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PERFORMANCE OF PEARL MILLET (*Pennisetum glaucum* (L.) VARIETIES AS INFLUENCED BY NITROGEN RATES AND FUNGICIDE LEVEL IN NORTHERN GUINEA AND SUDAN SAVANNA, AGRO-ECOLOGIES OF NIGERIA

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ABSTRACT

Field trials were conducted at the Teaching and Research Farm, University of Maiduguri and Abubakar Tafawa Balewa University Bauchi to determine the effect of fungicide and nitrogen rates on pearl millet varieties during 2014 cropping season. A randomized complete block designed was used to evaluate two pearl millet varieties (Super sosat and PEO5984): fungicide treatments (Untreated and Metalaxyl-treated) and four nitrogen rates (0, 15, 30, 45 and 60 kg N/ha), each replicated three times. The results showed that pearl millet growth and yield parameters were significantly higher for PEO5984 than Super sosat. Percentage establishment score were not affected by pearl millet variety while plant height was greater for Super sosat. Similarly, Number of pannicles per plot while pannicles length/plant and panicle weight per plot were higher with Super sosat variety. For 1000-grain weight, number of pannicles per plant and grain yield per hectare were significantly higher for PEO5984 variety compared with Super sosat. Increase in N-rates significantly increased growth and yield/ha of millet. In-case of fungicide, untreated seeds with matalaxyl recorded lower values than treated seeds. Thus, pearl millet PEO5984 treated with matalaxyl in combination with 60 kg N/ha proved beneficial and enhanced the productivity of the system in Northern Guinea and Sudan Savanna of Nigeria.

Keywords: Pearl millet; nitrogen rates; fungicides; Guinea and Sudan savanna

INTRODUCTION

Pearl millet (*Pennisetum glaucum* L.) is an important food crop widely cultivated in Africa and India. Estimated global area of its production was 24.2 million ha with approximately 45% of the world's production in West Africa, where it is of major importance (FAO, 2014). Pearl millet is the sixth most important cereal in the world, after rice, wheat, maize, barley and sorghum (Anonymous, 2010). In Nigeria, the crop is cultivated on about 5.0 million hectares of land, with annual production of 3.4 million metric tons (FAOSTAT, 2011). Nigeria is the leading producer of pearl millet, covering about 28% of the global production. Pearl millet is a nutritious crop, producing almost all the required nutrients

needed by human (Izge *et al.*, 2007). Filardi *et al*. (2005) reported that pearl millet produces higher protein content levels than maize and has approximately 85% of the energy content of maize. It also contains higher amount of carotene, riboflavin (Vitamin B2) and niacin Vitamin B4 (Singh *et al*., 2009).

Pearl millet plays significant role in food security of the entire drier regions of Northern Nigeria (Izge *et al.*, 2007). Regrettably, its yield and potentials are constrained by many factors, comprising pest, diseases and soil fertility (FAO, 2014) since the soils of the millet growing areas are predominantly sandy, low in organic matter and inherent soil fertility (Ajayi *et al*. 1998). Furthermore, downy mildew has impeded progress in millet production while several other improved varieties have succumbed to the disease (Williams 1984).

Fungicides like Metalaxyl protect the crop against soil borne pests such as termites and diseases and thereby permit vigorous growth of the crop (Aliyu *et al*., 2011). When applied as seed dressing chemical, Matalaxyl protects the seeds against soil and seed borne diseases (Aliyu *et al*., 2011). Further impetus to the present study stemmed from Deshmukh *et al*. (1978) that nitrogen is reported to enhance crop vigour against diseases. Thus, we hypothesize that inclusion of Matalaxyl into pearl millet production and application of nitrogen may improve performance of pearl millet. The aim of this study is therefore, to determine the response of pearl millet varieties to fungicide and nitrogen in two agro ecologies of Northern and Sudan savanna, Nigeria.

MATERIALS AND METHODS

Experimental Site

Multi-locational trials were conducted during 2014 rainy season at Abubakar Tafawa Balewa University Teaching and Research Farm, Bauchi (latitude 10^0 17' N, 9^0 49' E and 690.2 m above sea level) in Northern Guinea Savanna and Lake Chad Research Institute (LCRI) Research Farm, Maiduguri (latitude 11^0 51' N, 13^0 05' E and 315.5 m above sea level) in Northern Sudan Savanna of Nigeria. The total amount of rainfall ranged between 300 – 800 mm.

Treatments and Experimental Design

Treatments comprised millet varieties Super sosat (LCICMV-3) and PEO5984 (LCICMV-4): fungicide treatments (Untreated and Metalaxyl-treated) and nitrogen rates (0, 15, 30, 45 and 60 kg N/ha) laid out in randomized complete block design (RCBD) in three replications. The experimental fields were cleared and harrowed with tractor-driven disc. Soil samples from the two locations were randomly collected at 0-15 cm depth using soil auger. It was then analyzed for physico-chemical properties using standard procedures (Blake and Hartge, 1986). Seeds of pearl millet variety were dressed with Metalaxyl at 10 g satchet/8 kg seeds on the stipulated treatments. Two seeds were planted per hole at 75 × 30 cm in a plot of 5 × 4.5 m. The seedlings were later thinned to 2 per stand at 2 weeks after sowing (WAS). Fertilizer was applied based on the treatments and blanket of 30 kg P_2O_5 ha^{-1} and 30 kg K_2O ha^{-1} in the form of single super phosphate (18% P_2O_5) and murate of potash (60% K_2O), respectively were applied at sowing to all Zero N plots. Nitrogen was applied in 2 split doses. First dose of 30 kg N, 30 kg P_2O_5 and 30 kg K_2O ha^{-1} was applied using NPK (15:15: 15) at 2 weeks after sowing (WAS) to all the N rate plots. The balance of N rates was applied using

Urea (46% N) by side placement at 4 WAS. Weeding was done manually at 3 and 6 WAS. Harvesting was done manually when the crop reaches physiological maturity as observed from the change in leaves' color from green to yellow. PEO5984 variety has a yield potential of 2.5-3 t/ha, 65-70 days to maturity while Super sosat has 1.5-2.5 t/ha, 80-90 days to maturity and both varieties are moderately resistant to both downy mildew and striga (NACGRAB, 2014).

Data Collection

Establishment score (%): This was taken by visual observation. This was done by scoring the established plants and score them on a percentage basis. Establishment score was taken from the net plot area at 6 and 9 WAS.
Plant height (cm): Plant height was taken using meter rule. Measurement was done on the three tagged plants from ground level to the tip of the plant at 3, 6 and 9 WAS.
Number of panicles (22.5 m^2): Number of Panicles per plot were counted and recorded at harvest.
Panicle length (cm): Panicle length was taken from five tagged plants from the net plot area using meter rule. Measurement was done from base to the growing tip at harvest.
Panicle weight per plot (kg): Panicles of three tagged plants from the net plot was determined at harvest. This was achieved by weighing the panicles using weighing scale and the mean determined thereof.
Thousand grain weight (g): Thousand grain weight was determined by counting and weighing 1000 grains using sensitive weighing balance.
Grain yield ha^{-1}: Grain yield per hectare was determined by weighing all the grains harvested from net plot after threshing and winnowing and converted to kilograms per hectare.

$$\text{Grain yield kg}^{-1} = \frac{\text{Seed yield/net plot}}{\text{Net plot area}(m^2)} \times 10{,}000 \ m^2$$

Data Analysis

Data collected were subjected to Analysis of Variance (ANOVA) using Statistix 8.0 Analytical Software Package (Statistix, 2005). Difference between means were compared using Least Significant Difference (LSD) at 5% level of probability, while significant interactions were compared using Duncan Multiple's Range Test (DMRT) also at 5% level of probability.

RESULTS

Analysis of the top (0-15 cm) soil sampled from the sites prior to sowing revealed sandy loam as textural class consisting of 67.4% vs 75.3% (sand), 6.3% vs 10.9% (silt), and 26.3% vs 13.8% (clay), at Bauchi and Maiduguri, respectively. Soil pH at Bauchi was slightly acidic (5.12), neutral (7.24) in Maiduguri. Both locations contained low organic carbon (0.75 - 1.80 g/kg), total N (0.08 - 1.40 g/kg), exchangeable K (0.19-0.88 Cmol/kg) and moderate available P (8.11-14.7 mg/kg) and low cation exchange capacity (4.63-4.51 Cmol/kg). Therefore, the nutrient content of the soils was low according to the FAO ratings (FAO, 1980).

Table 1 present results on effects of pearl millet variety, nitrogen rate and fungicide on percentage establishment score at 6 and 9 WAS at Bauchi and Maiduguri. There was no significant (P>0.05) of the treatments on percentage establishment of pearl millet. Application of 60 kg N/ha lead to higher plant establishment in Bauch at 6 WAS. However, this did not differ with 45 kg N/ha (Table 1). Similar trend was observed in Maiduguri at 6 WAS. Percentage establishment score was higher for seed treated with fungicide compared with untreated. Untreated plots recorded higher establishment score in Bauchi at 9 WAS. In Bauchi at 9 WAS, increase in N resulted into significant ($P \leq 0.05$) increase in establishment score. At 9 WAS in Maiduguri, application of 60 kg N/ha recorded higher percentage establishment. However, this did not differ significantly ($P \leq 0.05$) with 45 and 30 kg N/ha. At both locations, treated plots recorded higher establishment score in Maiduguri. Interaction of millet variety ×fungicide on establishment score was significant ($P \leq 0.05$) at 6 and 9 WAS at Bauchi. In Maiduguri at 9 WAS, nitrogen rate ×fungicide exerted significant ($P \leq 0.05$) effect.

Table 1: Effects of nitrogen fertilizer and fungicide on percent establishment score (%) of pearl millet at 6 and 9 WAS at Bauchi and Maiduguri in 2014 wet season

	Bauchi		Maiduguri	
Treatments	6 WAS	9 WAS	6 WAS	9 WAS
Millet Variety (V)				
PEO5987	95.57	94.43	97.05	93.5
Super Sosat	95.59	93.43	96.89	93.78
LSD (≤ 0.05)	0.73	0.42	0.38	0.68
LSD	ns	ns	ns	ns
Nitrogen Fertilizer (kg/ha) (N)				
0	87.83	84.82	91.24	81.94
15	94.94	92.18	96.53	92.51
30	96.94	95.56	98.07	96.67
45	98.74	97.92	99.30	98.06
60	99.43	99.16	99.72	99.02
SE±	0.40	0.67	0.61	1.08
LSD (≤ 0.05)	1.15	1.95	1.73	3.09
Fungicide (F)				
Treated	97.48	91.89	98.27	96.99
Untreated	93.67	95.97	95.67	90.61
SE±	0.25	0.42	0.38	0.68
LSD (≤ 0.05)	0.72	1.23	1.73	1.95
Interactions				
V × N	ns	ns	ns	ns
V × F	ns	ns	ns	ns
N × F	*	*	ns	*
V × N × F	ns	ns	ns	ns

ns= not significant, WAS= weeks after sowing

Plant height was significantly ($P \leq 0.05$) affected by all the treatments throughout the sampling period at both locations (Table 2). However, at 6 WAS there was no significant effect observed. Super sosat recorded higher plant height throughout the sampled stages ($P \leq 0.05$). by nitrogen rate at all sampling stages in both locations. Increased N lead to significant ($P \leq 0.05$) increase in pearl millet height in both locations. Application of 60 kg N/ha

significantly ($P \leq 0.05$) increase plant height than other rates (Table 2). At all sampling stages, seed treated with fungicide produced taller plants compared with untreated.

Table 2: Effects of variety, nitrogen fertilizer and fungicide on plant height (cm) of pearl millet at 3, 6 and 9 WAS at Bauchi and Maiduguri in 2014 wet Season

	Bauchi			Maiduguri		
Treatments	3 WAS	6 WAS	9 WAS	3 WAS	6 WAS	9 WAS
Millet Variety (V)						
PEO5987	39.47	84.73	188.67	29.79	80.51	164.02
Super Sosat	40.98	85.07	215.81	31.41	79.76	198.89
SE±	0.33	0.69	2.03	0.30	0.30	2.74
LSD (≤ 0.05)	0.97	ns	5.83	ns	ns	7.86
Nitrogen Fertilizer (kg/ha) (N)						
0	25.28	64.56	161.51	25.75	60.38	149.43
15	33.68	76.85	188.90	28.69	69.46	172.88
30	39.75	82.98	207.38	31.05	76.62	184.41
45	48.49	92.92	217.75	32.53	88.87	197.10
60	53.92	107.2	235.66	34.98	105.30	203.45
SE±	0.53	1.04	3.21	0.49	0.96	4.34
LSD (≤ 0.05)	1.53	3.15	9.21	1.39	1.30	12.44
Fungicide (F)						
Treated	44.34	90.38	213.43	33.42	91.34	199.55
Untreated	36.12	76.42	191.05	27.78	68.93	163.36
SE±	0.33	0.69	2.03	0.38	0.60	2.74
LSD (≤ 0.05)	0.96	1.99	5.82	0.88	1.73	7.86
Interactions						
V × N	*	*	ns	ns	ns	ns
V × F	*	*	ns	ns	ns	ns
N × F	*	*	*	*	ns	*
V × N × F	ns	Ns	ns	ns	ns	ns

ns= not significant, WAS= weeks after sowing

Response of variety, nitrogen rate and fungicide on yield components of pearl millet is presented on Table 3. Number of panicles per m^2 were significantly ($P \leq 0.05$) affected by millet variety at Bauchi, where PEO 5984 produced more panicles than Super Sosat. No significant ($P \leq 0.05$) effect of variety on number of panicles was noticed at Maiduguri. In both locations, it was observed that increased application of nitrogen resulted into significant ($P \leq 0.05$) increase in number of panicles per m^2. Application of 60 kg N/ha produced higher number of panicles in both locations. Panicle length per plant was significantly ($P \leq 0.05$) affected by variety (Table 3). Super sosat recorded the longest panicles than PEO 5984 at Bauchi. Increase in N resulted into corresponding increase in panicle length per plant in both locations. Higher panicle lengths were observed with application of 60 kg N/ha. Metalaxyl treated seeds produced a greater number of panicle than untreated at Bauchi. However, at Maiduguri, untreated seeds recorded higher number of panicles per area. Panicle weight per plant and panicle length were higher when treated with metalaxyl. Two ways interactions of V × N and V × F was observed in Bauchi. There was significant ($P \leq 0.05$) 2 and 3 way interaction of V × N and V × F and V × N × F on panicle length per plant at Maiduguri. In both locations, Super sosat variety recorded significantly ($P \leq 0.05$) higher panicle weight per plot than PEO 5984 (Table 3). Application of 60 kg N/ha significantly ($P \leq 0.05$) increased panicle weight than other treatments. Higher panicle weight was observed on

treated seeds. There were two ways interactions of V × N and N × F on panicle weight per plant at both locations. There was significant ($P \leq 0.05$) effect of variety on 1000 grain weight at both locations. Super sosat gave higher 1000 grain weight at Bauchi while at Maiduguri, PEO 5984 produced higher grain weight. One thousand grain weight was significantly ($P \leq 0.05$) increased with increase in N rate in both locations. Application of 60 kg N/ha produced higher grain weight. Weight of 1000 grains was significantly ($P \leq 0.05$) affected by fungicide (Table 4). Seed treated with metalaxyl recorded significantly ($P \leq 0.05$) higher grain weight than untreated seeds. There were two way interactions of N × F on panicle weight per plant at both location ($P \leq 0.05$).

Table 3: Effects of pearl millet variety, nitrogen fertilizer and fungicide on number of panicles per plot, panicle length (cm) and panicle weight per plot (kg) at Bauchi and Maiduguri

	Number of Panicles/plots		Panicle length/plant (cm)		Panicle weight/plot (kg)	
Treatments	Bauchi	Maiduguri	Bauchi	Maiduguri	Bauchi	Maiduguri
Millet Variety (V)						
PEO 5984	131.60	115.30	21.41	19.58	3.47	2.91
Super Sosat	120.57	112.60	27.16	27.44	4.49	3.69
SE±	1.38	1.33	0.21	0.21	0.05	0.04
LSD (≤ 0.05)	3.95	Ns	0.59	0.58	0.14	0.12
Nitrogen (kg/ha) (N)						
0	75.42	51.80	19.24	19.24	2.00	1.30
15	100.42	90.92	22.80	22.38	3.00	2.38
30	125.92	113.92	24.19	23.60	3.88	2.97
45	148.92	113.50	25.78	25.13	4.85	4.15
60	180.25	141.33	28.76	27.20	6.17	5.71
SE±	2.18	2.10	0.21	0.07	0.08	0.07
LSD (≤ 0.05)	6.25	6.02	0.59	0.92	0.22	0.19
Fungicide (F)						
Treated	146.43	92.43	26.00	25.39	4.67	4.01
Untreated	105.73	135.47	22.56	21.63	3.29	2.59
SE±	1.38	1.38	0.21	0.21	0.05	0.04
LSD (≤ 0.05)	3.90	3.80	0.05	0.58	0.14	0.12
Interactions						
V × N	*	*	ns	*	*	*
V × F	*	*	ns	*	ns	Ns
N × F	ns	*	*	ns	*	*
V × N × F	ns	*	ns	ns	ns	Ns

ns= not significant, WAS= weeks after sowing

Performance of pearl millet varieties, nitrogen rate and fungicide on grain yield/ha in Bauchi and Maiduguri is presented in Table 4. Grain yield was higher for PEO 5684 at Bauchi while Super sosat variety gave higher yield in Maiduguri. Grain yield was significantly ($P \leq 0.05$) increased with increase in N rate. Application of 60 kg N/ha recorded the highest grain yield at both locations. There was significant 2 way interaction only of V × N and N × F for Bauchi and Maiduguri, respectively.

Table 4: Effects of pearl millet, nitrogen fertilizer and fungicide on thousand grain weight (g) and grain yield (kg/ha) at Bauchi and Maiduguri during 2014 wet season

	Thousand grain weight (g)		Grain yield (kg/ha)	
Treatments	Bauchi	Maiduguri	Bauchi	Maiduguri
Millet Variety (V)				
PEO 5984	8.84	9.34	1152.60	1060.10
Super Sosat	9.12	9.21	980.70	1029.70
SE±	0.09	0.04	20.39	28.70
LSD (≤ 0.05)	0.25	0.13	58.37	
Nitrogen (kg/ha) (N)				
0	7.12	7.88	522.20	433.30
15	8.27	8.53	781.50	842.50
30	8.81	9.10	988.90	1006.10
45	9.41	9.86	1351.90	1216.70
60	11.25	11.01	1688.90	1725.90
SE	0.14	0.07	32.24	45.38
LSD (≤ 0.05)	0.39	0.20	92.29	129.90
Fungicide				
Treated	9.50	9.80	1235.50	1262.20
Untreated	8.35	8.75	897.80	827.60
SE±	0.09	0.04	20.39	28.70
LSD (≤ 0.05)	0.25	0.13	58.37	82.18
Interactions				
V × N	Ns	ns	*	Ns
V × F	Ns	ns	ns	Ns
N × F	*	*	ns	*
V × N × F	Ns	ns	ns	Ns

ns= not significant, WAS= weeks after sowing

Interaction of Nitrogen Rate × Fungicide

There was significant ($P \leq 0.05$) interactions of N × F on panicle length, number of panicles per plot and thousand grain weight (Table 5). Panicle length and thousand grain weight was significantly ($P \leq 0.05$) higher for treated seeds in combination with 60 kg N/ha. Thus, both metalaxyl and nitrogen rates have significant influence on panicle length and thousand grain weight.

Table 5: Interaction of nitrogen (kg/ha) × fungicide on Panicle length and number of Panicles per plot at Maiduguri, thousand grain weight for Bauchi and Maiduguri

	Bauchi	Maiduguri	Maiduguri
Treatments	Panicle length (cm)	Number of Panicles/plot	Thousand grain weight (g)
0 × Treated	18.37g	38.50h	7.52h
0 × Untreated	21.42f	65.17g	8.24g
15 × Treated	21.37f	62.17g	8.23g
15 × Untreated	24.23d	119.67e	8.83g
30 × Treated	22.85e	125.17e	8.60f
30 × Untreated	25.53cd	136.67d	9.60d
45 × Treated	24.23d	90.33f	9.22e
45 × Untreated	27.32bc	157.50b	10.49c
60 × Treated	26.00a	198.33a	11.85a
60 × Untreated	31.52b	146.00c	10.16b
SE±	0.46	2.97	0.10

Means followed by the same letter(s) in a column are not significantly different ($P \leq 0.05$)

Interaction of Nitrogen Rate × Millet Variety on Yield Components

At both locations, Panicle weight was significantly ($P \leq 0.05$) higher for Super sosat in combination of 60 kg N/ha (Table 6). Thus, both nitrogen and millet variety recorded significant interactions on yield component of millet.

Table 6: Interaction of nitrogen ×millet variety on panicle weight per plant in Bauchi and Maiduguri

	Bauchi	Maiduguri
Treatments	Panicle weight per plant (g)	
0 × PEO 5984	1.65f	1.03h
0 × Super sosat	2.35e	1.55g
15 × PEO 5984	2.53e	2.17f
15 × Super sosat	3.46d	2.60e
30 × PEO 5984	3.41d	2.78e
30 × Super sosat	4.30c	3.15d
45 × PEO 5984	4.10c	3.58c
45 × Super sosat	5.56b	4.72b
60 × PEO 5984	5.63b	4.97b
60 × Super sosat	6.70a	6.40a
SE±	0.11	0.09

Means followed by the same letter(s) in a column are not significantly different ($P \leq 0.05$)

Interaction of Millet Variety × Fungicide on Yield Components

Panicle length and weight were significantly ($P \leq 0.05$) higher for untreated Super sosat variety. More number of panicles per plot were observed by treated millet varieties with metalaxyl at for both locations (Table 7).

Table 7: Interaction of millet variety ×fungicide on panicle length per plant, panicle weight per plant and number of panicles per plot

	Maiduguri		Bauchi	Maiduguri
Treatments	Panicle Length (cm)	Panicle weight (g)	Number of panicles/plot	
PEO 5984 ×Treated	18.52	3.31	108.87	96.07
PEO 5984 ×Untreated	20.64	3.51	154.33	134.53
Super sosat ×Treated	24.75	2.88	102.60	88.80
Super sosat ×Treated	30.13	4.51	138.53	136.40
LSD (≤0.05)	0.83	0.17	5.58	0.17

DISCUSSION

PEO8495 variety recorded higher yield at both locations than Super sosat. This could be as a result of their genetic make-up, adaptability to the environment as well as their ability to exploit growth factors such as moisture, sun light and nutrients for assimilate production and subsequent mobilization to the sink for grain production (Akintobi, 2005).Yield and yield components of the millet varieties could be influenced by a number of factors which include genetic make-up, seed quality, crop husbandry, effects of pest and diseases, competition for growth factors such as water, nutrients and light. However, among all the factors, genetic

make-up is the most important variable that affect crop performance. Furthermore, ability of different crops to exploit environmental resources; light, nutrients and space could have been the reason for the accounted variation in yield and yield components. Although, Ioramen and Odiaka (2012) attributed variation in growth characters of cowpea varieties to differences in their genetic makeup as well as their adaptability to their environment.

Nitrogen is one of the limiting nutrients to crop production in Northern Nigeria Alhassan, *et al*., (2006). The result confirmed the positive response of pearl millet to N application in the study areas. The fact that growth and yield increased linearly with increase in N-rates corroborated the role nitrogen plays in enhancing both growth and yield of crops. The probable reasons for recording significant response with increase in nitrogen rates could be attributed to the role it plays as an essential element of bio-molecules such as amino acids, proteins, nucleic acids, phyto-hormones and a number of enzymes and coenzymes. El-tilib *et al*. (2005) reported that increasing nitrogen rates caused significant effect in many growth and yield attributes of pearl millet at the rate of 90 kg N/ha. Similarly, Munirathnam *et al*. (2006) observed higher harvest index in different varieties due to increased levels of nitrogen with 25 kg N ha^{-1}. The retardation of growth and development due to lack of N could not be far from the fact that nitrogen influences growth stimulation, expansion of the crop canopy and interception of solar radiation. Hence, it could be concluded that for achieving higher growth and grain yield in millet production, application of N is very critical.

Treating the seeds with metalaxyl had significant effect on growth and yield of pearl millet. Untreated seeds with matalaxyl recorded less effect compared with treated seeds. The physiological basis could be due to the fact that untreated seeds are susceptible to soil borne diseases, notably, downy mildew. This does not provide adequate protection, thus resulting in reduced seed germination, growth and eventual yield loss. Furthermore, it was stated that matalaxyl untreated seed produce oospores which hinders seedlings establishment. Singh and Emechebe (1998) reported that matalaxyl treated seed protect the crop from downy mildew after emergence.

Interaction of nitrogen × pearl millet variety revealed that application of 60 kg N/ha with super sosat produced higher panicle weight than control. This could be due to the beneficial effects of metalaxyl and increased photosynthetic activities due to higher nitrogen rate. Similar findings were made by Singh and Ajeigbe (2002). Emechebe (1998) reported beneficial effect of metalaxyl in protecting the seeds from soil borne diseases as well as enhanced growth and development.

CONCLUSION

In conclusion, nitrogen rate as well as metalaxyl determined the performance of pearl millet varieties. PEO 5984 out-performed Super sosat in the study areas, with grain yield of 1060.1 and 1029.70 kg/ha for Bauchi and Maiduguri, respectively. Incase of nitrogen, application of 60 kg N/ha recorded higher growth and yield. Consequently, pearl millet PEO 5984 variety treated with matalaxyl was optimized at 60 kg N/ha in Sudan savanna.

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