Preserving the Viability of Stored Maize Seed with Fungicides

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ABSTRACT

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Maize seeds of 9.8 and 16.0% moisture were inoculated with spores of storage fungi, treated with 750 ppm of active ingredient of fungicide (benomyl, captan, captafol, chlorothalonil, carbendazim plus maneb, dichlofluanid, and thiabendazole), and stored at 85% relative humidity. Treated samples with 9.8% initial moisture content germinated 82–93% after 150 days, compared with 14% in untreated controls. Germination after 102 days in samples with 16.0% initial moisture content ranged from 7% in untreated controls and seeds treated with thiabendazole to 92% in seeds treated with carbendazim plus maneb.

Viability of maize seeds to be used for planting is usually preserved by low moisture content, low temperature, or both (1,2). In some areas, however, maintaining such storage conditions is expensive and difficult, and fungicides, if effective against storage fungi and not injurious to seed, might be useful to preserve viability.

Over the past several years, we have tested many compounds for protecting seeds against invasion by storage fungi; those used in the tests described here were chosen as the most likely candidates for further testing.

MATERIALS AND METHODS

Seeds of the commercial hybrid H-412 were used. These seeds had a moisture content of 9.8% and germination of 100%. None of the surface-disinfected kernels plated on agar yielded storage fungi.

Two 9-kg seed lots were inoculated with dry spores of *Aspergillus glaucus*, *A. candidus*, *A. flavus*, and *Penicillium* from pure cultures grown on autoclaved moist maize seeds. The kernels used to inoculate the seed were removed. Water was added to one seed lot to adjust moisture content to 16.0% (4); the other lot remained at the original 9.8% moisture content.

Each inoculated seed lot was divided into nine 1-kg portions (control plus eight fungicides), and each of these was divided into three replicates of 300 g each (the remaining 100 g was discarded). The tests were conducted as completely randomized designs with three replicates.

Seeds were treated at the rate of 750 ppm of active material of benomyl, captafol, captan, chlorothalonil, DPX-14 (150 ppm of carbendazim plus 600 ppm maneb), dichlofluanid (Euparen), and thiabendazole. Two samples of captafol (A and B) from different sources were tested. The fungicides were applied in powder form.

Seeds were stored at 85% relative humidity, maintained by means of a saturated solution of potassium chloride (5), at 26–27 C. Samples were periodically removed from each replicate and tested for moisture content, germination, and presence of storage fungi. Moisture content was determined by drying replicate portions of approximately 5–10 g each at 130 C for 24 hr and is given on a wet-weight basis. To determine percentage germination, 100 kernels were incubated between moist paper at 25 C; seedlings were counted after 4 and 7 days.

To measure fungus invasion, 25 kernels of each replicate were shaken for 1 min in a 2% solution of NaOCl, rinsed in sterile water, plated on malt-salt agar (2% agar, 2% malt, 6% NaCl), and incubated for 7 days at 25 C. It is known that some fungicidal compounds do not prevent fungi from invading moist seeds but do prevent their growth on agar. Even thorough washing may not remove such compounds from the seed. For this reason, a small incision was made in the pericarp over the embryo of each kernal plated on agar to permit internal fungi to grow. The more or less standard surface-disinfection technique used here may not always distinguish between external contamination and internal infection (3), but judging from the results, it served our purpose.

RESULTS AND DISCUSSION

Table 1 summarizes the test results. On seeds with initial moisture content of 9.8% stored 150 days, moisture content ranged from 15.8 to 16.3%. Germination ranged from 14% in the controls to 93% in seeds treated with captafol. Untreated seed was heavily invaded by storage

Table 1. Moisture content, germination, and fungi of treated maize seed (H-412)[w]

Treatment	Moisture content (%)	Germination[x] (%)	Seeds yielding fungi (%)	
			Aspergillus glaucus	*Aspergillus candidus*
9.8% initial moisture content[y]				
Captafol (A)	16.1	93 a	0	2
Captan	15.8	92 a	0	2
Benomyl	16.1	92 a	0	0
Dichlofluanid	15.9	90 a	0	3
Chlorothalonil	16.0	89 a	0	5
Carbendazim + maneb	15.8	87 a	0	0
Captafol (B)	16.2	82 a	2	10
Thiabendazole	16.0	82 a	32	2
Control (untreated)	16.3	14 b	82	42
16.0% initial moisture content[z]				
Carbendazim + maneb	16.3	92 a	0	0
Captan	16.3	88 a	0	0
Dichlofluanid	16.3	87 a	2	0
Chlorothalonil	16.4	85 a	0	0
Captafol (A)	16.3	84 a	0	0
Captafol (B)	16.4	77 ab	2	6
Benomyl	16.3	68 b	2	0
Thiabendazole	16.9	7 c	60	30
Control (untreated)	16.6	7 c	70	20

[w] Average of three replicates.
[x] Entries followed by different letters are significantly different (Scheffé, $P = 0.05$).
[y] Seeds stored 150 days at 85% relative humidity at 26–27 C.
[z] Seeds stored 102 days at 85% relative humidity at 26–27 C.

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fungi. All the fungicides appeared to be effective in maintaining the viability of the seed; however, 32% of seeds treated with thiabendazole yielded *A. glaucus*, and the seedlings were smaller than those from other treatments.

On seeds stored with an initial moisture content of 16.0% (Table 1, bottom), most of the decrease in germinability evidently resulted from invasion of the seed by storage fungi. Seed with the higher initial moisture content had a faster decrease in germination than seed with 9.8% initial moisture content, which gradually increased during storage.

In what we would regard as conditions of moderate risk of damage by storage fungi (9.8% initial moisture content, 85% relative humidity, 27 C for 150 days), the tested fungicides maintained seed viability of 82–93% (Table 1, top). However, in conditions of high risk of damage by storage fungi (16.0% initial moisture content, 27 C for 102 days), only five of the fungicides maintained seed germinability above 80% (Table 1, bottom). In conditions favorable to the growth of storage fungi, application of suitable fungicides appears promising and merits further investigation.

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