Journal of Stored Products and Postharvest Research Vol. 2(2), pp. 24 - 28, February 2011
Available online http://www.academicjournals.org/JSPPR
ISSI 21410- 6567 ©2011 Academic Journals

Full Length Research Paper

Seed borne pathogens on farmer-saved sorghum (*Sorghum bicolor* L.) seeds

Abdulsalaam S. and Shenge K. C.*

Department of Crop Protection, Ahmadu Bello University, P. M. B. 1044, Zaria, Nigeria.

Accepted 7 January, 2011

An experiment was conducted at Samaru, Zaria, Nigeria to determine the type of seed borne fungal pathogens associated with farmer-saved sorghum seeds. The sorghum seeds were obtained from sorghum farmers in Samaru and Bomo villages, both in Sabon Gari Local Government Area of Kaduna State. Half of the each sample was washed in distilled water, while the second half was not. Seven fungal genera were identified to be growing on the seed samples. These were *Helminthosporium* sp, *Aspergillus* sp, *Fusarium* sp, *Rhizoctonia* sp, *Penicillium* sp, *Sclerotium* sp, and *Curvularia* sp. There was also another fungus, whose identity is yet to be determined. All the seven fungi occurred in the unwashed seed sub-samples, whereas only five of the seven occurred in the sub-samples that were washed with distilled water.

Key words: Seed-borne pathogens, sorghum, storage, farmer-saved seeds.

INTRODUCTION

Almost 90% of all the world's food crops are grown from seeds (Schwinn, 1994). Seed are widely distributed in national and international trade, and germplasm is also distributed and exchanged in the form of seeds in breeding programmes. Due to their high mobility, seeds are a highly effective means for disseminating plant pathogens over long distances. Numerous examples exist in agriculture literature for the international spread of land diseases as a result of the importation of seeds that were infected or contaminated with pathogens (Agarwal and Sinclair, 1996).

In sorghum (*Sorghum bicolor*), covered smut (*Sphacelotheca sorghi*), head smuth (*Sphacelotheca reiliana*) and long smut (*Tolyposporium ehrenbergii*) have been reported to be the most destructive pathogens, causing heavy losses in third world countries (Frowd, 1980). *Peronosclerospora sorghi,* the downey mildew pathogen in sorghum and maize, and *Sclerospora graminocola* in pearl millet transform the floral primordial into vegetative leafy structures causing 30 to 70% losses in seed production in the semi-arid tropics (Williams,1984). A yield loss of 58 to 70% of hybrid sorghum and millet with 60 to 76% ergot severity has been reported in most sorghum and millet growing countries (Thakur and Chahal, 1987). Besides, these losses in potential yield, mold fungi which grow on the seed substratum produce mycotoxins which are hazardous to man and animals (Halt, 1994). Commercially, discolored sorghum seeds caused by fungi are of poor quality (Castor and Frederikser, 1980: Gopinath and Shetty, 1987), reducing their acceptability and thus, the market value of the produce. Grain mold causes crop loss by reducing seed size and weight, the food value and keeping quality of grains (Gopinath, 1984: Bandyopadhyay, 1986).

Many of the diseases that cause reduced yields in sorghum have seed borne phases. Seed borne inoculum therefore, has severe implications for yield, seed production and distribution systems, trade, human nutrition and germplasm. The management of these pathogens during the seed-borne phase is considered to be the cheapest disease control strategy (Shenge, 2007). However, effective management can only be implemented effectively if the pathogens are correctly identified. It is in view of this that the current study aimed

*Corresponding author. E-mail: kcshenge@yahoo.co.uk. Tel: +234 806 764 7583.

Table 1. Physical Inspection of sorghum seeds obtained from Bomo and Samaru villages of Kaduna State.

Sample *	Pure seed (g)	Abnormal seed (g)	Inert matter (g)	Total (g)
A[1]	980	16.7	3.3	1000
B[1]	980	18.8	1.2	1000
C[1]	980	15. 8	4.2	1000
D[1]	980	17. 8	2.2	1000
E[1]	970	21.4	8.6	1000
F[2]	990	8.4	1.6	1000
G[2]	990	8.3	1.7	1000
H[2]	990	9.0	1.0	1000
I[2]	990	9.2	0.8	1000
J[2]	980	15.2	4.8	1000

[1]seed samples obtained from Bomo village; [2] seed samples obtained from Samaru village.

at detecting seed borne pathogens on farmer saved sorghum seeds at Samaru, Zaria, North-Western Nigeria.

MATERIALS AND METHODS

Experimental location

The laboratory experiment was conducted in the Seed Pathology Laboratory of the Department of Crop Protection, Ahmadu Bello University, Zaria.

Sources of experimental materials

Ten samples of sorghum seeds collected from sorghum growing areas of Samaru, Zaria were used for the isolation and detection of seed-borne fungi.

Physical inspection of the seeds

The ten samples of sorghum seeds were physically inspected with the unaided eye on the basis of which they were separated into pure seeds, seeds of other crops and inert matter. One kilogram (kg) of each sample was poured into a plastic tray. Pure seeds were separated from abnormal seeds and inert matter and each of these components were weighed separately and their various weights recorded.

Seeds with physical abnormalities, like shriveling of the seed coat, reduction or increase in seed size, discoloration or spots in the seed coat were classified under abnormal seeds. Inert matter included soil, sand, stones, plant debris, fungal fruiting bodies etc.

Plating of the seed component

Seeds from each sample were divided into two sub-samples. The first sub-sample was washed with distilled water for five minutes before plating, while the second sub-sample was not. Four hundred seeds from each sub-sample were placed on three layers of moistened blotters placed in 90 mm diameter Petri plates at the rate of 25 seeds/plate. Plates were then incubated for 7 days, during which time they were examined daily for fungal growth.

Examination of incubated seeds

Sampling for germination was done at 72 h (3 days) after incubation, while identification of sporulating fungi was done at 7 days. The Petri dishes were brought to the examination area in the laboratory, where each seed was examined under a microscope. Growth habits of the various fungi growing in the Petri plates were observed carefully. Slide preparations of the various fruiting structures of the fungi were made and observed under a microscope for identification. The various types of fungi were identified using identification keys and cross-checked for each seed plated to identify the type of fungus growing on each seed.

RESULTS AND DISCUSSION

Physical inspection of sorghum seeds

The results obtained (Table 1) showed that the 10 samples of sorghum seeds obtained from Bomo village contained mostly normal seeds (970 to 980 g) (97 to 98%). Abnormal seeds occurred in the range of 15.8 to 21.4 g (1.58 to 2.14%), while inert matter constituted 1.2 to 8.6 g (0.12 to 0.86%). Sorghum seed samples obtained from Samaru village consisted of 980 to 990 g (98.0 to 99.0%) normal seeds. Abnormal seeds constituted 8.3 to 15.20 g of the working sample (representing 0.83 to 1.52% of the samples), while inert matter contributed 0.80 to 4.80 g (0.08 to 0.48%) of their weight. Statistical analyses of the data using T-test showed that there was no statistical difference ($P > 0.05$) between the samples.

Germination counts and identification of seed-borne fungi isolated from washed and unwashed sorghum seeds

The results showed that for all the samples, germination of washed sorghum seeds was generally higher than those of unwashed seeds (Tables 2 and 3). A

Table 2. Fungal pathogens associated with farmer saved sorghum seeds at Samaru (seeds washed with distilled water).

Treatment	Germination (%)	Seed-borne fungi isolated in washed sorghum seeds				
		Helminthosorium sp.	*Aspergillus* sp.	*Fusarium* sp.	*Rhizoctonia* sp.	*Curvularia* sp.
A[1]	81.32[b]	0.0	0.3	0.0	0.0	0.3
B[1]	90.72[b]	0.0	0.0	0.0	0.3	0.0
C[1]	84.02[b]	0.0	0.3	2.0	0.0	0.0
D[1]	82.72[b]	0.0	2.3	14.0	3.7	0.0
E[1]	57.3[b]	0.0	1.7	10.3	0.3	0.0
F[2]	66.72[b]	0.0	1.3	3.7	0.0	0.7
G[2]	97.32[a]	0.3	6.0	7.0	0.0	0.0
H[2]	97.32[a]	0.0	11.0	0.7	0.0	0.0
I[2]	96.02[a]	0.0	7.0	3.3	0.0	0.0
J[2]	98.72[a]	0.0	7.0	4.7	0.0	0.0

Means followed by the same subscript are not significantly different by LSD at P > 0.05 1= Seed samples obtained from Bomo Village; 2= Seed samples obtained from Samaru Village.

Table 3. Fungal pathogens associated with farmer saved sorghum seeds at Samaru (seeds not washed with distilled water).

Sample	Germination (%)	Seed-borne fungi isolated in unwasted sorghum seeds						
		Fusarium sp.	*Rhizoctonia* sp.	*Aspergillus* sp.	*Curvularia* sp.	*Sclerotium* sp.	*Penicillium* sp. and *Sclerotium* sp. (mixed)	*Unidentified*
A[1]	78.7[abc]	4.5	0.0	3.0	0.0	0.0	0.3	0.0
B[1]	86.72[b]	0.0	0.7	1.7	0.0	8.0	0.0	0.0
C[1]	56.0b[c]	5.0	0.3	1.0	0.3	0.0	0.0	0.0
D[1]	48.0[cd]	6.7	1.7	1.7	0.0	0.0	0.0	0.0
E[1]	22.7[d]	20.3	0.0	2.3	0.0	0.0	0.0	0.0
F[2]	48.0[cd]	10.7	0.3	7.3	0.0	0.0	0.0	0.3
G[2]	97.32[a]	9.0	0.0	6.7	0.0	0.0	0.0	0.0
H[2]	97.32[a]	2.3	0.0	8.7	0.3	0.0	0.0	0.0
I[2]	97.32[a]	3.0	0.0	7.3	0.0	0.0	0.0	0.0
J[2]	100.02[a]	6.0	0.0	12.7	0.0	0.0	0.0	0.0

Means followed by the same subscript are not significantly different by LSD at P > 0.05. [1] Seed samples obtained from Bomo Village; [2] Seed Samples obtained from Samaru Village.

comparison of the washed seed samples showed that samples G, H, I, and J (all from Samaru village) had germination rates that were significantly higher than those of the other samples. A similar trend was observed in the unwashed seeds samples. Farmer-saved sorghum seed samples from

Samaru had germination scores that were significantly ($P > 0.05$) higher than those from Bomo village.

Results of fungal identification showed that all the seed samples were contaminated with various fungal pathogens. Fungal pathogens identified included *Helminthosorium* sp, *Aspergillus* sp., *Fusarium* sp., *Rhizoctonia* sp., *Fusarium* sp., *Penicillium* sp. and *Curvularia* sp. The frequency of occurrence of the pathogens was higher in unwashed sorghum seeds than in those washed with distilled water. Of all the pathogens identified, *Aspergillus* sp. was the most abundant; occurring in all the washed and unwashed seed samples. However, the unwashed seed samples were more heavily colonized by the fungal pathogens, as all seven of them were detected on the seed samples.

The results of this study show that the association of sorghum seeds with plant pathogens in Samaru appears to be a prevalent situation. All the samples tested were associated with at least one known pathogen. These results are in agreement with those of Kamal and Mughal (1968) and Khan et al. (1974), who reported the presence of *Alternaria, Helminthosporium, Fusarium, Curvularia, Stemphylium, Rhizopus, Cladosporium, Aspergillus,* and *Penecillium* species in sorghum seeds. The results also collaborate those of Khan and Bhutta (1994) and Bhutta and Hussain (1999), who reported the occurrence of *Drechslera sorokiniana* and *Fusarium moniliforme* as major pathogens of sorghum seed. Other reports by Singh (1983) also showed that *Aspergillus*, *Drechslera, Penicillium* and *Fusarium* spp., were common associates of stored sorghum seeds. The common occurrence of other pathogens like *Alternaria, Curularia, Fusarium, Aspergillus,* and *Penicilium* has been widely reported (Martin et al., 1984; Ghosh and Nandi, 1986). The implications of this widespread seed infestation is highlighted in the report of Dharmvir et al. (1968), who determined that sorghum seeds colonized during storage were responsible for reducing plant population by 42% in the field. The consequence of such infestation is not only limited to yield losses, but also accounts for the build-up of mycotoxins in infected grains. The findings of this study are therefore, important as they highlight the need for effective measures aimed at reducing seed-borne infection of sorghum seeds in Zaria. The results of this study also show that simply washing seeds with distilled water reduced the inoculum of surface-dwelling seed-borne pathogens.

Each year, about 20% of the sorghum that otherwise would be available for food and feed is lost due to diseases (Fakir, 1999). Seed health plays an important role in the successful cultivation and yield exploitation of a crop species. Among various factors that affect seed health, the most important are the seed borne fungi that not only lower seed germination, but also reduce seed vigour resulting in low yield.

Healthy seed plays an important role not only for successful cultivation but also for increasing the yields of crops. Seed-borne pathogens of sorghum are responsible for variation in plant morphology and also reducing yield up to 15 to 90% if untreated seeds are grown in the field (Wiese, 1984). Several seed-borne pathogens are known to be associated with sorghum seed which are responsible for deteriorating seed quality during storage. Since populations of most of the fungi associated with seeds build up in store, observance of the basic principles of good storage practices is crucial to effective storage of grains, especially on long term basis. The level of moisture content in stored grains affects both its grade and storability and has been designated as an essential pre-requisite for microbial activity which enhances the rate of damage. Seed stored in humid and warm environments tend to absorb moisture from the surroundings, leading to increased seed moisture content until equilibrium is established (Asiedu et al., 1999). As seed moisture content increases, the rate of deterioration also increases (Roberts, 1972). As a first step, the temperature has to be kept as low as possible by ventilating with a small air flow rate in periods when the ambient air temperature is high. Secondly, the storage has to be made sufficiently safe by lowering the moisture content to between 13 and 14%. A grain is a living organism whose activities generally increase with temperature and moisture content. Simultaneously, high temperature and moisture content stimulate the life of pests, that is, insects, moulds and microorganisms. At high levels of infestation, the pests produce additional moisture and heat and the process of grain degradation becomes self accelerating. High humidity and temperatures are prevalent in the tropics, where they present a challenge to the safe storage of grains. Storage conditions for the sorghum grain samples used in the current study could not be established. However, it is to be expected that any effort to effectively manage the fungal pathogens associated with stored sorghum seeds/grains will have to include components that address the issue of safe storage.

The fact that more of the fungal pathogens identified were detected on the unwashed sorghum seeds suggests that such fungi could be surface contaminants. This further highlights the need for seed treatment as a strategy for managing the pathogens. Seed treatment is considered to be a cheap and highly effective means of managing seed-borne diseases in crops (Shenge, 2007).

REFERENCES

Bandyopadhyay R (1986). Grain mold. In: Fredariksen, RA (ed). Compendium of sorghum diseases., Am. Phytopathol. Soc., St. Paul Minnesota, USA, pp. 36-38.

Bhutta AR, Hussain SA (1999). Seed–borne pathogens of wheat in Pakistan. Rachis, 18(2): 66-68.

Castor LL, Frederiksen RA (1980). *Fusarium* head blight, occurrence and effects on sorghum yields and grain characteristics in Texas. Plant Dis., 64: 1017-1019.

Dharmvir AKL, Joshi LM, Pathak KD (1968). Preliminary note on the

occurrence of black point disease of wheat in India. Indian Phtopathol., 21: 234.
Dawson, WAJM. and Bateman, GL (2001). Fungal communities on roots of wheat and barley and effects of seed treatments containing fluquinconazole applied to control take-all. Plant Pathol., 50: 5-82.
Fakir, GA (1999). Seed Health-an Indispensable Agro-technology for crop production. Lecture note for course on Agro-technology and Environment Management for the CARITAS officers at GTI, BAU, Mymensingh from June 21-30, 1999, pp. 1-4.
Frowd, JA (1980). A world review of sorghum smuts. International Crops Research Institute for the Semi-Arid Tropics, 1980. Proceedings of the international workshop on sorghum diseases, sponsored jointly by Texas A and M University, USA and ICRISAT, 11-15 December, 1978, Hyderabad, India, pp. 331-348.
Gopinah, A (1984). Seed-Borne *Fusarium* diseases of sorghum. PhD Thesis, University of Mysore, India, p. 263.
Gopinath A, Shetty HS (1987). Comparison of field and Laboratory evaluation of head mould of sorghum with special reference to *Fusarium*. Indian Phytopathol., 40: 52-55.
Halt M (1994). *Aspergillus flavus* and aflatoxin B1 in flour production. Eur. J. Epidermiol., 10(5): 555-558.
Kamal M, Mughal SM (1968). Studies on plant diseases of South West Pakistan. Agric. Res. Inst. Tandojam, p. 207.
Khan SA, Jamil Mathur SB, Neergaard P (1974). Survey on new seed organisms of Pakistan. Seed Sci. Technol., 2: 477-479.
Khan MQ, Bhutta AR (1994). Seed-borne fungi of wheat cultivars in Pakistan. Pak. J. Ind. Res., 9: 397-398.
Martin JW, Seaman WL, Atkinson TG (1984). Diseases of field crops in Canada. p. 160.
Roberts EH (Ed) (1972). Viability of Seeds. Chapman and Hall, p. 448.
Schwinn FJ (1994). Seed treatment - A pancea for plant protection? In: Seed treatment: Progress and Prospects Mono. 57, BCPC, Thornton Health, UK, pp. 3-14.
Shenge KC (2007). Bacterial speck and bacterial spot disease of tomato in Tanzania: Pathogen characterization, epidemiology and management options. PhD Thesis, Sokoine University of Agriculture, Morogoro, Tanzania, p. 271.
Singh DV (1983). Fungi associated with wheat seeds and their significance. Seed Res., 11: 103-105.
Thakur RP, Chahal SS (1987). Problems and strategies in the control of ergot and smut in pearl millet. Proceedings of the International Pearl Millet Workshop, 7-11 April, 1987. International Crops Research Institute for Semi-Arid Tropics, Hyderabad, India. pp. 173-182.
Wiese MV (1984). Compendium of wheat diseases. 3rd Ed. Am. Phytopathol. Soc., p. 106.
Williams RJ, Rao KN (1984). A review of sorghum grain moulds. Trop. Pest Management. 27: 200-211.