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EARLY SOWING AND METALAXYL SEED TREATMENT REDUCED INCIDENCE OF PEARL MILLET DOWNY MILDEW [*SCLEROSPORA GRAMINICOLA* (SACC.)] IN SAMARU, NIGERIA

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Abstract: Three separate field experiments were conducted in 2001, 2002 and 2003 to determine the efficacy of combining sowing date, seed treatment with metalaxyl and use of host plant resistance for the control of pearl millet downy mildew. Early sowing gave lower disease incidence and higher grain yield than late sowing. The disease was controlled when metalaxyl treated seeds were sown early. The highest disease incidence and the lowest grain yields were obtained when untreated seeds were sown late. Use of resistant pearl millet cultivar along with seed treatment using metalaxyl at the dose of 2 g a.i./kg seeds greatly reduced disease incidence and increased grain yield in comparison with the seed treatment of susceptible cultivar.

Key words: downy mildew, *Sclerospora graminicola,* pearl millet, metalaxyl, early sowing, resistant cultivars

INTRODUCTION

Pearl millet [*Pennisetum glaucum* (L.)] is a staple diet of many tropical and subtropical countries. The total area under pearl millet cultivation is about 37.7 million hectares, out of which 18.2 hectares are in Africa and 17.7 in India (FAO 1995). Amongst the 20 pathogens known to infect the pearl millet crop, downy mildew, *Sclerospora graminicola* (Sacc.) Schroet, is the most widely spread and most destructive (Singh et al. 1993). The disease is widely distributed in the temperate and tropical areas of the world, but especially important in Africa and India (Singh et al. 1993). First reported in India in 1907 by Butler, this disease is now found in more than 20 countries, causing variable losses (Singh et al. 1993; Jeger et al. 1998). Estimated yield losses of 10 – 55% in Nigeria (King 1970; Selvaraj 1978) and 34–57% in India (Gupta and Singh 1996) have been reported.

The effect of seed treatment has been reported by Williams and Singh (1981), Williams (1984) and Singh and Shetty (1990). Metalaxyl as seed treatment was able to reduce pearl millet downy mildew (PMDM) incidence by 80% at a rate of 2 g a.i/kg seeds (Reddy et al. 1991; Shishupala et al. 1990). Effective control of downy mildew of maize and sorghum using metalaxyl as seed treatment have also been reported by different scientists (Anaso 1985; Odvody and Frederiksen 1984) Metalaxyl protects seedlings for the first 20–30 days after sowing (Anahosur and Patil 1980; Anaso 1985; Williams 1984). In millet, however, the tillers produced after 30 days after sowing (DAS) are susceptible, hence metalaxyl seed treatment alone does not provide satisfactory control of PMDM (Subramanya et al. 1981). There is also the risk of metalaxyl becoming ineffective with time because of its narrow spectrum of activity. Already, there are reports of a decline in its effectiveness against certain phycomycetes (Reuveni et al. 1980; Edgington and Bruin 1981). To ensure longevity of metalaxyl, Jeger et al. (1998) suggested that it should be combined with other fungicides or/and other disease management strategies including use of resistant cultivars and cultural practices.

Early sowing has been reported as an effective control method against PMDM. Singh et al. (1987), Singh et al. (1993) and Chahal et al. (1978, 1994) reported that crops sown early in the season before sporangial inoculum level have built up, usually escape infection or have very low infection by soil-borne oospores. Thakur (1992) and Sevaraj (1987) recorded increased downy mildew incidence when pearl millet sowing was delayed. Similar results were obtained with sorghum downy mildew by Anaso (1987) and Tuleen et al. (1980). Early sowing as a control method, however, is sometimes impracticable and unsatisfactory because of variability in rainfall patterns and tillering ability of pearl millet.

Host plant resistance provides a practical and economic method of controlling PMDM and is also environmentally friendly. There are many reports in literature of screening pearl millet and resistance in pearl millet have been reported on many occasions (Singh et al. 1993; Singh et al. 1987; Anonymus 1994, 1995). *Sclerospora graminicola* is a heterothellic, host specific and highly variable pathogen hence virulence of the oospore population gradually shifts to fit the genotype of the pearl millet cultivar grown, thereby breaking the resistance (Singh et al. 1993). In India, several downy mildew resistant pearl millet cultivars were withdrawn 2–3 years after their release because they became susceptible to the pathogen new population. These were replaced with other cultivars resistant to the new population.

Due to the limitation associated with the different individual control methods, integrated pest management approach seems the most effective. Integrated control involves the use of two or more methods of control to reduce disease incidence. It was in this view that chemical (seed treatment), cultural control (sowing date) and use of host resistance were evaluated in combinations against PMDM.

MATERIAL AND METHODS

Three separate field experiments were conducted in 2001, 2002 and 2003 at Samaru (lat. 11°11'N; long. 7°38'E and 686 m above sea level), which is in the Northern Guinea Savanna (NGS) agro-ecological zone of Nigeria. The first trial was

to determine the optimum sowing date for pearl millet using a local variety (Zango), while the second and third were to determine the efficacy of sowing date and cultivar in combination with seed treatment. The first trial had six treatments, consisting of six sowing dates, starting from June 16th to August 5th at 10-day intervals. The treatments were sown in randomised complete block design (RCBD) with three replications. Disease incidence (number of diseased plants expressed as a percentage of total number of plants in a plot) was recorded at 25, 35, 45, 55 and 65 days after sowing (DAS). Disease severity was scored on a 1–5 scale as described by Williams et al. (1981), where: 1 = no disease; 2 = symptoms on aerial tillers only; 3 = symptoms on less than 50% basal tillers; 4 = symptoms on more than 50% basal tillers; and 5 = total destruction of stand or no production of normal head.

Per cent disease severity index was calculated using a formula described by Williams et al. (1981) as follows:

$$\frac{n_1(1-1)+n_2(2-1)+n_3(3-1)+n_4(4-1)+n_5(5-1)}{N(5-1)}\times 100$$

where, n_1–n_5 = number of plants with different disease grades described in the 1–5 scale above ; N = total number of plants assessed.

In the subsequent season, the best four sowing dates were used along with a seed treatment fungicide (metalaxyl) at a rate of 2 g a.i/kg seed. The trial was also sown in a randomised complete block design (RCBD) with three replications. Disease incidence and severity were also recorded as in the first trial.

In the third trial, treatments were made up of two cultivars (Zango, a local pearl millet cultivar commonly grown by farmers around and SE2124, downy mildew resistant cultivar) with and without metalaxyl seed treatment at a rate of 2g a.i/kg seed. Disease incidence and severity were recorded as earlier described. In all the three trials the grain yield was recorded

The data collected were subjected to analysis of variance and means were separated by the least significant difference (LSD).

RESULTS AND DISCUSSIONS

Downy mildew incidence and severity in pearl millet is influenced by sowing date (Table 1). There were significant differences between the treatments in respect of downy mildew incidence, severity and grain yield. Early- sown (June 16 and 26) crops had lower disease incidence, severity and higher grain yield, than late-sown crops. There were no significant differences between the last 3 sowing dates, however, the August 5th sowing could not produce grain due to cessation of rains. The early-sown crops must have escaped infection at the most susceptible seedling stage as reported by Cohen and Sharma (1977) in Israel. Thakur (1992) recorded an increased incidence of pearl millet downy mildew when sowing was delayed. Similar results were reported by Selveraj (1987), Chahal et al. (1994), Singh and Williams (1980), Singh et al. (1993). Anaso (1989) reported reduced incidence of sorghum downy mildew on maize and increased gain yield in early-sown crop in Nigeria. The best sowing

Table 1. Effect of sowing date on pearl millet downy mildew using a local variety Zango

Treatment	2000				2001			
	30 DAS Disease incidence (%)	60 DAS Disease incidence (%)	60 DAS Disease severity (%)	Grain yield (kg/ha)	30 DAS Disease incidence (%)	60 DAS Disease incidence (%)	60 DAS Disease severity (%)	Grain yield (kg/ha)
June 16	0.3	2.2	0.1	1359	0.0	3.0	0.1	1310
June 26	2.4	6.0	0.3	1267	2.0	5.8	0.4	1056
July 6	8.0	15.2	1.1	1208	7.4	18.5	2.1	639
July 16	10.9	22.1	2.1	273	11.4	32.4	2.8	375
July 26	12.0	19.0	1.9	193	11.8	30.5	2.6	205
August 5	13.0	14.4	2.0	–	12.0	16.3	2.7	–
LSD (p=0.05)	2.1	3.92	0.40	134	2.3	4.2	0.43	533

DAS – Days after sowing

time for pearl millet in Samaru, therefore, is between mid June to first week of July, when the crop is likely to get low infection and high grain yield.

Table 2 shows that early-sown plots had lower population only when the seeds were not treated, although the difference was not significant. The lowest plant population was obtained in late-sown plots even when treated seeds were sown. The disease incidence at 30 days after sowing (DAS) was also variable depending on the treatment. Plots sown with untreated seeds had higher disease incidence, which increased with late sowing dates. At dough stage, disease incidence was the highest in late sown plots where untreated seeds were used. Late sowing with treated seeds had the same level of disease as early sowing with untreated seeds. At dough stage the effect of sowing date is clearly seen when protection from metalaxyl is over. Anahosur and Patil (1980) and Anaso (1985) reported that metalaxyl is effective between 20–30 days after sowing (DAS). In pearl millet, however, secondary and tertiary tillers produced after 30 days after sowing (DAS) remain susceptible, although the main stem is susceptible only in the first 26 DAS (Subramaya et al.

Table 2. Effect of sowing date and seed treatment on pearl millet downy mildew using a local variety Zango

Treatment (sowing date +seed treatment)	Plant population	30 DAS Disease incidence (%)	60 DAS Disease incidence (%)	Grain yield (kg/ha)
June 16 + metalaxyl	126	0.0	0.0	1302
June 16 only	102	2.5	5.3	1283
June 26 + metalaxyl	123	0.03	1.93	1300
June 26 only	100	2.44	6.36	1251
July 6 + metalaxyl	124	0.09	2.71	1270
July 6 only	99	9.42	4.50	1028
July 16 + metalaxyl	97	1.03	4.64	870
July 16 only	82	10.81	24.62	750
LSD (p = 0.05)	23	0.14	1.72	252

DAS – Days after sowing

1981). In early-sown plots using treated seeds, the main stem is protected against soil-borne oospore infection, while the tillers are produced when sporangia infection is low due to dry weather, hence escaping infection. Sporangial production, dispersal and infection is favoured by high relative humidity and low temperature (Singh et al. 1987, 1993).

Table 3 shows that there are significant differences among treatments in respect to plant population, disease incidence and grain yield. Seed treatment gave high plant population irrespective of the cultivar; however, there was no significant difference between improved downy mildew resistant cultivar and local cultivar in terms of germination expressed as plant population. At 30 DAS disease assessment, there was no significant difference between local and improved cultivars when both were treated with metalaxyl. The plots sown with treated seeds had lower disease than those sown with untreated seeds irrespective of the cultivar. At dough stage assessment, there were significant differences between the treatments, with treated downy mildew resistant cultivar having the lowest disease incidence, while the untreated local cultivar had the highest. The effect of host plant resistance is clear at dough stage (65 DAS), where disease incidence observed in plots sown with untreated seeds of the downy mildew resistant cultivar was lower than those sown with treated and untreated seeds of a local susceptible cultivar. Combining resistant cultivar with seed treatment does not only reduce the disease incidence and increases grain yield but extends the life of the host resistance and prevents de-

Table 3. Effect of seed treatment and variety on pearl millet downy mildew

Treatment	Plant population	30 DAS Disease incidence (%)	60 DAS Disease incidence (%)	Grain yield (kg/ha)
		2001		
Zango only	125	–	23.6	1176
Zango+ metalaxyl	160	–	2.30	1325
SE2124 only	130	–	1.50	1200
SE2124+ metalaxyl	162	–	0.33	1300
LSD (p=0.05)	20	–	0.04	200
		2002		
Zango only	32	7. 14	8.82	1052
Zango + metalaxyl	50	0.0	3.40	1198
SE2124 only	39	6.39	7.27	1194
SE2124+ metalaxyl	51	0.00	0.0	1296
LSD (p=0.05)	17.3	0.03	0.66	127
		2003		
Zango only	45	16.77	19.7	1100
Zango + metalaxyl	58	1.35	5.38	1361
SE2124 only	44	9.02	3.60	1103
SE2124+ metalaxyl	60.0	0.68	2.99	1322
LSD (p=0.05)	12.0	0.69	0.39	201

DAS – Days after sowing

velopment of fungicide résistance (Odvody and Frederisksen 1981). Mbaye (1994) reported host plant resistance to be the most valuable for control of pearl millet downy mildew, although seed treatment with metalaxyl can contribute further to decreasing disease incidence.

For maximum grain yield and better control of downy mildew in pearl millet, resistant, high yielding cultivar should be seed dressed and sown early. Where any of the three factors is not obtainable, the other two could be combined for better downy mildew control and high grain yield.

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POLISH SUMMARY

WCZESNY SIEW I ZAPRAWIANIE NASION METALAXYLEM OBNIŻA NASILENIE MĄCZNIAKA PRAWDZIWEGO [*SCLEROSPORA GRAMINICOLA* (SACC.)] W UPRAWACH PROSA PERŁOWEGO [*PENISETUM GLAUCUM* (L.) W NIGERII

W polowych doświadczeniach prowadzonych w latach 2001–2003 w Samara (Nigeria) wykazano, że zaprawianie nasion prosa perłowego (*Penisetum glaucum*) metalaksylem w dawce 2 g s.a./kg nasion skutecznie chroniło rośliny przed porażeniem przez mączniaka właściwego (*Scleropsora graminicola*).