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Evaluation of yield and yield components of groundnut genotypes under *Cercospora* leaf spots disease pressure

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Abstract

Yield reduction in groundnut genotypes has been attributed to many factors including *Cercospora* leaf spots disease. Knowing the groundnut varieties that are tolerant to this disease and at the same time having higher yield potentials would help farmers and breeders to make the right choice of a variety for cultivation or for further improvement. Therefore, this study was conducted during September-December, 2013 growing season to evaluate the yields and yield components of 20 groundnut varieties in a field designated as a 'hot spot' for *Cercospora* leaf spots disease in Council for Scientific and Industrial Research-Crop Research Institute (CSIR-CRI), Fumesua-Kumasi, Ghana. Significant differences ($p<0.05$) were observed in all the traits studied *viz*., days to 50% flowering, number of matured pods per plant, pod weight per plant (g), 100 seed weight (g), pod yield (kg/ha), disease incidence, defoliation and disease severity. The mean pod yield was 1312kg/ha for the 20 genotypes. The top 11 high yielding cultivars (Oboshie, GK7, Obolo, Otuhia, Nkatekokoo, Bremawuo, Jenkaar, Adepa, Nkatiesari, Summnut22 and Manipinta) were all moderately resistant to the disease. These varieties should be preferred for commercial production in areas where *Cercospora* leaf spot disease exists.

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Introduction

Groundnut (*Arachis hypogaea* L.) belongs to the Fabacaea family and is grown in most tropical and sub-tropical countries including Ghana (FAOSTAT, 2013). It provides income and food for a lot of people in Ghana and many countries (Asibuo *et al.* 2008; Ibrahim, 2010).The haulms are used as fodder for livestock, especially during dry seasons (Tsigbey *et al.,* 2003). It also helps in soil conservation by adding Nitrogen to the soil (Dupriez and DeLeener, 1988).Yields of groundnut have generally been reported to be low in developing countries compared to developed countries due to many factors including diseases (Janila *et al.,* 2013a). Among the diseases, leaf spots has the greatest impact on groundnut yield which may cause more than 50% yield losses (Leal-Bertioli *et al.*, 2009; Waliyar, 1991).Yield losses due to early and late leaf spots in Northern Ghana can be as high as 100% in wet years (Tsigbey *et al.*, 2003).

The leaf spots disease is of two forms: early leaf spots (ELS) which is caused by *Cercospora arachidicola* Hori and late leaf spots (LLS) caused by *Cercosporidium personatum (*Berk. & M.A. Curtis) Deighton (Leal-Bertioli *et al.*, 2009; Mcdonald *et al.*, 1985). The early leaf spot is characterised by the presence of light brown to black lesions with chlorotic hallow on the upper surface of the leaves (Plate 2a) (Mcdonald*et al.*, 1985). The late leaf spot is characterised by dark brown to black circular lesion (usually without chlorotic halo) on the lower surface of the leaves and can be formed on the stems and petioles (Plate 2b and c) (Mcdonald *et al.*, 1985).

Plate 1. Watering of the groundnut field using sprinkler irrigation system.

Plate 2a. Groundnut leaves severely infected with early leaf spots.

Plate 2b. Groundnut leaves severely infected with late leaf spots.

Plate 2c. Groundnut stems and petioles severely infected with late leaf spots.

Because most groundnut farmers in Ghana are relatively poor, they do not use any form of fungicide to control leaf spots diseases (Tsigbey *et al.*, 2003). Host plant resistance has been preferred to other methods in leaf spots management due to its cost-effectiveness and environmental friendliness (Jordan *et al.,* 2013). However, report indicates that disease resistance in groundnut is mostly associated with low yield, poor pod formation, poor kernel characteristics and late maturity making breeding for leaf spot resistance difficult (Singh *et al.*, 1997; Subrahmanyam *et al.*, 1995). Varieties that are tolerant to *Cercospora* leaf spots are very useful to

farmers in order to maximise profit. Tolerant varieties could also serve as good parental sources for groundnut improvement programmes.

Therefore, this study was carried out to evaluate the yields of 20 groundnut varieties under *Cercospora* leaf spots infection (early and late combined) in a groundnut field designated as a 'hot spot' for leaf spots diseases.

Materials and methods

Genetic materials

Twenty (20) groundnut genotypes were used for the study. Information about the genotypes and source of collection is presented in Table 1.

Table 1. Characteristics and sources of the groundnut genotypes used for the study.

Genotype	Sub-species	Days to maturity	Oil content (%)	Average No. of seeds/pod	Source
1CG 7878	*Hypogaea*	120	-	2	ICRISAT, Niger
55-437	*Fastagiata*	90	49	2	ICRISAT, Niger
Obolo	*Fastagiata*	105-110	48	2	CSIR-CRI, Ghana
Oboshie	*Fastagiata*	105-110	46	2	CSIR-CRI, Ghana
Yenyawoso	*Fastagiata*	90	50	2	CSIR-CRI, Ghana
Bremawuo	*Fastagiata*	90	-	3	CSIR-CRI, Ghana
Kumawu	*Fastagiata*	90	46	2	CSIR-CRI, Ghana
Konkoma	*Fastagiata*	90	44	3	CSIR-CRI, Ghana
Jenkaar	*Hypogaea*	110-120	-	2	CSIR-CRI, Ghana
Adepa	*Hypogaea*	110-120	47	2	CSIR-CRI, Ghana
Nkosour	*Hypogaea*	110-120	-	2	CSIR-CRI, Ghana
Azivivi	*Hypogaea*	110	-	2	CSIR-CRI, Ghana
Shitaochi	*Fastagiata*	86-90	46	2	CSIR-CRI, Ghana
Nkatekokoo	*Fastagiata*	86-90	63	3	CSIR-CRI, Ghana
Behenase	*Fastagiata*	90	-	3	CSIR-CRI, Ghana
Manipinta	*Hypogaea*	110-120	55	2	CSIR-CRI, Ghana
Otuhia	*Hypogaea*	110-115	49	2	CSIR-CRI, Ghana
GK7	*Hypogaea*	110-120	45	2	CSIR-CRI, Ghana
Nkatiesari	*Hypogaea*	110	46	2	CSIR-CRI, Ghana
Sumnut22	*Hypogaea*	110-120	45	2	CSIR-CRI, Ghana

Gaikpa *et al.* (2015)

Experimental site and design

The study was carried out in CSIR-CRI, Fumesua-Kumasi in the Ashanti Region of Ghana. This place is in the semi-deciduous forest zone with annual rainfall of between 1500mm and 2000mm. The soil at this place is classified under Kumasi Series locally called ferric Acrisol or forest Ochrosols (FAO/UNESCO, 1990).

The 20 groundnut genotypes were planted on a field designated as 'hot spot' for early and late leaf spots pathogens using Randomised Complete Block Design (RCBD) with three replications during the September-December, 2013 growing season. The land area was ploughed and harrowed. Each of the 20 genotypes was sown in a 2 m long double row. Seeds were sown at two seeds per stand and later thinned to one. Intra-row planting distance was 20cm with inter-row distance of 50cm. A space of 1m was left between the various replications. Standard agronomic practices were followed but without application of fungicide. Irrigation was carried out in the absence of rain using sprinkler irrigation system (Plate 1) to ensure leaf spot disease build up.

Data collected

Yield and yield components

The agronomic data taken includes days to 50% flowering, number of matured pods/plant, pod weight/ plant (g), pod yield (kg/ha), 100 seed weight (g). Ten (10) plants harvested from the middle of the rows from each plot were used to estimate pod yield per hectare using the expression:

$$\text{Pod yield per ha} = \frac{\text{Pod weight (kg)}}{\text{Area harvested (m}^2\text{)}} \text{x} 10000$$

For number of matured pods per plant, matured pods from 10 plants from each plot were counted and averaged for each genotype.

Disease components

Disease incidence in groundnut population

Incidence of early leaf spot was assessed at 30, 40 and 50 days after sowing (DAS) and late leaf spot at 60 and 70 DAS by counting the number of plants infected and expressing it as a percentage of the total number of plants per plot as given as

$$\text{Incidence} = \frac{\text{Number of plants infected per plot}}{\text{Total number of plants per plot}} \text{x}100$$

Leaf spots incidence per plant

Percentage of leaves infected by leaf spots per plant was recorded on five middle plants from each plot and averaged for each genotype. It was recorded at 60, 75 and 90 days after sowing. The expression below was used:

$$\text{Percentage of leaves infected per plant} = \frac{\text{Number of leaves infected per plant}}{\text{Total number of leaves per plant}} \text{x}100$$

Defoliation

Percentage of leaves defoliated per plant was recorded at 75 and 90 days after sowing on five middle plants from each plot. Leaves defoliated as a result of leaf spots (early and late leaf spots combined) were counted carefully and expressed as a percentage of the total number of leaves per plant given as

$$\text{Percentage defoliation} = \frac{\text{Number of leaves defoliatedper plant}}{\text{Total number of leaves per plant}} \text{x}100$$

Disease Severity

Disease severity (early and late leaf spots combined) was assessed based on a rating scale of increasing severity of 1-9 (Subrahmanyam *et al.,* 1995). Disease score 1 means 0% foliar infection; 2 for 1–5%; 3 for 6–10%; 4 for 11–20%, 5 for 21–30%; 6 for 31–40%; 7 for 41–60%, 8 for 61–80% and 9 for 81–100% of foliar area infection with plants having almost all leaves defoliated leaving bare stems. Genotypes with a disease score 4-6 were considered moderately resistant and 7 were designated as susceptible as reported by Pande and Rao (2001).

Statistical analysis

The data collected were summarised using Microsoft Excel software. Percentage data were transformed using arcsine transformation in Microsoft Excel prior to analysis of variance. GenStat Statistical Software (12.0 edition) was used for analysis of variance and to find correlations among means. Means were separated using Tukey's HSD (5%).

Results

Agronomic (yield) components

Significant differences ($p<0.05$) were observed for the agronomic parameters recorded on the 20 groundnut genotypes (Table 2). The mean number of days to 50% flowering was 30 DAS. The variety Nkosour (a *hypogaea*) had the longest days to 50% flowering while Bremawuo and Nkatekokoo (*fastigiata*) had the lowest. Genotype GK7 (a *hypogaea*) had the highest number of matured pods per plant whiles Yenyawoso and Konkoma (*fastigiata*) had the lowest. Oboshie (a *fastigiata*) had the highest pod weight per plant and pod yield (kg/ha) and Yenyawoso had the lowest. In addition, Oboshie had the highest 100 seed weight whiles 55-437(a *fastigiata*) had the lowest.

Disease components

Early and late leaf spots incidence among 20 genotypes of groundnut

Highly significant difference ($p<0.01$) was observed among the groundnut genotypes with respect to incidence of early and late leaf spot diseases (Table 3). At 30 DAS and 40 DAS, Nkatiesari (a *hypogaea*) had the lowest incidence of early leaf spot and 55-437 (a *fastigiata*) the highest (Table 3). At 60 DAS, ICG7878, (a *hypogaea*) had the lowest late leaf spot incidence whiles 55-437, Yenyawoso, Bremawuo, Kumawu, Konkoma, Nkosour, Shitaochi, Nkatekokoo and Behenase had the highest incidence at 60 DAS(Table 3). By 50 and 70 DAS all plants (100%) had been infected with early and late leaf spot diseases respectively but at differing degrees of severity.

Table 2. Days to 50% flowering, number of matured pods/plant, pod weight/ plant (g), pod yield (kg/ha), and 100 seed weight (g) of the 20 groundnut genotypes.

Genotype	Days to 50% flowering	Number of matured pods/plant	Pod weight/ plant (g)	Pod yield (kg/ha)	100 Seed weight(g)
1CG7878	33	13	11.27	1024	38.00
55-437	26	17	10.47	952	26.33
Obolo	32	16	18.87	1715	50.67
Oboshie	32	20	28.73	2612	59.00
Yenyawoso	27	9	8.07	733	34.67
Bremawuo	25	16	16.00	1455	27.67
Kumawu	28	13	10.33	939	34.00
Konkoma	27	9	10.60	964	35.67
Jenkaar	32	16	15.47	1406	43.33
Adepa	32	15	15.27	1388	43.33
Nkosour	34	11	9.67	879	39.33
Azivivi	32	17	14.67	1333	43.67
Shitaochi	26	14	10.53	958	28.67
Nkatekokoo	25	15	15.93	1448	31.33
Behenase	26	13	12.33	1121	31.67
Manipinta	33	17	14.93	1358	38.67
Otuhia	30	16	16.07	1461	45.33
GK7	30	21	19.53	1776	44.00
Nkatiesari	31	20	14.93	1358	36.00
Sumnut22	31	16	14.93	1358	38.33
Mean	30	15	14.43	1312	38.48
CV (%)	3.30	21.60	20.80	20.80	7.80
Tukey's HSD (5%)	2.9**	10.99*	9.859**	896.99**	9.329**

*,**=Significance at p<0.05 and p<0.01 respectively

Table 3. Early and late leaf spots incidence among groundnut population (%) (Transformed).

Genotype	ELSat 30 DAS	ELS at 40 DAS	LLS at 60 DAS
1CG 7878	31.10	51.00	50.93
55-437	65.30	85.50	90.00
Obolo	64.20	69.20	76.32
Oboshie	27.10	37.70	60.58
Yenyawoso	53.00	74.80	90.00
Bremawuo	33.30	65.40	90.00
Kumawu	51.60	79.10	90.00
Konkoma	52.20	75.90	90.00
Jenkaar	13.70	55.10	81.59
Adepa	27.70	53.00	80.90
Nkosour	53.20	75.50	90.00
Azivivi	33.20	40.60	85.46
Shitaochi	65.00	83.50	90.00
Nkatekokoo	40.70	83.50	90.00
Behenase	37.00	78.20	90.00
Manipinta	4.10	51.10	55.11
Otuhia	49.90	52.10	76.28
GK7	52.20	74.60	55.42
Nkatiesari	4.10	33.70	52.09
Sumnut22	49.20	78.20	59.44
Mean	40.40	64.90	77.21
CV (%)	31.00	17.10	9.50
Tukey's HSD (5%)	39.299**	34.419**	24.229**

** Significance at p<0.01

Early and late leaf spots incidence in individual plants

There were highly significant differences (p<0.01) among the 20 genotypes of groundnut with respect to the proportion of leaves infected with the disease per plant (Table 4). At 60 DAS, Yenyawoso (a *fastigiata*) recorded the highest percentage of leaf incidence per plant whiles Nkatiesari had the lowest. Also, at 75

DAS, Shitaochi (a *fastigiata*) recorded the highest percentage of leaves infected per plant whiles Nkatiesari recorded the lowest. Besides, at 90 DAS, 55-437 (a *fastigiata*) had the highest percentage of leaves infected per plant whiles 1CG 7878 had the lowest.

Table 4. Mean percentage of leaves infected per plant and defoliation (%) per plant (Transformed).

Genotype	Percentage of leaves infected/plant			Percentage defoliation/plant	
	60 DAS	75 DAS	90DAS	75 DAS	90 DAS
1CG7878	24.83	39.34	52.50	27.08	32.48
55-437	48.50	59.76	75.29	38.58	52.76
Obolo	43.23	53.68	65.54	33.22	45.05
Oboshie	38.05	50.24	63.57	33.88	48.32
Yenyawoso	48.66	58.45	70.96	37.50	46.25
Bremawuo	46.36	55.90	67.01	34.84	42.88
Kumawu	46.28	55.55	66.23	39.48	48.09
Konkoma	46.21	56.25	68.26	36.85	43.82
Jenkaar	27.59	44.44	60.98	28.69	40.49
Adepa	26.32	43.25	59.39	25.48	30.01
Nkosour	33.60	48.88	65.56	32.84	40.88
Azivivi	28.25	45.52	63.02	32.08	43.19
Shitaochi	46.68	57.02	69.51	47.08	50.87
Nkatekokoo	42.47	52.23	62.97	29.03	37.21
Behenase	40.67	51.52	63.48	34.09	42.44
Manipinta	23.53	39.66	54.11	22.69	25.70
Otuhia	27.90	45.33	62.81	26.65	32.48
GK7	22.12	40.06	55.88	28.14	30.94
Nkatiesari	17.56	41.18	61.69	30.12	34.25
Sumnut22	32.03	42.55	52.57	24.99	32.71
Mean	35.54	49.04	63.07	32.17	40.04
CV (%)	8.40	4.00	4.70	11.60	9.60
Tukey's HSD (5%)	9.629**	6.079**	9.269**	11.859**	11.999**

** Significance at p<0.01

Leaf defoliation

Average percentage of leaves defoliated per plant was highly significant (p<0.01) across the 20 groundnut genotypes (Table 4). At 75 DAS, Manipinta (a *hypogaea*) had the lowest percentage defoliation and Shitaochi the highest. Again, at 90 DAS, Manipinta had the lowest defoliation whiles 55-437 had the highest. Percentage of leaves defoliated was significantly and positively associated with leaf spots severity score, incidence among population and among individual plants (Table 6).

Leaf spots disease severity

Highly significant differences (p<0.01) were observed among the groundnut varieties with respect to leaf spot disease severity (Table 5). The mean severity score was 4.10 for 60 DAS and 5.70 for 90 DAS. Genotypes 1CG7878, GK7 and Nkatiesari (*hypogaea*) had the lowest severity score whiles 55-437 and Shitaochi (*fastigiata*) had the highest at 60 DAS. Genotype ICG7878 had the lowest score at 90 DAS while three genotypes (55-437, Konkoma and Shitaochi) had the highest. Sample photographs of leaves and stems/petioles of the groundnuts infected with early and late leaf pots are presented in plates 2a, b and c.

Association between agronomic traits and disease severity

The agronomic (yield) parameters of the groundnut genotypes *viz.* days to 50% flowering, number of matured pods per plant**,** pod weight/plant**,** pod yield (kg/ha)and100 seed weight (g) positively associated to each other but negatively associated with leaf spots disease incidence, severity, percentage of leaves infected and defoliated per plant. Disease components significantly and highly associated among themselves (Table 6).

Table 5. Means of leaf spots severity scores.

Genotype	60 DAS	90 DAS	Reaction
1CG7878	3.0	4.7	Moderately resistant
55-437	6.0	7.0	Susceptible
Obolo	4.0	6.0	Moderately resistant
Oboshie	3.3	6.0	Moderately resistant
Yenyawoso	4.7	6.0	Moderately resistant
Bremawuo	5.3	6.0	Moderately resistant
Kumawu	5.3	6.7	Susceptible
Konkoma	5.3	7.0	Susceptible
Jenkaar	3.3	5.0	Moderately resistant
Adepa	3.0	5.0	Moderately resistant
Nkosour	4.0	5.0	Moderately resistant
Azivivi	3.0	5.0	Moderately resistant
Shitaochi	6.0	7.0	Susceptible
Nkatekokoo	4.7	6.3	Moderately resistant
Behenase	4.3	6.3	Moderately resistant
Manipinta	3.3	5.0	Moderately resistant
Otuhia	3.7	5.0	Moderately resistant
GK7	3.0	5.0	Moderately resistant
Nkatiesari	3.0	5.0	Moderately resistant
Sumnut22	3.7	5.0	Moderately resistant
Mean	4.10	5.70	
CV (%)	12.00	4.40	
Tukey'sHSD (5%)	1.59**	0.99**	

** Significance at $p<0.01$. Severity rating scale of 1-9, where per cent infected leaf area was: 1 = 0%, 2 = 1–5%, 3 = 6–10%, 4 = 11–20%, 5 = 21–30%, 6 = 31–40% and 7 = 41–60%, 8 = 61–80% and 9 = 81–100%.

Table 6. Correlations betweenthe agronomic traits anddisease components.

	1	2	3	4	5	6	7	8	9	10	11	12	13
1	-												
2	0.26	-											
3	0.30	0.74**	-										
4	0.30	0.74**	1.00**	-									
5	0.71**	0.39	0.74**	0.74**	-								
6	-0.63*	-0.47	-0.49	-0.49	-0.58	-							
7	-0.60*	-0.59	-0.47	-0.47	-0.45	0.56	-						
8	-0.72**	-0.52	-0.28	-0.28	-0.42	0.68**	0.74**	-					
9	-0.60*	-0.34	-0.31	-0.31	-0.36	0.40	0.77**	0.78**	-				
10	-0.59	-0.35	-0.34	-0.34	-0.40	0.47	0.62*	0.77**	0.82**	-			
11	-0.48	-0.26	-0.16	-0.16	-0.21	0.37	0.64*	0.81**	0.85**	0.90**	-		
12	-0.81**	-0.46	-0.48	-0.48	-0.69**	0.74**	0.71**	0.88**	0.77**	0.80**	0.71**	-	
13	-0.78**	-0.34	-0.23	-0.23	-0.46	0.62*	0.62*	0.89**	0.77**	0.82**	0.78**	0.89**	-

*, ** =Significantly different from zero at $p<0.5$ and $p<0.01$ respectively, **1**=days to 50% flowering, **2=** number of matured pods per plant**, 3=** pod weight/plant**, 4=** pod yield**, 5**=100 seed weight**, 6**= ELS incidence at 40 DAS,**7**= LLS incidence at 60 DAS, **8**= percentage of leaves infected at 60 DAS,**9**= percentage of leaves infected at 90DAS, **10**= percentage of leaf defoliation at 75 DAS, **11**= percentage of leaf defoliation at 90 DAS, **12**=severity score at 60 DAS, **13=** severity score at 90 DAS.

Discussion

The significant differences observed in this study indicate that agronomic variation exists across the 20 groundnut genotypes. This could be due to differences in the genetic composition of these genotypes. This finding is very useful for selecting agronomically favourable genotypes for breeding programmes. Similarly, Upadhyaya (2003) asserted that agronomic traits are useful in describing how a particular groundnut genotype is different from the other. In a previous study, Gaikpa *et al.* (2015) found molecular variation across these genotypes of groundnuts. Janila *et al.* (2013a) maintained that number of matured pods per plant, pod yield per plant and 100 seed weight are very important yield contributing parameters. This explains the significant

and high positive correlation between the agronomic traits in this study. Physiologically, pod yield is a function of crop growth rate, duration of reproductive growth, and the proportion of crop growth rate partitioned toward pod yield (Janila *et al.,* 2013a). Generally, the genotypes of *hypogaea* subspecies flowered earlier than the *fastigiata* group. This indicates that *fastigiata* cultivars matured relatively earlier than *hypogaea* groups. Hildebrand and Subrahmanyam (1994) had earlier reported a similar finding in groundnuts.

The genotypes showed significant different levels of resistance to *Cercospora* leaf spots disease. Genotypes that flowered earlier had the earliest disease incidence among population of plants and the highest percentage of leaves infected per plant, defoliation per plant and disease severity scores compared to their late flowering counterparts. Therefore, genotypes of *hypogaea* group were less severely infected by the disease compared to the *fastigiata* ones. This may be due to their genetic resistance or tolerance to the disease. It could also be due to their ability to produce some level of phenolic prohibition which helps in inhibition of spore germination and function of microbial toxins of the pathogens (Kalaichevan, 1980). The negative associations of disease parameters to yield and yield components show that the disease affected the yield potential of the groundnut. All the top 11 high yielding genotypes in this study were moderately resistant. These genotypes performed above national average of pod yield 840kg/ha in Ghana (Nutsugah *et al*., 2007) which shows that they were tolerant to the *Cercospora* disease. Similarly, Janila *et al.* (2013b) found some groundnut genotypes which had both high agronomic potential and disease resistance. The susceptible *fastigiata* genotypes *viz*., 55-437, Kumawu, Konkoma and Shitaochi recorded lower pod yields, 26.52% to 28.43% less than the mean pod yield in this study indicating that they were less tolerant to the disease. Surprisingly, some moderately resistant genotypes *viz*., Yenyawoso, Nkosour, Behenase and ICG7878 had pod yields of 14.56% to 44.13% less than the mean pod yield of 1312 kg/ha observed in this study. In fact, the lowest yielding genotype in this study, Yenyawoso was moderately resistant. This confirms the assertion that some resistant genotypes are not necessarily high yielding (Singh *et al*., 1997; Subrahmanyam *et al*., 1995) because yield in itself is a polygenic trait influenced by many factors (Janila *et al*., 2013b).

Despite the level of tolerance observed across the 20 genotypes, it is also important to note that the disease had effect on the overall pod yield of these genotypes since none of the genotypes had a pod yield up to the 3156kg/ha recorded for Nkatiesari on-station in Ghana (Kombiok *et al*., 2012). Besides, in the absence of leaf spots disease, Azivivi, Adepa, Nkosour and Jenkaar could yield between 2000 to 2500 kg/ha (CSIR, 2007) far beyond their yields recorded in this study. Yield reduction in groundnut as a result of *Cercospora* leaf spots disease has been reported in most cases (Leal-Bertioli *et al*., 2009; Tsigbey *et al*., 2003; Waliyar, 1991). This is because the *Cercospora* pathogens have been found to produce cercosporin during their early growth stages which causes lipid peroxidation and breakdown of photosynthetic pigments of plant tissues (Stoessl *et al*., 1990; Shabana *et al*., 2013) leading to inefficient dry matter production and partitioning. The pathogens have also been found to destroy the stomata pore with their gem tubes (Shokes and Culbreath, 1997).

Conclusion

Significant yield variations were found across the 20 groundnut genotypes grown under the *Cercospora* leaf spots disease pressure. Groundnut genotypes Oboshie, GK7, Obolo, Otuhia, Nkatekokoo, Bremawuo, Jenkaar, Adepa, Nkatiesari, Summnut22 and Manipinta were both high yielding and moderately resistant to leaf spots and could be cultivated or disseminated to areas with the high levels of *Cercospora* leaf spots disease pathogens. They could also be used in groundnut breeding programmes for further improvement.

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