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SHORT COMMUNICATION

FUNGI ASSOCIATED WITH MAIZE SEED DISCOLOURATION AND ABNORMALITIES IN SOUTH WESTERN NIGERIA

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ABSTRACT

Three seed samples of maize showing different forms of discouloration and abnormalities were screened for associated fungi. *Fusarium moniliforme* and *Aspergillus flavus* were isolated from all the categories of seed tested. The percentage incidence of *F. moniliforme* was significantly higher on seeds which showed white streaks, purple/pink discolouration, discoloured germ end and wrinkling than that of any other fungus. *Cephalosporium acremonium* and *Nigrospora oryzae* were also associated with purple/pink discolouration while *Dreschslera maydis, Fusarium semitectum, Curvuluaria lunata* and *Colletotrichum graminicola* were observed on seeds with brown spots. *Botryodiplodia theobromae* was more predominant on blackened seeds. *Cephalosporium acremonium, B. theobromae, D. maydis* and *F. moniliforme* were mainly associated with seeds with discoloured germ ends while wrinkled seeds were observed to harbour *F. moniliforme, D. maydis* and *C. graminicola.*

Key Words: Discolouration, incidence, maize, seed-borne fungi, wrinkled seeds

RÉSUMÉ

Trois échantillond de graines de maïs montrant differentes formes de décoloration et d'anomalies ont été évaluées pour les champignons associés. *Fusarium moniliforme* and *Aspergillus flavus* ont été isolés de toutes les catégories de graines testées. Le pourcentage d'incidence de Fusarium moniliforme était significativement plus élevé sur les graines qui ont montré des raies blanches, une décoloration purpre/rose, un bord du germe décoloré et une entorse plus que d'autres champignons. *Cephalosporium acermonium* et *Nigrospora oryzae* ont été aussi associés avec une décoloration purpre/rose alors que *Dreschslera maydis, Fusarium semitectum,* et *Collecttrichum graminicola* étaient sur les graines avec des tâches brunes. *Botryodiplodia theobromae* était plus dominant sur des graines noircies. *Cephalosporium acremonium, B. theobromae, D.maydis* et *F. moniliforme* étaient principalement associes avec les graines ayant des fins des germes decolores alors que les graines tordues etaient observees chez *F. moniliforme, D. maydis* et *C. graminicola.*

Mots Clés: Décoloration, incidence, maïs, graine issue des champignons, graines tordues

INTRODUCTION

Maize (*Zea mays* L.) is the main cereal crop grown in south western Nigeria. It is used primarily as staple food for human consumption, animal feeds and as raw material for industrial purposes.

The maize seeds are known to be attacked by various types of pathogens. Of these, fungi account

for over 75% of reported cases (Cassin and Cotti, 1979). These fungi may cause damage to seeds in form of seed abortion, shrunken seeds, reduced seed size, seed necrosis, seed rot and physiological alteration (Neergaard, 1979; Umechuruba, 1986; Shetty, 1988). They affect maize seeds either in storage or in the field causing seed discolouration, seed rotting and caking, mycotoxin contamination and loss of viability (Ullstrup, 1974; Oyeniran, 1977; Pattern, 1981). Infected seeds act as media for survival of these fungi as well as their dispersal to disease-free areas (Agarwal, 1981). The objective of this study therefore was to isolate, identify and obtain information on the incidence of various seed-borne fungi associated with different types of discolouration and abnormalities on seeds of maize common in southwestern Nigeria.

MATERIAL AND METHODS

Seeds of three cultivars of maize viz: TZAR-W, DMRESR-W and DMRLSR- W (tagged samples 1, 2 and 3, respectively), were obtained from the Institute of Agricultural Research and Training (IAR & T), Ibadan and International Institute of Tropical Agriculture (IITA), Ibadan. The seeds were subjected to visual observation and examination under stereoscopic microscope. Seeds that showed distinct symptoms were selected and thereafter categorised into three groups viz: discloured seeds, wrinkled seeds and seeds with discloured embryo end.

Discloured seeds were further sub-grouped into seeds with white streaks, seeds with brown spots, seeds with pink/purple discolouration and blackened seeds.

Planting and incubation of seeds. Infected seeds of each cultivar were surface-sterilised in 2% available chlorine in NaOCI for 15 min and then rinsed for 2 min each in three changes of sterile distilled water prior to plating. Five seeds were plated in each petri dish containing 10 ml of potato dextrose agar (PDA). In each of the categories and subgroupings, a total of 400 seeds were plated in four replicates of 100 seeds per replicate for each cultivar. These Petri dishes were randomly arranged in a Gallenkamp illuminated growth chamber (model 3B5202B) at a temperature of 28 ± 2^{o}C under alternating cycles of 12 h light and 12 h darkness. On the 8th day incubated seeds were observed for fungal growth and identification under stereoscopic and compound microscopes. Identification was on the basis of presence and characteristics of typical structures such as conidia and hypha (Benoit and Mathur, 1970; Chidambaram *et al.*, 1970; Barnett and Hunter, 1972).

The number of seeds infected by each kind of fungus was counted and when more than one fungus grew on the same seeds, it was regarded as multiple infection. The data collected were transformed prior to analysis using square root transformation method. Analysis of variance and mean separation were performed using Statistical Analysis Software (SAS, 1994).

RESULTS

Fusarium moniliforme, *Cephalosporium acremonium*, and *Migrospora oryzae* were associated with white streaks radiating from the embryonic ends of the maize seeds. However, the incidence of *F. moniliforme* was significantly higher than that of any of the other fungi in all the three cultivars tested (Table 1). On cultivar TZSR-W, *F. moniliforme* was identified from 98% of seeds that showed white streaks. The incidence of *F. moniliforme* on seeds that showed purple/pink discolouration was significantly higher than any other fungi isolated on cultivars TZSR-W (89.5%) and DMRLSR-W (52.0%). The percetange incidence of *F. graminearum* was also significantly high on cultivars DMRESR-W (49.0%) and DMRLSR-W (49.5%). *F. semitectum* was also isolated although in small amounts (0.5%) on cultivar DMRLSR-W seeds exhibiting purple/pink discolouration.

Fusarium moniliforme, *Drechslera maydis*, *Curvularia lunata* and *Colletotrichum graminicola* were observed on seeds with brown spots. The incidence of *D. maydis* (45%) on cultivars TZSR-W was significantly higher than that of other fungi isolated from brown spotted seeds.

Fusarium moniliforme, *D. maydis* and *Botryodiplodia theobromae* were mostly associated with blackened seeds of the three cultivars tested. The percentage incidence of *B.*

TABLE 1. Seed-borne fungi associated with four different types of discolouration on seed of three maize cultivars in Nigeria

Fungus	White streaks			Pink/Purple			Brown spots			Blackened seeds		
	1*	2	3	1	2	3	1	2	3	1	2	3
Fusarium moniliforme	98.0a	83.0a	87.a	89.5a	38.5b	52.0a	0.0d	18.5b	26.3a	8.5c	26.b	20.5n
Fusarium graminearum	0.0c	6.5bc	0.5c	14.0b	49.0a	49.5a	0.0d	0.0d	0.0c	0.0c	0.0d	
Fusarium semitectum	0.0c	0.0c	0.0c	0.0c	0.0d	0.5c	11.0c	6.5c	2.5c	0.0d	0.0c	0.0d
Drechslera maydis	0.0c	0.0c	0.0c	0.0c	0.0d	0.0c	45.8a	10.8b	6.0bc	15.0c	21.0b	28.3b
Curvularia lunata	0.0c	0.0c	0.0c	0.0c	0.0d	0.0c	10.0c	9.5bc	13.8b	0.0d	0.0c	0.0d
Colletotrichum graminicola	0.0c	0.0c	0.0c	0.0c	0.0d	0.0c	0.0d	15.8b	18.5ab	17.8c	0.0c	0.0d
Cephalosporium acremonium	5.5c	12.5b	10.8b	0.0c	0.0d	0.0c	0.0d	0.0d	0.0c	0.0d	0.0c	0.0d
Diplodia maydis	0.0c	0.0c	0.0c	0.0c	0.0d	0.0c	19.0b	0.0d	0.0c	0.0d	0.0c	0.0d
Nigrospora oryzae	0.0c	6.0bc	1.5c	0.0c	0.0d	0.0c	0.0d	0.0d	0.0c	63.0a	49.5a	53.5
Botrupdoplodia theobromae	0.0c	0.0c	0.0c	0.0c	0.0d	0.0c	0.0d	0.0d	0.0c	63.0a	49.5a	53.5
Aspergilus spp	21.0b	14.5b	10.3b	18.5b	13.3c	16.5b	28.5b	35.0a	26.0a	31.0b	17.5b	13.5c
Penicillium spp	0.5c	1.8c	3.5bc	0.0c	0.0d	0.0c	0.0d	0.0d	0.0c	0.0d	0.0c	0.0d

*1 = cultivar TZSR-W; 2=DMRESR-W, 3 = DMRLSR-w

**Each value is a mean of four replicates (100 seeds/replicate/cultivar/abnormality)

Means followed by the same letter in the same column are not significantly different at P≤0.05

theobromae on the blackened seeds of the three cultivars incubated (63.0%, 49.5% and 53.3% on cultivars TZSR-W, DMRESR-W and DMRLSR-W, respectively) were significantly higher than any other observed fungi. Table 1 also shows that the incidences of *Aspergillus* spp. were significantly high on the seeds of all the cultivars regardless of the type of discolouration.

Table 2 shows that the incidence of *F. moniliforme* was significantly higher than that of *C. acremonium, D. maydis, C. gramimicola* and *Aspergillus* spp. on seeds showing distinct discloured embryo end in all the three maize cultivars used. Table 2 also shows that of all the fungi isolated from wrinkled seeds, incidence of *F. moniliforme* was highest. *D. maydis, B. theobromae, C. graminicola* and *Curvularia lunata* were other fungi associated with wrinkled seeds.

DISCUSSION

The seed-borne fungi isolated included both field and storage fungi *F. moniliforme, D. maydis, B. theobromae, C. acremonium* and *Colletrocrichum graminicola*. Other field fungi included *Curvularia lunata, F. semitectum* and *Nigrospora oryzaae*. The storage fungi were *Aspergillus* spp. and *Penicillium* spp.

The association of *F. moniliforme* with all the different types of seed disclouration and abnormalities, and its high incidence may be due to the susceptibility of the maize crop to attack by this fungus. *Fusarium moniliforme* has been reported to cause seed and ear rots, stalk rot and leaf sports (Headrick and Pataky, 1989). Thomas and Buddenhagen (1980) and Zummo and Scott (1992) observed higher incidence of *F. moniliforme* than other fungi isolated from maize seeds. This was also true in this study.

Maize white streaks, often radiating from embryonal end of the seeds, were commonly infected by *F. moniliforme, C. acremonium* and *N. oryzae*. Although Kumar (1986) observed the association of *F. moniliforme* and *C. acremonoium* with streaks in maize seeds, *Nigrospora oryzae* is being reported in this part of maize seed for the first time. *Fusarium moniliforme* and *F. graminearum* were associated with pinkish/ purple seeds. Similar observation was reported by

TABLE 2. Fungi associated with discloured embryonic end and wrinkled seeds

Fungus	Seeds with discoloured embryonic end			Wrinkled seeds		
	1*	2	3	1	2	3
Fusarium moniliforme	88.5**	69.8a	74.0a	72.8a	56.0a	48.5a
Cephalosporium acremonium	9.0b	2.5c	0.5c	0.0d	0.0c	0.0c
Drechslera maydis	11.5b	13.5b	8.0bc	11.3bc	2.5c	9.5b
Botryodiplodia theobramae	8.0b	9.5bc	6.5bc	10.0bc	0.0c	0.0c
Colletotrichum graminicola	0.0c	0.5c	2.5bc	7.5c	9.8b	0.5c
Curvularia lunata	0.0c	0.0c	10.5b	2.0c	0.5c	2.0c
Aspergillus spp.	16.0b	21.5b	18.0b	21.0b	43.0a	46.0a
Penicillium spp.	0.0c	0.0c	0.0c	0.0c	6.8b	12.5b

*1=Cultivar TZSR-W; 2 = DMRESR-W, 3= DMRLSR-W
**Each value is a mean of four replicates (100 seeds/replicate/abnormality)
Means followed by same letter (s) in the same column are not significantly different at $P \leq 0.05$

Neergaard (1979). Brown spots on maize seeds were associated with *F. moniliforme*, *F. graminearum*, *D. Maydis*, *C. lunata* and *F. semitectum*. Blackened maize seeds were infected with *B. theobromae*, *D. maydis*, *F. moniliforme* and *C. graminicola* as previously reported by Neergaard (1979; 1981), Singh and Singh (1981), and Kumar and Shetty (1983). Similar results were obtained in this study.

The isolation of some economically important seed-borne fungi of maize from the discoloured embryo ends may be due to the fact that the embryo contains abundant protein materials. The common occurrence of isolation of *F. moniliforme* from wrinkled seeds might be due to the fact that the fungus can enter the seeds through the silk, wounds, and through systemic infection, causing physiological damage to seed development. *Aspergillus* and *Penicillium* spp. were the storage fungi isolated from the different forms of discolourations and abnormalities. However, *Aspergillus* spp. were constantly observed in all the different categories of seeds. The influence of these fungi on germination and growth of maize plants is however negligible (Kumar and Shetty, 1983). Some *Aspergillus* spp. are, however, destructive on stored products and their presence in indicative of poor storage condition. The findings in this investigation suggest that maize seeds with various forms of discolouration and abornomalities have the potential to cause seed deterioration in storage and epiphytotitcs in the field.

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