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EFFECTS OF SEED DRESSING CHEMICALS ON IMPROVED AND LOCAL VARIETY OF PEARL MILLET INFECTED WITH *Sclerospora graminicola*

Shuaibu, A.M. *[1], Ahmad, F. S. [1], Zakari, S. M.[1], Abdullahi, S.[1], Tijjani, A.[2] and Mohammed, U. A.[3]

[1]Department of Plant Biology, Faculty of Life Sciences, Bayero University Kano, P. M .B 3011, Kano, Nigeria.
[2]Deparment of Biological Science, Faculty of science, Federal University Gashua, Gashua, Yobe, Nigeria
[3]Department of Biological Sciences, Faculty of Sciences, Bauchi State University Gadau, Bauchi, P.M.B. 065, Bauchi State, Nigeria.
GSM: +2348134412110, E-mail: musashuaibuabubakar@gmail.com

Abstract

Pearl millet is an important staple food the world over. One of the constraints of its production is the downy mildew disease caused by Sclerospora graminicola which is a very destructive disease of pearl millet. The disease is common in places where pearl millet is cultivated for food and fodder and these includes some Asian and African countries. A field experiment was conducted at Minjibir, International Crop Research Institute of Semi-Arid Tropic (ICRISAT) station, Kano state situated within the Sudan savanna of North West Nigeria between longitude 08.66485^{o}N and latitude 12.1459^{o}E at an altitude of 440m to test the effect of seed dressing chemicals on yield and growth of pearl millet infected with Sclerospora graminicola on improved and local variety. The experiment include ten treatment (Apron star, Agrolyser, Apama plus, Boost extra, Dress force, MOP, SSP, All-star, Apron star + Boost extra, and control) and replicated three times in a split plot design. The improved variety is super sosat while the local variety is Jirani. The experiment was investigated during the 2017 rainy season. The result obtained showed that seeds dressed with SSP, Apron star + Boost extra lower the incidence of downy mildew disease caused by Sclerospora graminicola on both Jirani and Super sosat variety. The super sosat variety is more tolerant to disease downy mildew than the Jirani variety. Seed dressing chemicals increased the yield and growth of improved pearl millet variety while there is no significant difference with the local variety compared to the control.

Key words: Pearl millet, downy mildew, varieties and Seed dressing chemicals.

INTRODUCTION

Pearl millet [*Pennisetum glaucum* (L.) R. Br] is an important staple food the world over most especially in the semi-arid and warmer parts of the world that are close to the equator. It is grown yearly on 26 million ha or there about (Raj and Wati, 2014; Jidda and Anasa, 2017). In some parts of Nigeria, pearl millet is the second most consumed staple food crop after sorghum. Millet is a group of highly variable small-seeded grasses, widely grown around the world as cereal crops or grains for fodder and human food (D'Andrea *et al.*, 2001). Pearl millet is the only cereal that reliably provides grain and fodder under dry land conditions. It is rich in nutrition compared with other cereals and adapts well to low-fertility soils in areas receiving less than 400mm of annual precipitation (Bhatnagar *et al.*, 2002). Despite the fact that the crop possess a huge potential in Nigeria, it is prone to a lot of pathogenic diseases. One of the most important pathogenic diseases is downy mildew which is caused by *Sclerospora graminicola* (Sacc.) (Jidda and Anasa, 2017). Seeds of crops play an important role in the transmission of plant pathogens causing plant diseases. The pathogen may be externally or internally seed-borne or associated with seed as contaminant. Many important diseases of plants caused by fungi spread through seeds. (Neergard, 1977). Healthy seeds plays an important role for increasing successful cultivation and yield of crops.

Fungicidal seed treatment may kill or inhibit seed-borne pathogens and may form a protective zone around seeds that can reduce seed decay and seedling blight caused by soil-borne pathogens, resulting and vigorous seedlings (Singh *et al.*, 1995). However, downy mildew caused by *Sclerospora graminicola* (Sacc.) Schroet is a major biotic constraint, causing an annual economic loss of $US 270million in the major pearl millet producing

countries (Shetty *et al.,* 1995). It is highly destructive and widespread (Singh *et al.,* 1995). Epidemics have also been reported from Asia and Africa (Wilson *et al.,* 2000) and this disease has been the major biotic factor affecting grain yield for the last decades (Singh *et al.,* 1998). The pathogen can be transmitted to new areas by wind and infected seeds (Sundaram *et al.,* 1973). *S. graminicola* can be controlled efficiently with systemic fungicide metalaxyl (Dang *et al.,* 1983, Muthusamy *et al.,* 1981 and William *et al.,* 1981). Seed dressing with Apron 35SD (6 kg/t seeds) in pearl millet growing regions of India and foliar application of Ridomil MZ72 (2 kg/ha) for seed crop were recommended (Singh *et al.,* 1990).

MATERIALS AND METHOD

Experimental site (Location)

The research was conducted at International Crop Research Institute for the Semi-Arid Tropics (ICRISAT) station, Wasai town Minjibir Station. Minjibir Local Government, Kano State in the Northern Sudan Savanna of Nigeria between longitude 08.66485^{o}N and latitude 12.1459^{o}E at an altitude of 440m (IITA, Kano).

Varieties

Two millet varieties: improved (Super sosat) and local (Jirani) were used for the experiment.

Experimental layout and Procedure

The field experiment was carried out during the rainy season 2016, the trial was laid out in a split plot design. The measurement of the plot are as follows:

Main plot = 40 rows, 5m long (40×5×0.75) = 150m^2. Sub plot = 40 rows, 5m long (4×5×0.75) = 15m2. Gross plot = 40 rows (30m) × 35.5m = 1080m^2. Net plot = 2 rows × 5m long = 7.5m^2

The super sosat and Jirani varieties of pearl millet was sown in the main plot, while the variable seed dressing chemicals of Apron star, Dress force, SSP, Agrolyser, MOP, Apron star + Boost extra, Apama plus, All-star and the control of the test was sown in the sub plot and replicated three times. There was 70cm and 30cm inter and intra spacing between plants stands and rows respectively. There was 0.75m and 1.5m as spacing between plots and replicates respectively. The total land area used = 30m × 33m.

The seeds were put in ten (10) bowls labeled with each treatment, leaving the control unlabeled. The powdered chemicals such as Apron star, Dress force, SSP, All + star and Apama plus was sprinkled on each bowl of seed respectively and little amount of water was added, after which it was mixed thoroughly. Agrolyser which is in a solid state was first been dissolved in water before applying to the seed while MOP was applied as solid, little water was added to help mixing. The control bowl is left untreated and served as reference.

The treated seed and control was sown 3cm deep per hill. Each plot has a different treatment as the design is split plot. First weeding was done manually after 2 weeks of sowing, this was done as at when due to keep the experimental plots weed free throughout the experiment. Nitrogen fertilizer at 272 kg ha-1 was used in the form of urea as per agronomic practices. No other conventional fertilizers were used during the experiment and it was applied after four (4) weeks of sowing. The millet was thinned to three (3) plants per stand.

Pathogen inoculation

Conidial suspension of the cultured pathogens (106 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)

DATA COLLECTION

The data was collected on emergence percentage, based on the following parameters:

Growth parameters

SPAD (Chlorophyll content) 3, 6 and 9 weeks after sowing: This measures the chlorophyll content of the plants and was taken at 3, 6 and 9 week after sowing from the net plots, 5 plants were randomly selected, measured and the average taken.

LAI (Leaf Area Index): This was determined at 6, and 9 weeks after sowing: Septometer was used to measure the leaf area index of the plants. Five (5) locations were randomly selected and the average taken at 3, 6 and 9 weeks after sowing.

Vegetative parameters

50% flower: this was calculated by observing individual plot from the first appearance of flower until 50% of the plants have flowered. Plant height: net plot plant height was measured using measuring tape and recorded.

Yield parameters

Panicle number: net plot panicle number was counted and recorded, one day before harvesting.

Panicle weight: net plot panicle weight was measured using weighing scale after harvesting and recorded. Panicle length: the length of the panicle was recorded by measuring the net plot using a meter rule after harvesting. Grain weight: net plot grains were weighed using a scale after harvesting and the value was taken. 1,000 seeds: the seeds were first counted using a counting machine for a 1000 seed. Then weighed and the value was recorded.

Disease incidence

Downy mildew. D.I% = $\frac{\text{number of infected plant}}{\text{total number of plant}} \times 100$

Data Analysis

The data was subjected to General linear model, Analysis of Variance (ANOVA) using Minitab sixteenth edition. Where there is significant difference the means were separated using the Tukey method.

RESULTS AND DISCUSSION

Results recorded in Table 1 indicated that Apron star + Boost extra had the mean highest value of chlorophyll content, leaf area index, plant weight (kg) overall while Apron star recorded the highest panicle number. The variety Super sosat also had the highest value of chlorophyll content, leaf area index, plant weight (kg) overall while Jirani recorded the highest panicle number.

In Table 2 Agrolyser was the treatment that produced the tallest plants while Boost extra had the tallest panicle. In terms of disease incidence the highest value recorded was observed in plants treated with Agrolyser and MOP. On the other hand plants treated with MOP had the heaviest 1000 seed weight and 50% flower while Boost extra had the highest total grain weight. Super sosat performed better in terms of plant height, panicle length, 1000 seed weight, grain weigh and 50% flower while Jirani had the highest value of disease incidence.

Table 3 provides information on the interaction between the varieties and treatments. Here Apron star + Boost extra treatment had the higher chlorophyll content in Super sosat variety and Dress force in Jirani variety, although Dress force had the highest mean chlorophyll content. Boost extra has the highest leaf area index and plant weight on the other hand Apron star recorded the highest panicle number in Super sosat variety. While in Jirani variety Apron star + Boost extra, Apama plus and Apron star recorded the higher leaf area index, panicle number and plant weight respectively.

All-star, Boost extra, MOP, had the highest mean values for plant height, panicle length and disease incidence in the variety super sosat. While Apron star, Agrolyser and MOP had the highest values in terms of plant height, panicle length and disease incidence in Jirani. In relation to 1,000 seed weight and grain weight comparison MOP and Boost extra recorded the highest values for the variety super sosat while MOP and Apron star had the highest values in Jirani. Agrolyser comes on top in terms of 50% flowering in super sosat while MOP was on top for the variety Jirani.

Table 1: Comparison of chlorophyll content (SPAD), Leaf Area Index (LAI), panicle number and plant weight to improved (Super sosat) and local (Jirani) varieties of pearl millet in response to various seed dressing chemicals.

Treatment	SPAD 3	SPAD6	SPAD 9	LAI 6	LAI 9	Panicle number	Plant weight (kg)
Agrolyser	39.17[a]	49.65[a]	45.88[a]	3.0[a]	2.04[a]	74.5[a]	2.68[a]
All star	42.50[a]	51.81[a]	47.84[a]	2.77[a]	2.0[a]	74.5[a]	2.83[a]
Apama plus	40.45[a]	52.36[a]	48.12[a]	3.05[a]	2.08[a]	92.5[a]	2.86[a]
Apron star	39.62[a]	50.50[a]	45.23[a]	2.91[a]	2.06[a]	98.0[a]	3.17[a]
Boost extra	41.78[a]	53.15[a]	47.70[a]	3.09[a]	2.16[a]	75.5[a]	3.09[a]
Dress force	41.65[a]	53.00[a]	50.15[a]	2.92[a]	2.09[a]	78.5[a]	2.96[a]
MOP	39.87[a]	51.05[a]	50.30[a]	2.94[a]	2.1[a]	59.0[a]	2.69[a]
SSP	38.72[a]	51.50[a]	49.85[a]	2.85[a]	2.22[a]	76.5[a]	2.86[a]
Apron star + Boost extra	41.47[a]	51.77[a]	47.63[a]	3.02[a]	2.2[a]	88.5[a]	3.17[a]
Control	41.87[a]	48.77[a]	48.08[a]	2.72[a]	1.93[a]	66.0[a]	2.88[a]
Variety							
Super sosat	41.86[a]	50.79[a]	49.45[a]	3.30[a]	2.31[a]	68.70[ab]	3.35[a]
Jirani	39.56[ab]	51.93[a]	46.71[a]	2.56[ab]	1.87[ab]	88.00[a]	2.49[ab]
S.E. ±	3.2	4.6	4.1	0.3	0.21	7.2	0.42

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

Table 2: Comparison of plant height, panicle length, disease incidence, 1,000 seeds, grain weight, and 50% flower to improved (Super sosat) and local (Jirani) varieties of pearl millet in response to various seed dressing chemicals.

Treatment	Plant Height (cm)	Panicle length (cm)	Disease Incidence	1,000 seed	Grain weight	50% flower
Agrolyser	198.62[a]	22.98[a]	1.67[a]	9.63[a]	1978.33[a]	50.0[a]
All star	199.55[a]	23.09[a]	1.0[a]	10.27[a]	2243.3[a]	50.0[a]
Apama plus	185.84[a]	22.75[a]	1.33[a]	9.54[a]	2058.6[a]	49.0[a]
Apron star	185.28[a]	23.09[a]	1.0[a]	9.28[a]	2286.03[a]	50.0[a]
Boost extra	192.78[a]	24.05[a]	1.0[a]	9.57[a]	2329.11[a]	49.0[a]
Dress force	191.11[a]	23.61[a]	0.67[a]	9.7[a]	2094.93[a]	49.5[a]
MOP	187.22[a]	22.97[a]	1.67[a]	10.79[a]	1906.04[a]	51.0[a]
SSP	170.83[a]	22.56[a]	0.84[a]	9.98[a]	2056.47[a]	50.33[a]
Apron star + Boost extra	185.0[a]	24.28[a]	1.17[a]	9.65[a]	2254.77[a]	49.5[a]
Control	188.61[a]	22.65[a]	1.17[a]	10.0[a]	2030.37[a]	50.5[a]
Variety						
Super sosat	209.13[a]	25.68[a]	0.3[ab]	10.02[a]	2423.57[a]	54.0[a]
Jirani	167.83[ab]	20.72[ab]	2.0[a]	9.66[a]	1824.02[ab]	45.77[a]
S.E. ±	11.2	2.8	0.12	0.7	24.5	4.7

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

Table 3: Comparison of chlorophyll content (SPAD), Leaf Area Index (LAI), panicle number and plant weight to the interaction between improved (Super sosat) and local (Jirani) varieties and treatments of various seed dressing chemicals.

Interaction (Variety*Treatment)	SPAD 3	SPAD6	SPAD 9	LAI 6	LAI 9	Panicle number	Plant weight (kg)
Super sosat * Agrolyser	38.77[ab]	47.23[ab]	43.97[ab]	3.33[a]	2.15[a]	60.0b	3.07a
Super sosat *All star	44.80[a]	52.13[a]	45.57[ab]	2.77[ab]	2.18[a]	44.0c	2.83ab
Super sosat *Apama plus	43.57[a]	49.83[ab]	43.53[ab]	3.52[a]	2.37[a]	74.0[ab]	3.2[a]
Super sosat *Apron star	39.0[ab]	50.13[ab]	44.03[ab]	3.27[a]	2.28[a]	94.0[a]	3.47[a]
Super sosat *Boost extra	43.63[a]	54.27[a]	48.4[ab]	3.65[a]	2.51[a]	76.0[ab]	3.87[a]
Super sosat *Dress force	44.63[a]	53.27[a]	47.23[ab]	3.22[a]	2.23[a]	66.0[b]	3.2[a]
Super sosat *MOP	42.13[a]	53.53[a]	47.97[ab]	3.69[a]	2.39[a]	53.0[ab]	3.2[a]
Super sosat *SSP	38.9[ab]	49.67[ab]	47.97[ab]	3.24[a]	2.38[a]	90.0[a]	3.63[a]
Super sosat *Apron star + Boost extra	42.3a	49.97[ab]	49.97[ab]	3.27[a]	2.49[a]	71.0[ab]	3.77[a]
Super sosat *Control	40.83[ab]	47.83[ab]	48.43[ab]	3.02[ab]	2.16[a]	59.0[b]	3.23[a]
Jirani * Agrolyser	39.57[ab]	52.07[a]	47.80[ab]	2.67[ab]	1.94[ab]	89.0[a]	2.3[b]
Jirani * All star	40.20[ab]	51.50[a]	50.10[a]	2.78[ab]	1.82[ab]	105.0[a]	2.83[ab]
Jirani * Apama plus	37.33[ab]	54.90[a]	52.70[a]	2.58[b]	1.79[ab]	111.0[a]	2.53[ab]
Jirani * Apron star	40.23[ab]	50.87[ab]	46.43[ab]	2.54[b]	1.85[ab]	102.0[a]	2.87[ab]
Jirani * Boost extra	39.93[ab]	52.03[a]	47.00[ab]	2.52[b]	1.82[ab]	75.0[ab]	2.30[b]
Jirani * Dress force	38.67[ab]	52.73[a]	53.07[a]	2.62[ab]	1.95[ab]	91.0[a]	2.73[ab]
Jirani * MOP	37.60[ab]	48.57[ab]	52.63[a]	2.2[b]	1.81[ab]	65.0[b]	2.17[b]
Jirani * SSP	38.53[ab]	53.33[a]	51.73[a]	2.46[ab]	2.07[ab]	63.0[b]	2.1[b]
Jirani *Apron star + Boost extra	40.63[ab]	53.57[a]	45.30[ab]	2.77[ab]	1.91[ab]	106.0[ab]	2.57[ab]
Jirani * Control	42.90[a]	49.70[ab]	47.73[ab]	2.42[ab]	1.7[ab]	73.0[ab]	2.53[ab]
S.E. ±	6.4	6.7	6.66	0.33	0.23	7.2	0.31

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

Table 4: Comparison of plant height, panicle length, disease incidence, 1,000 seeds, grain weight, and 50% flower to the interaction between improved (Super sosat) and local (Jirani) varieties and treatments of various seed dressing chemicals.

Interaction (Variety*Treatment)	Plant H (cm)	Panicle length (cm)	Disease Incidence	1,000 seed	Grain weight	50% flower
Super sosat * Agrolyser	215.56[a]	23.47[a]	0.33[b]	10.13[a]	2201.5[a]	55.0[a]
Super sosat *All star	232.44[a]	25.71[a]	0.33[c]	10.9[a]	2420.23[a]	54.0[a]
Super sosat *Apama plus	213.89[a]	25.8[a]	0.33[c]	9.8[a]	2289.03[a]	53.0[a]
Super sosat *Apron star	187.78[ab]	26.1[a]	0[d]	9.23[ab]	2430.97[a]	54.0[a]
Super sosat *Boost extra	214.45[a]	27.37[a]	0.33[c]	9.97[a]	2955.43[a]	54.0[a]
Super sosat *Dress force	211.11[a]	26.63[a]	0.33[c]	9.87[a]	2210.30[a]	54.0[a]
Super sosat *MOP	219.44[a]	25.97[a]	0.67[bc]	10.6[a]	2301.9[a]	54.0[a]
Super sosat *SSP	176.67[b]	23.9[a]	0[d]	9.3[ab]	2614.17[a]	54.0[a]
Super sosat *Apron star + Boost extra	201.11[a]	27.25[a]	0[d]	9.93[a]	2619.57[a]	54.0[a]
Super sosat *Control	218.89[a]	24.57[b]	0.67[bc]	10.47[a]	2192.63[a]	54.0[a]

Jirani * Agrolyser	181.67 ab	22.48 a	3.0a	9.13 ab	1755.17 b	45.0 ab
Jirani * All star	166.66 b	20.47 ab	1.67 ab	9.63 ab	2066.37 a	46.0 ab
Jirani * Apama plus	157.78 b	19.7 ab	2.33 a	9.27 ab	1828.17 b	45.0 ab
Jirani * Apron star	182.78 ab	20.07 ab	2.0 a	9.33 ab	2141.1 a	46.0 ab
Jirani * Boost extra	171.11 b	20.73 ab	1.67 ab	9.17 ab	1702.8 b	44.0 ab
Jirani * Dress force	171.11 b	20.58 ab	1.0bc	9.53 ab	1979.57 a	45.0 ab
Jirani * MOP	155.0 b	19.97 ab	2.67 a	10.97 a	1510.17 b	48.0 ab
Jirani * SSP	165.0 b	21.22 ab	1.67 ab	10.67 ab	1498.77 b	46.67 ab
Jirani *Apron star + Boost extra	168.89 b	21.30 ab	2.33 a	9.37 ab	1889.97 b	45.0 ab
Jirani * Control	158.33b	20.73ab	1.67ab	9.53ab	1868.1b	47.0ab
S.E. ±	15.6	5.6	0.1	0.34	32.5	8.6

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

DISCUSSION

The tested seed dressing chemicals exerted different impacts on the yield and growth of pearl millet (*pennisetum glaucum*) and reduced the incidence of downy mildew disease caused by *sclerospora graminicola*. The research shows that an appropriate SSP, Apron star and Apron star + Boost extra lower the incidence of downy mildew disease caused by *Sclerospora graminicola* on super sosat 100% while in the local variety (Jirani) Dress force lower the incidence most (1.0). And also improved (Super sosat) variety is more tolerant to downy mildew disease caused by *Sclerospora graminicola* than the local (Jirani) variety.

Seed treatments increase the growth of both the improved and local variety of pearl millet (Table 1 and 2). With exception of Apron star and Apron star + Boost extra in local variety treatment. While in the improved variety all the treatments except Apron star + Boost extra lower its growth. Seed treatments influenced radically the grain yield of both the improved and local variety. All the treatment except Agrolyser, SSP, Apron-star + Boost extra, Apron star, All- star, Dress force, lower the yield of the Jirani variety. While in the Super sosat variety MOP, Apama plus, Agrolyser, Dress force, SSP, lower its yield.

The seed dressing chemicals have the capacity to disrupt infection cycles of downy mildews either by killing their asexual spores or by preventing of growth of the parasite within its host. Germling infection and basal tillers of pearl millet is very detrimental, while secondary tillers infection does not contribute much in terms of yield reduction (Singh, 1981; Deepak and Shekar, 2005). Similar result was obtained by Singh (1990) by Seed dressing with Apron 35SD (6 kg/t seeds) in pearl millet growing regions of India. And also by Williams and Singh (1981), by dressing the seed with metalaxyl. Pandya *et al*., (2007) reported that the seed treatment with metalxyl (Apron 35 WS) seed controlled downy mildew up to 20-22 days after sowing.

CONCLUSION

Seed dressing chemicals have great impact on growth of both improved (Super sosat) and local (Jirani) varieties of pearl millet.

Also, seed dressing chemicals have positive impact on the yield of both improved and local varieties of pearl millet.

It also lowers the incidence of downy mildew disease caused by *S. graminicola* up to 100% in improved variety (Super sosat) and 70-80% in the local variety (Jirani)

Therefore, this result will immensely serve as first-hand vital information to the farmers for the effective management of downy mildew disease caused by *Sclerospora graminicola* in Nigerian Savannah and other semi-arid regions.

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