

Effects of Variety and Fungicidal Rate on *Cercospora* Leaf Spots Disease of Groundnut in the Sudan Savanna

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ABSTRACT: A field study was carried out at the University of Maiduguri Teaching and Research Farm during the 2006, 2007 and 2008 cropping seasons to evaluate the effects of variety and fungicidal rate on *Cercospora* leaf spot disease of groundnut. The experimental design used was Randomized Complete Block Design (RCBD) with twelve treatment combinations of three varieties of groundnut (Ex-Dakar, RRB and ICGV-86024) and four levels of fungicidal rate (0, 1, 2 and 4 kg/ha, of fungicide mancozeb) replicated three times. Disease incidence and disease severity were significantly higher in Ex-Dakar and 0 kg/ha, thus had lower yields. Higher seed and haulm yield were recorded by RRB, ICGV-86024, as well as 2 and 4 kg/ha, as a result of lower disease incidence and severity.

Keywords: Groundnut; *Cercospora* leaf spots; Variety; Fungicidal rate; Yield

INTRODUCTION

In Nigeria leaf spot and rosette virus are the most serious damaging diseases of groundnut (Alabi *et al.*, 1993). 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 and Swanevelter, 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). Reduction of initial inoculum is achieved through cultural measures such as crop rotation, removal of volunteer plants, and burial of groundnut residue (Shokes and Culbreath 1997). Spraying with fungicides is required to achieve optimal yields during most years (Bailey *et al.*, 1994). In addition, low to moderate resistance is present in some released cultivars and much effort has been directed at developing cultivars with high levels of leaf spot resistance.

This paper reports the results of an experiment to identify the ideal fungicidal rate and variety of groundnut that will record the lowest incidence

and severity of *Cercospora* leaf spot of groundnut in the Sudan savanna in North-Eastern Nigeria.

MATERIALS AND METHODS

The study was conducted at the Teaching and Research Farm of the Department of Crop Protection, Faculty of Agriculture, University of Maiduguri, (11°51'N; 13°15'E) Nigeria, during 2006, 2007 and 2008 cropping seasons. The soil type of the experimental site was sandy loam and has been classified as typic ustipsamment (Rayar, 1984). The area had been continuously cropped with groundnut for several years resulting in build up of disease inocula. Natural epiphytotic in field were therefore relied upon as the source of inocula in all the seasons. The treatments consisted of factorial combination of four fungicidal rates and three groundnut cultivars, making 12 treatment combinations. The fungicidal rates comprised 0, 1, 2 and 4 kg/ha, of mancozeb which is a wettable powder (WP) whereas the varieties of groundnut included Ex-Dakar, RRB and ICGV 86024. The treatments were laid out in a Randomized Complete Block Design (RCBD) and replicated three times. The layout consisted of three blocks each comprising twelve sub-plots measuring 5 x 4 m² (i.e. 20 m²) replicated three times giving a total of 36 plots. A space of one metre (1m) was left between the blocks and half-metre (0.5m) was left between plots. The total area of experimental plot was 50 x 13.m² (1075m²). The land was ploughed

mechanically by tractor followed by leveling with hoe before laying out of plots. The seeds were dressed with seed dressing chemical, Aldrex - T before sowing. Sowing was done manually by hoe using dibbling method. Two seeds per hole were sown. The fertilizer applied was NPK (15:15:15) at the rate of 360 kg/ha,¹ at sowing. Weeding was done manually by hoe and hand pulling at three weeks and six weeks after sowing. Fungicide application started 4 weeks after sowing and was applied fortnightly using knapsack sprayer according to the treatments. Ten plants were selected randomly in each plot for data collection. Parameters taken were disease incidence, severity, number of pods per stand, seed and haulm yield. Data on disease incidence was taken at 65 days after sowing and at harvest. The number of stands showing symptoms of the diseases in each plot was counted and the percentage of disease incidence was computed. Disease severity assessment was carried out using a scale of 1 to 9 (Subrahmanyam *et al.*, 1995). Ten plants were selected at random which were observed and scored. Based on the extent of disease on each, a scale number was assigned. The data collected were subjected to analysis of variance (ANOVA) based on randomized complete block design and the difference between means was determined using least significant difference (L.S.D) as described by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Disease Incidence and Severity: Only in 2007 variety significantly ($P<0.05$) influenced disease incidence at 65 days after sowing. Ex-Dakar recorded disease incidence that was significantly ($P<0.05$) higher than that recorded by RRB and ICGV-86024. The two varieties had statistically similar disease incidences (Table 1). With the exception of 2007, there was significant ($P<0.05$) difference in disease severity at 65 days after sowing among the three varieties in all the years and their combined analysis. In 2006 and combined analysis, Ex-Dakar had disease severity that was significantly ($P<0.05$) higher than that of the remaining two varieties, while in 2008, the disease severity recorded by Ex-Dakar and RRB was statistically similar and that of RRB and ICGV-86024 was also similar. This could be due to difference in host resistance to the disease. Waliyar *et al.* (1995) as well as Bailey (2002)

reported that commercial cultivars vary in their susceptibility to early leaf spots (ELS) and late leaf spots (LLS). Variation and reactions of groundnuts to *Cercospora* leaf spot disease were also reported by Knauff and Gorbet (1990). Izge *et al.* (2007) also reported a lot of variability existing among the groundnut varieties evaluated in all characters.

Fungicidal rate was found to significantly ($P<0.05$) affect disease incidence at 65 days after sowing in all the years and their combined analysis (Table 1). Result revealed that the untreated check consistently recorded the highest disease incidence, while 4 kg/ha,¹ on the other hand recorded the lowest, in all the trials and their combined analysis. In 2006, the untreated check and 1 kg/ha,¹ treatment recorded similar disease incidences, while 1 kg/ha,¹ and 2 kg/ha,¹ recorded similar disease incidences. Furthermore, the disease incidences recorded by 2 kg/ha,¹ and 4 kg/ha,¹ were also statistically similar. In 2007, 2008 and combined analysis, the trend of disease incidence as affected by application of mancozeb was observed to be similar. Application of 1 kg/ha,¹ resulted in significant reduction in disease incidence. Increasing the application rate to 2 kg/ha,¹ caused further significant reduction of the disease incidence. Further doubling of the application rate to 4 kg/ha,¹ caused further significant ($P<0.05$) reduction of the disease incidence except in 2008. The disease incidence was reduced by 42.25%, 32.58% and 17.84% as the result of respectively spraying mancozeb at the above application rates. The use of fungicide mancozeb (Dithane M54) for the control of plant diseases has been documented (Thapar *et al.*, 1995; Elad *et al.*, 1996) specifically for the control of *Cercospora* leaf spot in Nigeria (RMRDC, 2004). Fontem and Aighewi (1990) reported that in a trial to test the efficacy of fungicide on late blight of potato in the west province of Cameroon, fungicide sprays significantly reduced epidemic rates and areas under disease progress curves. Vawdrey *et al.* (2004) reported that disease assessment conducted 2 weeks before harvest showed that mancozeb applied at the rate of 100g a.i. ha,¹ was less effective than higher rates of 1760, 2000, or 2500g a.i.ha,¹ in controlling yellow Sigatoka disease of banana. On the other hand, Bergquist (1974) reported that there was no

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difference due to different rates of mancozeb applied to control Phytophthora leaf blight of Taro, in the lower rainfall location, but in the wetter location, 4.48 kgha,¹ rate gave better control than the 1.12 kgha,¹ rate. James *et al.* (2005) also reported that, in the field, chlorothalonil and mancozeb were the most efficacious of the fungicides tested in controlling anthracnose on three cultivars of *Euonymus fortunei*.

The severity of *Cercospora* leaf spots also varied among the three groundnut varieties at 65 days after sowing. Disease severity was significantly higher in variety Ex-Dakar than the other varieties, probably due its inherent susceptibility to attack by the pathogens than the other varieties. This result agrees with Izge *et al.* (2007) who in a study to determine the level of variability of groundnut to *Cercospora* leaf spot concluded that, the study found a lot of variability existing among the groundnut varieties evaluated in all characters, and that the varieties ICGV-SM-93531, ICGV-IS-96802, ICGV-IS-96827 and ICGV-IS-96808 have been found to be tolerant to *Cercospora* leaf spot disease based on their level of incidence and their respective kernel yield. Bdliya and Muhammad, (2006) also reported that severity of *Cercospora* leaf spot varied among the three groundnut varieties he studied and the disease severity was significantly higher in Ex-Dakar compared to RMP 12 and Damboa local. Other authors have also reported variation in severity of *Cercospora* leaf spots on different groundnut varieties (Hemingway, 1957; Subrahmanyam *et al.*, 1983).

The severity of *Cercospora* leaf spots varied among the fungicidal rates at 65 days after sowing. The lowest severity was recorded by 2 and 4 kgha,¹ rates, while the highest was recorded by the untreated check. This difference in disease severity among the rates of mancozeb application could be attributed to the difference in intrinsic toxicity of the three rates which is determined by the amount of active ingredient of the fungicide applied per unit area. Patel and Patel (1980) found that chlorothalonil and mancozeb provided satisfactory control of downy mildew on muskmelon.

Fungicidal rates 1 kgha,¹, 2 kgha,¹ and 4 kgha,¹ reduced the severity of *Cercospora* leaf spots at 65 days after sowing, by 16.84%, 31.02%, 32.83% respectively. The use of fungicide mancozeb (Dithane M54) for the control of plant diseases has been documented (Thapar *et al.*, 1995; Elad *et al.*, 1996) and specifically for the control of *Cercospora* leaf spot in Nigeria (RMRDC, 2004). There is dearth of literature on the effects of fungicide rate on plant diseases in Nigeria. Nevertheless, Vawdrey *et al.* (2004) reported that mancozeb applied at the rate of 1 kg a.i. ha,¹ was less effective than higher rates of 1.76, 2 or 2.5 kg a.i. ha,¹ in controlling yellow Sigatoka disease of Banana. On the other hand, Bergquist (1974) reported that there was no difference due to different rates of mancozeb applied to control Phytophthora leaf blight of Taro in the lower rainfall location, but in the wetter location, 4.48 kgha,¹ rate gave better control than 1.12 kgha,¹ rate. These earlier reports corroborate the results of this study.

Number of pods per stand: There was significant difference in number of pods per stand among the groundnut varieties only in 2006. Ex-Dakar recorded significantly the lowest number of pods compared to RRB and ICGV-86024 who had statistically similar number of pods per stand. Generally the lowest number of pods per stand was obtained in 2007 when compared to 2006 and 2008 (Table 2). This could be attributed to the disease tolerance of the variety Ex-Dakar, since the disease severity was more on the variety. This result confirmed the earlier report by Bdliya and Muhammad (2006), who reported that Ex-Dakar is a high-yielding cultivar which requires less rainfall and is more tolerant to the *Cercospora* leaf spot than RMP 12 and Kano 38. The reason for the three varieties having similar pod yield could be due to the fact that all of them are improved varieties developed to suit the agro-ecological zone where the study was conducted.

The mean number of pods per stand was significantly higher in groundnut sprayed with mancozeb at the rate of 4 and 2 kgha,¹ than those sprayed at the rate of 1 kgha,¹. The number was generally lower in the untreated control. This could be due the lower disease incidence and severity recorded as a result of application of

mancozeb compared to the untreated control. The application of mancozeb resulted in pod yield increase from 10.12% - 29.07%, 22.22% - 63.51% and 5.33% - 34.02% in 2006, 2007 and 2008 rainy season respectively. These results agree with the findings of Naab *et al.* (2005) who reported that application of foliar sprays of fungicide in Ghana was effective in controlling *Cercospora* leaf spot and improved groundnut biomass and pod yield by 39% and 75% respectively when averaged

across cultivars and years. In Nigeria, Salako (1985) investigated the application of a range of fungicides for disease control in groundnuts and reported a yield increase of 132 ó 286% over unsprayed control plots depending on the fungicide used. In a similar study, Subrahmanyam *et al.* (1984) observed significant increase in pod yield in all cultivars than in unsprayed plots.

Table 1: Effects of variety and fungicidal rate on incidence and severity of *cercospora* leaf spots of groundnut during 2006, 2007, 2008 and combined analysis at Maiduguri.

Treatment	Incidence of <i>Cercospora</i> (%) at 65 DAS				Severity of <i>Cercospora</i> (%) at 65 DAS			
	2006	2007	2008	Combined	2006	2007	2008	Combined
Variety (V)								
Ex-Dakar	45.70	57.80a	50.71	49.43	43.13a	39.89	41.66a	41.57a
RRB	41.92	52.40b	48.67	48.92	26.35b	37.36	38.08ab	38.03b
ICGV86024	39.78	52.51b	46.21	46.88	28.70b	34.54	35.45b	32.90b
SE±	3.184	0.719	2.205	0.478	1.308	1.290	1.631	1.461
Significance level	Ns	**	Ns	Ns	**	Ns	*	**
Fungicidal rate (F)								
4 kgha, ¹	33.80c	36.68d	38.70c	36.39d	27.03c	32.20c	31.95c	30.40c
2 kgha, ¹	41.58bc	44.62c	41.24c	42.48c	28.93c	31.15c	33.58c	31.22c
1 kgha, ¹	44.24ab	60.35b	50.71b	51.77b	34.87b	38.55b	39.53b	37.64b
0 kgha, ¹	50.25a	75.29a	63.47a	63.01a	40.09a	47.15a	48.52a	45.26a
SE±	2.623	1.109	1.866	0.816	1.206	1.105	1.434	1.2480
Significance level	**	**	**	**	**	**	**	**
Interaction								
V x F	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns

Within a treatment group, means in a column followed by the same letter(s) are not significantly different at 5% probability according to DMRT.

Seed Yield: Variety of groundnut did not significantly affect seed yield except in 2006. The variety ICGV-86024 had significantly the highest seed yield, followed by RRB, while the lowest was recorded by Ex-Dakar (Table 2). The results also revealed that seed yield was lowest in 2007 when compared with 2006 and 2008. Furthermore, Ex-Dakar yielded higher in 2008, while RRB and ICGV-86024 yielded more in 2006. This might be as a result of moderate resistance to *Cercospora* leaf spot by RRB and ICGV-86024 varieties in the subsequent years after the first trial in 2006 as well as the disease tolerance of Ex-Dakar variety. Disease tolerance

of Ex-Dakar has been reported by Bdliya and Muhammad (2006) as well as RMRDC (2004).

Fungicidal rate also produced significant (P<0.05) effect on seed yield in all the years and combined analysis. A similar trend of seed yield was observed in 2006 and combined analysis. The results showed that the unsprayed check (0 kgha,¹) significantly and consistently had the lowest seed yield in all the years and combined. The application of mancozeb at the rate of 1 kgha,¹ caused a significant increase in seed yield except in 2007.

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Table 2: Effects of variety and fungicidal rate on number of pods per stand, seed and haulm yield of groundnut during the 2006,2007, 2008 and combined analysis at Maiduguri

<u>Treatment</u>	<u>Number of pods per stand of groundnut</u>				<u>Seed Yield (kgha.,¹)</u>				<u>Haulm Yield (kgha.,¹)</u>			
	2006	2007	2008	Combi ned	2006	2007	2008	Combin ed	2006	2007	2008	Combi ned
<u>Variety</u>												
Ex-Dakar	28.41b	25.83	30.91	28.39	1398.9c	1166.6	1463.3	1342.9	3800.4	4508.7	4871.7a	3982.7
RRB	34.83a	25.26	32.35	30.82	1554.9b	1161.0	1517.1	1411.0	3678.4	5524.2	3774.6b	4325.7
ICGV- 86024	35.35a	24.81	31.72	30.71	1738.3a	1148.4	1423.1	1436.3	4757.4	4839.7	3639.2b	4822.9
SE ±	0.5061	1.173	1.728	0.614	44.727	73.78	100.33	100.33	343.58	522.51	288.66	284.80
Significance	**	Ns	Ns	Ns	**	Ns	Ns	Ns	Ns	Ns	*	Ns
<u>Fungicidal rate</u>												
3.2 kg a.i./ha	36.85a	30.02a	35.93a	34.26a	1819.1a	1375.3a	1772.8a	1655.7a	4523.4a	6253.3a	4275.1	4945.2
1.6 kg a.i./ha	34.92a	30.41a	35.68a	33.67a	1841.7a	1370.6a	1760.3a	1657.6a	4342.2a	5780.4a	4240.0	4827.8
0.8 kg a.i./ha	31.44b	22.44b	28.24b	27.37b	1418.9b	1030.4b	1339.3b	1262.8b	4202.8b	4288.9b	4179.4	3740.4
0 kg a.i./ha	28.55c	18.36c	36.81c	24.57c	1175.1c	858.4b	998.9c	1010.8c	3246.3b	3507.4b	3686.0	3995.1
SE ±	1.005	1.205	1.587	8.248	82.793	90.258	54.830	36.66	288.82	389.73	213.04	232.25
Significance	**	**	**	**	**	**	**	**	**	**	Ns	**
<u>Interactions</u>												
V x F	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns

Within a treatment group, means in a column followed by the same letter(s) are not significantly different at 5% probability according to DMRT.

The seed yield was significantly and successfully increased as a result of increasing the rate of mancozeb application to 2 kgha.,¹ in all the years and combined. But further increase of the rate to 4 kgha.,¹ did not result in significant seed yield increase in all the years and combined analysis. This could be attributed to the efficacy of mancozeb in reducing the incidence and severity of *Cercospora* leaf spot disease of groundnut. Efficacy of fungicides on *Cercospora* leaf spot of groundnut has been reported (Salako, 1985; Naab *et al.*, 2005). Specifically, mancozeb (Dithane

M54) has been reported to provide satisfactory control of *Cercospora* leaf spot disease of groundnut in northern Nigeria (RMRDC, 2004). Other workers reported its efficacy on other fungal diseases of crops (Grove, 1980; Patel and Patel, 1980).

Haulm Yield

Variety of groundnut did not significantly ($P < 0.05$) affect haulm yield except in 2008. Ex-Dakar yielded significantly ($P < 0.05$) higher haulm than RRB and ICGV-86024. The haulm yields of

the two varieties were statistically similar (Table 2). Fungicidal rate also produced significant effect on haulm yield of groundnut in 2006, 2007 and combined analysis, 2008 exclusive. In the two years and combined, 0 kg/ha,¹ and 1 kg/ha,¹ had statistically similar haulm yield. The yield significantly ($P < 0.05$) increased due to spraying Mancozeb at the recommended rate of 2 kg/ha,¹. Increasing the rate to 4 kg/ha,¹ did not significantly ($P < 0.05$) increase the haulm yield (Table 2). The fungicidal rate caused a higher haulm yield in 2007 than the remaining years. This result could be attributed to disease tolerance of Ex-Dakar in 2008 which has resulted in more vigorous plants in respect of the higher incidence and severity of early leaf spots coupled with the efficacy of mancozeb in reducing the incidence and severity of *Cercospora* leaf spot disease of groundnut.

CONCLUSION

Host resistance or tolerance and adequate fungicidal rate are essential for optimum yield in that they play an important role in the reduction of infection by diseases. Consequently, in this study, the effects of variety and fungicidal rate on *Cercospora* leaf spot disease of groundnut were evaluated. Disease and yield parameters were accordingly assessed and it was discovered that, the varieties used did not differ much in the parameters assessed as indicated in the combined analysis, but generally ICGV-86024 and RRB outperformed Ex-Dakar in all respect. On the other hand, the untreated control recorded higher disease incidence and severity of *Cercospora* leaf spot disease. Conversely, application of mancozeb at the rates of 2 kg/ha,¹ and 4 kg/ha,¹ resulted in lower disease incidence and severity with corresponding higher yields that were statistically similar. Therefore, 2 kg/ha,¹ of fungicide mancozeb and either RRB or ICGV-86024 appeared to be more promising and hence recommended.

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