Al-Azhar J. Agric. Sci. Sector Res.,
Vol. 2 : pp 41- 59 (June)2007

INJURIOUS EFFECTS OF SOME FUNGI ASSOCIATED WITH STORED MAIZE GRAINS

By

[1]El-Shazly A. M.A., A.M. Zedan, [2]A.A.M Abd Al – Rahman and M.S.K. Abo El-Dahab

(1) Plant Pathology Botany Department, Faculty of Agric. Al Azhar Univ.
(2) Field Crops Research Institute, Agric. Reserch Center, Egypt.

ABSTRACT: Under natural storage conditions Maize grain CVS. exhibited,decreasing of germinability, moisture content, 100 seed weight, protein % and during concequtive storage months, while the average percentage of seed discolouration the electrical conductance of seed solution increased with the long storage periods.

PDA medium, salt wart agar medium supplemented with 10% of NaCl (SWA) and Blotter method were used. Four storage fungi, ***Aspergillus flavus***, Linkex Fr, ***A. niger*** (group), Van Tiegh, ***Penicillium expansum*** Link and ***Fusarium moniliforme***, J.Ve Diagn were isalated from the one month post harvest or stored maize grains, other contaminating fungi i.e. ***Rhizopus*** sp., ***Cephalosporium maydis*** corda, ***Alternaria alternata*** Nees, ***Trichothecium roseum*** Link and ***Epicocum*** sp. Sacc were also isolated. The storage fungi, ***A. flavus, A. niger*** and ***Penicillum expansum***, exhibited higher occurrence at the late storage period, while ***F. moniliforme*** decreased during consequtive storage months, especially by Blotter method than the other fungi.

The tested storage fungi. could invade and kill grain germs causing reduction in their germination as well as vegetative seedling growth. ***A. flavus*** and ***C. maydis*** caused the lowest percentage of seed germination and survived seedling. The cultivar S.C.15 was the most sensitive to infection. Also, relatively similar negative effects on seedling length and fresh & dry weight were found ***A. flavus*** and ***C. maydis*** affected leaves caused the drastic decrease in chlorophyll a,b and carotenoids content. Single cross hybrid 129 was the less sensitive in comparison with other cultivars. Chlorophyll b in all treatments showed a daramatic decrease % than other pigments.

INTRODUCTION

Fungi represent one of the major factors which usually induce discolouration and deterioration of grins and seeds during storage (Assawah and El-Arosi, 1960). Numerous reports had list alarg number of fungi isolated from stored seeds, as ***Aspergillus*** spp., ***Penicllium*** ssp.,***Fusarium moniliforme***. They were the sole agent of any discolouration or/and deterioration of maize grains.

In Egypt, Assawah and El-Arosi (1960), Fathi (1966), El- Abbasi (1990) and Zedan (1991) isolated some species of Aspergilli, Penicilla, Fusaria and other fungi from stored maize grains and other seeds on PDA, SWA media and Blotter method. Generaly, many authers mentioned that the seed borne pathogens reduce the quality of the seed either for planting purpose by lowering germination capacity and seedling growth or lowering its food and feed values by discolouration and seed deterioration (Tewabech *et al.*, 2001).

The present work aimed to isolate and identify the frequent of fungi associated with the storage nine maize grains CVs. after 1.3. 5 and 7 months of harvest and their role in maize grains and seeds deterioration.

MATERIALS AND METHODS

Collection of grain samples: Grain samples of nine maize CVs., white cvs. namely, single cross hybrid (S.C. 14, 15 and 129) and triple cross hybrid (T.C. 322, 324 and 326) and yellow cvs. namely, S.C. 155 and T.C. 351 and 352, grown in Sakha and El – Gemmeiza Research Stations, Egypt, during four weeks post harvest of successive trial seasons 2002 and 2003. Samples were stored in weft bags on shelfs under lab. conditions over periods of 1, 3, 5 and 7 months.

Deterioration of maize grains during storage:

In each the storage periods, the factors on the affecting deterioration of stored maize grains at the natural storage conditions were determination:

a) The percentage of seed germination was determined using wetted filter paper in Petri dishes according to ISTA rules (1993).

b) Seed moisture content expressed as percentage of wet weight was calculated by the oven-drying method.

c) Also, one thousand randomized maize grains were used to detect the average percentage of germ discolouration as described by Qasem and Christensen (1958).

d) One hundred grains in three replicates was using to determination of 100 grain weight.

e) Grain protein percentage was estimated according to the improved kjeldahl method of A.O.A.C (1980). Percentage of protein was calculated by multiplying the percentage of total nitrogen by the factor 6.25 and expressed as percent of seed on the seed dry weight basis according to Jackson (1973).

f) Percentage of seed oil was determined according to the A.O.A.C. (1975).

g) Electrical conductivity tests (E.C.) were recorded as μ mhos/g seed. The method adopted by Matthews and Alison (1987) was used here.

Seed health test:

In each storage period, maize grains CVs (T. C. 324, T.C 326 grown in sakha station and T.C. 351, T.C 352 and S.C 155 in El-Gemmeiza station) were tested by standard Blotter method and the agar plate methods of the International Rules for Seed Testing Association (I.S.T.A, 1993) was used for detect seed – borne micoflora.

Randomized, one hundred maize grain CVs were surface sterilized using 1% sodium hypochlorite solution, then plated on to either potato dextrose agar (PDA) or salted wort agar (SWA) medium (Smith, 1969) or the Blotter method (Neergaard, 1977). Salted wort Agar medium contained 15.0g, Malt extract, 1.5g. peptone, 1.75g. dipotassium phosphate and Ammonium chloride per liter of distilled water. SWA medium was salted with 10% of sodium chloride (W.V.) by relative humidity (R.H.) 96.5% (Smith, 1969). The plates were incubated at 28^0_C. The incubation periods were 8 days in PDA, 7 and 10 days in alternating cycles 12 hours darkness and 12hrs. light provided under cool white fluorescent tubes in SWA and blotter media.

The single pure fungal colonies were made a ccording to Sheltye and Sheltye, (1988), then cultures were purified by the single spore or hyphal tip techniques. Identification of the genera and species of

Aspergilli and Penicillia groups were carried out according to proceedings described by Raper and Fennel. (1965), Raper and Thom, (1949). Other isolated colonies were identified using the commonwealth Mycological Institute, kew, Surry, England (CMI) description sheets, Danish Government Institute of Seed Pathology (DGISP) publication and some references published by Barnett and Hunter (1972) and Singh ***et al*** (1991). Pure fungal cultures were maintained on PDA slants at 5^0C.

Effect of artificial inoculation with storage fungi on seed germination and growth characters: Visible disease free and apparantly sound – maize grains cvs. were planted in greenhouse in artificially inoculated soil with the fungal inocula, according to the technique adopted by Papavizas and Christensen (1960), while untreated soil also planted to serve as control (without Fungus) in greenhouse. Percentage of germination and survived seedlings were recorded 4 weeks from sowing. Seedlings were gently removed from soil at 4 weeks old and washed carefully for determining the seedling length, fresh and dry weight and chlorophyll a,b and carotenoids leaf contents. Equal numbers of discs from the leaves of each maize cultivars were obtained, from affected and health plants, chlorophyll a,b and carotenoids contents were determined according to Mackinney's formula (1941). Absolute methanol was used in extracting leef samples, optical densties of pigment extracts were measured by aid of a Bechmann DB spectrophotometer at wave length of 665,650 and 452.5 nm, respectively. The amounts of chlorophyll a,b and carotenoids were calculated as mg/gram of leaves dry weight.

RESULTS AND DISCUSSION

Date recorded in (Table 1), illustrate that average of percentage of seed germination, moisture content, 100 seed weight, protein% and oil% decreased during consecutive storage months (from 98.11%, 14.66%, 31.15g., 6.89% and 5.79% at one month to 93.77%, 11.72%, 29.56g., 3.68% and 4.67 at 7 storage month, respectively), while the average percentage of seed discolouration and the electrical conductance of seed solution increased with long storage period (from zero% and 3.61μ mohs to 16.37% and 5.11μ mohs/ g. seed, respectively) These trends were also recorded by Bhattacharya and Raha (2003) and El-Sharkawy (2004) who found a gradual loss of carbohydrate (soluble and insoluble), protein content, oil content and weight of 100 corn grains associated with the

Table (1): Changes accuring in maize grains at the natural storage conditions:

Location	Cultivars	Germination	Moisture content%	Discoloration %	100 seed weight	Protein %	Oil%	electrical conductivity
Sakha	S.c 129	96.50	13.06	9.89	21.77	4.59	4.15	7.83
	T.c 322	96.70	12.56	10.89	36.00	5.60	4.72	1.92
	T.c 324	96.70	12.79	10.22	42.03	5.67	5.02	2.40
	T.c 326	95.70	12.84	10.44	32.47	5.70	4.60	2.73
El-Gemmeiza	T.c 351	95.70	12.69	8.89	25.77	6.45	7.23	4.01
	T.c 352	95.70	12.82	9.44	32.03	6.20	6.92	3.45
	S.c 155	97.70	12.87	8.89	27.77	6.12	5.56	4.40
	S.c 15	96.50	13.01	10.00	27.03	4.65	4.73	5.69
	S.c 14	95.00	12.85	11.33	27.95	4.48	3.89	7.15
Storage periods	F. test	**	**	**	**	**	**	**
	L.S.D 5%	1.52	0.03	0.74	0.31	0.17	0.29	0.11
	1 month	98.11	14.66	-	31.15	6.89	5.79	3.61
	3 month	96.66	12.70	4.18	30.50	6.34	5.41	4.14
	5 month	95.33	12.32	9.33	30.04	5.08	4.99	4.72
	7 month	93.77	11.72	16.37	29.56	3.68	4.67	5.11
	F. test	**	**	**	**	**	**	**
	L.S.D5%	1.00	0.02	0.43	0.20	0.11	0.02	0.09

- **S.c = Single cross hybrid.**
- **T.c = Triple cross hybrid.**

long storage period. Also, Fahim ***et al*** (1982), Zedan (1991), Zedan and Seif El-yazal (1992) and Abo El-Dahab (2006) who mentioned that pathogenicity tests on cereal grains proved that the ***Aspergilli., Penicillia*** groups and ***Fusarium moniliforme,*** as the storage fungi caused more serious losses than the field fungi (***Alternaria alternate*** and ***cephalosporium maydis***), and the extent of germ discolouration was not in proportion with the magnitude of grain invasion or decrease in germination. These findings suggest that the reduction in germinability depends not only on germ invasion but may principaly attributed to the interior changes in the grain constituents during fungal invasion. The brown discolouration of the germs could result in the oxidation of some components such as oil, protein and pigments. Zedan and Arab (1994) found that ***A. flavus*** can readily enter the injured kernels forming visible sporulation, bright greenish- yellow fluorescence (BGYF) on the glum and high aflatoxin contamination. The apparent decrease in 100 seed weight with long storage cauld be due to the degradation of cellulose, starch and protein by fungi to initiate new vegetative cells and thereby, consumed most of the released soluble sugars. Herter and Burris (1989), Ismail ***et al*** (1989, Tekrony and Hunter (1995) and Abo El-Dahab (2006) reported that seed vigour or seedling length of maize seed exposed to drying injury changed a wide range of conductivity values, suggesting that the leukage of electrolytes and sugars from seed or seedling cells may be attributed to the impairment of membrane permeability which greatly influences the normal physiological functioning of the cells leading to disruption of the normal osmotic relation-ships. Increased leakage of materials from essential metabolites necessary for their normal functioning and this may explain the failure or delay of the seed germination.

Fungi associated with post harvest maize grain CVs: The tested maize grain CVs. obtained throughout one month post harvest, had no or little visible discolouration and electrical conductivity, were used to study grain micoflora at post harvest.

Examination of the inoculated plates in (Table 2), indicated that PDA medium stimulated fast growing Fungi, i.e. ***fusarium moniliforme*** covered all maize grains cvs. the plates, followed by ***A. niger, Penicillium expansum*** and ***A. flavus***. Also, this trend was found in isolation %.On contrast, ***Cephalosporium maydis*** and ***Rhizopus*** sp. were not commonly associated with the grain samples. The total fungal

(2): Average counts and isolation% of fungi associated with maize grains at one month post harvest.

Location	Sakha						EL-Gemmeiza									Mean of Isolation %
Cultivars	T.C. 324			T.C 326			T.C. 352			T.C. 352			S.C 155			
Isolated fungi	PDA	SWA	BL.	PDA	SWA	BL.	PDA	SWA	BL.	PDA	SWA	BL.	PDA	SWA	BL.	
Aspergillus flavus	17.8*	18.1	19.6	16.4	22.1	19.3	16.5	19.3	17.0	16.5	20.0	18.2	20.5	19.0	17.0	18.49
A. niger	25.6	30.1	21.7	23.3	27.2	24.1	25.3	30.1	25.0	26.6	28.8	25.0	23.9	26.2	23.2	25.73
Penicillium expansum	22.2	26.5	20.0	19.2	23.5	21.7	20.2	24.1	20.5	17.7	26.2	22.7	18.1	26.2	18.3	21.80
Fusarium moniliforme	34.4	25.3	32.0	41.1	27.2	33.7	38.0	26.5	37.5	37.9	25.0	33.0	37.5	28.6	41.8	33.51
Cephalosporium maydis	-	-	1.1	-	-	-	-	-	-	1.3	-	-	-	-	-	00.16
Rhizopus sp.	-	-	1.1	-	-	1.2	-	-	-	-	-	1.1	-	-	-	00.22
Total fungal counts	90	83	92	73	81	83	79	83	88	79	80	88	88	84	82	100

* = Isolation%, SWA= Salted wort agar, BL.= Blotter, T.C.= Triple cross hybrid, S.C= Single cross hybrid.

Total fungal counts on PDA medium= 409 colonies.

SWA medium = 411 colonies

Blotter method=433 colonies

colonies on the standard blotter method or SWA medium were higher than those on PDA medium (433, 411 and 409 colonies, respectively). Similar results were recorded by El-Abbasi (1990), Zedan (1991), Bhattacharya and Raha (2003), Fandohan ***et al*** (2003) and Abo El-Dahab (2006) who suggested that defferences in frequencies of seed-borne fungi obtained from different sample sources, cultivars (Mankevicione et al 2005) and the media (Flanning, 1982) used might be due to many factors i.e. weather (climate, temperature, humidity) and/or insect damage and/or soil conditions, subsequent handling of grain mass.

Fungi associated with stored maize grain CVs.: Data presented in (Table 3) revealed that 6 identified genera and species of fungi were consistently detected at the various storage months for five tested grains CVs- sampled from Sakha and El-Gemmeiga stations. ***Aspergillus niger*** was frequently associated with stored maize grains raised from two locations at the three storage periods, it gave the highest average fungal counts (117, 136 and 156) and average percentage of isolation were about 25.3%, 26.1% and 27.5%, respectively. ***Penicillium expansum***, ***A. flavus*** and ***F. moniliforme*** exhibited the next frequency to ***A. niger*** at the storage periods (109, 128 and 144 respectively)followed by ***P. expansum***, (48, 122 and 140 respectively) for A. ***flavus*** and (137, 125 and 111 fungal counts). The other isolated fungi; i.e. ***Alternaria alternata*** and ***Rhizopus*** sp. constituted the lowest average counts and isolation% compared with the previous fungi.

A gradual increase in total fungal counts was easily noticed for the maize grains stored for 3,5 and 7 months (463, 522 and 568, respectively). Aspergilli and ***Penicillium xpansum*** showed a remarkable progressive increase up to the 7th month of storage, and were apparently the most prevalent fungi during long storage of grains. Contrarily, total count of F. ***moniliforme*** decreased during consecutive storage months. Tanaka ***et al*** (2001) and Abo El- Dahab (2006) supported the same data. They also added that the damage markedly increased by store unfavourable, moist conditions and relatively high temperature. Rocandori ***et al*** (1971) found that, in most cases, that storage conditions were favourable for the preservation of viability in many grains were also adequate for the survival of field fungi. They also concluded that the way of harvesting, and weather during the period between ripening and harvest are considered critical factors affecting seed deterioration and microbial activity. As field and storage fungi readily survive under

Table (3): Average counts and isolation% of fungi associated with stored maize grains on Blotter method.

Storage periods	Three months							Five months							Seven months						
Cultivars / Isolated fungi	T.C.324	T.C.326	T.C.351	T.C.352	S.C.155	A.C.	Iso.%	T.C.324	T.C.326	T.C.351	T.C.352	S.C.155	A.C.	Iso.%	T.C.324	T.C.326	T.C.351	T.C.352	S.C.155	A.C.	Iso.%
Aspergillus flavus	21.3	20.9	21.1	22.4	20.2	98	21.2	23.6	25.0	22.0	24.8	21.5	122	23.4	24.0	25.9	23.4	25.2	24.8	140	24.6
A. niger	25.5	24.2	26.3	25.5	24.7	117	25.3	26.5	25.0	26.0	25.7	27.0	136	26.1	28.9	25.9	27.0	27.9	27.5	156	27.5
Penicillium expansum	23.4	24.2	24.2	23.4	22.5	109	23.5	24.5	24.0	27.0	23.8	23.4	128	24.5	24.8	24.1	27.0	25.2	25.7	144	25.4
Fusarium moniliforme	28.7	29.7	28.4	28.7	32.6	137	29.6	23.6	24.0	25.0	22.9	24.3	125	23.9	19.8	20.7	19.8	18.9	18.4	111	19.5
Cephalosporium maydis	-	-	-	-	-	-	-	0.9	1.0	-	1.9	1.9	6.0	1.1	0.8	1.7	1.8	1.8	1.8	9.0	1.6
Rhizopus sp.	1.1	1.0	-	-	-	2	0.4	0.9	1.0	-	0.9	1.9	5.0	1.0	1.7	1.7	1.0	1.0	1.8	8.0	1.4
Total fungal counts	94	91	95	94	89	463	100	106	104	100	105	107	522	100	121	116	111	111	109	568	100

A.C.= Average count of fungi, Iso.%= Isolation %, T.c.= Triple cross hybrid, S.C= Single cross hybrid.

storage conditions until the following season, their presence in harvested seed may provide a potential for seedling disease problems, or discoloration and deterioration for grains. These points will be studied and discussed in the coming investigation.

Effect of artificial inoculation with storage fungi on seed germination and growth characters:

Data given in (Table 4) indicate that all the tested fungi could invade and kill grain germs causing reduction in their germination, seedling height, fresh and dry weight and chlorophyll a,b and carotenoid contents of both seed maize cvs. Leaves. The inoculated cultivars caused the highest reduction in seed germination and survived seedling percentages, compared with the control (uninoculated) treatments (78-8 & 93.9%) and (70.8 & 90.0%) respectively. The cultivar S.C.15 was the most sensitive to infection, while the cultivar T.C. 324 was resistant in this respect. On the other hand, **A. *flavus*** and **C. *maydis*** were the most effective fungi on the tested cultivars (75.6 & 70.0) and (76.9 & 70.6), respectively.

Another point of view. The inoculated cultivars caused decrease in vegetative growth. Data in Table (5) prove that inoculated cultivars caused decrease in seedlings length percentage. The CVs. T.C. 324. T.C 326 and S.C. 129 showed the highest percentage of reduction (26.8 , 25.6 and 25.0%), respectively. No significant differences were found between the fungi ***C. maydis***, ***P. expansum, A. flavas*** and ***F. moniliforme*** in reducing seedling height, ***A. niger*** was the least in this respect (19.3% reduction)

Data given in (Table 6) reveal that presence of significant differences between maize cultivars. T.C. 326 showed highest decrease in fresh and dry weight (36.9&44.0%), while S.C. 15 recorded the lowest decrease% (17.2&20.5%), respectively.

Data in (Table 7) show that the storage fungi caused an obvious decrease in chlorophyll a, b and carotenoids content of leaves, affected cultivars as compared with the control ones. Data proved also that chlorophyll, b in all treatments showed drastic decrease% than the other pigments of affected leaves. ***A. flavus*** and ***C. maydis*** affected leaves resulted high decrease in chlorophyll a, b and carotenoids as compared with other fungi. Single cross hybrid 129 was less sensitive to infection with fungi. In addition to, the reduction percent in chlorophyll a and b

Table (4): Effect of storage fungi on the percentage of maize seed germination and survived seedling.

Varieties	S.C 15		S.C 14		S.C 129		S.C 155		T.C 351		T.C 352		T.C 322		T.C 324		T.C 326		Mean of	
Fungi	Ger	S.S	Ger	S.S	Ger	S.S	Ger	S.S	Ger	S.S	Ger	S.S	Ger	S.S	Ger	S.S	Ger	S.S	Ger%	S.S%
Aspergillus flavus	70.0	65.0	65.0	55.0	75.5	65.0	72.5	70.0	77.5	67.5	80.0	75.0	80.0	77.5	82.5	80.0	77.5	75.0	75.6	70.0
Aspergillus niger	72.5	67.5	72.5	70.0	82.0	77.5	80.0	75.0	82.5	75.0	85.0	77.5	85.0	75.0	85.0	80.0	82.5	75.0	80.8	74.7
Cephalosporium maydis	65.0	60.0	70.0	65.0	70.0	62.5	72.5	67.5	77.5	70.0	77.5	70.0	87.5	80.0	90.0	82.5	82.5	77.5	76.9	70.6
Fusarium moniliforme	75.0	70.0	77.5	67.5	75.0	65.5	80.0	70.0	82.5	72.5	85.0	75.0	85.0	75.0	87.5	77.5	85.0	75.0	81.4	72.0
Penicillium expansum	67.5	52.5	75.0	57.5	85.0	75.0	77.5	65.0	72.5	60.0	75.0	62.5	82.5	75.0	87.5	80.0	82.5	72.5	78.3	66.7
Mean of inoculated cvs.	70.0	63.0	72.0	63.0	77.5	69.1	78.5	69.5	78.5	69.0	80.5	72.0	84.0	76.5	86.5	80.0	82.0	75.0	78.8	70.8
control	90.0	87.5	92.5	90.0	95.0	90.0	95.0	87.5	90.0	85.0	92.5	87.5	95.0	92.5	97.5	95.0	97.5	95.0	93.9	90.0
F.test	N.S.																			

L.S.D- 5% for: seed germination of cultivars= 4.32, S.S of cultivars= 4.57.
seed germination of fungi= 3.52, S.S of fungi =4.9.
Ger= germination% S.S = Survived seedlings%

Table(5): Effect of the storage fungi on percentage of decrease seedlings length (cm) at 4 week old.

Fungi	S.C 15	S.C 14	S.C 129	S.C 155	T.C 351	T.C 352	T.C 322	T.C 324	T.C 326	Mean
Aspergillus flavus	18.4	18.8	11.1	31.7	30.5	21.0	19.1	25.7	28.7	22.8
Aspergillus niger	18.3	14.7	23.8	20.9	18.2	7.9	20.0	22.8	16.9	19.3
Cephalosporium maydis	24.4	20.0	32.9	27.9	14.8	18.5	22.9	34.6	31.7	25.4
Fusarium moniliforme	7.4	27.0	37.4	10.7	23.1	9.4	26.0	28.7	31.1	22.3
Penicillium expansum	35.9	20.4	19.9	17.2	25.9	24.9	19.9	22.3	19.6	22.9
Mean of inoculated cvs.	20.9	20.4	25.00	21.7	22.5	18.3	21.6	26.8	25.6	22.5
Control	38.4	37.00	41.1	39.3	39.2	38.5	46.7	47.5	47.2	-

L.S.D. at 5% cultivars x fungi = 8.6
L.S.D. at 5% cultivars = 3.8
L.S.D. at 5% fungi = 2.9

was higher than carotenoids content in all affected plants. These findings coincided with those obtained by Zedan, and Seif El -Yazal (1992), Teixeira and Machand (2003) and El-sharkawy (2004) who suggested that the seeds might be affected by the mycotoxins secreted by some fungal seed coating, especially Aspergilli and penicillia group which might adduce the presence of aflatoxins. The negative effect of toxigenic on seed germination and growth of plants suggested that toxigenic in seeds had functional role as anti-auxins probably by inhibiting RNA synthesis (Van Overbreek, 1966) or inhibiting mitotic division of meristematic cells (Berestetskil ***et al***, 1978). As it was reported by Durbin (1983) and Tewabech ***et al.*** (2001) the function of pathotoxin in pathogenisis process, may be through accelerating senescence of the host. It is well known that senescens is characterized by decline in structure and photochemical activity of chloroplasts. The question which arise now is: Why chlorophyll b showed dramatic decrease than chlorophyll a and carotenoids content? in this respect, Cohen ***et al*** (1979) found that photosystem II activity decline more rapidly than photosystem I in senescing barley leaf discs. As reported by Wessels (1977), fragmentation of chloroplasts into large units proved that enrichment of photo system II is associated with an increase in

Table (6): Effect of the storage fungi on decrease percentage in the fresh and dry weight of maize seedling.*

Fungi	S.C 15		S.C 14		S.C 129		S.C 155		T.C 351		T.C 352		T.C 322		T.C 324		T.C 326		Mean	
	F.W.%	D.W%	F.W.%	D.W%	F.W.%	D.W%	F.W.%	D.W%	F.W.%	D.W%	F.W.%	D.W%	F.W.%	D.W%	F.W.%	D.W%	F.W.%	D.W%	F.W.%	D.W%
Aspergillus flavus	31.1	29.8	33.3	22.8	25.7	29.8	44.7	41.1	47.7	31.3	46.8	39.1	41.0	36.8	39.6	38.1	49.7	52.0	39.9	35.7
Aspergillus niger	19.8	19.1	29.4	21.1	20.8	20.4	39.2	29.3	46.8	22.3	42.5	20.4	47.2	26.3	46.2	28.6	47.0	33.6	37.6	24.6
Cephalosporium maydis	11.3	13.3	10.0	19.0	18.0	26.7	11.9	35.2	17.1	35.8	18.6	34.4	22.6	30.5	25.3	26.6	25.9	44.0	17.9	29.5
Fusarium moniliforme	12.4	21.0	15.5	25.0	27.2	43.3	15.1	36.1	22.6	39.7	19.4	35.9	14.1	28.4	13.5	33.3	21.1	42.4	17.8	33.9
Penicillium expansum	11.3	19.1	11.1	26.9	12.4	37.3	23.9	39.6	37.1	39.7	37.9	39.4	38.1	33.7	22.5	36.2	41.0	48.0	26.1	35.5
Mean of inoculated cvs.	17.2	20.5	19.9	22.9	20.8	31.5	26.9	36.3	34.3	33.8	33.1	33.8	32.6	31.1	29.4	32.6	36.9	44.0	27.9	31.8
Control	2.8	0.6	2.9	0.6	3.0	0.8	3.1	0.7	3.6	0.9	3.3	0.9	4.1	1.0	4.2	1.0	4.6	1.2	-	-

F.W.= Fresh weight and D.W.= Dry weight.

Fresh weight: L.S.D. at 5% cultivars = 3.2
L.S.D. at 5% fungi = 2.4
L.S.D. at 5% cultivars x Fungi = 7.6

Dry weight: L.S.D. at 5% cultivars = 2.9
L.S.D. at 5% fungi = 2.0
L.S.D. at 5% cultivars x Fungi = 6.3 .

Table (7): Effect of maize cultivars infection with the storage fungi on chlorophyll a,b and carotenoids of the seedling leaves.

Cultivars	pigments	*A. flavus*	*A. niger*	*C. maydis*	*F. moniliforme*	*P. expansum*	Mean	Control
S.C 15	Ch,a%	52.1	41.7	41.9	43.1	38.9	43.5	5.66
	Ch.b%	59.6	49.1	49.8	62.2	43.5	52.8	2.67
	Car.%	25.9	17.0	15.6	14.7	16.9	18.0	2.24
S.C 14	Ch,a%	51.9	43.1	41.7	40.4	39.7	43.4	5.47
	Ch.b%	60.5	51.2	62.1	51.2	44.1	53.8	2.56
	Car.%	26.0	17.5	16.1	15.3	16.6	18.3	2.23
S.C 129	Ch,a%	39.5	34.5	38.0	35.2	37.2	36.9	6.4
	Ch.b%	47.0	37.7	48.1	40.3	42.2	43.1	2.68
	Car.%	15.9	15.9	15.0	13.4	15.0	15.0	2.46
S.C 155	Ch,a%	51.2	37.9	40.3	38.3	35.7	40.7	6.89
	Ch.b%	54.1	40.6	46.3	42.4	43.1	45.3	2.83
	Car.%	15.3	15.3	13.7	15.3	14.1	14.7	2.49
T.C 351	Ch,a%	42.7	40,9	39.2	40.5	34.7	39.6	6.65
	Ch.b%	55.2	45.3	52.9	53.2	51.7	51.7	3.44
	Car.%	18.8	17.0	18.8	19.9	17.0	18.3	2.82
T.C 352	Ch,a%	40.9	35.2	39.3	38.1	36.4	38.0	6.79
	Ch.b%	53.7	46.8	52.3	50.8	46.5	50.0	3.31
	Car.%	18.3	17.6	19.4	19.7	16.5	18.3	2.79
T.C 322	Ch,a%	39.2	37.3	38.9	38.1	36.2	37.9	6.6
	Ch.b%	63.2	45.8	50.0	50.8	45.1	51.0	2.64
	Car.%	17.8	18.2	20.2	19.7	17.0	18.6	2.53
T.C 324	Ch,a%	43.0	37.9	37.8	36.5	35.4	38.1	6.72
	Ch.b%	60.5	48.1	49.5	51.5	45.0	50.9	2.91
	Car.%	17.9	17.9	19.3	20.1	16.8	18.4	2.74
T.C 326	Ch,a%	39.0	40.8	39.3	39.5	37.4	39.2	6.61
	Ch.b%	55.1	47.3	42.8	50.2	45.9	48.3	2.83
	Car.%	18.4	18.4	19.5	20.3	17.3	18.8	2.66
Mean	Ch,a%	44.4	38.8	39.6	38.9	36.8	39.7	-
	Ch.b%	56.5	45.8	50.4	50.3	45.2	49.6	-
	Car.%	19.4	17.2	17.5	17.4	16.4	17.6	-

L.S.D. at 5%	Ch.a%	Ch.b%	Car.%
cultivars	0.20	0.11	0.11
fungi	0.14	0.08	0.08
cultivars x Fungi	N.S	N.S	N.S

chlorophyll, b. The decrease in chlorophyll b and carotenoids content of maize leaves inoculated with the tested fungi may be due to accelerating of senescence.

It may be logic to suggest that the further studies should be again investigated in the grain–hermitage or under modified storage conditions. Moreover, more treatments are required to be conducted to reach the maximum benefit of such means for minimizing these problems.

REFERENCES

Abo El-Dahab, M.S.K. (2006): Pathological and technological studies on maize seeds. M.SC. Thesis, Fac. of Agric., Al-Azhar Univ.

A.O.A.C., (1975): Official Methods of Analysis" Association of official Agricultural chemists, 12th Ed. Washington. D.C, USA.

A.O.A.C. (1980): Official Methods of Analysis"Association of official Agricultural chemists, 13th Ed. Washington, D.C. USA.

Assawah, M.W. and H. El Arosi, (1960): Fungi associated with wheat, barley and maize grains. Egyptian J. Botany, 3: 153 -164.

Barnett, H.L. and B.B. Hunter, (1972): Illustrated genera of imperfect fungi. Burgess publishing co., Minnesota, 3rd Ed., pp: 2411.

Berestetskil, OA., T.A., Elisashvili and A.V. Borovkov, (1978): Formation of phytotoxic 6- methyl – salicylic acid by some soil micro – organisms and its effect on pants. Sol - skokhozyay stvenaya, Biologiya (1978) 13 (6) : 868 -871. All union Res. Inst. Agric. Microbial. Leningrad, ussr.(c.f. R. P. P. vol. 59 : 176).

Bhattacharya, K. and S. Raha, (2003): Deteriorative changes of maize, groundnut and soy been seeds by fungi in storage., Mycopathologia, 155 (3): 135 – 141.

Cohen, A. S.; R. B. Papavok and A. Szalik (1979): Effect of polyamines in chlorophyll and protein content, photochemical activity and chloroplasts ultrastructure of barley leaf discs during senescence – Plant Physiol., 64 : 717 – 720.

Durbin, R.D. (1983): The biochemistry of fungal and bacterial toxins and their modes of action. In Biochemical Plant Pathology, Ed callow, J.A., John Wiley and sons chichster, New York, Brisbane, Toronto, Singapore,. 137-162.

El-Abbasi, I.H., (1990): Studies on some seed-borne diseases of certain food crops in Egypt M. Sc. Thesis, Fac. Of Agric., Ain Shams Univ., 83 pp.

El-Sharkawy, H.H.A., (2004): Integrated control to maize post harvest deseases in Egypt. M.Sc. Thesis, Fac. of Agric. Mansoura Univ.

Fandohan, P., K. Hell, W. F.O. Marasas, and M.J. Wingfield, (2003): Infection of maize by ***Fusarium*** sp. and contamination with fumonisin in Africa. African Journal of Biotec., 2 (12) 570-579.

Fathi, S. M., (1966): Some studies on seed and seedling diseases of corn. M.Sc. thesis, Fac. of Agric., Ain Shams Univ. 99pp.

Flanning, B., (1982): Mold frequency index as a measure of germination of barley and malt J. Inst. Brewing, 88 (3): 133-145.

Herter, U. and J.S. Burris, (1989): Evaluating drying injury in corn seed with a conductivity test. Seed Science and Technology, 17: 625 – 638.

Ismail, M.K.I, A.M. Salama, M. I. A. A. and S.A, Ouf (1989): Bioassay of *Eucalyptus rostorata* leaf extractives on *sclerotium cepivorum* Berk Egypt J. Bot., 32 No 1-2: 109-126.

International Seed Testing Association (ISTA), (1993): International Rules for seed testing Seed. Science and Technology, 21 Supplement Rules.

Jackson, M.L., (1973): Soil Chemical Analysis, 2nd Ed. Prentice – Hall Inc. India. Private Limited, New Delhi. 144-197.

Mackinney, G., (1941): Absorption of light by chlorophyll solutions. J. Biol. Chem. 140: 315-322.

Mankereviciene A., O. Auskalniene and S. Suproniene, (2005): Contamination of grain of various maize hybrids with mycotoxins deoxynivalenol, zearalenone and mould fungi, Latvian Journal of Agronomy, 8, LLU.

Matthews, S. and A. P. Alison (1987): Electrical conductivity test methods (2nd edition), 37-43, Published by ISTA.

Neergaard P., (1977): Seed pathology Volumes 1 & 11 John Wiley & Sons, New York.

Papavizas, G.C. and C.M. Christensen, (1960): Grain storage studies: Effect of invasion by individual species and mixture of species of

Aspergillus upon germination and development of discoloured germs in wheat. Cereal Chem., 37: 197-203.

Qasem, S. A. and C.M. Christensen, (1958): Influence of moisture content, Temperature and time on the deterioration of stored corn by fungi. Phytopathology, 48: 544-549.

Raper, K.B. and D. I. Fennell, (1965): The genus *Aspergillus* Baltimore, The Williams and Wilking Co., Baltimore, Mary land, U.S.A.

Raper, K.B. and C. Thomc (1949): Amanual of the Penicillia. Williams and Wilking Co., Baltimore. Maryland, U.S.A.

Rocandori, R.W., S. M., Mc Carter and J.L. Crawford (1971): Influence of Fungi on cotton seed deterioration prior to harvest-Phytopathology, 61: 1326-1328.

Shetty, S.A. and H.S. Shetty, (1988): Development and evalution of methods for the detection of seed –borne fungi in rice . Seed Sci. & Technol. 16: 693-698.

Singh, K., J. C. Frisvad, U, Therance and S. B. Mathur, (1991): An Illustrated manual on identification of some seed- borne Aspergillis, Fusaria, Penicillia and their mycotoxins. Danich Government Institute of Seed Pathology for Developing Countries, Hellerup, Copenhagen Denmark.

Smith, Co., (1969): An Introduction to industrial mycology. 6th Ed., London. Edward Ltd.

Tanaka, M. A. de S., J.A. Maeda and I. H. de A. Z. Plazas, (2001): Fungi associated to corn seeds under storage conditions. Scientia Agricola, 58 (3): 501-508.

Teixeira, H. and J. D. C. Machand, (2003): Transmissibility and effect of ***Acremonium strictum*** in maize seeds. Cienc. Agrotec., Lavras, 27 (5): 1045-1052.

Tekrony D. M. and J. L. Hunter, (1995): Effect of seed maturation and genotype on seed vigour in maize. Crop Science, 35: 857-862.

Tewabech, T., G. Ayana, F. Abeba and D. Wegary, (2001): Maize pathology research in Ethiopia. Proceeding of the second national Maize workshop of Ethiopia. pp 97-105.

Van Overbreek, J. (1966): Plant hormones and regulators. Science, 152: 721-731.

Zedan, A. M., (1991): The fungal flora associated with storage grains of Egyptian rice cultivars and their role in grain deterioration. Al-Azhar J. Agric. Res. 14: 61-79.

Zedan, A.M. and A.M. Seif El-Yazal, (1992): Effect of grain storage fungi on quality and germinability of rice grains J. Agric. Sci Mansoure Univ., 17 ((5): 986- 995.

Zedan, A. M. and Y.E. Arab, (1994): ***Aspergillus flavus*** mould of maize kernels and its chemical control by insecticides Egypt. J. Appl. Sci., 9 (1): 437- 449.

التأثيرات الضارة لبعض الفطريات المصاحبة لحبوب الذرة الشامية المخزونة

[١] أحمد محمد الشاذلي، أحمد محمد علي زيدان [٢] أحمد أحمد محمد عبد الرحمن، مجدي سعد الدين خليل أبو الدهب

[١] قسم النبات الزراعي (أمراض النبات) كلية الزراعة- جامعة الأزهر

[٢] معهد بحوث المحاصيل الحقلية - مركز البحوث الزراعية - مصر

أظهرت حبوب الذرة الشامية المخزونة طبيعياً نقصاً في نسبة إنبات الحبوب والمحتوى الرطوبي ووزن ١٠٠ حبه ونسبة البروتين والزيت أثناء فترات التخزين المتعاقبة (١، ٣، ٥، ٧ شهور) بعد الحصاد بينما كانت نسبة الحبوب الملونة والمواد المتأينة تزداد طردياً مع زيادة فترة التخزين.

تم إجراء العزل من الحبوب المعقمة سطحياً وبعد نهاية كل فترة من الفترات السابقة والتي جمعت عيناتها من محطتي البحوث الزراعية بسخا والجميزة.

كانت الفطريات السائدة هي أسبرجيللس فلافس، اسبرجيللس نيجر، بنسليوم اكسبنثم، فيوزاريوم مونيليفورم وذلك على بيئة PDA وبيئة وارت المملحة بكلوريد الصوديوم بنسبة ١٠% وأوراق الترشيح المبللة. وقد وجد أن الفطريات الثلاثة الأولى تزداد طردياً مع طول مدة التخزين. بينما يتناقص الفطر الأخير مع زيادة فترة التخزين.

اختبرت تأثير هذه الفطريات على إتلاف حبوب تسعة أصناف من الذرة الشامية والمتواجدة بمنطقتي إنتاج البذور بمحطتي البحوث السابقة على إنبات حبوب تلك الأصناف وخواص نموها الطول والوزن الطازج والجاف للبادرات ونسبة كل من كلوروفيل a & b والكاروتينيدات، وقد سببت هذه الفطريات نقصاً كبيراً في كل هذه الخواص مقارنة بالبادرات السليمة (غير المعداه) وخاصة صنفي فردي ١٤، ١٥، ١٥٥. كما وجد أن الفطران أسبرجيللس فلافس وفيوزاريوم مونيليفورم اشدها ضرراً بهذه الخواص كما ثبت أن محتوى الأوراق من كلوروفيل (b) تأثر كثيراً عن باقي الصبغات.

ومن المنطقي أن يتم تكرار هذه التجارب على الحبوب المخزونة بالصوامع أو تحت ظروف التخزين المعدلة حتى تتم الفائدة وهذا ما سيتم متابعته في المستقبل.