Esxon Publishers

International Journal of Applied Research and Technology
ISSN 2277-0585

Publication details, including instructions for authors and subscription information:
http://www.esxpublishers.com

Effects of Inter and Intra Row Spacings of Pearl Millet (*Pennisetum glaucum* (L.) R. Br.) Infected with Downy Mildew (*Sclerospora graminicola* (Sacc.) Schroet) on 1000 Grain Weight in Kano State, Nigeria

Gaya, A. G., Fulani, M. and Abdulkadir, N. A.

Kano University of Science and Technology, Wudil, Kano State, Nigeria

Available online: February 28, 2014

To cite this article:

Gaya, A. G., Fulani, M. and Abdulkadir, N. A. (2014). Effects of Inter and Intra Row Spacings of Pearl Millet (*Pennisetum glaucum* (L.) R. Br.) Infected with Downy Mildew (*Sclerospora graminicola* (Sacc.) Schroet) on 1000 Grain Weight in Kano State, Nigeria. *International Journal of Applied Research and Technology.* 3(2): 32 – 38.

International Journal of Applied Research and Technology
Vol. 3, No. 2, February 2014. 32 – 38.

Esxon Publishers

Effects of Inter and Intra Row Spacings of Pearl Millet (*Pennisetum glaucum* (L.) R. Br.) Infected with Downy Mildew (*Sclerospora graminicola* (Sacc.) Schroet) on 1000 Grain Weight in Kano State, Nigeria

Gaya, A. G., Fulani, M. and Abdulkadir, N. A.

Kano University of Science and Technology, Wudil, Kano State, Nigeria

(Received: 31 January 2014 / Accepted: 14 February 2014 / Published: 28 February 2014)

Abstract

In this study, field trials were carried out at the Teaching and Research farm of Kano University of Science of Technology, Wudil with two pearl millet varieties in 2003, 2004 and 2005 rain seasons to investigate the effect of inter- and intra-row spacings of pearl millet infected with downy mildew on 1000 grain weight in Kano State, Nigeria. The experimental materials consist of factorial combinations of two varieties (SOSAT C88 and Zango), three inter-row spacings (50, 75 and 100cm) and four intra-row spacings (15, 30, 45 and 60cm). The treatments were laid out in randomized complete block design with three replications. Data collected on 1000 grain weight were subjected to analysis of variance and Duncan's Multiple Range Test (DMRT) was used for the separation of means at 1% and 5% levels of significance. Result shows that SOSAT C88 pearl millet had significantly ($P \leq 0.01$) the heaviest 1000 grains than Zango pearl millet which had lighter 1000 grains. Millets spaced out at 75cm inter-row had significantly ($P \leq 0.01$) heaviest 1000 grain weight than other two inter-row spacings which produced pearl millet with the lightest 1000 grains. Furthermore, spacing pearl millet at 60cm intra-row resulted in having the heaviest 1000 grains having similar values with 30cm. Lightest 1000 grains were obtained in millets spaced at 15cm intra-row. Interaction effect occurred only between inter- x intra-row spacings. Result further shows that pearl millet varieties planted at 75 x 30cm and 75 x 60cm inter- x intra-row spacing combinations had significantly ($P \leq 0.05$) the heaviest 1000 grains in contrast with other spacing combinations which gave 1000 grains with the least weight in 2004 and 2005. It is however, recommended to grow SOSAT C88 pearl millet variety as well as use 75cm inter-row and 30 or 60cm intra-row spacings respectively for heavier 1000 grains than wider or shorter spacings which resulted in having lighter grains.

Keywords: Downy Mildew, 1000 Grain Weight, Inter-Row, Intra-Row, Pearl Millet

For corresponding author:
E-mail: *info@esxpublishers.com*
Subject: *0114-0224*

Introduction

Pearl millet (*Pennisetum glaucum* (L.) R. Br.) has traditionally been an important grain, forage and stover crop primarily in the arid and sub-tropical regions of the world. It is the world's six most important cereal crop, providing diet to about five hundred million people in the arid and semi-arid tropics particularly in India (Bilqueze, 1979; Nwasike, *et al*., 1982; Yayock, *et al*., 1988 and NRC, 1996). Over 40 percent of land sown annually to cereals is devoted to millet (Ikwelle, 1998). Nwasike (1988) reported that as the climate becomes drier pearl millet production exceeds that of sorghum due to its draught-tolerant character and the reverse is the case as rainfall increases. Being able to thrive where habitats are harsh, it is perhaps the best of all life-supporting grain (FAO, 1992). This report further pointed out that it yields reliably well in regions too hot and too dry to consistently support good yield of maize or sorghum. Already, the crop is gaining ground into the hotter and drier part of Latin America, Central Asia, the Middle East, Australia and West Africa (NRC, 1996). The world area planted to millet is about 65 million hectares, with the major part in India and Africa (Nene and Singh, 1975). The area sown to the crop in West Africa is estimated at 12 million hectares, while in Nigeria, millet is cultivated on 5 million hectares (FAO, 1992), equivalent to 20.84 percent of the 23.99 million hectares of the country's total arable land.

Pearl millet production in Nigeria increased gradually between 1985 and 1994, reached a peak in 1988 and 1990, and then declined (CBN, 1994). The report further shows that the increase may be attributed to the cumulative effects of subsidies associated with National Food Production Programme, while the decline may be due to the effects of reduction of such subsidies. However, abiotic and biotic factors militate against meaningful millet production in Nigeria. Low and erratic rainfall leading to drought period of varying lengths, poor soil fertility and low water holding capacity, traditional practices such as low crop density were among the factors affecting millet production (Rai and Kumar, 1994). They further reported that other factors include none or low application of fertilizers, poor/zero tillage, lean household capital, poor credit and input provision (which limit the scope for improved management practices) and low genetic yield potentials of landraces which respond only minimally to improved management.

Diseases such as downy mildew, ergot, and smut are the most important diseases of pearl millet (Wlliams, 1984). Among these, downy mildew caused by *Sclerospora graminicola* (Sacc.) Schroet is the most serious in West Africa (Thakur and King, 1988) as it receive higher ratings when compared to ergot and smut (Lueschner *et al*., 1993). Werder and Manzo (1992) further mentioned that downy mildew, ergot and smut are the three most widespread and important diseases of pearl millet in Nigeria. Yield losses of up to 50 percent due to downy mildew have been reported in West Africa (Singh *et al*., 1993). Jeger *et al*., (1998) reported that downy mildew can cause devastating yield losses in pearl millet and this is a major constraint to productivity. Zakari (2003) reported an average annual yield loss in Nigeria of 17 percent. In spite of the high population growth rate of 3.2 percent in Nigeria, as well as high demand against lower production of the crop, it is expected that the projected production increase would erase any deficit by 2010 (Bukar *et al*., 1997). Moreover, there is increasing decline in millet productions due to series of attack by pests and diseases as earlier on mentioned. Efforts directed at increasing millet productions through the use of chemicals even though proved effective but for other side-effects of these chemicals, there is need for alternative economic and friendly control measures against these pests and diseases. Therefore, it is imperative to carry out this research with the aim of investigating the effect of inter- and intra-row spacings of pearl millet infected with downy mildew on 1000 grain weight in Kano State, Nigeria.

Materials and Methods

The trial was carried out at the teaching and research farm of Kano University of Science and Technology Wudil (Latitude 10^{o} 33'S, Longitude 7^{o} 34'N to 9^{o} 24'E; elevation 427-428m) (KNARDA, 2003) in 2003, 2004 and 2005 rain seasons. In this trial, two pearl millet varieties; SOSAT C88 and Zango were used. They were choosen because, Zango (a local landrace and adopted) was the most susceptible to downy mildew in the previous screening exercise and SOSAT C88 (an improved and new to the present farmers) was moderately susceptible to downy mildew. The inter-row spacings used were 50cm, 75cm and 100cm while intra-row spacings were 15cm, 30cm, 45cm and 60cm. The experimental materials consist of factorial combinations of 2 varieties, inter-row spacings (3) and intra-row spacing (4). The treatments were laid out in randomized complete block design with three replications. Each plot measured 4m x 4m ($16m^2$) and 1m pathway was left between the replications. Each pearl millet variety was planted using the different inter- and intra-row spacings in the plots.The number of pearl millet stands in each plot varies because of different inter- and intra-row spacings used. All the cultural practices of pearl millet and the inoculation procedures were carried out as in the fertilizer trial.

The land was prepared and all the cultural practices of pearl millet were carried out. Seeds were treated with Apron Plus at the rate of 30g/kg of the seeds before planting to control pre- and post-emergence damping-off of seedlings. Five millet seeds were planted in June (beginning of the rain season) at a spacing of 75cm x 30cm making 5 rows of pearl millet. Missing stands were supplied at seven days after sowing. The seedlings were thinned to two seedlings/hill two weeks after sowing. Super plus 280 EC insecticide was sprayed two times (second and seventh week after sowing) against harmful insects that might attack the crop. The active ingredients for the insecticidal spray are cypermethrin 30g and dimethoate 250g. Downy mildew infected pearl millet were placed on the aerial parts of the plants for effective infection. Moreover, conidial suspension of the cultured pathogens (10^6 spores mL^{-1}) was sprayed on the plants at 7 days old (Singh *et al*., 1997) to ensure that maximum infection took place during the trial (Williams *et al*., 1981). This method provides uniform distribution of sporangial inoculum throughout the test materials during the infection period (early seedling stage) in a natural manner.

Data were collected on 1000 grain weight by cutting and drying (under the sun) the heads (15) of pearl millet after maturity which were later threshed (with mortar and pestle)and weighed using an electric weighing balance machine from the each plot. Data collected for three years (2003, 2004 and 2005) were also combined and subjected to analysis of

variance according to Gomez and Gomez (1984) and Duncan's Multiple Range Test (DMRT) was used for the separation of the means at 1% and 5% levels of significance (Duncan,1955).

Results and Discussion

Statistical analysis shows that there wasn't any significant difference among varieties in 2004, but SOSAT C88 had significantly ($P \leq 0.01$) the heaviest 1000 grains as compared to Zango pearl millet variety which produced the lightest 1000 grains in 2003 and 2005 (Table 1). Different inter- and intra-row spacings had no influence on 1000 grain weight in pearl millet varieties in 2003, however, when varieties spaced at 75cm inter-row spacing, significantly ($P \leq 0.01$) produced the heaviest 1000 grains in contrast to planting them in other inter-row spacings which gave the lightest 1000 grains in 2004 and 2005. Moreover, varieties spaced at 30 and 60cm intra-row spacings had significantly ($P \leq 0.01$) the haviest 1000 grains in 2004 and 2005 while 1000 grains with the lightest weight were obtained when the pearl millets were spaced at 15cm intra-row spacing in the same years above. Combine result shows that SOSAT C88 pearl millet had significantly ($P \leq 0.01$) the heaviest 1000 grains than Zango pearl millet which had lighter 1000 grains (Table 1). Millets spaced out at 75cm inter-row had significantly ($P \leq 0.01$) heaviest 1000 grain weight than other two inter-row spacings which produced pearl millet with the lightest 1000 grains. Furthermore, spacing pearl millet at 60cm intra-row resulted in having the heaviest 1000 grains having similar values with 30cm. Lightest 1000 grains were obtained in millets spaced at 15cm intra-row. Interaction effect occurred only between inter- x intra-row spacings.

Interaction effect was only significant between inter- x intra-row spacings in 2004 and 2005 and results in both Tables 2 and 3 showed that pearl millet varieties planted at 75 x 30cm and 75 x 60cm inter- x intra-row spacing had significantly ($P \leq 0.05$) the haviest 1000 grains in contrast with other spacing combinations which gave 1000 grains with the least weight in 2004 and 2005. Combine interaction effect between inter- x intra-row spacing shows that heaviest 1000 grains were significantly ($P \leq 0.05$) obtained from pearl millet varieties spaced at 75 x 30cm and 75 x 60cm respectively than those spaced at other spacing combinations which produced lighter 1000 grains, particularly 50 x 15cm combination which produced pearl millet with the lightest 1000 grains (Table 4).

Individual and combine results show that SOSAT C88 pearl millet variety had heaviest 1000 grains than Zango pearl millet in 2003 and 2005 respectively after inoculating them with downy mildew organism. This also proved the efficient performance of an improve variety over a local landrace. The 75cm inter-row spacing used produced pearl millets with heaviest 1000 grain weight than other spacings in 2004 and 2005 with similar result obtained from the combine analysis. Moreover, pearl millets intra-spaced at 60 and 30cm respectively had heaviest 1000 grains in the same years above in contrast with those inra-spaced at 15cm which had lightest 1000 grain weight in both years. This shows that spacing pearl millets at 75cm inter-row and 30 and 60cm intra-row respectively resulted in having heaviest 1000 grain weight. Both interaction effects between inter- x intra-row spacings in 2004 and 2005 and that from the combine analysis showed that 75 x 30cm and 75 x 60cm had heaviest 1000 grain weight in contrast to other spacing combinations which produced pearl millets with lightest 1000 grain weight. Above result confirmed spacing pearl millet at either recommended spacing of 75 x 30cm or 75 x 60cm gave positive result in terms of 1000 grain weight against close spacing (15cm) which gave lightest 1000 grains.

Conclusion and Recommendations

Based on this research work, it is may be concluded to grow SOSAT C88 pearl millet variety using 75cm inter-row and 30 or 60cm intra-row spacings respectively for heavier 1000 grains than wider or shorter spacings which resulted in having lighter grains. It is however, recommended to grow SOSAT C88 pearl millet variety as well as use 75cm inter-row and 30 or 60cm intra-row spacings respectively for heavier 1000 grains than wider or shorter spacings which resulted in having lighter grains.

References

Bilquez, A P. (1979). General features of research on millet in Africa. Millet/Sorghum Research Seminar, Bombay, 31st August-4th September, 1970. 17pp.

Bukar, S., Aliyu, A. and Bakshi, J. S. (1997). Nigerian National Agricultural Research Strategy Plan; 1996-2010. Department of Agricultural Sciences. Federal Ministry of Agriculture and Natural Resources, Abuja, Nigeria. 335pp

CBN, (1994). Pearl millet production in Nigeria. Central Bank of Nigeria. *Statistical* Bulletin 5 (1): 1-100.

Duncan, D. B. (1955). Multiple Range and Multiple F. Test. *Biometrics*, 11: 1-42.

FAO (1992). Food and Agriculture Organisation Production yearbook.Vol. 41. Rome, Italy. 200pp.

Gomez, A. K. and Gomez, A. A. (19840). Statistical Procedures for Agricultural Research, 2nd Edition, John Wiley and Sons, New York, USA. 20-95.

Ikwelle, M. C. (1998). Pearl millet in Nigerian agriculture. Pp 1-8. In: Pearl Millet in Nigerian Agriculture: production, utilization and research priorities. Proceedings of the Pre-season National Co-ordination and Planning Meeting of the Nationally Co-ordinated Research Programme on Pearl Millet, Maiduguri, Nigeria. 21st-24th April 1997. (Emechebe, A. M, Ikwelle, M. C., Ajayi O., Aminu Kano, M. and Anaso, A. B. ed.).

Jeger, M. J., Gilijamse, E., Bock, C. H. and Frinking, H. D. (1998). The epidemiology, variability and control of downy mildews of pearl millet and sorghum with particular reference to Africa. *Plant Pathology*, 47: pp 554-569.

KNARDA (2003). Kano South Senetorial District Agricultural Show, 16th-17th February 2003. Kano Agricultural and Rural Development Authority, Kano State, Nigeria. 1p.

Leuschner, K. L., Rohrbach, D. D. and Osmanzai, M. (1993). Sorghum and millet in South Africa. Pp 39-54. In: Sorghum and millets commodity and research environments (Byth, D. E., ed.). Patancheru, A. P. 502 324, India.

Mehrotra, R. S. and Aggarwal, A. (2003). Plant Pathology, Second Edition. Tata McGraw-Hill Publishing Company Limited, 7 West Patel Nagar, New Delhi 110008, India.p466.

Nene, Y. L. and Singh, S. D. (1975). A Comprehensive review of downy mildew and ergot of pearl mille. PP 106. In:. International Crops Research Institute for the Semi-Arid Tropics, Hyderabad, India, 1975.

NRC (1996). *Loss of Crops in Africa* Vol. 1. Grains. National Research Council. National Academy Press, Washington D. C., USA. Pp 100-120.

Nwasike, C. C. (1988). Progress in millet improvement in Nigeria. Regional IAR/ICRISAT Pearl Millet Workshop, Zaria, Nigeria. 15-19th August 1988. 32pp.

Nwasike, C C., Baker, E. F. and Eghareuba, P. N. (1982). The potential for improving millet (*Pennisetm typhoides* (Burm) Stapf and Hubband). In farming system of the Semi-Arid areas of Nigeria. *Samaru Research Bulletin*. 32pp.

Rai, K. N. and Kumar, K. A. (1994). Pearl millet improvement at ICRISAT: an update. *International Sorghum and Millet Newsletter*, 35: 1-29.

Singh, S. D., King, S. B. and Werder, J. (1993). Downy mildew disease of pearl millet. *ICRISAT Information Bulletin*, 37; 35pp.

Singh, S. D., Wilson, J. P., Navi, S. S., Talukdar, B. S., Hess, D. E. and Reddy, K. N. (1997). Screening Technique and sources of resistance to downy mildew and rust in pearl millet. *Information Bulletin*, 48: pp 3-51.

Thakur, S. P. and King, S. B. (1988). Downy mildew disease of pearl millet. *Information Bulletin*, No. 2. ICRISAT. 17pp.

Werder, J. and Manzo, S. K. (1992). Pearl millet diseases in West Africa. pp 109-112. In: *Sorghum and millet diseases*: a second world review (Miliano W. A. J., Frederiksen, R. A. and Bengston, G. D. eds). ICRISAT, India.

Williams, R. J., Singh, S. D. and Pawar, M. N. (1981). An improved field screening technique for downy mildew resistance in pearl millet. *Plant Disease*, 65: 239-241.

Williams, R. J. (1984). Downy mildew of tropical cereals. *Advances in Plant Pathology*, 2: 1-103.

Yayock, J. Y., Lambin, G. and Owonubi, J. J. (1988). Crop Science and Production in Warm Climates, London, Macmillan. 307pp.

Zakari, G. S. T. (2003). Crop Loss Assessment for resistance to Downy Mildew (*Sclerospora graminicola* (Sacc.) Schroet.) In Nigeria. Ph D Thesis, University of Maiduguri, Nigeria. pp 4-12.

Tables

Table 1: Effect of inter- and intra- row spacings on 1000 grain weight (g) of two pearl millet varieties infected with downy mildew in three years

	1000 grain weight (g))			
Variety	**2003**	**2004**	**2005**	**Combine**
SOSAT C88	12.39_a	13.50	13.50_a	13.13_a
Zango (Check)	9.36_b	12.72	12.86_b	11.65_b
S.E. ±	0.49	0.28	0.22	0.21
	**	NS	*	**
Inter-row spacing (cm)				
50	10.88	12.41_b	12.63_b	11.97_b
75	10.96	14.54_a	14.50_a	13.33_a
100	10.79	12.38_b	12.42_b	11.86_b
S.E. ±	0.60	0.34	0.27	0.24
	NS	**	**	**
Intra-row spacing (cm)				
15	10.50	12.33_b	10.83_c	11.22_c
30	10.83	13.50_{ab}	14.50_a	12.94_{ab}
45	10.06	12.50_b	13.17_b	12.24_b
60	11.11	14.11_a	14.22_a	13.15_a
S.E. ±	0.70	0.39	0.31	0.29
	NS	**	**	**
Interaction				
Variety x inter-row	NS	NS	NS	NS
Variety x intra-row	NS	NS	NS	NS
Inter- x Intra-rows	NS	*	*	*
Variety x inter- x intra row	NS	NS	NS	NS

Means followed by the same letters within the same column and treatment are not significantly (P≤0.01 and P≤0.05) different according to Duncan's Multiple Range Test (DMRT), * = Signficant at 5% probability, ** = Significant at 1% probability, NS = Not significant

Table 2: Interaction effect between intra-and inter-row spacings of pearl millet variety infected with downy mildew on 1000 grain weight (g) in 2004

	Inter-row (cm)		
Intra-row (cm)	**50**	**75**	**100**
15	11.67_b	12.83_b	12.50_b
30	12.83_b	16.17_a	11.50_b
45	12.17_b	13.00_b	12.33_b
60	13.00_b	16.17_a	13.17_b
S. E. ±		0.68	

Means followed by the same letters are not significantly (P≤0.01) different according to Duncan's Multiple Range Test (DMRT)

Table 3: Interaction effect between intra-and inter-row spacings of pearl millet variety infected with downy mildew on 1000 grain weight (g) in 2005

	Inter-row (cm)		
Intra-row (cm)	**50**	**75**	**100**
15	10.33_{d}	11.67_{cd}	10.50_{d}
30	13.83_{b}	17.00_{a}	12.67_{bc}
45	13.17_{bc}	13.33_{bc}	13.00_{bc}
60	13.17_{bc}	16.00_{a}	13.50_{b}
S. E. ±		0.53	

Means followed by the same letters are not significantly (P≤0.05) different according to Duncan's Multiple Range Test (DMRT)

Table 4: Combine interaction effect between intra-and inter-row spacings of pearl millet variety infected with downy mildew on 1000 grain weight (g)

	Inter-row (cm)		
Intra-row (cm)	**50**	**75**	**100**
15	10.67_{c}	11.61_{bc}	11.39_{bc}
30	12.61_{b}	14.53_{a}	11.39_{bc}
45	12.22_{bc}	12.61_{b}	11.89_{bc}
60	12.39_{b}	14.28_{a}	12.78_{b}
S. E. ±		0.50	

Means followed by the same letters are not significantly (P≤0.05) different according to Duncan's Multiple Range Test (DMRT)