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EFFICACY OF SOME FUNGICIDES IN THE MANAGEMENT OF CERCOSPORA LEAF SPOT OF GROUNDNUT IN THE SUDAN SAVANNA OF NIGERIA

Bulus Shapshi Bdliya, Kyari Karabi Gwio-Kura*

Department of Crop Protection, Faculty of Agriculture, University of Maiduguri
P.M.B 1069, Maiduguri, Borno State, Nigeria

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Abstract: The efficacy of Benlate 50 WP (benomyl), Bentex T (benomyl + thiram), Ridomil 72 WP (metalaxyl) and Trimangol 80 WP (maneb) applied as foliar spray in the control of cercospora leaf spot of groundnut in the sudan savanna of Nigeria was evaluated during the 2002 and 2003 cropping seasons. Three spray regimes (once, twice and thrice per season) were evaluated. Strip plot design with three replications was used in setting up the experiments. Ex-Dakar, a cercospora leaf spot susceptible groundnut variety was used as planting material. All the four fungicides significantly reduced the incidence and severity of cercospora leaf spot in both seasons. However, the application of Bentex T significantly better reduced the incidence and severity of the disease than the other fungicides. This was followed by application of Benlate 50 WP. Ridomil 72 WP and Trimangol 80 WP which gave moderate control of the disease. Three sprays with fungicides gave better control of the disease than one or two sprays in the season. The highest seed yield of 1716 kg/ha and 2263 kg/ha in 2002 and 2003, respectively, were obtained following treatment with Bentex T. The lowest yield of 962 kg/ha and 1270 kg/ha in 2002 and 2003, respectively, were recorded from the control plots. Also the highest seed yield of 2028 kg/ha and 2672 kg/ha in 2002 and 2003, were obtained following three sprays compared to 939 kg/ha and 1239 kg/ha in 2002 and 2003, respectively, for one spray in the season. The highest haulm yield of 6131 kg/ha and 6722 kg/ha in 2002 and 2003 was recorded from plots treated with Bentex T compared to 4752 kg/ha and 5166 kg/ha in 2002 and 2003, respectively, obtained from the control. Haulm yield of 6355 kg/ha and 7027 kg/ha in 2002 and 2003 were obtained following three sprays compared to 5088 kg/ha and 5593 kg/ha in 2002 and 2003, respectively, recorded for the control. Bentex T or Benlate 50 WP could be used to reduce the effect of cercospora leaf spot and improve groundnut production in the sudan savanna of Nigeria.

Key words: groundnut, fungicides, cercospora leaf spot, control, sudan savanna, Nigeria

*Corresponding author:
bsbdliya@yahoo.com

INTRODUCTION

Cercospora leaf spots of groundnut caused by *Cercospora arachidicola* (early leaf spot) and *Phaeoisariopsis personata* (late leaf spot) are important diseases of groundnut in Nigeria and other regions of the world (Subrahmanyam *et al.* 1980). It is the most important disease of groundnut in the sudan savanna of Nigeria where the largest groundnut production takes place. In addition to reduction in seed yield, it causes serious damage to the foliage which is a valuable fodder for livestock especially during a dry season. The disease is soil borne. Experimental results showed that yield losses could be as high as 30–40% (Mohammed 2004). In the USA yield losses of 50% were reported due to cercospora leaf spot attack on groundnut (Shokes and Culbreath 1997; Hagan *et al.* 2006).

Chemical control of cercospora leaf spot have been practiced in the USA for a long time with varying degrees of success (Backman *et al.* 1977; Smith and Littrell 1980). The use of fungicides such as benomyl to control the disease was found acceptable in the USA in the 70ties untill when resistance to the chemical was detected (Littell 1974; Clark *et al.* 1974; Culbreath *et al.* 2002). In Nigeria chemical control of cercospora leaf spot of groundnut is not widely practiced. This might particularly be due to high costs of chemicals and lack of expertise for handling chemicals by farmers. Recent researches in the sudan savanna (Mohammed 2004; Alkali 2005; Bdliya and Muhammad 2006) showed that controlling cercospora leaf spot can lead to the increase in yield of the local varieties and insures high haulm quality. The lack of resistant varieties to cercospora leaf spot in the study area still makes the use of chemicals for controlling the disease necessary.

This paper reports the results of the study of efficacy of four fungicides at different spray regimes in controlling cercospora leaf spot of groundnut in the Sudan savanna of Nigeria.

MATERIALS AND METHODS

The experiments were conducted on the Teaching and Research farm of the Department of Crop Protection, Faculty of Agriculture, University of Maiduguri, Nigeria during the 2002 and 2003 cropping seasons. The mean annual rainfall for the two seasons was 494 mm and 653 mm, respectively. The mean minimum and maximum temperatures during the rainy season in 2002 were 24.86°C and 36.34°C, respectively, and for 2003 23.74°C and 34.62°C, respectively.

Ex-Dakar an upright, early maturing spanish valencia variety, tolerant to drought, and highly susceptible, but tolerant to both early and late cercospora leaf spots was used. The four fungicides were Benlate 50 WP (1.0 kg a.s./ha), Trimangol 80 WP (2.0 kg a.s./ha), Ridomil 72 WP (1.5 kg a.s./ha) and Bentex T (1.25 kg a.s./ha). A 6 litre Volpi hand sprayer was used to apply the fungicides. The experiments were laid out in a strip plot design with three replications. Each plot measured 3x5 m and one replication consisted of 15 plots. Spacing of 50 cm was maintained between plots and 2 m between replications. Sowing was done on the 16th July in 2002 and 17th July in 2003 when the rainfall was fully established. The seeds were sown at a spacing of 35x25 cm and at a rate of one seed per stand. Recommended cultural practices except for fertilizer application were carried out. No seed dressing chemical was used.

Three spray regimes were evaluated: one, two and three sprays in the season. The sprays were done fortnightly. The first fungicide spray was applied at 28 days after sowing (DAS). The one spray regime consisted of a single spray at 28 DAS only, two spray regime consisted of spraying at 28 DAS followed by another spray at 42 DAS (two sprays in the season) while the three spray regime consisted of sprays at 28 DAS, 42 DAS and 56 DAS. Disease incidence and severity assessments started a week after the third spray (*i.e.* at 63 DAS). Control plots remain unsprayed.

Natural inoculum was relied upon because the site has been cropped with cercospora leaf spot susceptible local groundnut variety "Damboa local" for five successive years and the inoculum potential of the soil was very high. The inoculum load was maintained by harrowing the residues from previous seasons' groundnut crop into the soil before the onset of the rains each year. The combined effect of the two leaf spots was assessed because it is more devastating than their individual effects.

Incidence of cercospora leaf spot and disease severity were taken at 63 DAS, 77 DAS and 91 DAS in both seasons. Disease incidence (DI) was assessed by counting the number of plants showing leaf spot symptoms in each net plot and expressing it as percentage of the total stands in the net plot:

$$DI = \frac{\text{Number of infected plants/plot}}{\text{Total number of plants/plot}} x100$$

Disease severity (early and late leaf spots combined) was assessed on a scale of 1–9 as described by Subrahmanyam *et al.* (1995) 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%, 9 = 81–100%. It was based on 20 tagged plants randomly selected from the middle rows of each plot. Obtained data were computed using the formula:

$$DS = \frac{\sum n}{N x 9} x100$$

where: DS – cercospora leaf spot severity (%),
$\sum n$ – sum of individual ratings,
N – total number of plants assessed,
9 – highest score on the severity scale.

Hundred seed weight was determined by counting and weighing 100 seeds randomly taken from the seed yield of each plot. Four replicates of 100 seeds were taken per plot. Seed yield was estimated by weighing dried seeds from each net plot and expressed in kg/ha. The haulm yield was estimated by weighing the dried haulms from each net plot and expressed in kg/ha.

All data obtained were subjected to analysis of variance based on strip plot design and the difference between means compared using Duncan's Multiple Range Test.

RESULTS

Table 1 shows the efficacy of the four fungicides and three spray regimes on the incidence of cercospora leaf spot in 2002 and 2003. In general, the four fungicides significantly reduced the incidence of disease compared to the control in both seasons for the three evaluation dates. However, treatment with Bentex T consistently contributed to the lowest incidence of the disease in both seasons for the three evaluation dates followed by Benlate 50 WP. Application of Trimangol 80 WP and Ridomil 72 WP reduced moderately the disease incidence in most cases though not significantly compared to Benlate 50 WP. The incidence of the disease was generally higher in 2003 than in 2002. The combined analysis also showed significantly lower disease incidence on plots sprayed with Bentex T followed by Benlate 50 WP. Trimangol 80 WP and Ridomil 72 WP also gave moderate control. Three sprays with the fungicides in the season also significantly reduced the incidence of the disease compared to a single and double applications. The combined analysis also followed similar trends. There was no significant difference between one and two sprays with the fungicides. However, interaction of fungicides and spray regime with the incidence of the disease was not significant in both seasons (Table 1).

Table 1. Effect of fungicides and spray regime on the incidence of cercospora leaf spot in 2002 and 2003 seasons at Maiduguri, Sudan savanna

Treatment	Cercospora leaf spot incidence [%]								
	63 DAS			77 DAS			91 DAS		
	2002	2003	combined	2002	2003	combined	2002	2003	combined
A. Fungicides									
Benlate	38.7 bc	45.6 c	42.1 bc	48.9 bc	58.0 bc	54.2 bc	59.2 bc	70.0 cd	65.3 cd
Trimangol	49.5 b	55.6 b	46.8 b	59.6 b	71.6 b	67.6 b	68.7 b	87.6 ab	83.7 b
Ridomil	42.1 bc	51.6 bc	42.5 bc	52.1 bc	66.5 bc	60.3 bc	64.1 bc	81.4 bc	72.8 bc
Bentex T	33.3 c	37.2 c	35.2 c	44.3 c	47.9 c	45.4 c	52.3 c	58.6 d	55.2 d
Control	84.1 a	82.3 a	83.2 a	100.0 a	100.0 a	100.2 a	100.0 a	100.0 a	100.0 a
SE±	4.868	5.339	5.21	5.617	6.879	6.71	6.343	8.423	8.31
B. Spray regime									
Once	59.5 a	62.0 a	61.1 a	73.3 a	79.9 a	78.7 a	87.1 a	97.8 a	96.4 a
Twice	48.9 ab	56.9 ab	53.9 ab	63.7 ab	73.3 ab	69.4 ab	78.5 b	89.7 a	80.9 b
Thrice	40.2 b	44.7 b	41.1b	48.3 b	57.4 b	52.5 b	56.4 c	71.2 b	63.8 c
SE±	2.368	4.220	2.89	2.732	5.437	3.73	3.1	6.654	4.89
C. Interaction									
A x B	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.

Column means followed by the same letter are not significantly different at p = 0.05 probability level according to Duncan's Multiple Range Test
n.s. – not significant at p = 0.05
DAS – days after sowing

The effects of fungicides on severity of the disease also showed that treatment with Bentex T significantly reduced cercospora leaf spot severity in the two seasons at the three evaluation dates though it did not differ significantly from treatment with Benlate 50 WP in most of evaluation dates (Table 2). There was no significant difference between treatment with Trimangol 80 WP and Ridomil 72 WP in most cases. However, all the four fungicides significantly reduced the disease severity below that of the control. Three applications of the fungicides also significantly reduced severity of the disease compared to one and two sprays in the season (Table 2). The interaction of fungicides and spray regimes showed significant effects on the disease severity at 91 DAS in 2002 and at 63 DAS in 2003 and combined analysis at 63 DAS, 77 DAS and 91 DAS.

Table 2. Effect of fungicides and spray regime on severity of cercospora leaf spot in 2002 and 2003 seasons at Maiduguri, Sudan savanna

Treatment	Cercospora leaf spot severity [%]								
	63 DAS			77 DAS			91 DAS		
	2002	2003	combi-ned	2002	2003	combi-ned	2002	2003	combi-ned
A. Fungicides									
Benlate	32.2 c	41.5 c	35.4 cd	40.5 c	50.3 bc	44.5 bc	44.6 c	57.4 c	51.0 c
Trimangol	35.3 b	46.0 b	40.6 b	41.5 b	53.3 b	47.4 b	48.2 b	62.4 b	55.3 b
Ridomil	35.2 b	41.8 c	36.8 c	41.4 b	53.8 b	47.6 b	45.0 c	64.3 b	55.2 b
Bentex T	32.1 c	41.1 c	34.8 d	38.7 c	49.3 c	43.9 c	43.1 c	50.8 d	48.6 c
Control	44.6 a	58.3 a	51.3 a	52.7 a	68.7 a	60.6 a	61.4 a	78.9 a	70.1 a
SE±	0.988	1.430	0.934	1.313	1.761	1.532	1.346	1.520	1.424
B. Spray regime									
Once	42.4 a	52.7 a	47.3 a	49.8 a	64.6 a	57.2 a	57.9 a	74.5 a	66.2 a
Twice	38.2 b	50.1 b	44.1 b	45.4 b	59.1 b	52.2 b	52.5 b	68.2 b	60.3 b
Thrice	29.9 c	40.2 c	35.2 c	35.5 c	54.7 c	40.6 c	41.0 c	52.8 c	46.9 c
SE±	0.641	0.84	0.685	0.697	0.960	0.828	0.725	0.77	0.741
C. Interaction									
A x B	n. s.	*	*	n.s.	n.s.	*	*	n.s.	*

Column means followed by the same letter are not significantly different at p = 0.05 probability level according to Duncan's Multiple Range Test
*significant at p = 0.05
n.s. – not significant
DAS – days after sowing

The interaction of fungicides and spray regimes at 91 DAS in 2002 showed that three sprays with Bentex T gave the lowest disease severity followed by three sprays with Benlate 50 WP (Table 3). Similarly, at 63 DAS in 2003 triple application of Bentex T gave the lowest disease severity followed by three applications of Benlate 50 WP (Table 3). Generally three applications of the four fungicides gave the lowest disease severities than one and two sprays during the season.

Table 3. Interaction of fungicides and spray regime on cercospora leaf spot severity at 91 DAS in 2002 and 63 DAS in 2003 seasons

Treatment	Cercospora leaf spot severity [%]					
	2002			2003		
	91 DAS			63 DAS		
	once	twice	thrice	once	twice	thrice
Benlate	52.9 cde	45.9 d–g	35.7 g	47.8 bcd	44.0 cde	34.2 de
Trimangol	56.2 bc	55.3 b–e	42.5 fg	53.3 bc	53.6 bc	46.8 b–e
Ridomil	55.5 bcd	52.6 cde	42.2 g	52.8 bc	50.2 bc	40.7 cde
Bentex T	51.9 cde	45.8 efg	26.1 h	41.0 cde	43.1 cde	33.6 e
Control	58.5 b	62.8 b	72.8 a	62.7 ab	59.5 b	65.8 a
SE±		2.132			2.150	

Means within DAS followed by the same letter are not significantly different at p = 0.05 probability level according to Duncan's Multiple Range Test
DAS – days after sowing

Table 4. Effect of fungicides and spray regime on 100 seed weight, seed and haulm yield

Treatment	100 seed weight [g]			Seed yield [kg/ha]			Haulm yield [kg/ha]		
	2002	2003	combi-ned	2002	2003	combi-ned	2002	2003	combi-ned
A. Fungicides									
Benlate	30.2 b	36.1 b	33.2 bc	1697 a	2242 a	1963 a	5974 a	6572 a	6273 ab
Trimangol	30.4 b	36.0 b	33.0 c	1372 ab	1812 ab	1808 a	5674 a	6379 a	6188 b
Ridomil	30.0 b	36.6 b	33.5 b	1576 a	2075 ab	1587 c	5893 a	6482 a	6273 ab
Bentex T	32.0 a	38.4 a	35.2 a	1716 a	2263 a	1979 a	6131 a	6722 a	6426 a
Control	28.7 c	34.4 c	31.5 d	962 b	1270 b	1111 d	4752 b	5166 b	4959 c
SE±	0.217	0.264	0.24	91.0	121.0	104.2	96.7	129.9	112.2
B. Spray regime									
Once	29.5 b	35.4 b	32.4 c	939 b	1239 b	1085 c	5088 c	5593 b	5341 c
Twice	30.1 ab	36.2 ab	33.2 b	1454 a	1920 ab	1680 b	5611 b	6172 b	5892 b
Thrice	31.2 a	37.4 a	34.3 a	2028 a	2672 a	2341 a	6355 a	7027 a	6691 a
SE±	0.170	0.193	0.18	71.1	95.3	81.7	77.68	91.37	82.57
C. Interaction									
A x B	*	*	*	*	*	*	*	*	*

Column means followed by the same letter are not significantly different at p = 0.05 probability level according to Duncan's Multiple Range Test
*significant at p = 0.05

The highest 100 seed weight was obtained for sprays with Bentex T in 2002. The control had the lowest 100 seed weight of 28.7 g. Application of the other fungicides also gave higher seed weight than the control (Table 4). Similar trends also followed in 2003 with the highest seed weight from plots sprayed with Bentex T. The combined analysis also showed that spraying with Bentex T gave higher seed weight. Seed yield of 1716 kg/ha was obtained after spraying with Bentex T in 2002 followed by spraying with Benlate 50 WP while the lowest seed yield of 962 kg/ha was recorded from unsprayed plots. Similar trends followed in 2003 with the highest seed yield from plots sprayed with Bentex T and Benlate 50 WP. The combined analysis also showed that spraying with Bentex T gave higher seed yield than the spraying with other fungicides. Three sprays with the fungicides also gave the highest seed weight and seed yield compared to one and two sprays in both seasons (Table 4).

Haulm yield was higher in plots sprayed with Bentex T followed by Benlate 50 WP in 2002. The lowest haulm yield of 4752 kg/ha was reorded in the control. Similarly, in 2003 spraying with Bentex T resulted in haulm yield of 6722 kg/ha which was higher than in the other treatments. This was followed by treatment with Benlate 50 WP though the differences were not significant. The combined analysis also showed that treatment with Bentex T gave the highest haulm yield (Table 4). The application of Trimangol 80 WP and Ridomil 72 WP gave moderate seed and haulm yield.

Table 5. Interaction of fungicides and spray regime on 100 seed weight, seed and haulm yield in 2002 cropping season

Treatment	100 seed weight [g]			Seed yield [kg/ha]			Haulm yield [kg/ha]		
	spray regime								
	once	twice	thrice	once	twice	thrice	once	twice	thrice
Benlate	29.0 c	31.0 bc	32.0 a	963 ef	1523 c–f	2463 ab	5204 de	5915 cd	6815 ab
Trimangol	28.7 c	29.0 c	31.0 ab	933 ef	1359 cde	1805 abc	5048 de	5559 cde	6278 abc
Ridomil	29.0 c	30.0 bc	31.7 ab	941 de	1426 cde	1992 abc	5155 de	5815 bcd	6804 ab
Bentex T	30.0 bc	32.0 a	32.0 a	1042 de	1716 a–d	2527 a	5252 de	6015 bcd	7126 a
Control	28.0 c	28.7 c	29.7 c	800 f	1172 def	1255 bcd	4752 e	4753 e	4758 e
SE±		0.256			122.0			131.3	

Means within parameters followed by the same letter are not significantly different at p = 0.05 probability level according to Duncan's Multiple Range Test

The interaction of fungicides and spraying regime had significant effects on seed weight, seed and haulm yield in both seasons. In 2002, three sprays with Bentex T gave the highest seed weight followed by Benlate 50 WP though they were not significantly different from the treatments with the other fungicides. The control had relatively lower seed weight (Table 5). Similarly, seed and haulm yield were higher with three sprays of Bentex T and Benlate 50 WP though the difference were not significant. Also in 2003 three sprays with Bentex T gave higher seed weight, seed

and haulm yield than the other treatments and the control (Table 6). In general, seed weight, seed and haulm yield were higher in 2003 than 2002 and also higher for three sprays compared to one and two sprays for both seasons.

Table 6. Interaction of fungicides and spray regime on 100 seed weight, seed and haulm yield in 2003 cropping season

Treatment	100 seed weight [g]			Seed yield [kg/ha]			Haulm yield [kg/ha]		
	spray regime								
	once	twice	thrice	once	twice	thrice	once	twice	thrice
Benlate	34.9 cde	37.3 abc	38.4 ab	1271 ef	2004 cde	2672 abc	5724 def	6506 bcd	7497 a
Trimangol	34.4 e	34.7 de	37.0 abc	1232 ef	1883 def	2383 bcd	5553 ef	6115 cde	7337 ab
Ridomil	34.9 cde	36.0 b–e	38.1 ab	1241 ef	1920 def	2606 abc	5685 def	6397 cd	7485 a
Bentex T	38.5 ab	38.4 ab	38.9 a	1395 def	2266 a–d	3335 a	6617 bc	6617 bc	7772 a
Control	34.5 de	34.5 de	34.7 de	1056 f	1436 c–f	1785 c–f	5227 f	5236 f	5043 f
SE±		0.366			62.2			148.0	

Means within parameters followed by the same letter are not significantly different at p = 0.05 probability level according to Duncan's Multiple Range Test

DISCUSSION

The results obtained showed that Bentex T significantly reduced the incidence and severity of the disease compared to the other fungicides. This was followed by Benlate 50 WP. The corresponding yields following treatment with these chemicals were also higher than with the other chemicals and the control. The efficacy of Benlate as fungicide for controlling cercospora leaf spot has been reported by many authors (Porter 1970; Brenneman and Culbreath 2000; Culbreath *et al.* 2002). It was a major fungicide used for controlling cercospora leaf spot in the USA in the 70ties and 80ties until when resistance to the fungicide developed (Clark *et al.* 1974; Littrell 1974; Hagan *et al.* 2006). In the present study, Bentex T seemed to exhibit higher effect on the fungus than Benlate 50 WP, probably due to the additional effects of thiram component. Trimangol 80 WP and Ridomil 72 WP were less effective in controlling the disease. Three sprays with the fungicides in the season gave a better control of the disease than one or two sprays. Three sprays with Bentex T resulted in the highest control of disease, followed by three sprays with Benlate 50 WP. The effectiveness of benomyl based fungicides in controlling cercospora leaf spot have also been reported by other authors (Campbell *et al.* 2005; Culbreath *et al.* 2002). However previous reports have shown that more than one fungicide spray is needed in a season for effective control (Hagan *et al.* 2003). In the field, the effect of most fungicides did not last more than 2 weeks and hence repeated applications is necessary to provide adequate control of the disease in the season. Moreover, since late leaf spot occurs later in the season

repeated sprays are necessary to provide control of subsequent infections. Disease incidence and severity were generally higher in 2003 than 2002 probably because the year 2002 was drier than 2003 thereby making the conditions less favourable for the growth of most fungal pathogens and especially cercospora leaf spot which spreads better under humid conditions.

Seed yield was the highest on plots treated with Bentex T and Benlate 50 WP in both seasons. Plots treated with Trimangol 80 WP and Ridomil 72 WP gave moderate yield. These results showed clearly that controlling cercospora leaf spot increased yield of groundnut. Seed yield was also higher following three sprays than one or two sprays confirming earlier reports (Hagan *et al.* 2006).

The results of this study have shown that all the fungicides used increased haulm weight over the control, the highest haulm yield was obtained following the application of Bentex T and Benlate 50 WP. This might be due to the effective control of the cercospora leaf spot by the two fungicides. Culbreath *et al.* (2002) reported that higher control of cercospora leaf spot was achieved with mixture of benomyl and chlorothalonil. Also Smith and Littrell (1974) reported that using mixture of benomyl and mancozeb reduced resistance development by cercospora leaf spot fungus and gave effective control of the disease. Similar results have also been reported by Trivellas (1988). In our study also Bentex T which is a mixture of benomyl and thiram gave a better control than Benlate 50 WP. Increased haulm yield following the application of fungicides have earlier been reported by other authors (Hagan *et al.* 2003). Haulm weight was also found to increase with number of sprays in the season. Seed weight was found to be slightly higher on protected crops than on the unprotected ones.

Since resistant varieties to cercospora leaf spot are not available to the farmers in the study area, chemical control of the disease might still be an option to adopt for reducing build up of inoculum in the environment and the level of cercospora leaf spot damage to groundnut so that optimum production of the crop could be achieved.

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POLISH SUMMARY

SKUTECZNOŚĆ NIEKTÓRYCH FUNGICYDÓW W OCHRONIE ORZECHA ZIEMNEGO PRZED CERKOSPOROZĄ LIŚCI W REJONIE SUDAŃSKIEJ SAWANNY NIGERII

W artykule przedstawiono wyniki badania skuteczności fungicydów Benlate 50 WP (benomyl), Bentex T (benomyl +tiuram), Ridomil 72 WP (metalaksyl) i Trimangol 80 WP (maneb) w zwalczaniu plamistości liści wywoływanej przez *Cercospora arachidicola* i *Phaeoisariopsis personata*. Porównywano również efektywność 3 programów zwalczania, w których fungicydy stosowano jednorazowo, dwukrotnie lub trzykrotnie.

Badania były prowadzone w rejonie sudańskiej sawanny Nigerii, w latach 2002 i 2003. Artykuł zawiera informacje dotyczące wpływu stosowanych zabiegów na wysokość plonu nasion oraz naci na występowanie i nasilenie porażenia, z uwzględnieniem korelacji między poszczególnymi czynnikami doświadczalnymi.

Wszystkie zastosowane preparaty istotnie ograniczały występowanie choroby oraz przyczyniały się do istotnego wzrostu plonu w porównaniu do niechronio-

nej kombinacji kontrolnej. Najlepsze wyniki uzyskano po zastosowaniu preparatu Bentex T oraz 3 zabiegów opryskiwania roślin w sezonie wegetacyjnym. Preparaty Ridomil 72 WP i Trimangol 80 WP ograniczały występowanie i nasilenie choroby w istotnie niższym stopniu. Najwyższy plon nasion wynoszący w latach 2002 i 2003, odpowiednio 1716 kg/ha i 2263 kg/ha uzyskano stosując preparat Bentex T, natomiast najniższy plon w wysokości 962 kg/ha i 1270 kg/ha w niechronionej kontroli. Również plon naci orzecha ziemnego używanej jako paszy dla zwierząt i jej zdrowotność były najwyższe po zastosowaniu Bentexu T. W większości przypadków wyniki uzyskane przy użyciu tego preparatu nie różniły się istotnie od wyników zastosowania preparatu Benlate 50 WP. Wpływ preparatów Ridomil 72 WP i Trimangol 80 WP na wysokość plonu był istotnie niższy, ale statystycznie wyższy w porównaniu do niechronionej kombinacji kontrolnej. W przeprowadzonych doświadczeniach udowodniono celowość stosowania chemicznej ochrony orzecha ziemnego przed plamistością liści wywoływaną przez *C. arachidicola* i *P. personata*, zwłaszcza preparatami Bentex T i Benlate 50 WP, co pozwoli na zwiększenie produktywności upraw tej rośliny w Nigerii, w rejonie sudańskiej sawanny.