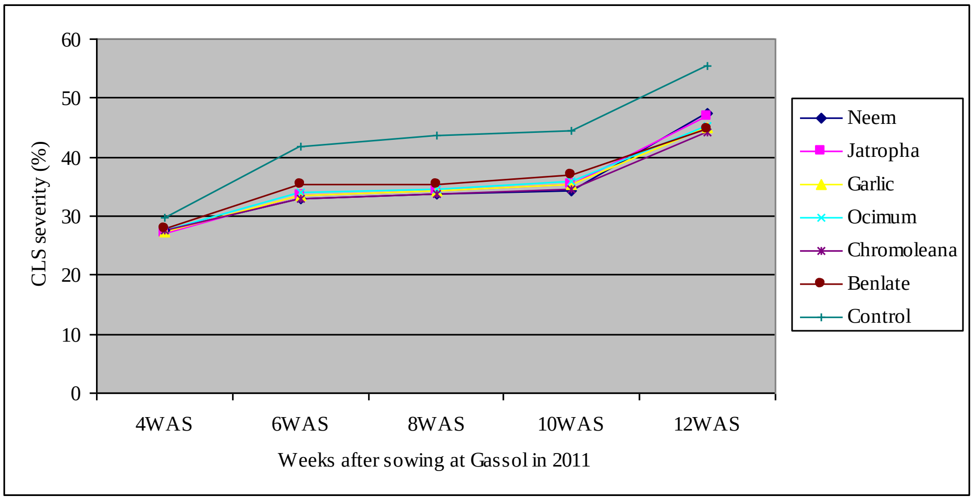

Figure 2: Effects of some plants extracts on the severity of CLS of sesame in field trial at Gassol, Taraba state, Nigeria in 2011

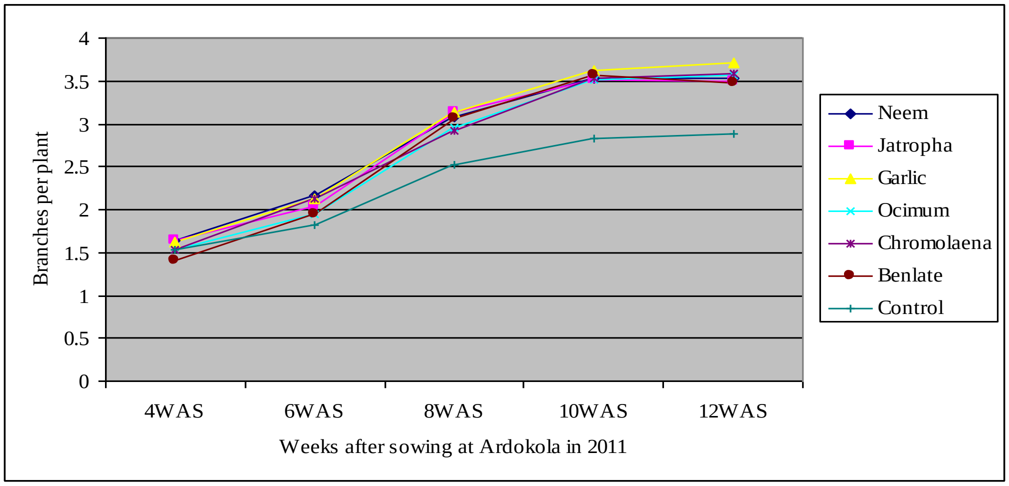

Figure 3: Effects of CLS on sesame branches following the application of some plant extracts at Ardokola, Taraba state, Nigeria in 2011

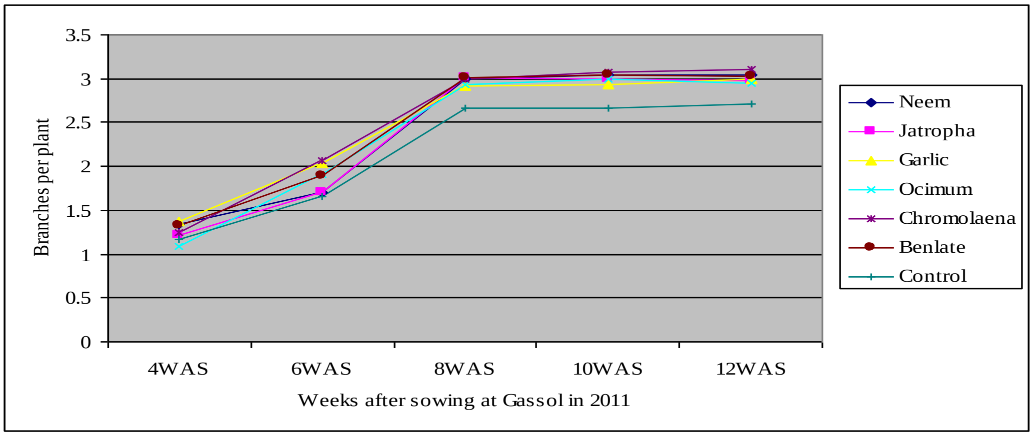

Figure 4: Effects of CLS on sesame branches following the application of some plant extract at Gassol, Taraba state, Nigeria in 2011

VI. Discussion

Although the incidence and severity of cercospora leaf spot in this study was observed at the early stage of the plant growth and progressed steadily, it however became very prominent at 12 WAS and characterized by a sharp increase in both locations. The gradual progress of CLS and the increase observed is a confirmation of the fact that the disease progressed slowly and becoming severe only towards physiological maturity (Rotem, *et al*., 1989), which was probably due to high build up of relative humidity with time. Sesame is most susceptible to Cercospora leaf spot at 8 to 10 weeks of growth. As such, control of Cercospora leaf spot on sesame is most critical between 8 and 10 weeks of age (Ojiambo *et al*., 1999; Rotem *et al*., 1983). Hence, the Plant extracts gave about 7.1% to 8.64% reduction in disease intensity compared to untreated checks (with severities of 57.94 and 55.44% in Ardokola and Gassol respectively). Plotting disease curves as cumulative values or curves of growth rates and yield indications is a common base for comparison of epidemics and sometimes permits some inferences (Anaso, 1996; Anaso *et al*., 1990; Krantz, 1964; Van Der Plank, 1963;). The magnitude of this increase in rate of disease progress may have been related to varying environmental conditions on components of the infection cycle of CLS disease. It is generally true that pathogenic organisms are sensitive to their environment particularly during infection and establishment process. Temperature and humidity are the most important variables, with humidity being particularly critical for shoot diseases (Jones and Clifford, 1983; Tripathi *et al.,* 1998). Thus the relative humidity (RH) of 80% to 85% and average daily temperature of 27 to 29^0c during the period of this trial (Table 2) has confirmed the work of several researchers (Ojiambo *et al*., 1999; Rotem *et al*., 1983).

These weather factors cumulatively have tremendous effect on leaf spotting activity of the pathogen and consequently influence plant height, number of branches, capsules which in turn affected of the seed yield of sesame. However, the application of plant extracts as well as the synthetic fungicide (Benlate) has significantly influenced the severity of CLS which drastically reduced the intensity of the disease thereby inducing significantly better agronomic traits that contributed to higher yield over the untreated check. This was further validated by Khan *et al.* (2009) who inferred that branch plant^{-1}, pods plant^{-1} and seed yield of sesame were significantly influenced by different management practices. Uwala (1998) also inferred that amongst the agronomic parameters measured, the total number of branches, plant height and capsule numbers were positively correlated with seed yield. Uwala who conducted experiment in 1995 and 1996 at Yandev to assess the effectiveness of three fungicides in the control of leaf spot disease of sesame caused by *Cercospora sesami*, revealed that uncontrolled effect of the disease could lead to reduction of plant height (19.08%), number of capsules (21.50%), number of branches (33.40%) and yield (54.11%) when compared with the best treatment of 64.67cm, 283, 5.00 and 5.26g/plot respectively. Olowe (2007) found significant positive relationships between grain yield and plant height at 50% flowering and physiological maturity. He also noted that number of capsules per plant and number of branches per plant were significantly correlated with grain yield.

The effectiveness of systemic fungicides like benomyl (benlate) and Mancozeb (Dithane M4-5) to control cercospora leaf spot and other fungal diseases have been demonstrated (Uwala, 1998; Enikuomehin, 2005; Anaso and Olatunde, 1989). Experiences in several countries have shown that continued usage of systemic fungicides enhanced the development of resistant strains of certain pathogens (Dekker, 1977; Dekker, 1982; Priest and Wood, 1961). From the results it could be clearly seen that the performance of the plant extracts is comparable to the synthetic fungicide benomyl, and therefore this has given the farmers ample opportunities to try many alternatives that are user friendly. Therefore, using plant extracts in crop protection would be a potential source of sustainable eco-friendly botanical fungicides that are economically and environmentally friendly for producers of sesame and other crops.

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