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RESEARCH ARTICLE

EFFICACY OF PLANTS EXTRACTS ON CERCOSPORA LEAF SPOT INCIDENCE AND SEVERITY OF GROUNDNUT (*Arachis hypogaea* L.) *IN-VIVO*

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ABSTRACT

Cercospora leaf spot diseases of groundnut (*Arachis hypogaea* L.) caused by *Cercospora arachidicola* and *Cercosporidium personatum* is an important disease that has the potential to significantly reduce the economic value of the crop. A research was conducted to determine the incidence and severity of the disease in four groundnut accessions: ICIAR-19BT, NGB01293, NGB00157 and NGB01294 grown in Abeokuta. Field experiments were conducted to determine the effect of aqueous extracts of these plants on incidence and severity of Cercospora leaf spot disease in split-plot fitted into a Randomized Complete Block Design with three replicates. Data obtained were subjected to Analysis of Variance and means were separated using Duncan's Multiple Range Test at 5% level of probability. The results showed that groundnut accessions were infected by Cercospora leaf spot disease. Range of disease incidence was between 45.6% (NGB01293) and 63.4% (ICIAR-19BT) at 8 Weeks After Planting (WAP). Disease was "very severe" (rating 5.0 on a scale of 1-5) in NGB00157 relative to 4.67 (ICIAR-19B) and 4.0 (NGB01294) at 11 WAP. All tested aqueous extracts significantly ($p < 0.05$) reduced the incidence and severity of Cercospora leaf spot disease on the field. Extract of *C. odorata* enhanced the lowest disease incidence (ranging from 15.0 to 10.0%) in the four accessions at 8 WAP while *T. procumbens* induced the lowest severity rating of 1.0 (on a scale of 1-5) in four accessions at 11 WAP. The study concluded that plant extracts can effectively control Cercospora leaf spot disease of groundnut and its causative organisms. However, *T. diversifolia C. odorata* and *T. procumbens,* should be used as a potential biocide in plant disease management, as they showed fungicidal and fungitoxic ability.

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INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is one of the world's most important oilseed crops (Dwivedi *et al*., 2003), ranking the 13th most important food crop and 4th most important oilseed crop of the world (Surendranatha *et al*., 2011) cultivated in more than 100 countries in six continents (Sharma and Mathur, 2006). Its cultivation is mostly confined to the tropical, subtropical, and warm temperate (zones) countries between 40° N and 40° S latitude (Ephrem, 2015). It is also an important cash crop in subsistence and commercial farming systems, as well as an important food source (Izge *et al*., 2007). Groundnut kernels have high nutritive value containing 40-50% fat, 20-50% protein and 10-20% carbohydrate and are rich in vitamin E, niacin, riboflavin, thiamine, falacin, calcium, phosphorus, magnesium, zinc, iron and potassium (USAD, 2010). Groundnut kernels are consumed directly as raw, roasted or boiled kernels or oil extracted from the kernel is used as culinary oil (Ephrem, 2015). Oil pressings, seeds, and the haulms of groundnut are used as animal feed while the oil cakes are used as industrial raw material and fertilizer (Ayele, 2010). The diversify uses of groundnut plant and it related products makes it an excellent cash crop for domestic markets as well as for foreign trade in several developing and developed countries (Ephrem, 2015). Its protein is the cheapest source of dietary protein in places where meat is scarce and very expensive for large proportion of subsistent farming communities (Trawalley, 1998). The hay (vine) is a nutritious animal feed, particularly for the subsequent dry season when green forage is not available (Naab *et al*., 2005). Additionally, according to Naab *et al*., 2005; Nutsugah *et al*., 2007 groundnut seed and hay are often sold in local markets, providing income to resource-poor farmers. Groundnut is

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affected by several diseases, such as early leaf spot (*Cercospora arachidicola* S. Hori), late leaf spot (*Phaeoisariopsis personatum* Berk. and Curt.), collar rot (*Aspergillus niger*), rust (*Puccinia arachidis* Speg), and bud necrosis (bud necrosis virus (BNV) (Ephrem, 2015). Early leaf spot (caused by *Cercospora arachidicola* S. Hori) and Late leaf spot (caused by *Cercosporidium personatum*) are most devastating and economically important foliar fungal diseases and major yield reducing factor of groundnut worldwide with an annual yield losses of 15 to 50% Lucas *et al*., 1992, Backman and Crawford, 1984; Khaleque, 1985, Smith *et al*., 1992 and Mirza, 1998. Most farmers control these diseases using synthetic fungicides. The negative environmental impacts, mammalian toxicity and high costs are making their use unattractive thereby searching for alternatives such as natural plant-based chemicals (Asawalam, 2006). Plants have the ability to synthesize aromatic secondary metabolites, like phenols, phenolic acids, quinones, flavones, flavonoids, flavonols, tannins and coumarins (Cowan, 1991). These groups of compounds show antimicrobial effect and serve as plant defense mechanisms against pathogenic microorganisms (Das *et al*., 2010). Many research workers have tried to find out safe and economical control of plant diseases by using extracts of different plant parts (Hasan *et al*., 2005; Bdliya and Alkali, 2008). The use of plant extracts with antifungal activity offers an alternative method for the management of leaf spot disease of groundnut because it is highly economical, environmentally safe, and easily available to resource poor farmers (Rahman and Hossain, 1996). Hence the objective of the study was to evaluate and determine the effect of plants extracts on Cercospora leaf spot incidence and severity on four groundnut accessions under field conditions

MATERIALS AND METHODS

Experimental Site

Experiments were carried in Teaching and Research Farm of the Federal University of Agriculture, Abeokuta (Latitude 7° 15´N and Longitude 3° 23 ´E) in the Forest/Savanna transition agroecology of Southwest, Nigeria. Two hundred grams each of Four (4) accessions of certified groundnut (*Arachis hypogaea L*.) seeds were collected from National Centre for Genetic Resources and Biotechnology (NACGRAB), Oyo State, Southern-western Nigeria. Standard land preparation was done with plots size of 5 m * 5 m with 0.5 m between plots and 1m interval between replications. The experiment was laid out in split-plot fitted into a Randomized Complete Block Design with three replicates. Two seeds were sown per hole at a depth of about 5cm. The inter- and intra-row distances were 50cm and 25cm, respectively. Thinning was done at 2 WAP to maintain one stand per hole. The plants were examined for disease symptoms weekly and quantitative assessments (numbers of plants/leaves infected) were made until 11 WAP.

Assessment of disease incidence

Numbers of infected leaves was obtained from five randomly tagged plants per plot at 4, 6, and 8 WAP and was expressed as percentage of the total number of leaves per tagged plant using the formula adopted from Subrahmayam *et al*. (1995):

$$\text{Disease incidence (\%)} = \frac{\text{Number of infected leaves per tagged plant}}{\text{Total number of leaves per tagged plant}} \times 100$$

Assessment of disease severity

Disease severity was assessed by counting the number of lesions on leaves per tagged plant obtained from tagged plants which disease incidence was assessed at 9 and 11 WAP and rating the symptoms expression on a 1.0 to 5.0-point scale (Table 1).

Table 1. Disease severity score for Cercospora leaf spot disease of groundnut

Scale	Rating	Cercospora leaf spot characteristics
1.0 – 1.99	No infection	No visible symptoms
2.0 – 2.99	Low infection	1 – 25% of total leaf area is covered by lesions
3.0 – 3.99	Moderate infection	26 – 50% of the total leaf area is covered by spots, with 15% defoliation.
4.0 – 4.99	Severe infection	51 – 75% of the total leaf area of the whole plant covered by spots, with more than 30% defoliation
5.0	Very severe infection	76 – 100% of the leaf area of the whole plant is spotted, and/or more than 50% of the total number of leaves is defoliated

Source: Modification of CSIR (2007)

Data collection and analysis

Plant height, weight of fresh haulm, weight of 100- pods yield and Total Leaf Area were obtained from five randomly tagged plants for which incidence and severity were assessed as stated by Kalra and Dhiman, (1977) TLA = L*B* Kemp's Constant (0.66)

Laboratory studies

Laboratory studies involved media preparation, isolation of fungal pathogens as well as collection and preparation of plant extracts. Potato Dextrose Agar (PDA) (BAM Media M127) was prepared by dissolving 39 grams in 1 litre Erlenmeyer flask and then made up to 1 litre using sterile distilled water. The medium was autoclaved at 121^{o}C for 15 minutes at 15 lb. The sterilized medium was allowed to cool to 45°C, before supplemented with streptomycin sulphate (3 grams) and aseptically dispensed into sterilized 9 cm diameter glass Petri dishes.

Isolation of fungi from diseased leaves

Fungal species were isolated from diseased leaves of groundnut showing characteristic symptoms of Cercospora leaf spot. The Cercospora leaf spot disease was characterized by necrotic lesions on leaves which were circular to angular spots or dots and vary in size from less than 1 mm to 10 mm in diameter. Margins of infected leaves (2 - 5 mm diameter) were cut to contain both diseased lesions and healthy uninfected tissues using flame-sterilized scissors and forceps. Cut out portions were surface-sterilized (1 % NaOCl for 5 min then rinsed in five changes of sterile distilled water) and blottered dry with tissue paper in the laminar flow.

The dried diseased cut out were then inoculated on PDA. Inoculated Petri dishes were incubated at 28 ± 2 °C. Fungi grew from the plant parts were subcultured until pure cultures were obtained. The fungi were identified with the aid of colony and hyphal characteristics and measurement of conidial length was done using ocular micrometer (Holliday, 1980; Domsch *et al*., 1981; Barnett and Hunter, 1999).

Pathogenicity test

Conidia of fungal was removed by flooding each petri dish with 10 ml of sterile distilled water and scrubbing the surface with a glass rod. Conidial suspension was filtered through three layers of muslin cloth to remove mycelial fragments. The suspension was made to 100 ml. The conidial concentration was determined using the Neubauer Hemocytometer. Seeds of three accessions of groundnut were surface-sterilized (1% NaOCl for 5 min) and planted in planting bags containing 20 kg of heat-sterilized soil (150 ^{o} C for 90 min). The experimental design was complete randomized design (CRD) in three replicates in the screen house. Each replicate contains eight pots and seedlings were thinned to 2 plants per pot at 2 WAP making a total of sixteen plants per replicate. The treatments consisted of plant sprayed with each fungal isolate singly and in different combinations. The adaxial surfaces were sprayed till run-off at 3WAP of the leaves with hand sprayer and with conidial of each isolate singly and in different combinations at a concentration of 2.9 x 10^3 spore/ml. Each plant was covered with a transparent polythene bag for 48 h to maintain high humidity. Control plants were sprayed with sterile distilled water. Disease assessment was by visual observation for presence or absence of symptoms from 10 to 30 days after inoculation. Fungi were re-isolated from the diseased tissue and compared with original isolates.

Sources of plant extracts and preparation

Leaves of three plant species namely *Tithonia diversifolia* (Hemsley) A. Gray (Mexican sunflower), *Chromolaena odorata* Linn, and *Tridax procubens* Linn. (Coat button) were used in the experiment. These were obtained within the premises of the Federal University of Agriculture, Abeokuta. Fresh leaves of *T. diversifolia* , *C. odorata* and *T. procumbens* were washed in tap water then surfaced-sterilized with (1% NaOCl for 5min and rinsed in five changes of sterile distilled water) and air dried at (28 ± 2 °C) for 1h. Fifty grams, seventy-five grams and hundred grams of each plant material were grounded using sterilized Brabantia 5-speed blender (Model BBEK 1051) in 100 ml distilled water, and then filtered through a Whatman® No. 9 filter paper separately into a 250 ml Erlenmeyer flask to produce 50 %, 75 % and 100% extract concentrations. One fraction of the crude extracts was autoclaved at 121 °C/15 psi for 15 min and another were exposed to ultraviolet radiation (wavelength 438 nm for 5 h) for sterilization. Data were subjected to analysis of variance (ANOVA) and means were separated using Duncan's Multiple Range Test (DMRT) at 5% level of probability.

RESULTS

Incidence of Cercospora leaf spot disease of groundnut in Abeokuta, Nigeria

The incidence of Cercospora leaf spot disease among groundnut accessions are presented in (Table 2). The incidence ranged from 33.63 to 63.43% between 4 to 8 WAP. At 4 WAP, Cercospora leaf spot incidence was comparable ($p<0.05$) between groundnut accession NGB00157 and ICIAR-19BT as well as between NGB01293 and NGB001294. This trend was observable at 6 and 8 WAP. Incidence of Cercospora leaf spot was higher at 8 WAP than at 4 or 6 WAP in all accessions.

Table 2. Incidence of Cercospora leaf spot disease on four groundnut accessions at 4 to 8WAP

	Disease Incidence (%)		
Accession	4WAP	6WAP	8WAP
ICIAR-19BT	48.37±4.83^{ab}	58.57±3.21^{a}	63.43±3.09^{a}
NGB01293	33. 63±3. 81^{bc}	39.6±2.20^{b}	45.6±3.00^{b}
NGB00157	53. 8±4. 83^{a}	59.07±3.21^{a}	62.1±3.09^{a}
NGB01294	35.12±4. 73^{bc}	45.03+3.20^{b}	50.0±2.00^{b}

Values with different superscripts within the same column are significantly different ($p<0.05$)
Duncan's Multiple Range Test.±S.E – standard error).

Severity of Cercospora leaf spot disease of groundnut

Severity of Cercospora leaf spot was similar (Severe infection) on both ICIAR-19BT and NGB00157 at 9 WAP. Similarly, both NGB001294 and NGB00157 had moderate infection of Cercospora leaf spot, a severity rating characterized by 26-50% of total leaf area covered by spots. At 11 WAP, all accessions had become severely infected (range 4.0 - 4.47) except NGB00157 which exhibited very severe infection (Severity score 5.0). This condition is characterized by 51-75% of total leaf area of the whole plant covered with spots (Table 3).

Table 3. Severity of Cercospora leaf spot of different groundnut accession at 9 and 11 WAP in Abeokuta, Nigeria

Accession	Severity			
	9WAP		11WAP	
	Score	Rating	Score	Rating
ICIAR-19BT	4.0	Severe Infection	4.67	Severe Infection
NGB01293	3.33	Moderate Infection	4.0	Severe Infection
NGB00157	4.0	Severe Infection	5.0	Very Severe Infection
NGB01294	3.67	Moderate Infection	4.0	Severe Infection

Values are visual severity scores obtained 9 and 11 WAP from 15 plants per accession and within each treatment category scored on a 1.0–5.0 scale.

Agronomic characteristics of four accessions groundnut

Table 4 shows that there was no significant ($p<0.05$) differences among groundnut accessions with respect to plant height. Similar trend was observed in total leaf area. The fresh haulm weight of accessions NGB01293 and NGB00157 was comparable ($p<0.05$). The 100 seed weight of NGB01293 (29.77g) was significant ($p<0.05$) higher than that of ICAR-19BT and NGB01294.

Table 4. Agronomic characteristics of four accessions of groundnut

Groundnut Accession	PH (cm)	4W-TLA (cm^2)	WFH (g)	100 W (g)
ICIAR-19BT	14.13±0.60^{a}	6.67±0.52^{a}	20.67±1.88^{b}	18.87±2.77^{b}
NGB01293	15.23±0.61^{a}	5.29±0.51^{a}	29.57±1.78^{a}	29.77±2.87^{a}
NGB00157	14.23±0.63^{a}	5.00±0.50^{a}	27.2±1.88^{ab}	21.87±2.07^{ab}
NGB01294	14.28±0.63^{a}	5.37±0.50^{a}	19.07±1.77^{b}	13.43±2.78^{b}

Values with different superscripts within the same column are significantly different ($p<0.05$) Duncan's Multiple Range Test. (± S.E – standard error).
PH = Plant Height, 4W-TLA = 4Wks Total Leaf Area, WFH = Weight of Fresh Haulm 100 W= 100 seeds weight

Effect of aqueous extracts on incidence of Cercospora leaf spot of four groundnut accessions

All the plant extracts induced significant ($p<0.05$) reduction in the incidence of Cercospora leaf spot disease in all accessions

of groundnut (Figures 1 a-d). Similarly, the effect of the different extracts on Cercospora leaf spot incidence was comparable ($p<0.05$) on all accessions of groundnut. The range of Cercospora leaf spot incidence as influenced by the plant extracts on groundnut accession ICIAR-19BT, was between (20.24 and 30.05%) (Figure 1a)

Effects of plant extracts on the severity of Cercospora leaf spot of groundnut

The severity of Cercospora leaf spot was reduced by foliar spray extracts of the tested plants. At both 9 WAP and 11 WAP, extract of *T. procumbens* enhanced "no infection" rating

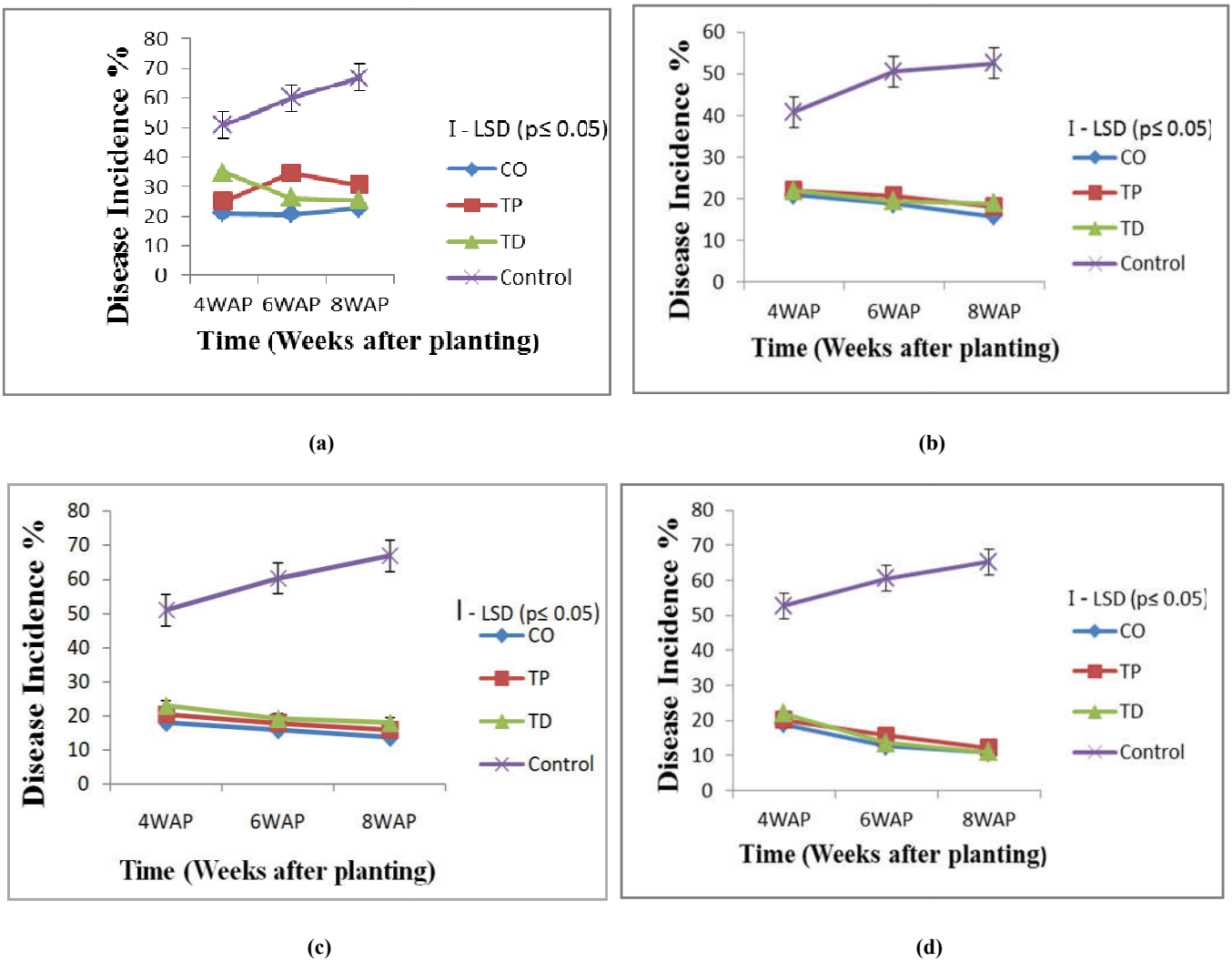

Figure 1. Effect of aqueous extracts of *Tithonia diversifolia* (TD), *Chromolaena odorata* (CO) and *Tridax procumbens* (TP) on incidence of Cercospora leaf spot disease of groundnut accessions (a) ICIAR-19BT, (b) NGB01293, (c) NGB00157 and (d) NGB012

Table 5. Effects of aqueous extracts of *T. diversifolia, C. odorata* and *T. procumbens* on the severity of Cercospora leaf spot disease of groundnut in Abeokuta, Nigeria

Accession Treatment (Plant Extract)	Severity			
	9 WAP		11WAP	
	Score	Rating	Score	Rating
ICIAR-19BT *C. odorata*	3.0	Moderate Infection	2.33	Low Infection
T. procumbens	1.67	No Infection	1.0	No Infection
T. diversifolia	2.6	Low Infection	2.33	Low Infection
Control	4.3	Severe Infection	4.0	Severe Infection
NGB01293 *C. odorata*	2.67	Low Infection	2.33	Low Infection
T. procumbens	1.0	No Infection	1.0	No Infection
T. diversifolia	2.33	Low Infection	1.33	No Infection
Control	4.67	Severe Infection	5.0	Very Severe Infection
NGB00157 C. *odorata*	3.33	Moderate Infection	3.67	Moderate Infection
T. procumbens	2.7	Low Infection	2.0	Low Infection
T. diversifolia	3.6	Moderate Infection	3.33	Moderate Infection
Control	5.0	Very Severe Infection	5.0	Very Severe infection
NGB01294 C. *odorata*	3.4	Moderate Infection	2.33	Low Infection
T. procumbens	2.0	Low Infection	1.0	No infection
T. diversifolia	2.33	Low Infection	1.0	No Infection
Control	4.67	Severe Infection	5.0	Very severe infection

Values are visual severity scores obtained 9 and 11 WAP 15 plants per accession within each treatment category. Plants were scored on a 1.0–5.0 scale. WAP *Chromolaena odorata*, *Tridax procumbens*, *Tithonia diversifolia*, Unsprayed control

Table 6. Effect of Plant Extract on the Agronomic performances of four accessions groundnut

Accession	Treatment (Plant Extract)	Agronomic Characteristics			
		PH (cm)	4W-TLA (cm^2)	WFH (g)	100 W (g)
ICIAR-19BT	*T. diversifolia*	15.06	7.95	29.57	24.10
	C. odorata	14.13	7.95	20.67	26.53
	T. procumbens	14.25	7.95	27.30	26.20
	Control	11.25	7.95	19.23	13.43
	LSD(p<0.05)	2.32	NS	6.65	6.34
NGB01293	*T. diversifolia*	15.20	6.04	23.6	28.23
	C. odorata	15.21	6.92	18.5	25.37
	T. procumbens	14.53	5.27	22.5	23.20
	Control	13.87	5.55	21.4	15.50
	LSD(p<0.05)	2.95	1.46	7.84	6.24
NGB00157	*T. diversifolia*	15.20	5.61	28.03	33.80
	C. odorata	14.10	6.17	29.40	28.47
	T. procumbens	14.70	4.54	28.73	22.93
	Control	11.31	4.55	24.77	14.23
	LSD(p<0.05)	2.95	1.24	5.16	5.39
NGB01294	*T. diversifolia*	15.90	5.15	25.3	26.53
	C. odorata	14.37	4.92	23.8	25.33
	T. procumbens	14.89	4.45	22.9	24.84
	Control	11.23	3.69	22.3	11.20
	LSD (p<0.05)	2.14	1.16	10.54	6.61

Values on the same column are significantly different LSD (p<0.05)
PH = Plant Height, 4W-TLA = 4Wks Total Leaf Area, WFH = Weight of Fresh Haulm 100 W = 100 seeds Weight

of Cercospora leaf spot severity of accessions ICIAR-19BT and NGB01293, a feature characterized by absence of visible symptoms of on the crop. On accessions NGB00157 and NGB01294, severity of Cercospora leaf spot was "low infection" at both 9 and 11 WAP. Groundnut accessions ICIAR-19BT exhibited "low infection" rating due to *T. diversifolia* foliar spray at both 9 and 11 WAP. *Tithonia diversifolia* sprayed completely protected the crop (NGB01293 and NGB01294) against Cercospora leaf spot infection at 11 WAP. Extract *C. odorata* also enhanced low infection of groundnut accessions at 11 WAP. This is characterized by 1-25% infection of total leaf area by lesions of Cercospora leaf spot. Conversely, unsprayed crops exhibited "Severe" (On ICIAR-19BT) and Very severe disease rating on (NGB01293, NGB00157 and NGB01294). Very severe infection rating is characterized by 76-100% infection of foliage as well as 50% defoliation (Table 5)

Effect of plant extract on Cercospora leaf spot and the agronomic performances of four accessions of groundnut

Table 6 shows that aqueous extract of *T. diversifolia* influenced the plant height in all the groundnut accessions, followed by *C. odorata* and *T. procumbens* which are comparable (p<0.05) on the same column. The unsprayed crops recorded low plant height. Total leaf area there was noticeable differences in accessions NGB01293, NGB00157 and NGB01294 sprayed with the aqueous extracts. ICIAR-19BT showed no significant (p<0.05) different with respect to total leaf area. Similarly, *T. diversifolia* was superior on fresh haulm weight in accessions ICIAR-19BT, NGB01293 and NGB01294 which was followed by *C. odorata* and *T. procumbens.* Accession NGB00157 sprayed with *C. odorata* impacted fresh haulm weight, while *T. diversifolia* and *T. procumbens* are comparable statistically. Similar trend was observed with weight of hundred seed, *T. diversifolia* was superior in NGB01293, NGB00157and NGB01294, while *C. odorata* recorded high weight of hundred seed compared to *T. diversifolia* and *T. procumbens.* Conversely, weights of hundred seed recorded from the unsprayed groundnut accessions were low.

DISCUSSION

This progression of the disease with time could be attributed to 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 Tunwari and Nahunnaro (2014) concept of infection sequence i.e. infections, sporulation and dispersal of pathogen. The differences observed among groundnut accessions with respect to disease severity might be due to inherent genetical differences among accessions to resist pathogens. The result is conformity to Izge *et al.* (2007) who reported variability existing among crop varieties in all characters and ascribed it to the differences inherent level of resistance to attack by the pathogens. Yield and yield quality is one of the most important traits in crop production as it is directly proportional to income generated. Hence, maximization of yield and yield quality must be given considerable consideration. Differences in haulm yield among groundnut accessions may not be unconnected to the level of damage done to the foliage by the pathogens. The lowest haulm yield could be associated with the higher disease pressure, leading to leaf destruction and defoliation. The result agrees with Smith (1984) who had reported low haulm yield and related it to high infection by Cercospora leaf spot. Furthermore, the result corroborates with Pattee and Young (1982) also reported that *C. personatum* produced cellulolytic and pectolytic enzymes that altered the starch, sugar and amino acid content of leaf tissue, resulting in reduced leaf efficiency and premature abscission. Harrison (1969) had also reported severe attack of the disease resulting in heavy defoliations of groundnut leaves. The significant differences showed by accessions with regards 100 seed weight maybe attributed to the high level of leaf spot disease incidence recorded during the experimentation. Leaf spot interferes with the photosynthetic processes by reducing total leaf area exposed to solar radiation invariably reducing the amount of assimilation and hence reduced seed weight. The results obtained concord with Thomas *et al.* (1996) who had reported that severe foliar infection during grain filling reduces grain weight.

The fungicidal effect of the plant extracts would be attributed to the presence of antimicrobial and antifungal substances. The three plant extracts used drastically suppressed the incidence and severity of Cersospora leaf spot diseases compared to untreated control. Among the plant extracts tested *C. odorata* gave an outstanding perfomance, followed by *T. procumbens* and *T. diversifolia*. Botanicals have found to be effective against leaf spot disease of groundnut Aage *et al*. (2003). Extracts/purified compounds from the plants were found to have a broad spectrum antifungal activity (Grayer and Harborne, 1994). The presence of anti-fungal compounds in higher plants had been recognized long ago, as an important factor to disease management as reported by Mahaddvean (1982). The fungicidal effects of plant extracts on different pathogens of crop plants have been widely reported (Amadioha and Obi 1999; Okigbo and Ogbonnaya, 2006; Olufolaji, 1999 and Onifade, 2002). However, the differences in the efficacy of the extracts would be attributed to the differences in the nature of their active ingredients (Onifade, 2002; Okigbo *et al*., 2009). Major compounds of plant extracts are phenols, flavonoids, alkaloids, quinones, saponines, tannins and sterols (Halama and Van Haluwin, 2004) and their fungicidal or fungistatic properties against various plant pathogens have been established (Scheuerella and Mahaffee, 2002). These products may either have direct inhibitory effects on pathogens, exhibiting fungicidal or fungistatic properties or they can help in establishment of favorable conditions for antagonistic microbes (Scheuerella and Mahaffee, 2002).

Conclusion

This study revealed Cercospora leaf spot incidence and severity was high in accessions ICIAR-19BT and NGB01293 whilst moderate in NGB00157and NGB01294. The use of *T. diversifolia*, *C. odorata* and *T. procumbens* suppressed Cercospora leaf spot incidence and severity under field conditions. There is no doubt about the potential of these natural plant products in fungal diseases control of groundnut. *T. diversifolia C. odorata* and *T. procumbens,* should be used as a potential biocide in plant disease management, as they showed fungicidal and fungitoxic ability. However, a higher concentration and at least three regime sprays should be used for better effects. The need to further investigate the active ingredients of these plant extracts using different parts cannot be overstated.

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