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Cercospora leaf spot disease management in sesame (*Sesamum indicum* L.) with plant extracts

O.A. Enikuomehin*
Department of Crop Protection, University of Agriculture, Abeokuta, Nigeria

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Abstract

The efficacy of aqueous leaf extracts of *Aspilia africana*, *Chromolaena odorata, Musa paradisiaca* and *Tithonia diversifolia* to control *Cercospora* leaf spot of two sesame cultivars (530-6-1 and Pbtil No.1) was evaluated. Sesame plants were sprayed with 7.5% extracts once every two weeks using a pneumatic hand sprayer, from the third week after planting. Results show that all extracts significantly ($p \leq 0.05$) reduced the incidence and severity of the disease. In particular, extracts of *C. odorata* and *A. africana* substantially reduced the number of infected leaves and number of lesions on foliage, and curtailed disease development, which in turn, protected flowers and capsules from infection. Seeds from the plots sprayed with extracts of *A. africana*, *C. odorata* and *T. diversifolia* also had significantly ($p \leq 0.05$) lower fungal infection (range: 4.50 to 8.75%) compared to unsprayed plots (10.25 to 13.5%). Likewise, germination percentage of seeds from the sprayed plants was higher (77.0 to 83.5%) than that of control (64.5 to 73.0%). Overall, leaf extracts of *A. africana*, *C. odorata* or *T. diversifolia* were comparable to Bentex T (20% Benlate+ 20% Thiram) in their effect to suppress *Cercospora* leaf spot disease in sesame cultivars.

Keywords: *Cercospora sesami*, fungicides, natural pesticides, plant products

Introduction

Sesame (*Sesamum indicum* L.) is an important oil seed crop of Nigeria and other parts of Africa (Schilling and Catan, 1991). Its seeds are rich in oil (50 to 52%), protein (17 to 19%) and carbohydrate (16 to 18%). Because of the high unsaturated fat and methionine contents (Schilling and Catan, 1991; Uzoh, 1998), sesame seed and oil are in high demand in Nigeria as export materials. Leaf spot disease caused by *Cercospora sesami* Zimm., however, is a major problem in the cultivation of this crop (Uwala, 1998). Moreover, this disease is prevalent in most sesame growing areas of Nigeria and in other parts of Africa (Nyanapah et al., 1995). It is particularly severe in the forest/savannah transitional zone of South West Nigeria, to which the crop has been recently introduced (Enikuomehin et al., 2002). The disease, which affects leaves of plants as early as 4 weeks after planting (WAP), starts as small pinhead-sized spots which extend up to 4 mm in diameter. Extensive infection of foliage and capsule leads to defoliation and damage of sesame capsules and yield losses may range from 22 to 53% (Enikuomehin et al., 2002).

Many synthetic fungicides had shown promise in the control of sesame diseases (Shokalu et al., 2002); however, the high cost of such chemicals forbids their use by ordinary farmers. Furthermore, continuous use of these chemicals may pose ecological problems. This, in turn, necessitates the search for alternatives in plant products, many of which have been reported to be effective in the control of several plant diseases (Enikuomehin and Peters, 2002; Okigbo and Emoghene, 2003). This study was carried out to determine the efficacy of the extracts of four tropical plant species for controling of *Cercospora* leaf spot disease of sesame.

*Author for correspondence: Phone: 234 803 33597277; E-mail <adeenikuomehin@yahoo.com>

Materials and methods

Sources and preparation of extracts

Plant extracts were obtained from fresh leaves of *Aspilia africana* (Pers.) C. D. Adams, *Chromolaena odorata* (Linn.) R. M. King and Robinson, *Tithonia diversifolia* (Hemsl.) A. Gray and *Musa paradisiaca* L. These plants were selected because they were associated with pest management and disease control practices in several parts of Africa (Stoll, 2001; Adodo, 2000). To obtain crude extracts, 75g leaf samples (species-wise), surface-sterilized with 1% NaOCl (5 min.) and rinsed five times in sterile distilled water were blended with 100 ml sterile distilled water, sieved through a sterile cheese cloth and the suspension was made up to 1 L.

Field experiment

A field experiment in randomized complete block design with three replicates was conducted at the Teaching and Research Farm, Abeokuta (7°15'N; 3°25'E). The treatments consisted of four leaf extracts, a synthetic fungicide [Bentex T (Benlate 20%+Thiram 20% wp)] and an unsprayed control. Two promising sesame cultivars introduced to south-west Nigeria: 530-6-1 and Pbtil No.1 were obtained from the National Cereals Research Institute, Badeggi. The seeds were sown in drills on August 24, 2003 in plots of size 3 x 2 m. The plant extracts (7.5%) were sprayed using a pneumatic hand sprayer from three WAP, i.e., before disease development and was repeated at two weeks interval until 11 WAP. The synthetic fungicide, Bentex T, was sprayed at the recommended rate of 2.3 g L^{-1} at 5 WAP and 8 WAP, while the control was left unsprayed.

Field disease assessment

The plants were examined for disease symptoms weekly and quantitative assessments (number of plants/leaves infected) were made until 12 WAP. Assessment of the number of infected plants was done in two permanent, randomly placed quadrats (50 x 100 cm) per plot. The total number of plants and number infected in a quadrat were counted and the percentage disease incidence was worked out. Number of leaves infected was obtained from five randomly tagged plants per plot and was expressed as percentage of the total number of leaves. Disease severity was assessed by counting the number of lesions at 13 WAP and rating the symptom expression on a *0* to *6* scale (Table 1). For this, five plants per plot were selected and on each plant, the number of lesions on a quarter of the area of one leaf at the second node was counted. Another set of five random plants per plot was used for disease rating (Enikuomehin et al., 2002). Seed yield from different plots was obtained after harvest.

Seed viability and incidence of mycoflora

Four hundred seeds from each treatment were plated on blotter paper at the rate of 50 seeds per petri-dish (9 cm dia). The plates were incubated at 28±2°C for 7

Table 1. Disease score for *Cercospora* leaf spot disease of sesame

Scale	Rating	*Cercospora* leaf spot characteristics
0	No disease	No trace of infection
1	Hypersensitivity	Hypersensitive spot on lower leaves only
2	Trace infection	Small lesions on lower leaves only
3	Slight infection	Small lesions on lower and upper leaves and stem
4	Moderate infection	Advanced lesions[1] on upper and lower leaves, with or without new infections on stem and petiole
5	Severe infection	Advanced lesions on upper and lower leaves, flower, buds, stems and petiole and slight infection of pod
6	Very severe infection	All features of 5 above with severe infection of pod

[1]Advanced lesion is characterized by a dark to dark-brown spot with a whitish to straw-coloured or perforated centre (Enikuomehin et al., 2002)

days with 12 h alternating cycles of light and darkness, and observations on seed germination fungal infection were noted.

Seed treatment with plant extracts

Seed samples of the two sesame cultivars (not from the batch harvested in the experiment described above) were soaked in 7.5% extract of the test plants for 30 and 60 min. Thereafter, the seeds were allowed to drain in open air on laboratory benches for 2 h before plating on blotter paper. Seeds soaked for the same periods in suspension of Bentex T (2.3 g L^{-1}) and sterile distilled water served as controls. Four hundred seeds from each treatment were plated at the rate of 50 seeds per petri-dish (9 cm-dia). Seeds were incubated as above and assayed for fungal incidence and germination.

All data were subjected to analysis of variance, and where there were significant differences ($p \leq 0.05$), mean separation was done using Duncan's Multiple Range Test (DMRT) or Least Significant Difference (LSD).

Results and discussion

In general, disease incidence was reduced by the application of plant extracts (Table 2). Percentage of plants infected in both sesame cultivars was significantly ($p \leq 0.05$) lower for *A. africana* and *C. odorata* extracts. Moreover, all plant extracts (except *M. paradisiaca* on cv. Pbtil No.1) significantly ($p \leq 0.05$) reduced the percentage of leaves infected and number of lesions per leaf. While the synthetic fungicide, Bentex T, also substantially reduced the number of lesions on foliage, it was statistically at par with that of *A. africana*, *C. odorata* and *T. diversifolia* extracts. This is consistent with the earlier reports that many plant products contain fungi-toxic constituents that have the potential to control plant diseases (Tewari and Nayak, 1991; Amadioha and Obi, 1999; Enikuomehin and Peters, 2002). Regarding the four focal species, although Owolade et al. (2003; 2004) reported the fungi-toxicity of *T. diversifolia* extract against *Colletotrichum capsici* (brown blotch of cowpea), there are no previous reports in this respect on *A. africana* and *C. odorata*. Furthermore, disease index score showed that plots of cv. 530-6-1 sprayed with extracts of *A. africana*, *C. odorata* and *T. diversifolia* and plots of cv. Pbtil No.1 sprayed with *A. africana*, *C. odorata* or *M. parasidiaca* had only "slight infections", characterized by small lesions on upper and lower leaves as well as stems only, and by implication, flowers and pods were not infected. Conversely, unsprayed plots showed "moderate" to "severe" infections.

Coincidentally, fungal incidence on seeds from extract-treated plots was between 7.0 to 10.5% (Table 3), which was significantly ($p \leq 0.05$) lower than that of control (10.25 to 13.5%), implying that capsules are probably

Table 2. Effect of field spray with plant extracts on the incidence and severity of *Cercospora* leaf spot disease in two cultivars of sesame (530-6-1 and Pbtil No.1) at Abeokuta, Nigeria

Treatment	Disease incidence (%)				Severity assessment			
	Plants infected		Leaves infected		Lesions per ¼ leaf area		Disease score (± S.E)[1]	
	530-6-1	Pbtil No.1	530-6-1	Pbtil No.1	530-6-1	Pbtil No.1	530-6-1	Pbtil No.1
A. Africana	78.7^{b}	57.1^{b}	31.7^{b}	40.0^{b}	7.7^{bc}	6.7^{b}	3.5 ± 0.16	3.8 ± 0.81
C. odorata	68.8^{b}	75.4^{b}	31.2^{b}	38.3^{b}	6.2^{bc}	7.9^{b}	3.5 ± 0.12	3.4 ± 0.81
T. diversifolia	82.5^{a}	75.6^{ab}	41.7^{b}	35.4^{b}	6.3^{bc}	5.6^{b}	3.7 ± 0.12	4.5 ± 0.52
M. paradisiaca	84.5^{a}	86.4^{a}	37.7^{b}	58.9^{ab}	8.3^{b}	7.1^{b}	4.0 ± 0.14	3.5 ± 0.47
Bentex T	56.1^{b}	56.2^{b}	22.0^{c}	19.0^{c}	4.7^{c}	5.7^{b}	3.3 ± 0.47	3.5 ± 0.47
Control	91.5^{a}	92.0^{a}	72.5^{a}	70.3^{a}	12.4^{a}	13.2^{a}	4.5 ± 0.41	5.3 ± 0.94

Values with different superscripts in the same column are significantly different ($p \leq 0.05$) in Duncan's Multiple Range Test.
[1]Data are means ± standard error of visual severity scores obtained 13 weeks after planting (WAP) from 15 plants per cultivar and within each treatment category. Plant were scored on a 0–6 scale (see text for details)

not infected in the sprayed plots. With the result, germination of seeds from the extract-treated plots was significantly ($p \leq 0.05$) greater (74.5 to 83.5%) than that of unsprayed plots (64.5 to 73.0%; Table 4). Previous studies (Enikuomehin and Peters, 2002) also showed that extracts of *Ocimum gratissimum*, *Azadirachta indica* and *Mangifera indica* reduced mycoflora load of sesame seeds through a possible reduction in capsule infection. In addition, seed treatment by soaking in plant extracts for 30 min can be advocated as preventive measure against cercospora leaf spot of sesame. Our results show that all plant extracts evaluated significantly reduced the incidence of fungi (2 to 4.5% as against 12 to 15% in control; Table 4). Likewise, germination of extract-treated seeds was higher (78.5 to 83.0%) compared to untreated seeds (72 to 74%).

A comparison of the data presented in Table 3 also show that overall grain yields from plots sprayed with *A. africana* (110 to 139 kg ha^{-1}), *C. odorata* (99 to 104 kg ha^{-1}) or *T. diversifolia* (149 to 155 kg ha^{-1}) were significantly higher than that of unsprayed plots (72 to

Table 3. Seed mycoflora, germination of harvested seeds and grain yield of two cultivars of sesame (530-6-1 and Pbtil No.1) as affected by different herbal sprays at Abeokuta in Nigeria

Treatment	Fungal incidence (%)		Seed germination (%)		Grain yield (kg ha^{-1})	
	530-6-1	Pbtil No.1	530-6-1	Pbtil No.1	530-6-1	Pbtil No.1
A. africana	8.8^{c}	7.3^{c}	78.5^{c}	83.0^{a}	110.0^{abc}	139.0^{ab}
C. odorata	8.0^{b}	7.0^{b}	77.0^{d}	81.0^{c}	104.9^{ab}	99.9^{bc}
T. diversifolia	4.5^{a}	7.5^{c}	83.5^{b}	78.5^{d}	155.0^{a}	149.6^{ab}
M. paradisiaca	10.0^{d}	10.5^{d}	74.5^{e}	65.5^{e}	100.0^{bc}	110.0^{abc}
Bentex T	4.5^{a}	6.5^{a}	89.0^{a}	82.0^{b}	146.4^{ab}	112.6^{abc}
Control	10.3^{d}	13.5^{e}	73.0^{f}	64.5^{f}	86.0^{c}	72.0^{c}

Values with different superscripts along the column are significantly different ($p \leq 0.05$) in Duncan's Multiple Range Test.

Table 4. Fungal incidence and germination of seeds soaked with 7.5% leaf extracts of four plant species for different durations on two Nigerian sesame cultivars

Duration of treatment/plant species	Sesame cultivars			
	530-6-1		Pbtil No.1	
	Fungal incidence (%)	Germination (%)	Fungal incidence (%)	Germination (%)
30 min.				
A. africana	4.5	79.5	5.5	79.0
C. odorata	4.0	79.5	3.5	80.5
T. diversifolia	4.5	78.5	4.5	80.5
M. paradisiaca	2.0	83.0	3.0	81.0
Bentex T	4.5	75.0	2.5	76.0
Control	15.5	72.0	12.0	74.0
LSD ($p \leq 0.05$)	3.63	2.90	2.64	2.15
60 min.				
M. paradisiaca	5.5	80.0	4.5	79.0
A. Africana	2.0	84.5	4.0	84.0
C. odorata	2.5	79.5	4.0	80.5
T. diversifolia	2.5	83.0	3.5	82.0
Bentex T	4.5	77.5	2.0	77.0
Control	25.0	62.0	13.5	76.0
LSD ($p \leq 0.05$)	6.69	6.09	3.10	2.26

86 kg ha^{-1}). The higher yield levels in the extract-treated plots (except for *M. paradisiaca*) were also comparable to that of Bentex T-sprayed plots (112 to 146 kg ha^{-1}), implying distinct advantages for certain plant extracts in suppressing disease development and promoting sesame yields at lower costs. Overall, this study reveals the potential of *A. africana, C. odorata* and *T. diversifolia* extracts to control the *Cercospora* leaf spot disease of sesame. Further studies are, however, necessary to determine the minimum concentration required for maximum disease control as well as the frequency and mode of application of the different plant extracts. Investigations into the active ingredients of the extracts and the mode of action are also necessary.

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