Influence of Variety and Sowing Dates on Incidence of *Cercospora* Leaf Spots Disease *of* Groundnut (*Arachis hypogaea* L.*)* in Makurdi, Benue State of Nigeria.

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ABSTRACT

Leaf spots disease of groundnut caused by *Cercospora* pathogens is one of the major economic production constraints militating against groundnut production in Nigeria. Field experiments were conducted during the 2011 and 2012 rany seasons at the Teaching and Research Farm of the Federal University of Agriculture, Makurdi Nigeria to assess the effect of sowing dates on the incidence of *Cercospora* leaf spot of groundnut. The 2 x 4 x 3 factorial (2 groundnut varieties/ 4 sowing dates/ 3 replications) experiment was laid out in a Randomized Complete Block Design (RCBD) and replicated three times. Results indicated no significant (P> 0.05) effect of *Cercoscora* leaf spot incidence on the two varieties in 2011 but in 2012 Ex-Dakar recorded significantly (P ≤ 0.05) higher leaf spot incidence at 54 DAS and 61 DAS compared to Borno-Red variety. Sowing groundnut seeds in from 14th June to 29th June recorded significantly higher (P ≤ 0.05) leaf spot disease incidence compared with sowing groundnut seeds in May. Ex-Dakar variety recorded higher leaf defoliation compared with Borno-Red variety in 2011 and 2012 seasons. Results indicated that Borno-Red had significantly (P ≤ 0. 05) higher 100 seed weight in 2011, while Ex-Dakar recorded higher 100 seed weight in 2012. The results has proved that early sowing of groundnut in May can be employed as alternative strategy for the management of *Cercospora* leaf spot disease of groundnut in Makurdi, Nigeria

Key word: Groundnut, disease incidence, sowing dates, leaf defoliation, leaf spot.

1. INTRODUCTION

Leaf spots disease is one of the major biotic production constraints of groundnut in Nigeria and other parts of the World particularly where the crop is not grown under any protection umbrella. *Cercospora arachidicola Hori* (Early leaf spot) and *Phaeoisariopsis personata (Berk & Curt)* (Late leaf spot) are the two main pathogenic fungal micro-organisms responsible for the disease. The destructive nature of the two diseases on groundnut crop has given it a significant recognition worldwide, including other parts of Africa [22]. The disease is prevalent in almost all groundnut growing areas of the world and

become endemic frequently ([16], [10]). Farmers in the developing countries have reported huge yield losses as a result of the negative impact of the disease attack on their crops. Infected soil, debris and shells are the three potential sources of leaf spots inoculaums. The pathogens usually remain overwinter in the soil and can infect almost every parts of the crop causing lesions on leaves, petioles, pegs, main stems and lateral branches [21]. The primary initial inoculum is responsible for the onset of the disease epidemic, while the rain-splash and wind-blown moist air helps in dispersing the secondary and tertiary spores to the adjacent susceptible plants. The environmental conditions and genetic make-up of the groundnut varieties plays a major role in the level of disease incidence and carry-over of the disease from seasons to season in different agro-ecological locations. In West Africa, about 50 to 70% yield loss have been reported [24] and because of the destructive nature of the disease, international attention has been given to the disease causal pathogens [12].

The used of unilateral chemicals for the management of the disease have been practiced in the developing countries since 1970s. Incidentally, these chemicals were associated with unwanted and unintended human and environmental consequences such as pesticides persistence, resistance, residual, pest resurgence and environmental pollution apart from their exorbitant cost and not readily available sometimes (Richard *et al*., [18]).

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The manipulation of sowing date is another very important disease management strategy that has to be put into consideration in any groundnut production; but because of variation in weather conditions in different locations it may not auger well to adopt a specific sowing date. [6], reported that sowing date influences vegetative and reproductive growth period and the availability of weather parameters. And when climatic conditions are not suitable for need of one of yield components, it would negatively affect the seed yield [4].

Therefore, the objective of this study was to assess the influence of sowing date~~s~~ on incidence of groundnut leaf spots disease in Makurdi, Benue State of Nigeria.

2. MATERIALS AND METHODS

The study was conducted at the Teaching and Research Farm of the Federal University of Agriculture Benue State, Nigeria ~~in~~ during the 2011 and 2012 cropping seasons. The location lies between the Latitude 7.41^{0}N and Longitude 8.35^{0}E; at an elevation of 95m above sea level located within the Southern Guinea Savanna of Nigeria [2]. The experimental field has been under intensive cultivation of groundnut crops for more than fifteen years which ensures availability of adequate natural source of disease inoculum. The site received total annual rainfall of 955.74mm and 1492.80mm in 2011 and 2012 respectively, and relative humidity of 69.45% and 72.83% in the first and second year respectively. It had maximum and minimum temperatures of 32.98^{0}C and 21.71^{0}C; 32.8^{0}C and 20.69^0 C in 2011 and 2012 respectively [9].

The experimental site was cleared and ~~rigged~~ ridged manually using cutlass and hoe. The total experimental area used measured 49m x 8m = 392m^2 (0.0392ha). The 2 x 4 x 3 factorial experiment (2 groundnut varieties / 4 sowing dates / 3 replications) was arranged in a Randomized Complete Block Design (RCBD). The two groundnut varieties (Borno Red and Ex-Dakar) and four different sowing dates (D1 = 15th May, D2 = 30th May, D3 = 14th June and D4 29th June) formed the 24 treatment combinations. The groundnut varieties were assigned in the main plots each measuring 15m x 2m (30m^2) whereas the four different sowing dates were

assigned in the sub-plots each measuring 3 x 2m (6m^2) with four ridges and replicated 3 times leaving 1m walking alley between the main plots and sub plots. Groundnut seeds were sown at a spacing of 20cm within rows and75cm between rows at the rate of 2 seeds per hole. The experimental plots were kept weed-free throughout the study period and no chemical was used.

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2.1 Data collection

2.1.1 Leaf spot incidence (%)

Disease incidence was assessed at 47, 54 and 61 DAS. The disease incidence was taken by counting the number of plants infected in the net plot and divided by the total number of plants per net plot and multiply by 100 using the disease incidence formula according to Turaki *et al.* [23].

$$Z = \frac{K}{Y} X\ 100$$

Where:

Z = Disease incidence (%)

K = Number of plant stands infected by the disease in the net – plot

Y = Number of plant stands infected and unifected by the disease in the net – plot

2.1.2 Leaf defoliation (%)

The leaf defoliation was assessed at 70, 80, 90 and100 DAS. Eight plants were selected at random, tagged in the net plot of each plot and scored for leaf defoliation using the leaf defoliation scale according to [20].

1	= No leaf fall
2	= less than 10% leaf fall
3	= 10 – 25% leaf fall
4	= 25 – 50% leaf fall
5	= More than 50% leaf fall

$$\text{Leaf defoliation} = \frac{\sum n \times 100}{N \times 5}$$

Where: $\sum n$ = summation of individual assessments

N = Total number of plants assessed

5 = Highest score of the defoliation scale.

2.1.3 One hundred seeds weight (g/plot)~~:~~

At 130 DAS of physiological maturity stage, all the groundnut stands in the net plot of each plot were carefully lifted up, the pods were picked, sun dry and shelled separately. One hundred seeds were randomly hand-picked from the net plot of each plot and weighed in gram using a sensitive electronic weighing scale model (Sartorius 6MBH Gottingen-Type Fabr-Nr.) in the Plant Pathology laboratory of the Department of Crop and Environmental Protection Department, University of Agriculture, Makurdi Benue State.

2.2 Data Analysis

Data collected were subjected to analysis of variance {ANOVA} using [19] version. Two-Way analysis of variance was used and means were separated using the Duncan's New Multiple Range {DNMRT} at 5%probability level [17].~~.~~

3. RESULTS

Results on incidence of leaf spots of groundnut as influenced by variety~~ies~~, sowing date and their interaction at 47, 54 and 61 DAS in 2011 and 2012 cropping seasons are presented in Table 1. In 2011, the effect variety~~ies~~ on incidence of leaf spots disease was~~ere~~ not significantly different ($P > 0.05$) from 47 to 61 DAS. However, in 2012, the effect of variety~~ies~~ on disease incidence was~~ere~~ significantly higher ($P \leq 0.05$) at 54 and 61 DAS but was not significant at 47 DAS. In 2011 and 2012, sowing date significantly influenced disease incidence at 47, 54 and 61 DAS. The interaction between variety~~ies~~ and sowing date

on disease incidence wasere not significantly different at 47 DAS and 61 DAS in 2011 and from at 47 to and 61 DAS in 2012, but was significant at 54 DAS in 2011.

In 2011, results show that groundnut sown between Early and 29th June had higher leaf spot incidence while the lowest leaf spot incidence of 14.51% was recorded from those groundnut plants sown in 15th May followed by those sown on 30th May which had disease incidence of 22.18% at 47 DAS. Similarly at 54 DAS, higher disease incidence values of 44.45% and 50.29% wereas recorded from those groundnut plants sown in 14th June and 29th June respectively. Those groundnuts sown in 15th May and 30th May had lower leaf spot disease spot incidence of 38.76% and 36.79% respectively at 54 DAS. Groundnut sown in 30th May, Early and 29th June had significantly higher leaf spot disease incidence of 64.69%, 68.43% and 67.80% respectively at 61 DAS. In 2012, among the varieties, Ex-Dakar recorded significantly (P<0.05) higher leaf spot incidence of 59.41% and 69.51% at 54 and 61 DAS respectively compared to Borno Red. In 2012, results indicated that those groundnut plants sown in 29th June recorded significantly higher

Table 1: Effect of Varieties, Sowing Dates and their Interaction on Incidence of Leaf Spot of Groundnut at 47, 54 and 61 DAS in 2011 and 2012 Cropping Seasons

Variety/Sowing Dates/Interactions	2011 Cropping Season			2012 Cropping Season		
	47 DAS	54 DAS	61 DAS	47 DAS	54 DAS	61 DAS
Variety (V)						
Borno Red	25.16±2.30	41.56±2.73	61.14±1.91	20.57±2.45	44.04±2.50^{b}	59.96±3.11^{b}
Ex-Dakar	24.06±2.42	43.58±2.01	66.91±2.42	24.88±2.07	59.41±1.91^{a}	69.51±1.99^{a}
P-value	*0.74NS*	*0.55NS*	*0.07NS*	*0.19NS*	*≤0.05*	*≤0.05*
CV	*33.20*	*19.50*	*11.90*	*34.60*	*14.90*	*14.00*
Sowing Dates (S)						
15th May	14.51±1.48^{c}	38.76±3.34^{b}	55.18±1.98^{b}	15.06±1.26^{c}	43.98±4.39^{b}	51.77±4.27^{b}
30th May	22.18±1.79^{b}	36.79±1.40^{b}	64.69±3.57^{a}	18.45±2.01^{c}	46.37±4.19^{b}	67.77±2.15^{a}
14th June	29.16±1.78^{a}	44.45±3.38^{ab}	67.80±2.54^{a}	25.44±2.75^{b}	57.92±3.14^{a}	69.02±2.17^{a}
29th June	32.58±1.53^{a}	50.29±2.16^{a}	68.43±1.70^{a}	31.94±1.42^{a}	58.63±3.04^{a}	70.39±2.27^{a}
P-value	*≤0.05*	*≤0.05*	*≤0.05*	*≤0.05*	*≤0.05*	*≤0.05*
CV	*16.40*	*15.50*	*9.80*	*21.00*	*17.70*	*10.80*
Interactions (VX S)						
Borno Red						

15th May	17.63	32.20[b]	54.00	13.00	34.52	44.23
30th May	20.71	36.10[b]	60.60	14.37	37.75	63.67
14th June	27.56	49.70[ab]	65.00	24.31	51.30	65.50
29th June	34.74	48.20[ab]	65.00	30.59	52.59	66.45
Ex-Dakar						
15th May	11.40	39.20[b]	56.40	17.11	53.45	59.31
30th May	23.65	37.50[b]	68.80	22.52	54.99	71.86
14th June	30.76	45.30[ab]	70.60	26.58	64.53	72.54
29th June	30.42	52.40[a]	71.90	30.59	64.68	74.33
P-value	*0.08NS*	*≤0.05*	*0.84NS*	*0.65NS*	*0.34NS*	*0.46NS*
CV	*14.80*	*12.00*	*9.20*	*19.40*	*7.10*	*7.40*

Mean values within each column followed by the same letter (s) are not significantly different ($P \leq 0.05$) from each other according to Duncan's New Multiple Rang Test (DNMRT). CV = coefficient of variation, Ns = Not significant

disease incidence of 31.94%, followed by those sown in Early June which had 25.44% disease incidence, while those groundnut plants sown in 15th May and 30th May recorded lower disease incidence of 15.06% and 18.45% respectively at 47 DAS. Results at 54 DAS revealed that higher disease incidence of 57.9%2 and 58.63% were recorded on those groundnut plants sown in 29th June and 14th June respectively, while those sown on 15th May and 30th May recorded lower leaf spot incidence of 43.98% and 46.37% which was not significantly ($P > 0.05$) different. Similarly at 61 DAS higher disease incidence of 70.39%, 69.02% and 67.77% were recorded on those groundnut plants sown in 29th June, 14th June and 30th May respectively, while those sown in 15th May had the lowest leaf spot incidence of 51.77%. The results of interaction between varieties and sowing date on disease incidence at 54 DAS revealed that disease incidence of 52.40% was recorded from Ex-Dakar sown in 29th June which was not significantly different from disease incidence of same variety sown in 14th June, Borno Red sown in 14th June and 29th June respectively. The interaction between varieties and sowing dates resulted in lower disease incidence in both Borno Red and Ex-Dakar varieties sown in 15th May and 30th May at 54 DAS. The interaction of variety and sowing dates was not significant at 47 DAS and 61 DAS in 2011 and throughout the period of 2012 season.

Results on leaf defoliation of groundnut as influenced by varietyies, sowing date and their interaction at 70, 80, 90 and 100 DAS in 2011 cropping season are presented in Table 2.

The effect of varietyies on leaf defoliation was significantly different ($P \leq 0.05$) at 70, 80, 90 and 100 DAS. The effect of sowing date on leaf defoliation waswere significantly different from 80 to 100 DAS The effect of interaction between varietyies and sowing date on leaf defoliation was not significantly different ($P \leq 0.05$) at 70 DAS but waswere significant at 80, 90 and 100 DAS. Ex-Dakar recorded significantly higher leaf defoliation 19.10%, 39.94%, 64.0?% and 80 38% compared with Borno Red had lower leaf defoliation of 14.94%, 33.14%, 54.34% and 75.56% at 70, 80, 90 and 100 DAS respectively. Result revealed that at 80 DAS, higher leaf defoliation of 39.45%, 37.87?% and 34.89% were recorded on those groundnut plants sown on 29th June, 14th June and 15th May accordingly compared to those groundnut plants sown in 30th May. At 90 DAS, the leaf defoliation trend was similar to those of 80 DAS. Those groundnut plants sown in 14th June and 29th June recorded higher leaf defoliation of 80.792% and 82.82% respectively compared to those groundnut plants sown in Midmid and 30th May at 100 DAS. Sowing groundnut in June resulted in significantly higher leaf defoliation compared with sowing groundnut in May.

Table 2: Effect of Varietyies, Sowing Dates and their Interaction on Leaf Defoliation of Groundnut at 70, 80, 90 and 100 DAS atDuring the 2011 Cropping Season

Variety/Sowing Dates/Interactions	70 DAS	80 DAS	90 DAS	100 DAS
Variety(V)				
Borno Red	14.94±0.42^{b}	33.14±0.82^{b}	54.34±1.20^{b}	75.56±1.36^{b}
Ex-Dakar	19.10±0.16^{a}	39.94±1.02^{a}	64.00±1.52^{a}	80.38±1.68^{a}
P-value	*≤0.05*	*≤0.05*	*≤0.05*	*0.03*
CV	*9.90*	*8.80*	*8.00*	*6.80*
Sowing Dates (S)				
15th May	17.26±0.94	34.89±1.87^{ab}	56.37±2.60^{ab}	74.95±2.02^{b}
30th May	15.57±1.06	33.96±1.70^{b}	55.13±2.13^{b}	73.33±1.97^{b}
14th June	17.33±1.23	37.87±1.77^{ab}	61.98±2.64^{ab}	80.79±1.69^{a}
29th June	18.06±1.20	39.45±1.82^{a}	63.19±2.70^{a}	82.82±1.39^{a}
P-value	*0.46NS*	*0.04*	*0.04*	*≤0.05*
CV	*16.00*	*12.00*	*10.50*	*5.60*

Interactions (V X S)				
Borno Red				
15th May	15.72	31.25	51.40	72.74
30th May	13.66	30.98	51.47	71.44
14th June	14.70	34.26	56.27	78.13
29th June	15.71	36.10	58.20	79.93
Ex-Dakar				
15th May	18.80	38.53	61.35	77.16
30th May	17.47	36.94	58.80	75.21
14th June	19.96	41.47	67.69	83.44
29th June	20.41	42.80	68.17	85.72
P-value	*0.63NS*	*0.96NS*	*0.78NS*	*0.96NS*
CV	*9.10*	*7.10*	*5.90*	*5.00*

Mean values within each column followed by the same letter (s) are not significantly different ($P \leq 0.05$) from each other according to Duncan's New Multiple Rang Test (DNMRT). CV = coefficient of variation, Ns = Not significant

Results on effect of variety~~ies~~, sowing date and their interaction on leaf defoliation at 70, 80, 90 and 100 DAS in 2012 cropping season are presented in Table 3. The effect of variety~~ies~~ on leaf defoliation was significant~~ly different~~ ($P \leq 0.05$) at 80 and 90 DAS but was not at 70 and 100 DAS. The effect of sowing dates on leaf defoliation was significant~~ly different~~ at 70, 90 and 100 DAS but was not at 80 DAS. The interactive effect of sowing dates and varieties on leaf defoliation was not significant ($P > 0.05$) ~~different~~ from 70 to 100 DAS

Results indicated that ~~variety~~ Ex-Dakar recorded significantly higher leaf defoliation of 39.61% and 66.13% compared to Borno Red which had the lower leaf defoliation of 32.44% and 56.88% at 80 DAS and 90 DAS respectively. Those groundnut plants sown in 29th June, 14th June and 15th May recorded higher leaf defoliation of 19.07%, 18.31% and 17.54% respectively while those groundnut plants sown in 30th May recorded the lowest leaf defoliation of 16.35% at 70 DAS.. Results showed that at 90 DAS those groundnut plants sown on 15th May, 14th June and 29th June recorded higher leaf defoliation of 59.75~~2~~% 64.72% and 64.74% respectively compared with leaf defoliation of those groundnut plants sown on 30th May.~~.~~ Similarly, at 100 DAS, higher leaf defoliation of 86.37% and 83.58% which did not differ significantly from each other was recorded from those groundnut plants sown in 29th June and 14th June respectively.

Result indicated that those groundnut plants sown in 15th May and 30th May recorded lower leaf defoliation of 77.41% and 78.72% respectively.

Table 3: Effect of Varietyies, Sowing Dates and their Interaction on Leaf Defoliation of Groundnut at 70, 80, 90 and 100 DAS at During the 2012 Cropping Season

Variety/Sowing Dates/Interactions	70 DAS	80 DAS	90 DAS	100 DAS
Varietyies (V)				
Borno Red	17.52±0.54	32.44±1.22^{b}	56.88±0.90^{b}	80.98±1.46
Ex-Dakar	18.11±0.64	39.61±0.55^{a}	66.13±1.25^{a}	82.06±1.19
P-value	*0.49NS*	*≤0.01*	*≤0..01*	*0.57NS*
CV	*11.60*	*9.10*	*6.20*	*5.70*
Sowing Dates (S)				
15th May	17.54±0.94^{ab}	33.74±2.01	59.75±1.91^{ab}	77.41±1.31^{b}
30th May	16.35±0.58^{b}	34.17±2.43	56.82±1.82^{b}	78.72±1.53^{b}
14th June	18.31±0.61^{ab}	36.94±1.70	64.72±2.60^{a}	83.58±0.92^{a}
29th June	19.07±0.89^{a}	39.26±1.16	64.74±2.18^{a}	86.37±0.57^{a}
P-value	*0.04*	*0.16NS*	*0.04*	*≤0.01*
CV	*10.70*	*12.80*	*8.60*	*3.40*
Interactions (V X S)				
Borno Red				
15th May	17.51	29.62	55.58	74.80
30th May	16.41	29.19	52.99	78.30
14th June	18.37	33.78	58.96	84.93
29th June	17.81	37.19	60.01	85.89
Ex-Dakar				
15th May	17.59	37.87	63.92	80.01
30th May	16.29	39.15	60.65	79.13
14th June	18.25	40.10	70.48	82.23
29th June	20.33	41.33	69.48	86.86
P-value	*0.60NS*	*0.21NS*	*0.10NS*	*0.10NS*
CV	*11.10*	*6.60*	*2.20*	*3.10*

Mean values within each column followed by the same letter (s) are not significantly different ($P \leq 0.05$) from each other according to Duncan's New Multiple Rang Test (DNMRT). CV = coefficient of variation, Ns = Not significant

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Results on effect of varietyies, sowing date and their interaction on 100 seed weight (g) in 2011 and 2012 cropping seasons are presented in Table 4.

The effect of varietyies on 100 seed weight (g) was significantly different in 2011 and 2012. The effect of sowing dates, interaction between the varieties and sowing dates on 100 seeds weight waseare not significantly different (P>0.05) in 2011 and 2012. Results of 2011 shows that Borno Red recorded significantly the highest 100 seed weight of 40.95g compared with Ex-Dakar which had 39.59g, but on contrary, Ex-Dakar recorded significantly the highest 100 seed weight of 39.63g compared to Borno Red which recorded 35.64g in 2012.

Table 4: Effect of Varieties, Sowing Dates and their Interaction on 100 Seed Weight (g) in 2011 and 2012 Cropping Seasons

Variety/Sowing Dates/Interactions	2011 100 Seed Wt (g) 2011	100 Seed Wt (g) 2012 100 Seed Wt (g)2012
Variety (V)		
Borno Red	40.95±0.26[a]	35.64±1.23[b]
Ex-Dakar	39.59±0.45[b]	39.63±0.46[a]
P-value	*≤0.01*	*≤0.01*
CV	*3.20*	*8.60*
Sowing Dates (S)		
15th May	39.84±0.72	39.37±1.03
30th May	40.60±0.64	37.40±1.70
14th June	40.31±0.63	37.07±1.64
29th June	40.33±0.45	36.70±1.83
P-value	*0.85NS*	*0.64NS*
CV	*3.80*	*10.30*
Interactions (V X S)		
Borno Red		
15th May	40.67s	37.97
30th May	41.55	34.77
14th June	41.29	35.10
29th June	40.31	34.71
Ex-Dakar		
15th May	39.02	40.77
30th May	39.66	40.03
14th June	39.33	39.05
29th June	40.35	38.68
P-value	*0.57NS*	*0.94NS*
CV	*3.40*	

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Mean values within each column followed by the same letter (s) are not significantly different (P ≤ 0.05) from each other according to Duncan's New Multiple Rang Test

(DNMRT). CV = coefficient of variation, Ns = Not significant

4. DISCUSSION

Sowing date has a significant effect on plant growth and disease development in any agricultural production system. The performance of crop in relation to date of sowing would enable the researcher to validate recommendation of sowing date at that agro-ecological location (Azamali *et al.*[3])

The finding from this study indicates that early sowing significantly lowered leaf spot disease incidence compared with the late sown plants in the two cropping seasons. Ex-Dakar was more susceptible and exhibited significantly higher disease incidence compared to Borno Red at 54 and 61 DAS in 2012. 15th May sown plants had lower leaf spot incidence compared to 30th May sown crops which were moderate in their disease incidence, while the 29th June and 14th June sown crops recorded significant higher leaf spot incidence from 47 to 61 DAS in 2011 and 2012. Relatively groundnut sown in 15th May and 30th May had significantly lower leaf spot incidence in 2011 and 2012 compared with those sown in 14th June and 29th June of both years. Likewise, higher disease incidence was recorded on groundnut plants sown on 14th June and 29th June from 54 to 61 DAS in 2012 than in 2011 which could be attributed to higher annual rainfall (1,492.8mm) and favorable average relative humidity (72.85%) resulting to higher disease incidence in 2012 (Table 1). This result agrees with the finding of [7] which reported that leaf spots is generally more severe on late sown groundnut plants than the early sown plants due to warm temperature later in the season that are more favorable for the growth and spread of the leaf spot pathogens. Similarly, significantly higher percentage of leaf defoliation was observed on Ex-Dakar compared to local Borno-Red in the two cropping seasons. This may be due to the higher leaf spot disease incidence recorded ~~in~~on Ex-Dakar ~~plants~~ which could have resulted ~~in~~in

subsequent higher leaf defoliation. This result agrees with the report of [5] in which *Cercospora* leaf spots varied among the three groundnut varieties they studied. Also [5] reported a higher leaf spot disease incidence in Ex-Dakar compared with RMP 12 and Damboa local varieties. The higher leaf defoliation recorded on plants sown in June could have been attributed to ~~due delay~~ late sowing and intensive buildup of disease inoculum which led to higher disease incidence and consequently higher leaf defoliation. This observation is in agreement with the report of [7] which stated that groundnut plant sown late began leaf shading early because of early severe disease infection and attack on the tender leaves. Similarly, Adipala *et al.* [1] reported that late sown groundnut showed high disease incidence and pest infestation resulting in lower yield whereas Waliyar *et al.*[25] reported that high leaf losses of up to 25 - 43% could result in the disruption of the photosynthetic process, lesser pods and lower fruit quality.

The variation in seed weight recorded among the groundnut varieties in the two cropping seasons implies that seed weight is a genotypic trait and could be equally influenced by environmental factors which is in conformity with the report of ([14, 15, 13]). This result agreed with report of Gorbet *et al*. [11] that number of spots per leaf and leaf defoliation both have a negative correlation with yield whereas [8] revealed in their finding that *Cercospora* leaf spot disease reduced yield by every 1% increase in disease severity. The management of groundnut leaf spot through the manipulating of sowing date was very effective in reduction of disease incidence and leaf defoliation.

5. CONCLUSION

This study has shown that early sowing of groundnut in May could be another alternative fruitful option for the management of *Cercospora* leaf spot disease of groundnut in Makurdi considering its cost effectiveness on the part of the farmers and environmental friendliness in terms of biodiversity.

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