



Incidence and Severity of Cercospora Leaf Spot of Groundnut (*Arachis hypogaea* L.) in Mokwa Southern Guinea Savanna Ecological Zone of Nigeria

Paiko A.S.¹, Sanusi M.S.², Bello L.Y.³, Wada A.C.^{3,4*}, Umar Alhassan¹, Emmanuel Kolo¹, Korokoa H.N.Z.¹, Rabba M.L.² and Kasim A.⁵

¹Department of Pest Management Tech., ²Department of Crop Production, ³Department of Pre-ND Science, Niger State College of Agric., PMB, 109, Mokwa, Nigeria

³Department of Crop Production, School of Agriculture and Agricultural Tech. Federal University of Technology, Minna, Nigeria

⁴National Cereals Research Institute, Badeggi, Nigeria

*Corresponding Author E-mail: drwada2013@gmail.com

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ABSTRACT

Yield reduction in groundnut has been attributed to many factors including Cercospora leaf spots disease. The present investigation was to assess disease incidence and severity of Cercospora leaf spot (CLS) of groundnut (*Arachis hypogaea* L.) in Mokwa Southern Guinea Savanna Agro Ecological Zone. Twenty farms in four villages were sampled for CLS in 2017 cropping season. The results revealed wide spread of the pathogens in all the farms, pointing to the challenges farmers face due to the effect of this pathogen in their groundnut farms. Resistant varieties to leaf spots may be cultivated or disseminated to areas with the high levels of Cercospora. They can also be used in groundnut breeding programmes for further improvement for use by farmers in the area.

Keywords: Breeding programmes, Groundnut farms, Leaf spots disease pathogens, Resistant varieties, Yield reduction.

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is an important food and forage crop because of its high protein and oil contents. Its seed is used as a source of cooking oil and in confectionary products for human consumption (Naab et al., 2005, Nutsugah et al., 2007). Groundnut hay or vine is a nutritious animal feed, particularly

for the subsequent dry season when green forage is not available. In addition, groundnut seed and hay are often sold in local markets, providing income to the resource-poor farmers (Naab et al., 2005, Nutsugah et al., 2007). Pod yield of groundnut crops in Nigeria averages only 850 kg/ha which is low compared to the 2500 kg/ha reported in developed countries.

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Patko et al. (2010) reported that low crop yields in some parts of Africa are attributed to foliar diseases (Alabi et al., 1993). Early leaf spot caused by *Cercospora arachidicola* Hori and late leaf spot caused by *Cercosporidium personatum* (Berk. & Curt) Deighton, are among the major diseases of groundnut worldwide, including Africa (Subrahmanyam et al., 1982, Subrahmanyam & Smith, 1989).

Leaf spot symptoms can appear on any above ground parts of groundnut plant including leaves, petioles, stipules, stems and pegs in the later stages of disease (Subrahmanyam et al., 1982, Subrahmanyam & Smith, 1989). As reported by Tshilenge (2010), the spots first develop on the upper surface of lower leaves as small necrotic pinhead size spots which enlarge and become light to dark brown or black circular spots ranging from 1 to 10 mm in diameter. At later stages these spots coalesce and result in defoliation, causing significant losses in biomass and yield. Early leaf spots are brown to reddish brown in color and always have a yellow halo. Most of the early leaf spot spores are formed on the upper leaf surface giving it a slightly raised surface, while lower leaf surface is usually smooth. Late leaf spots are characterized by dark brown to black spots and usually do not have yellow halo. Most of the late leaf spot spores are formed on the lower surface giving it a rough and tufted appearance, where as upper leaf surface is generally smooth. Leaf spot can cause yield losses of 50% - 70% in West Africa and up to 50% worldwide (Waliyar, 1990).

Butler (1990) reported that leaf spot can increase rapidly under favourable conditions as several secondary cycles may occur per season. The first appearance of leaf spot and its continuous progress throughout the growing season are heavily dependent upon weather conditions. Environmental conditions required for both types of leaf spot are warm temperatures and long periods of high humidity or leaf wetness. When adequate moisture is present, leaf spot infections may occur in a relatively short period when

Worldwide losses as high as 50% of the seed yield and even higher for haulms, due to *Cercospora arachidicola* and *Cercospora personata* have been reported (Salako, 1987, Nyval, 1989, Dewaele & Swanevelder, 2001).

Control of leaf spot diseases in Nigeria has depended on some cultural practices and on multiple applications of fungicides. Effective and long-term control of leaf spot disease can be achieved by applying recommended fungicides at the recommended time intervals. Combination of several control strategies is recommended (Kucharek, 2004). In Nigeria, *Cercospora* leaf spot is a major constraint to the production of groundnut (Alabi et al., 1993). However, no information exists on the incidence and distribution of the disease, and its associated causal agent in Mokwa. The objective of the present day study was to investigate disease incidence and severity of leaf spot pathogens among groundnut farms in Mokwa Local Government Area in Guinea Savanna Agro ecological Zone of Nigeria.

MATERIALS AND METHODS

Experimental site

The trial was conducted from four districts of Mokwa Local Government. Geographically, Mokwa is located on latitude 09°18'N and longitude 05° 04' E of the equator. It is situated on the southern Guinea savanna agro-ecological zone of Nigeria.

Sample collection

Twenty groundnut fields from four villages in Mokwa Local Government namely Mokwa, Raba, Muwo, and Jagi were sampled. A chosen portion of the field was selected based on the existence of disease symptoms observed. Thereafter, two replicates of the diseased crops were chosen at random and the number of diseased leaves on each plant was manually counted and recorded as R1 and R2 respectively. A total of 40 samples were collected and diseased leaves from each crop were counted and percentage distribution determined using the following formula:

$$\text{Disease incidence (\%)} = \frac{\text{Number of diseased plant leaves} \times 100}{\text{Total plant leaves sampled}}$$

Experimental design

The experimental design used was Randomized Complete Block Design (RCBD) with three replicates.

Preparation of medium for culture

The medium used for culturing was prepared according to the instructions of the manufacturers. All glass wares used were first sterilized in the autoclave before using for culturing. After preparation, the medium was sterilized in an autoclave at a temperature of 121°C for 15 minutes and allowed to cool before use.

Diagnostic techniques

The method used in isolating the fungi from the diseased leaves was as described by Donald (2008).

Small infected areas or margins of large ones were cut out and placed in 10% chlorox for different durations. Sterile forceps were used to rinse the tissue sections in distilled water and bottled on sterile filter paper. The tissue pieces were placed on separate petri dishes containing melted but cooled Potato Dextrose Agar (PDA) and were sealed with PCV tapes to avoid contamination.

Observation of mycelia growth

Single colonies appeared on all the plates after two days. The single colonies were sub-cultured after three days and the properties of the fungi were compared to those reported by Szentivanyi et al. (2006).

Statistical Analysis

All data obtained were subjected to analysis of variance (ANOVA) using Statistical Analysis System (SAS) to verify if there were significant differences among the diseases samples from the surveyed fields at 5 % level of Probability.

RESULTS AND DISCUSSION

Assessment of the disease severity of leaf spot disease

A thorough survey to document the disease incidence and severity was conducted in major

groundnut growing areas of Rabba, Jagi, Mokwa and Muwo villages of Mokwa LGA. The details of the locations and number of fields sampled are presented in Table 1.

In Jagi village, the disease severity observed was between 2.6 to 8.8. The mean maximum disease incidence of 91.9% was observed in Jagi 5farm, followed by Jagi farm 1 with 82.21% and the least incidence was observed in Jagi farm 3 with 80.91%.

In Rabba district, the disease severity was observed in all the surveyed areas and ranged from 3.8 to 7.6. The mean maximum disease incidence of 96.7% was recorded in Rabba 4 followed by Rabba 3 with 92%, while the least was observed in Rabba 1 with 64.7%. Bokani district recorded disease severity that ranged from 4.24 to 8.4. The mean maximum disease incidence of 95.39% was observed in farm 1 and the least disease incidence was in farm 5 with 61.6%.

In Mokwa, the disease severity recorded ranged from 2.6 to 7.2. The mean maximum disease incidence of 99.6% was observed in Mokwa farm 2, followed by farm 4 with 98.2% and the least incidence was observed in farm 1 with 77.4% (Table 1).

Total fungal count collected from sampling locations.

Results presented in Fig.1 shows the total fungal count (TFC) of the different sample locations from Jagi village. At 48 hours, the mean TFC from Jagi ranged from 7.00×10^6 to 18.00×10^6 colony forming units (cfu) per gramme which represents Jagiat day 2. However, TFC observed in day 3 ranged from 37.00×10^6 cfu/g to 64.00×10^6 cfu/g and at Day 4, it ranged from 48.50×10^6 cfu/g to 69.50×10^6 cfu/g and at Day 5, it ranged from 47.00×10^6 cfu/g to 75.50×10^6 cfu/g respectively (Fig.1).

At 48 hours, the mean TFC from Rabba observed ranged from 5.00×10^6 to 29.740×10^6 colony forming unit (cfu) per grams, which represents Rabba Day two.

However, TFC observed in Day three ranged from 30.00×10^6 cfu/g to 64.00×10^6 cfu/g and at Day four ranged from 48.50×10^6 cfu/g to 6.50×10^6 cfu/g and at Day five ranged from 7.00×10^6 cfu/g to 77.50×10^6 cfu/g respectively (Fig. 3).

At 48 hours, the mean TFC from Bokani observed ranged from 12.00×10^6 to 32.740×10^6 colony forming unit (cfu) per gram, representing Bokani Day two. However, TFC observed in Day three ranged from 21.00×10^6 cfu/g to 40.00×10^6 cfu/g and at Day four was within the range 32.50×10^6 cfu/g to 62.50×10^6 cfu/g and at Day five ranged from 38.00×10^6 cfu/g to 70.50×10^6 cfu/g respectively (Fig. 3).

At 48 hours, the mean TFC from Mokwa observed ranged from 32.00×10^6 to 49.740×10^6 colony forming units (cfu) per gramme, representing Mokwa Day 2. However, TFC observed in Day 3 ranged from 33.00×10^6 cfu/g to 52.00×10^6 cfu/g and at Day 4 was within the range 40.50×10^6 cfu/g to 58.50×10^6 cfu/g and at Day 5 ranged from 47.00×10^6 cfu/g to 66.50×10^6 cfu/g respectively (Fig. 4).

However, the mean total fungal count TFC of all samples collected ranged from Day two, Day three, Day four, and Day five respectively. The highest count was observed in Day five of Jagi 4 with 69.50×10^6 cfu/g

fungal count and the lowest count was observed in Day two of Jagi 2 with 6.00×10^6 cfu/g as shown in Fig. 4.

The disease incidence and severity as documented from this study varied possibly because of cropping pattern, environmental conditions, and use of different varieties and build up of inoculum load. The higher disease severity may be attributed to heavy rainfall and high temperature which favoured the disease (Nandini et al., 2014). Further, negligence of the crop as it is a hardy crop and growing in marginal lands without proper management practices also aggravated the disease. It was observed during the survey that incidence of the disease was negligible up to July. This clearly shows that the disease intensity depended on factors like location, cultural practices followed by use of infected seeds of susceptible varieties, improper drainage and meteorological factors like temperature, relative humidity and rainfall.

In general, it was observed that disease incidence was maximum during July-August which coincides with heavy rains and cool weather. This corroborates report by Talley et al. (2002) and Velásquez et al. (2018) that spread and intensity of pathogenic fungal infections are aggravated by high rainfall and relative humidity as was observed in this study in the case of Cercospora leaf spot.

Table 1: Locations and number of fields sampled for Cercospora leaf spot in Mokwa LGA, Nigeria, 2017

Location	Latitude ($^{\circ}$)	Longitude ($^{\circ}$)	Incidence (%)	Severity
JAGI 1	9.1493708 N	4.8212959 E	82.21	8.8
JAGI 2	7.3897041 N	1.9280913 E	81.4	3.2
JAGI 3	4.9410944 N	4.6009817 E	80.91	7.4
JAGI 4	6.7400059 N	3.7988962 E	81.2	2.6
JAGI 5	4.9886740 N	5.0120012 E	91.91	6.8
RABBA 1	8.3533335 N	3.2062224 E	64.7	7.6
RABBA 2	9.2224254 N	8.3100329 E	91.5	1.8
RABBA 3	8.9146500 N	5.0331745 E	92	1.6
RABBA 4	8.3833705 N	9.2333667 E	96.7	7.4
RABBA 5	8.4000266 N	8.3100073 E	71.1	3.8
BOKANI 1	9.3331301 N	5.0391103 E	95.39	6.6
BOKANI 2	8.2855026 N	8.3833966 E	75	8.4
BOKANI 3	4.5566336 N	8.4165570 E	77.81	5.8
BOKANI 4	8.1167740 N	4.770037 E	74.80	1.4
BOKANI 5	5.0033317 N	8.1740077 E	61.6	5.8
MOKWA 1	8.1774592 N	6.2626603 E	77.44	1.2
MOKWA 2	4.8458971 N	3.9559146 E	99.6	8
MOKWA 3	9.6006322 N	4.3335365 E	97.8	5.2

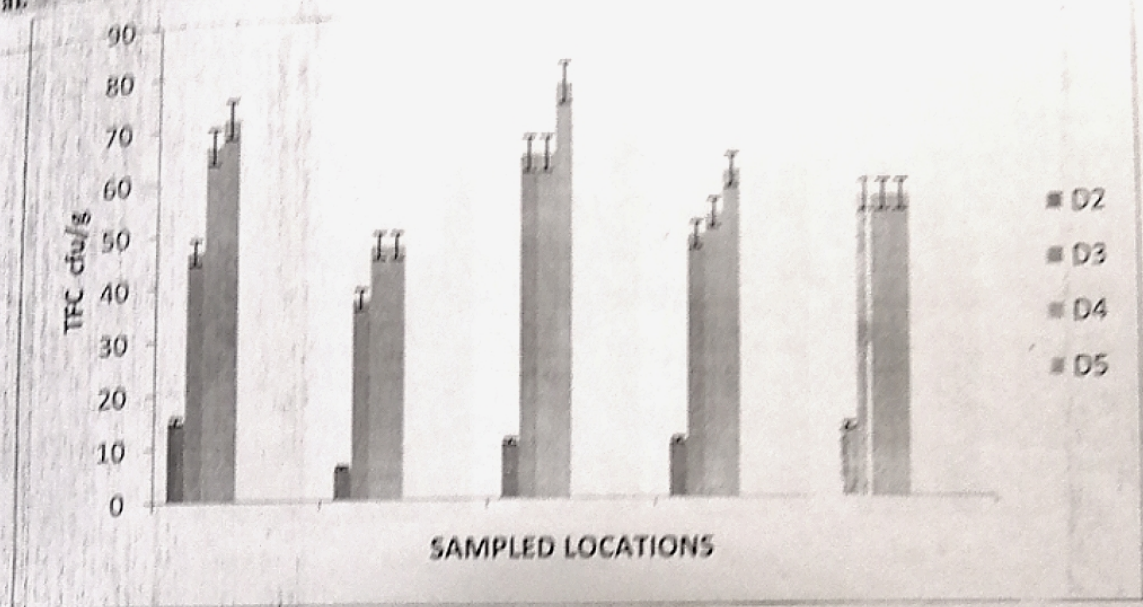


Fig. 1: Total fungal count from sampling locations in Jagi

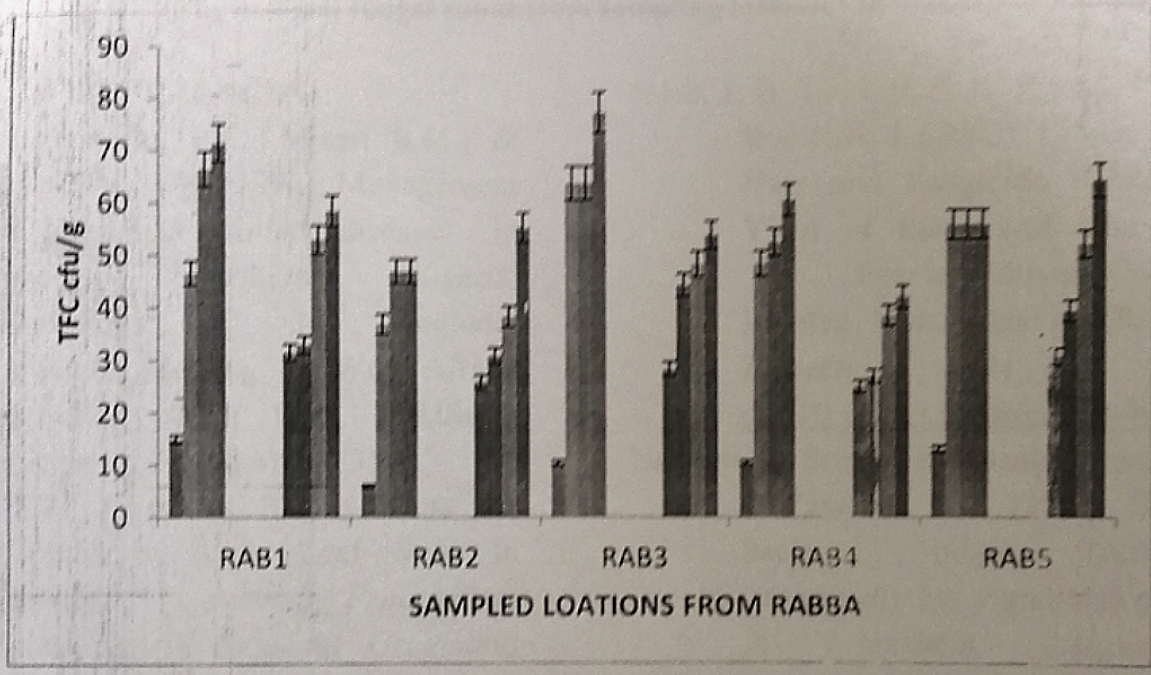
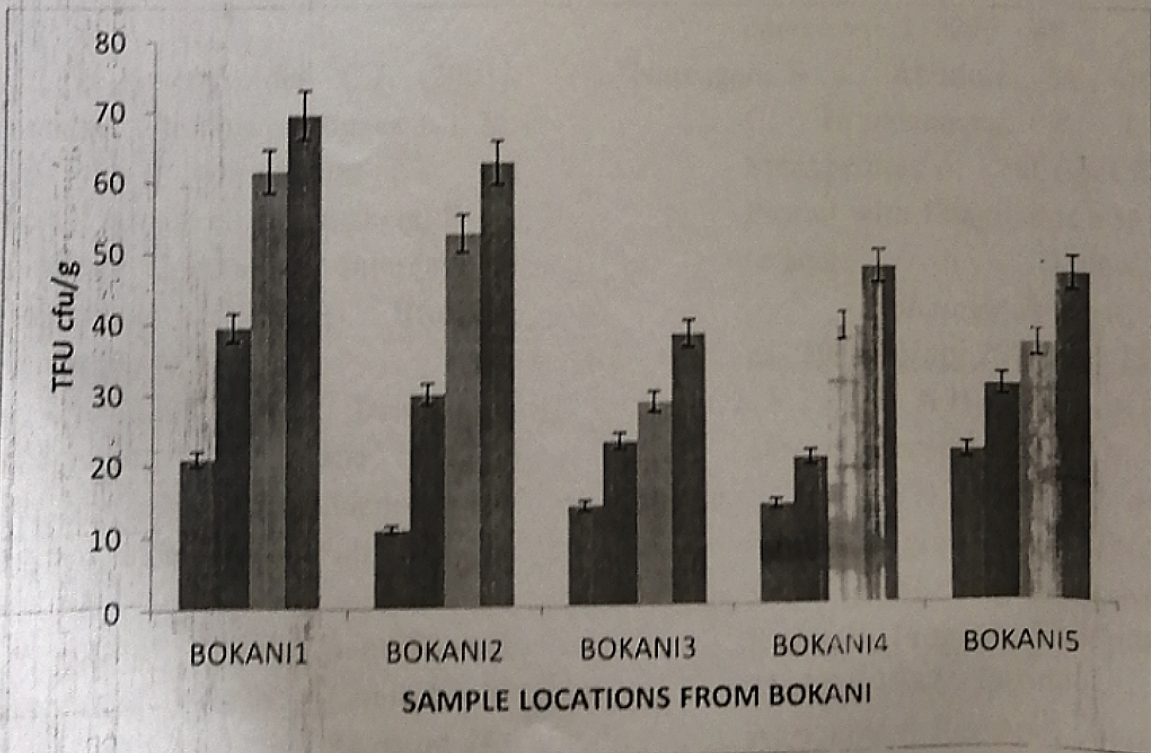


Fig. 2: Total fungal count from sampling locations in Rabba



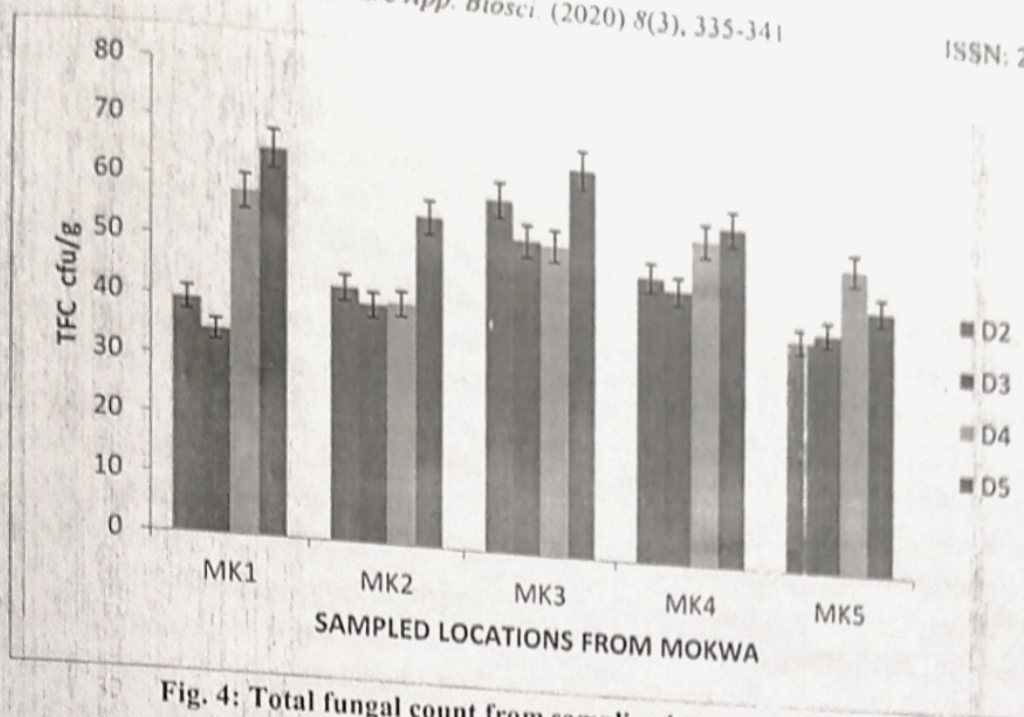


Fig. 4: Total fungal count from sampling locations in Mokwa

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