



EFFECTS OF FOLIAR APPLICATION OF MANCOZEB 80% WP (INCIDENCES) ON EARLY AND LATE LEAF SPOTS DISEASES (*Cercospora spp*) OF GROUNDNUTS IN SUDAN SAVANNAH OF NIGERIA

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ABSTRACT

Leaf spots caused by *Cercospora spp* is a serious constraint to the cultivation and improvement of groundnuts in Nigeria. Therefore, a field trial was carried out during the 2015 and 2016 rainy season at Maiduguri (latitude 11° 51' N, 13° 05' E) located in the Northern Sudan Savanna of Nigeria. The aim was to evaluate the effect of mancozeb 80% WP as foliar spray to control early and late leaf spots disease caused by *Cercospora arachidicola* Hori and *Phaeoisariopsis personata* (Berk. & Curt.) V. Arx1 respectively. Split Plot Design was used with factorial arrangement of treatments, which comprised four application rate of 2.0 a.i/ha (untreated, application time at 3, 6, and 9 weeks after sowing). A highly susceptible variety of groundnut (Ex- Dakar) was used. Results showed significant ($p \leq 0.05$) difference in leaf spots disease incidence, severity, pod and haulms yields during the period of the trials, in which sprayed plots were less, infected and gave higher yield than untreated check. Pod and haulms yields increased from 117.2 – 206.7 kg/ha, 627.8 – 1056.7 kg/ha and 1007.8 – 1716.2 kg/ha, 2416.7 – 3205.6 kg/ha in 2015 and 2016 respectively. The interaction effect of mancozeb by year on disease incidence and severity also showed significant ($p \leq 0.05$) effect which decreased with successive increased in sprays in both years. Thus, groundnut plants sprayed with mancozeb thrice at the interval of 3 weeks gave the best disease control, higher pod yield and recommended as control package to farmers.

Keywords: Mancozeb, *Cercospora*, leaf spots, and groundnut.

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is an important crop in Nigeria. The crop is cultivated on about 0.8 – 1.2 million hectares of land, with annual production of 3.8 million metric tonnes in Nigeria (FAOSTAT, 2008). However, the potential of the crop is constrained by numerous factors such as diseases, erratic rainfall and drought. Prominent among the diseases is the early leaf spot caused by *Cercospora arachidicola* Hori and late leaf spot caused by *Phaeoisariopsis personata* (Berk. & Curt.) v. Arx1 (Frimpong *et al.*, 2006a) which has been a major threat to both the cultivation and improvement of groundnuts as it causes over 15 to 50 % loss in grain yield annually. Presently, mancozeb is among the most effective and widely used fungicide for the control of *Cercospora* leaf spots in groundnut, mainly as foliar spray chemical.

Groundnut plays a significant role in the food security of the entire drier regions of northern Nigeria. Regrettably, its production is highly constrained by numerous factors such as diseases, erratic rainfall and drought. The groundnut foliar diseases, early leaf spot and late leaf spot, are caused by the pathogens, *Cercospora arachidicola* Hori and *Cercosporidium personatum* [syn. *Phaeoisariopsis personata* (Berk. & Curt.) V.Ar.] respectively are the most serious of these diseases. Furthermore, several degrees of losses arising from excessive

defoliation caused by leaf spot diseases, which thus affect pod filling and subsequent grain yield, are responsible for the wide range of losses 15 – 50 % reported from farmers' field. Such wide variations in losses mainly arise due to differences in fungicidal use.

The need by farmers to grow more groundnuts, in order to sustain themselves and other people requires that problems associated with leaf spots diseases are curtailed. Groundnuts are mainly cultivated by resource-poor farmers who make little attempts in the management of these diseases through cultural measures. Mancozeb is so far the fungicide recommended for the control of these diseases, hence the need to maximize its usage.

Critical analysis of the biology of *Cercospora* and groundnut suggests the need for a well articulated approach for the control of the disease (McDonald *et al.*, 1985). Primary infection starts from conidia or mycelia that have overwintered on crop residue such as pods, stems or leaves. Ascospores existing in the soil from leave debris or seed borne mycelia, in which planted seedlings get infected as it emerges from the soil. Subsequently, conidia released within the season results in secondary infection; thus, both ascospores and conidia contribute to disease epidemics. From the foregoing therefore, appropriate

and well-matched options need to be adopted for control of the disease.

The nature of *Cercospora spp* infection suggests the need for chemical control options, aimed at providing continuous control throughout the entire crop growth period. Such measures comprise the exploitation of fungicidal foliar spray with mancozeb aimed at the reduction of primary infection by ascospores in the first early three weeks of seedling growth. Fungicides equally control other diseases in the crop and thereby permit vigorous growth of the crop (Twumasi, 1993). Mancozeb is very effective in the control of *Cercospora* leaf spots of groundnuts. It is a non-systemic fungicide with multi-site, protective and curative action on contact. When applied as foliar chemical, it protects the seeds against soil and seed borne inoculum, as well as seedlings (Mohammed and Blidya, 2011). Further impetus to the present study stemmed from previous reports that fungicides reduce the incidence of *Cercospora* leaf spots disease (Culbreath *et al.*, 2002, Smith and Littrell 1980). Fungicides have also been reported to enhance crop vigour against diseases (Bdliya and Muhammad 2006, Bdliya and Kyari 2007). Thus, enhanced crop growth by fungicide application aimed at minimizing the effects of the disease by boosting plant vigour has been recommended.

In spite of the importance of *Cercospora* leaf spots diseases in yield reduction of groundnut, there is insufficient information in respect of mancozeb fungicides on the disease, which the present study seeks to address. Bringing this information to bear, in a holistic approach, in order to harness the benefits of effects of number of foliar application of mancozeb fungicide, form the focus of the study. Therefore, application of fungicide (mancozeb) appropriately would result in a better control of the disease.

The objective of the study is to determine the effect of mancozeb 80% WP as foliar spray in the control of *Cercospora* leaf spots diseases of groundnut.

MATERIALS AND METHODS

Description of Experimental Site

The trial was carried out during the 2015 and 2016 rainy season in Research Farm of Lake Chad Research Institute (LCRI) in Maiduguri (latitude 11° 51' N, 13° 05' E and 315.5 m above sea level) in Sudan Savannah of Nigeria.

Sources of Experimental Materials and Description

The fungicide (Mancozeb 80% WP) was procured from a reputable Agro-dealer in Maiduguri. The groundnut variety namely, (Ex- Dakar) was obtained from the germplasm bank of LCRI Maiduguri.

Field preparation and experimental Layout

The land was ploughed using a disc plough and harrowed twice to give a fine tilth. The harrowed land was then leveled and divided into three blocks (replicates). Pegs were used to demarcate boundaries between blocks. Each plot was 5.0 m x 6.0 m, and distance between blocks was 1.0 m, while plots were 50 cm apart.

A highly susceptible variety (Ex- Dakar) was used. Two groundnut seeds were sown per hole at the beginning of the rainy season at the depth of 3 – 4 cm, and at a spacing of 75 cm x 25 cm between and within rows, respectively. Weeding was done by hoe at three and six weeks after sowing.

Experimental Design and Treatments

The trial was conducted at the Lake Chad Research Institute experimental farm Maiduguri, in Sudan savanna zone of Nigeria. The study area has an annual precipitation of 550.3 mm; the soil of the area is sandy loam texture. The experiment had four treatment combinations (Untreated, mancozeb spray at 3 WAS, mancozeb spray at 6 and 9 WAS, mancozeb spray at 3, 6 and 9 WAS) at the rate of 2.0 a.i/ha. The treatment was laid out in split plot design, replicated five times.

Data Collection

Data were collected on growth and yield parameters, disease incidence: as the number of diseased plants expressed as a percentage of total number of plants in a plot at 3, 6 and 9 weeks after sowing (WAS). Disease severity was scored at 65 and 85 days after sowing on a 1- 9 scale, where: 1 = no disease, 2 = 1- 5%, 3 = 6 -10%, 4 = 11 – 20 %, 5 = 21 – 30%, 6 = 31-40%, 7 = 41-60%, 8 = 61-80%, 9 = 81-100%

Statistical Analysis

Data collected was subjected to analysis of variance (ANOVA) to determine the significance of treatments effects and their interactions. Means were separated using least significant difference (LSD) at 5% level of significance.

RESULTS

Table 1 shows the effects of foliar application of mancozeb 80% WP on *Cercospora* disease incidence during the 2015 and 2016 rainy season. Results at 3, 6, and 9 weeks after sowing consistently indicated that disease incidence was significantly less on fungicide-treated plots than in the untreated check. The lowest *Cercospora* leaf spots incidence was recorded on plots applied with mancozeb three times.

Table 1: Effect of number of foliar application of mancozeb 80% WP on disease incidence of groundnut infected by early and late leaf spot diseases (*Cercospora spp*) during 2015 and 2016 rainy season in Maiduguri

MANCOZEB	Disease incidence at 3 (WAS)		Disease incidence at 6 (WAS)		Disease incidence at 9 (WAS)	
	2015	2016	2015	2016	2015	2016
3 weeks	8.200b	4.60b	74.20b	32.80b	77.80b	37.20b
3&6 weeks	3.60c	2.20c	45.40c	18.20c	48.00c	23.40c
3,6&9 weeks	0.60d	0.80d	22.00d	4.40d	24.00d	14.40d
Control	12.00a	5.80a	101.20a	51.80a	101.40a	59.60a
SE±	0.3512	0.3488	1.8890	0.7735	3.1710	0.5859

WAS = weeks after sowing

Table 2 shows the effects of mancozeb 80% WP on *Cercospora* disease severity, pod and haulms yields during the 2015 and 2016 rainy season. Result shows significant ($p \leq 0.05$) difference in *Cercospora* disease severity, pod and haulms yield at 3, 6 and 9 weeks after sowing (WAS) in which sprayed plots with mancozeb fungicide was less infected and gave higher pod yield than untreated check. However, result did not show significant difference in disease severity at 65 days after sowing (DAS) in both 2015 and 2016. The effect of fungicide was significant on *Cercospora* severity throughout the assessment period. Disease severity was higher in 2015 than in 2016. Thus, higher grain and haulms yield were obtained in 2016. Pod and haulms yields increased from 117.2 – 206.7 kg/ha, 627.8 – 1056.7 kg/ha and 1007.8 – 1716.2 kg/ha, 2416.7 – 3205.6 kg/ha in 2015 and 2016 respectively.

Table 2: Effect of number of foliar application of mancozeb 80% WP on disease severity, pod and haulms yield of Groundnut infected by early and late leaf spot diseases (*Cercospora spp*) during 2015 and 2016 rainy season in Maiduguri

MANCOZEB	Disease severity at 65 (DAS)		Disease severity at 85 (DAS)		Pod yield (Kg/ha)		Haulms yield (Kg/ha)	
	2015	2016	2015	2016	2015	2016	2015	2016
3 weeks	65.20b	59.00b	73.80b	63.20b	116.67c	1276.6b	830.6b	2691.7bc
3&6 weeks	43.00c	38.00c	52.40c	43.60c	154.44b	1508.0a	922.2b	2950.0ab
3,6&9 weeks	28.80d	25.40d	27.20d	23.60d	206.67a	1716.2a	105.67a	3205.6a
Control	86.60a	80.00a	115.20a	80.80a	117.22c	1007.8c	627.8c	2416.7c
SE±	2.1467	1.9253	67.150	2.4590	65.194	72.920	32.204	158.71

DAS = days after sowing

Table 3 shows the interaction of mancozeb 80% WP x year of application on disease incidence, severity, pod and haulms yield (kg/ha) infected by leaf spots diseases (*Cercospora spp*) of Groundnut. Mancozeb application showed significant ($p \leq 0.05$) effect on disease incidence throughout the assessment period. Similarly disease severity was also significant except at 65 days after sowing. Pod yield was equally significant which increased with each successive increased in number of fungicide sprays in both years. Conversely, haulms yield was not significant in both 2015 and 2016.

Table 3: Interaction effect of number of foliar application of mancozeb 80% WP on groundnut infected by early and late leaf spot diseases (*Cercospora spp*) during 2015 and 2016 rainy season in Maiduguri

MANCOZEB (M)	Disease incidence at 3 (WAS)	Disease incidence at 6 (WAS)	Disease incidence at 9 (WAS)	Disease severity at 65 (DAS)	Disease severity at 85 (DAS)	Pod yield (Kg/ha)	Haulms yield (Kg/ha)
	3 weeks	6.40b	53.50b	57.50b	62.10b	68.50b	696.63c
3&6 weeks	2.90c	31.80c	35.70c	40.50c	48.00c	831.22b	1936.1ab
3,6&9 weeks	0.70d	13.20d	19.20d	27.10d	25.40d	961.43a	2131.1a
Control	8.90a	76.50a	80.50a	83.30a	98.00a	562.51d	1522.2c
SE±	0.2442	1.1349	1.7199	1.6005	2.6577	36.059	86.853
Year (Y)							
2015	6.10a	60.70a	62.80a	55.90a	67.15a	148.7b	859.3b
2016	3.35b	26.80b	33.65b	50.60b	52.80b	1377.2 a	2816.0a
SE±	0.1727	0.8025	1.2162	1.1317	1.8793	25.498	61.414
Interaction							
M x Y	**	**	**	Ns	**	**	Ns

WAS = weeks after sowing, DAS = days after sowing

DISCUSSION

Groundnut production in Nigeria and especially in the Savanna region is essentially restricted due to diseases notably among them includes *Cercospora* leaf spots (Alabi *et al.*, 1993). Results obtained have shown that mancozeb fungicide provided adequate protection to groundnut against early and late leaf spots diseases of groundnut. The performance of mancozeb significantly reduced *Cercospora* disease incidence and severity of groundnut and produced higher yield throughout the 2015 and 2016 rainy seasons compared with the untreated plots. This agrees with the work of (Khanl *et al.*, 2014 and Sunkad *et al.*, 2005) who stated that infection by *Cercospora* disease was significantly reduced through the application of mancozeb fungicide because of their effective activity of active ingredients on the pathogens. Mancozeb fungicide sprayed 3 times at 3, 6 and 9 weeks after sowing in 2015 and 2016 significantly reduced the incidence of leaf spots, the effects of the fungicide can be attributed to the (Dithiocarbamate) content in the products. This agrees with the work of Ahmad (1987) who recorded high efficacy of mancozeb against *Cercospora* leaf spots of groundnuts. Also, Vyas *et al.*, (1986) stated that mancozeb have insecticidal properties for protecting field crops against plant diseases. Also, Gondall *et al.*, (2012) reported the insecticidal properties of mancozeb against *Alternaria* leaf blight on tomato. Similarly, Abhishek *et al.*, (2014) reported that mancozeb fungicide was found to be effective towards fungal, bacteria and *actinomyces* population in soil. The effects could also be due to the carbamate contents present in the fungicide (Monika and Kidwai, 2017). Mancozeb fungicide was shown to exhibit fungicidal activities on various crops against a wide spectrum of fungal diseases (Hayes and Paiford 1995). Spraying groundnuts plant with mancozeb at 2.0 a.i./ three times at 3weeks interval reduced the incidence and severity of *Cercospora* leaf spots diseases and recorded higher grain and haulms yield than untreated plots. This agrees with the findings of Abhishek *et al.*, (2014) who reported that spraying 1000 and 2000ppm significantly decreased bacterial population. More so, Gondall *et al.*, (2012) reported that disease severity percentage in *Alternaria* leaf blight infection was significantly reduced 21 days after the application of mancozeb fungicide treatment as compared to untreated check. Plots without fungicide application showed high incidence and severity of diseases of leaf spots than treated plots and leaves were dark brown on the upper leaflet surface, lighter on the adaxial surface and surrounded by a chlorotic (yellow) halo, in extreme cases, leading to defoliation. Fungicide treated plants produced higher grain and haulms yield in 2015 and 2016 rainy seasons respectively. Lower yield was obtained from groundnut plants that were untreated with mancozeb. Warkentin *et al.*, (1999) reported that application of mancozeb was effective in reducing severity of *Mycosphaerella* blight of field pea and in increasing yield. The efficacy of mancozeb generally has the power to inhibit spore formation in pathogenic fungi resulting to its death (Monika and Kidwai 2017). Also, (Elsamen *et al.*, 2015)

reported that the insecticidal activity of carbamate present in mancozeb help in reducing the severity of the pathogens in the field thereby improving the growth and yield of crop in the areas where they are grown.

CONCLUSION AND RECOMMENDATION

This study investigated the effect of number of mancozeb 80% WP application as foliar spray in the control of groundnut infected with early and late leaf spots disease of groundnut caused by *Cercospora arachidicola* and *Phaeoisariopsis personata* respectively in Sudan Savanna of Nigeria. The findings of this study showed that mancozeb were found to be effective against early and late leaf spots of groundnut (*Cercospora spp*) infection when sprayed at 3, 6 and 9 weeks after sowing. It has significantly reduced the incidence and severity of infected plants/plot and significantly increased pod and haulms yield.

Application of mancozeb fungicide on *Cercospora* leaf spots of groundnut not only increased plant growth and yield but also controls disease incidence and severity and can be a good fungicide for chemical control. These fungicide, is available and easy to apply are effective and less costly in the management of diseases.

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