VIABILITY AND CHEMICAL COMPONENT OF GRAINS OF SIX MAIZE GENOTYPES AS AFFECTED BY EAR AND KERNEL ROT DISEASES, UNDER DIFFERENT AGRICULTURAL PRACTICES

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ABSTRACT

Maize genotypes reactions against ear and kernel rot diseases under natural infection indicated that, the single cross S.C Bashair-13 and both open pollinated varieties Giza 2 and Balady, exhibited the highest percent of infection by kernel rot causal organisms, under two tested sowing dates and two tested plant densities. While, the single crosses 107 and 122 exhibited the lowest percent of infection, under the same aforementioned treatments. The highest percent of infection was recorded at late sowing date (1 st July), late harvest date (135 days after sowing) and at high plant density, in all tested maize genotypes. *Fusarium moniliforme* appeared to be an early colonist of preharvested maize ears, infecting the kernels before *Penicillium sp.*, *Aspergillus niger*, *Aspergillus flavus* and other molds, the late fungi were increased at late sowing date and late harvest date.

Colonization of grain rot fungi i.e. *Fusarium moniliforme*, *Penicillium sp.*, *A. flavus* and *A. niger* led to a reduction in germination, a decrease in grain components (i.e. endosperm, ash %) and a decrease in weight as well as density of grains. While, fat %, crude protein %, free fatty acid % and acidity were increased. The decrease in endosperm content may be due to fungi nutrition and may be also due to stimulated of seed respiration, resulting in loss of viability as manifested by poor germination. Moreover, the increase of protein and fat % may be attributed to the increment of the total protein within the host-pathogen complex.

Key words: maize varieties, date of sowing, date of harvest, plant densities, ear and kernels rot fungi, germination, viability, acidity, chemical compositions.

INTRODUCTION

Maize is a subject to the attack of different diseases in Egypt i.e. late wilt, downy mildew and common smut, also it is a subject to the attack of kernel and ear rots in both field and store. Caldwell et al (1981) reported that, *Fusarium moniliforme* is a better competitor in preharvest maize than

Penicillium. Initial kernel infection of *F.moniliforme* may serve as an important deterrent to subsequent kernel invasion by other seed-infecting molds, as suggested by Wicklow (1988). Moreover, King (1981) and Wicklow (1988) found that *F. moniliforme* appears to be an early colonist of preharvest maize ears, infecting the kernels before *Penicillium* and other molds. In contrast, *Aspergillus flavus* and *Aspergillus niger* frequently grew out from the same kernel and showed a highly significant positive association. Diab et al (1989) and Tolba (1991) suggested that, maize grains obtained from early sown plants showed the maximum germination because of it's maturity and lowest moisture content. Increasing grain moisture content led to increased grain rot infection especially *Fusarium moniliforme* and decrease grain germinability. The percentage of fungal infection is positively correlated with the date of sowing. Prasad et al (1988) found that, *Aspergillus flavus* stimulated the hydrolysis of starch and protein producing extracellular amylase, protease and lipase enzymes. The hydrolytic product on one hand, may be utilized by the fungi for their nutrition and may be also lost due to stimulated seed respiration resulting in net loss in dry weight of the seed and loss in viability as manifested by poor germination. Also, the decrease in pH of the seed which reached it s maximum due to *A. flavus* may be due to accumulation of total free amino acids (TFAA) and fatty acids in the seed. Fahim et al (1982) found that, the highest amylase activity in vitro was recorded with *A. flavus*, followed by *Alternaria alternata* and *A. niger*. Whereas, *A. niger* followed by *A. flavus* showed the highest activity of protein decomposition and cellulytic activity. Gamal El-Din et al (1987) reported that, the most dominant fungi on maize grains could be arranged descendingly as *F. moniliforme*, *Penicillium sp. A. niger*, *A. flavus*, *Mucor sp.* and *Alternaria sp.* Prolonging storage periods generally resulted in reducing the weight of both the germ and hull in either healthy or infected grains with *N. oryzae*. Whereas no difference occurred when the grains were infected with *F. moniliforme*. Also the corn attacked by the tested fungi showed a marked increase in free and total phenols. Ghosh and Nadi (1986) found that, colonization of seed rot fungi led to a decrease in carbohydrate content in most cases. Christensen and Meronuck (1989) found that invasion of corn germs by *A. glaucus* preceded any detectable weight loss and change in germ color. By the time the dry matter loss had reached 0.5-1.0 %, the germs of corn kernels had been extensively infaded by the fungus. Gitali Das and Swati Sen Mandi (1992) showed that the scutellar amylase activity increased in unaged seeds, while it decreased in aged seeds. Purushotham et al (1996) indicated that, the tested fungi (i.e. *A. flavus*, *A. niger* and *Penicillium sp.)* caused a significant decrease in total carbohydrate content

of seeds. Maximum reduction in carbohydrate content was observed *in A. flavus* inoculated seeds.

The main objective of this experiment was to study the relation between ear and/or kernel rot and both of sowing and harvest dates in terms of seed component and seed germination.

MATERIALS AND MOTHODS

This experiment was performed at two locations i.e. Quotor (Kharbia) and Sakha (Kafr El-Sheikh) during 2001 growing seasons.

Split split plot design with four replicates was adopted in this experiment. The sub sub plots were cultivated by maize cultivars i.e. single crosses (s.c)107, 120, 122, Bashair-13 and two open pollinated varieties i.e. Giza 2 and Balady. The sub plots were represented by two planting distances i.e. 17.5 and 25 cm between hills to get the two tested plant densities of 32000 and 24000 plants / feddan, respectively. The main plots included two sowing dates i.e. 1 st of June and 1 st of July. The experimental unit consisted of 5 rows, 6 m long and 70 cm apart, each hill was planted with 3 seeds and thinned to 1 plant after 3 weeks of planting. Samples of 20 ear/cultivar were taken at random from each treatment after three different dates from sowing i.e. 105, 120, and 135 days. These samples were subjected to the determination of germination and the involved fungi as follows:- The treatment included 25 seed of each cultivar with four replicates. Seeds from each sample were immersed in 1 % sodium hypochlorite solution for 2 min. then washed several times in distilled sterile water and transferred to sterile PDA midium in petri plates 15 cm diameter and incubated at 25-27°C for 12 days. Percentage of seed germination and infection by seed rot fungi i.e. *Fusarium moniliforme*, *Penicillium sp.*, *A.niger*, *A. flavus* and other fungi, were recorded.

Viability test of seeds:

Germination test under optimum conditions was done according to the international rules (ISTA 1993). A germination paper of filter paper strips was folded into 10-50 pleats longitudinally which may be stapled at both ends. Seeds were placed in the pleats and sufficient water was added. These strips were either kept in boxes with tight fitting lids or placed directly in a (wet) type cabinet at 29 °C. Germination counts for normal seedlings were done after seven days.

Cold germination test was measured according to the procedures reported in the seedling vigor testing Hand Book (ISTA 1995).

Relative density of seeds:

Thousand seeds from each plot were weighted, their volume was measured by absolute displacement and relative density was calculated (Bourne, 1967).

All recorded data were subjected to the statistical analysis according to Snedecor and Cochron (1980).

Chemical composition of seeds:

Seed samples were taken at random from each plot and grounded to fine powder to pass through 2 m m mesh for chemical analysis; i.e., moisture content, crude protein (N % x 5.75), ash % as well as oil content by the soxhlet extraction method were determined according to the procedures of the A.O.A.C. (1990) and expressed as a percentage of the dry weight of the sample.

RESULTS AND DISCUSSION

Data presented in Table (1) showed that maize cultivar i.e Balady recorded the highest percent of infection by ear rot fungi, followed by Giza 2 and S.C Bashair-13 genotypes. The lowest infection percentage was recorded with S.C 107, 120 and 122 maize cultivars, respectively. The endosperm, density of grain and weight of 100-kernel decreased by increasing infection with the tested fungi, while, the percentage of protein, acidity, F.F.A and crude ash % increased by increasing infection with the tested fungi. These results were in agreement with those reported by Fahim et al (1982) and Prasad et al (1986).

As for sowing and harvest dates, data presented in Table (1) indicated that, the percentage of infection resulted from saprophitic fungi i.e *Penicillium sp.*, *A.niger* and *A.flavas* were higher at second sowing date and at 3 rd harvest date, while the percent of infection resulted from *Fusarium moniliforme* was high at the two tested sowing dates and at the three tested harvest dates. These results are in accordance with findings of King (1981), Wicklow (1988), Diab et al (1989) and Tolba (1991).

Regarding the two tested plant densities, data presented in Table (1) showed that the infection percentage due to maize grain rot fungi was higher under plant density (32000 plant / feddan) comparing with low plant density (24000 plant / feddan). The percent of free faty acid (F.F.A), fat % and acidity % in grains increased under high plant density, while, the percent of endosperm in maize grains were lower under high plant density. These results indicated that, the optimum sowing date, harvest date and plant density, which gave high germination and high quality of maize grains were 1 st of June, 120 days from sowing and 24000 plant / feddan, respectively.

Table (1): The means infection of maize varieties, date of sowing, date of harvest and plant densities and effect of them on development of ear and kernels rot fungi, germination , acidity, F.F.A and on component of maize grains in two tested locations.

Variables	variety						Sig	Date of sowing		Sig	Date of harvest			Sig	Density		Sig
	1	2	3	4	5	6		1	2		1	2	3		1	2	
F.m	22.12 d	28.95 c	27.45 c	42.95 b	43.61 b	49.37 a	**	34.64	36.85	**	35.34	35.86	36.03	N.S	29.79	41.69	**
P.sp	2.53 f	5.81 d	3.69 e	6.69 c	8.15 b	9.29 a	**	5.31	6.74	**	1.80 c	6.74 b	9.54 a	**	5.32	6.73	**
A.m	2.06 d	5.42 b	5.17 c	5.53 b	4.46 a	7.17 a	**	5.35	4.58	**	1.43 c	4.75 b	8.72 a	**	4.39	5.54	**
A.f	2.22 d	4.25 b	3.06 c	5.47 a	5.39 a	6.03 a	**	4.40	4.41	*	1.35 c	4.38 b	7.49 a	**	4.01	4.80	**
Other fungi	2.12 c	3.08 b	2.92 b	3.25 b	4.05 a	4.34 a	**	3.04	3.55	**	2.42 c	3.06 b	4.40 a	**	2.96	3.63	**
Germination lab %	95.69 a	95.00 a	93.97 a	94.86 a	93.31 a	88.42 b	**	95.14	91.94	**	93.78	94.06	92.79	N.S	94.99	92.09	**
Cold test %	87.42 a	86.61 a	88.61 a	85.75ab	84.97ab	82.28 b	*	85.96	85.92	*	84.29 b	88.15 a	85.38 b	**	85.77	86.11	*
Endosperm (%)	23.44 b	25.46 a	25.31 a	22.40ab	21.31 c	21.76 c	**	24.26	22.30	**	23.58	23.29	22.97	N.S	23.77	22.79	**
Empryo (%)	3.24 b	3.28 b	3.41 a	3.19 b	3.34 a	3.48 a	*	3.40	3.28	*	2.90 c	3.85 a	3.26 b	**	3.43	3.24	*
Lama (%)	2.08 a	2.13 a	2.04 a	1.71 b	1.75 b	1.72 b	*	1.96	1.85	*	1.90	1.97	1.85	N.S	1.94	1.87	*
F.F.A %	0.190 c	0.125 d	0.149cd	0.240 b	0.264ab	0.299 a	**	0.216	0.207	*	0.184 b	0.487 b	0.262 a	**	0.193	0.229	**
Acidity %	5.38 e	5.84 d	5.91 d	6.57 c	7.09 b	7.74 a	**	5.94	6.90	**	5.94 c	6.26 b	7.06 a	**	6.18	6.66	**
Density (weight/size)	1.26 a	1.23 b	1.19 c	1.14 d	1.10 e	1.06 f	**	1.17	1.16	*	1.20 a	1.17 b	1.12 c	**	1.18	1.15	**
Size (m m)	24.31 d	27.50 c	27.36 c	28.28 b	29.19 a	28.53 b	**	28.22	26.83	**	28.10 a	27.50 b	26.99 c	**	28.87	26.19	**
Weight (g)	31.43 d	33.07 b	33.72 a	32.27 c	31.72cd	30.66 e	**	33.43	30.87	**	32.98 a	32.23 b	31.23 c	**	33.58	30.71	**
Protein %	12.43de	12.73cd	12.22 e	12.87 c	13.57 b	14.26 a	**	13.02	13.01	*	12.31 c	12.96 b	13.77 a	**	13.01	13.02	*
Fat %	4.36 b	3.86 c	4.01 c	4.43 b	4.90 a	5.02 a	**	4.45	4.41	*	4.30 b	4.35 b	4.65 a	**	4.37	4.49	**
Moisture %	14.32 c	14.34 c	14.33 c	15.21 a	14.44 c	14.76 b	**	14.51	14.63	*	15.66 a	14.06 b	13.99 b	**	14.46	14.68	**
Ash %	1.41 bc	1.40 bc	1.43 b	1.34 c	1.36 c	1.54 a	**	1.47	1.35	**	1.40 b	1.49 c	1.35 c	**	1.43	1.40	*

Means designated by different letters in the same column are significantly different at 5% according to Duncan's multiple range test.

Regarding the effect of two tested sowing dates and three harvest dates under two plant densities on infection of six maize genotypes by ear and kernel rots causal organisms. the presented data in tables (2) and (4) and figure (1) showed that the maize genotypes i.e. s.c 107 and 122 exhibited the lowest percent of infection resulted from the tested fungi, while the single cross Bashair-13 and open pollinated varieties i.e. Giza 2 and Balady showed the highest percent of infection under the two tested sowing dates and two tested plant densities. The grain infection of the tested fungi were higher at second sowing date and at the high plant density (D_2) in all tested maize genotypes. The highest percent of infections of saprophytic fungi i.e. *Penicillium sp.* and *Aspergillus sp.* were recorded in the second sowing date, at *Penicillium* third harvest date under high tested plant density. The data in Tables (1). (2) and (3) also showed that. *Fusarium moniliforme* was first competitor pathogen and it's infection on the maize grains was observed before *sp.*, *Aspergillus sp.* and other molds. Here, the infection with *Fusarium moniliforme* was generally higher in all sowing dates and harvest dates. while the infection with *Penicillium sp*, *A. flavus*, *A. niger* and other fungi was only high at late sowing date and at late harvest date. These results were in accordance with finding of King (1981), Caldwell et al. (1981). Wicklow (1988), Diab et al (1989) and Tolba (1991), who found that, initial kernel infection by *F moniliforme* may serve as an important deterrent to subsequent kernel invasion by other seed-infecting molds. The percentage of fungal infection positively correlated with date of sowing.

As for the effect of infection by ear and kernel rot causal organisms on maize grain contents, data presented in Tables (2), (3), (4) and (5) indicated that the tested fungi especially *A. flavus*, *A. niger* and *Penicillium sp.* caused a significant decrease in endosperm percent in maize grain and 100-kernel weight. especially at late sowing date, late harvest date and under high plant density. The decrease in endosperm content may be due to the colonization of seed rot fungi, which led to the stimulation of amylase activities. invertase and protease, as recorded by Prasad et al. (1988). The density of grain (weight/size), the percent of embryo for the grain and the percent of lemma for the grain were also decreased due to infection by tested fungi especially at late sowing date and late harvest date under the higher plant density in susceptible grains (i.e. s.c 120, Bashair-13, Giza 2 and Balady). The crude ash (%) also decreased in few cases. The decrease in crude ash % may be due to the colonization of some ear rot fungi especially *A. niger*, which led to an increase of cellulytic activity as reported by Fahim et al. (1982). On the other hand, data in Tables (2), (3), (4) and (5) showed that, the crude protein % increased in maize grains which have high severity of rot diseases (at both late sowing and harvest

Table (2): Interaction between maize genotype, sowing date and plant density and its effect on kernel rot disease incidence in two locations i.e.Quotor (Kharbia) and Sakha (Kafr El-sheikh)

Maize genotypes	Sowing date	Plant densities	F- moniliforme		Penicillium sp		Aspergillas niger		Aspergillus flavus		Other fungi	
			Quotor	Sakha	Quotor	Sakha	Quotor	Sakha	Quotor	Sakha	Quotor	Sakha
S.c 107	first	D1	12.20	14.27	0.20	0.56	0.20	0.78	0.95	1.11	1.41	1.56
		D2	23.00	27.76	0.90	1.44	1.99	2.44	1.00	1.56	1.72	1.92
	Second	D1	13.60	16.84	2.61	3.56	1.60	2.11	2.20	2.78	1.93	2.00
		D2	24.30	29.60	4.00	4.56	2.30	2.89	3.23	3.44	2.56	3.00
S.c 120	First	D1	17.11	20.63	3.00	4.56	2.30	3.33	2.66	3.11	2.01	2.42
		D2	32.60	37.84	4.26	5.00	3.90	5.89	3.87	3.78	2.93	4.11
	Second	D1	31.01	33.92	4.13	5.56	3.00	4.11	3.99	4.89	2.80	2.56
		D2	35.00	33.40	6.00	8.11	6.20	8.33	4.98	5.22	3.00	3.22
S.c 122	First	D1	13.00	18.64	1.12	1.33	1.00	1.56	1.11	1.44	1.49	1.91
		D2	27.81	30.46	2.99	4.22	2.20	3.89	1.89	2.22	2.50	3.20
	Second	D1	22.31	26.33	2.00	2.89	2.10	2.22	2.58	4.11	2.81	3.11
		D2	32.00	34.37	4.68	6.33	3.60	5.00	3.96	4.44	3.20	3.44
Bashair-13	First	D1	29.60	35.18	4.00	5.78	3.10	4.11	3.84	4.11	2.69	3.10
		D2	48.33	51.02	5.88	6.78	5.00	6.44	4.55	4.78	3.20	3.33
	Second	D1	33.61	39.09	4.66	6.67	4.60	4.78	4.60	5.56	2.94	3.56
		D2	43.88	46.51	6.01	7.56	5.99	6.78	6.00	7.44	3.20	3.00
G2	First	D1	29.13	34.21	5.24	7.03	4.00	5.44	3.88	4.56	2.80	3.29
		D2	41.12	49.34	7.18	8.00	5.60	6.10	4.90	5.33	3.56	3.92
	Second	D1	33.68	42.07	6.90	7.78	4.80	6.22	4.53	5.67	2.99	3.89
		D2	46.13	48.80	8.00	9.78	6.89	8.07	5.88	6.00	4.60	5.11
Balady	First	D1	32.15	40.03	6.13	7.73	5.11	6.11	3.00	3.78	2.86	3.51
		D2	44.13	56.22	7.50	8.42	6.80	6.90	4.88	5.33	3.90	4.18
	Second	D1	43.66	46.26	8.12	9.44	5.60	7.00	4.00	5.44	3.96	4.56
		D2	51.19	54.96	10.40	11.56	7.50	8.67	5.92	6.56	4.83	5.11
L.S.D. at (5 %)			3.68	3.51	1.20	1.28	1.76	1.21	1.09	1.13	1.23	1.01

First = 1 st of June
Second = 1 st of July

D1 = 24000 plant / feddan
D2 = 32000 plant / feddan

Table (3): Means interaction between maize genotype, sowing date and plant density and its effect on standard germination, cold test germination, weight of 100-kernel, crude protein, fat and crude ash % in maize grains in two tested locations.

Maize genotypes	Sowing date	Plant densities	Standard germination %	Cold test germination %	Crude protein %	Fat %	Crude ash %	Weight 100-kernal (g)	Endosp-erm %	Embryo %	Lemma %	F.F.A %	Acidity %
S.c 107	first	D1	97.89	89.56	13.55	4.03	1.46	34.04	25.14	3.70	2.22	0.13	5.13
		D2	94.67	86.11	12.54	4.44	1.45	29.60	23.25	3.15	1.93	0.27	5.48
	Second	D1	95.89	86.22	12.29	4.61	1.32	34.17	22.93	2.92	2.20	0.20	5.43
		D2	94.33	87.78	11.33	4.35	1.40	27.90	22.44	2.71	2.28	0.25	5.45
S.c 120	First	D1	93.11	84.00	13.25	3.78	1.53	36.79	27.19	3.58	2.25	0.12	5.25
		D2	95.44	90.33	12.26	4.04	1.44	31.99	24.20	3.21	2.07	0.19	5.70
	Second	D1	97.44	84.22	12.34	3.83	1.32	31.97	25.18	3.32	2.20	1.3	6.04
		D2	94.00	87.89	13.09	3.78	1.30	31.53	25.28	3.02	1.98	0.22	6.35
S.c 122	First	D1	98.89	85.00	12.15	4.06	1.43	35.99	26.62	3.60	2.29	0.13	5.06
		D2	90.89	88.22	11.75	3.98	1.57	33.54	26.81	3.20	2.09	0.18	5.55
	Second	D1	96.33	95.56	12.42	4.22	1.42	32.74	24.26	3.19	2.00	0.12	5.65
		D2	89.78	85.67	12.55	3.79	1.31	32.61	23.55	3.19	2.00	0.24	6.67
Bashair-13	First	D1	97.89	88.00	12.63	4.57	1.37	35.39	24.75	3.24	2.40	0.19	5.43
		D2	92.11	83.78	13.11	4.49	1.33	32.39	21.94	3.15	2.20	0.25	6.08
	Second	D1	94.33	85.44	12.80	3.89	1.54	31.44	21.97	3.14	2.35	0.19	6.98
		D2	95.11	85.78	12.94	4.75	1.12	29.86	20.92	2.90	2.01	0.30	7.71
G2	First	D1	96.78	85.00	13.02	5.00	1.45	35.44	22.18	3.85	3.00	0.24	6.07
		D2	97.00	87.22	13.88	4.73	1.48	32.07	22.14	2.80	2.80	0.27	6.70
	Second	D1	94.89	83.89	13.43	4.78	1.22	31.02	20.24	3.50	3.10	0.23	6.35
		D2	84.56	83.78	13.95	5.09	1.29	28.36	20.67	3.23	2.90	0.30	7.40
Balady	First	D1	91.33	78.44	13.83	4.86	1.50	34.08	24.26	3.52	3.15	0.28	6.70
		D2	95.67	85.89	14.21	5.38	1.65	29.80	22.59	3.24	2.95	0.30	7.32
	Second	D1	85.11	83.89	14.36	4.83	1.57	29.93	20.49	3.12	3.10	0.27	6.80
		D2	81.56	80.89	14.62	5.02	1.43	28.84	19.69	2.95	3.00	0.32	7.86
L.S.D			3.52	5.70	0.537	0.322	0.138	1.10	1.274	0.251	0.301	0.110	0.447

First = 1 st of June D1 = 24000 plant / feddan
Second = 1 st of July D2 = 32000 plant / feddan

Table (4): Effect of three harvest date at two plant densities on development of kernels rot disease of six maize genotypesin two tested locations.

Maize genotypes	Harvest date	Plant densities	F- moniliforme		Penicillium sp		Aspergillas niger		Aspergillus flavus		Other fungi	
			Quotor	Sakha	Quotor	Sakha	Quotor	Sakha	Quotor	Sakha	Quotor	Sakha
S.c 107	First	D1	10.30	13.50	0.13	0.50	0.00	0.00	0.08	0.33	0.21	0.83
		D2	23.016	28.20	0.50	0.67	0.00	0.33	0.20	0.67	0.91	1.05
	Second	D1	13.14	16.00	2.10	2.50	0.50	1.83	1.88	2.50	0.81	1.17
		D2	24.11	29.00	3.60	4.00	1.90	2.50	2.18	2.67	0.99	1.50
	Third	D1	15.13	17.17	4.30	3.17	1.80	2.50	3.16	3.00	0.88	3.33
		D2	25.24	28.83	5.00	4.33	2.60	2.16	4.11	4.17	1.123	4.83
S.c 120	First	D1	17.30	20.45	0.40	0.83	0.00	0.66	0.30	0.67	1.00	1.47
		D2	28.20	34.15	1.00	1.17	1.39	0.83	1.00	1.17	1.60	2.33
	Second	D1	20.63	23.55	3.00	4.33	2.80	4.00	2.00	3.67	1.30	2.17
		D2	33.85	37.88	5.90	8.00	5.60	7.16	3.11	4.50	2.30	4.67
	Third	D1	19.80	22.83	7.80	9.17	7.00	9.16	4.20	8.17	2.60	3.83
		D2	34.00	34.83	10.00	11.33	9.20	10.66	5.90	7.33	3.01	4.00
S.c 122	First	D1	18.20	21.13	0.00	0.50	1.00	0.83	1.00	0.83	0.80	1.37
		D2	27.30	33.42	0.60	1.00	1.20	1.16	1.20	1.33	1.60	2.30
	Second	D1	17.90	22.83	2.30	3.67	1.50	2.83	2.30	3.50	1.31	2.33
		D2	29.22	31.83	3.90	5.33	1.80	3.66	3.20	3.33	2.00	2.50
	Third	D1	21.13	23.50	4.00	4.17	2.90	4.50	4.00	4.00	2.60	3.83
		D2	30.58	32.00	5.50	7.50	5.31	6.00	5.20	5.33	2.99	5.17
Bashair- 13	First	D1	28.12	39.92	1.11	1.67	0.80	1.00	0.81	1.00	1.36	2.65
		D2	36.88	51.80	2.20	2.50	1.00	1.50	1.50	1.83	1.50	2.33
	Second	D1	30.13	35.67	4.40	6.33	3.80	4.66	3.60	5.17	2.00	2.50
		D2	45.64	46.50	6.30	7.67	4.30	5.33	5.80	6.00	3.11	3.33
	Third	D1	33.16	35.82	8.13	10.67	7.20	10.16	6.99	8.33	3.00	4.83
		D2	47.28	48.00	9.90	11.33	9.23	10.50	8.50	9.50	3.30	3.83
G2	First	D1	32.28	38.25	1.83	2.55	1.80	2.15	1.01	1.50	2.66	3.10
		D2	46.33	48.55	2.64	3.18	1.90	2.60	1.20	1.50	2.50	3.72
	Second	D1	35.23	36.33	5.80	8.17	4.20	5.50	2.30	3.83	3.20	3.17
		D2	44.90	49.50	7.88	10.00	5.30	6.83	4.20	6.17	3.30	4.67
	Third	D1	37.18	39.83	9.18	11.83	6.40	9.66	6.80	9.50	4.21	4.50
		D2	47.18	49.17	11.60	13.17	9.96	12.00	8.20	9.83	5.00	5.17
Balady	First	D1	38.12	41.77	1.87	2.93	1.94	2.35	1.90	2.33	2.11	3.43
		D2	44.24	52.93	3.20	4.13	2.88	3.66	2.99	3.00	3.16	4.43
	Second	D1	40.16	44.50	3.28	9.00	4.00	5.33	4.10	4.00	4.11	3.50
		D2	48.82	56.67	8.54	11.83	6.20	7.33	5.80	6.17	5.00	5.17
	Third	D1	42.16	43.17	10.66	13.83	8.30	11.83	7.00	9.83	5.13	5.17
		D2	53.88	57.17	13.20	14.00	9.95	12.50	8.90	10.83	5.00	4.33
L.S.D.at (5%)			4.60	3.28	1.30	1.76	1.92	1.80	1.21	1.64	0.84	1.19

First = 105 days after sowing
Second = 120 days after sowing
Third = 135 days after sowing

D1 = 24000 plant / feddan
D2 = 32000 plant / feddan

Table (5):Means interaction between Maize genotype, date of harvest date and plant density and their effect of them on germination, cold test germination, crude protein, fat, weight of 100-kernal, acidity, Size of kernel, crude ash and density of grains in maize in two tested locations.

Maize genotypes	Sowing date	Plant densities	Standard germin -ation %	Cold test germin -ation %	Crude protein %	Fat %	Weight 100-kernal (g)	Acidity %	Size (m)	Density (W/S)	Crude ash %	Endo-sperm %	Embryo %	Lemma %	F.F.A %
S.c 107	First	D1	93.83	88.17	11.81	4.05	36.97	5.01	27.50	1.26	1.33	23.73	2.96	2.12	0.14
		D2	92.33	87.00	11.96	4.61	29.69	5.26	22.33	1.30	1.51	21.73	2.89	1.90	0.18
	Second	D1	99.17	88.67	13.85	4.14	34.37	5.43	26.83	1.29	1.42	24.27	3.76	2.30	0.13
		D2	94.33	89.67	11.58	4.33	29.75	5.45	22.83	1.31	1.46	22.51	2.94	2.01	0.19
	Third	D1	97.67	86.83	13.10	4.77	30.97	5.42	24.50	1.26	1.42	24.11	2.83	2.20	0.15
		D2	96.83	84.17	12.27	4.25	28.82	5.68	21.83	1.16	1.32	21.28	2.26	2.20	0.20
S.c 120	First	D1	96.83	83.17	12.01	3.84	35.15	4.90	27.83	1.28	1.29	23.93	3.03	2.00	0.12
		D2	96.00	87.00	12.61	3.91	31.59	5.66	29.83	1.22	1.50	22.83	2.85	2.20	0.13
	Second	D1	91.33	81.83	13.54	3.56	32.81	5.72	30.17	1.23	1.49	28.26	3.95	2.30	0.13
		D2	93.17	93.00	12.33	4.13	31.09	5.78	25.83	1.21	1.30	22.91	3.11	2.10	0.17
	Third	D1	97.67	87.33	12.84	4.01	35.19	6.78	27.33	1.23	1.48	26.36	3.31	2.02	0.19
		D2	95.00	87.33	13.08	3.69	32.61	6.22	24.00	1.20	1.32	23.38	2.99	2.00	0.22
S.c 122	First	D1	94.00	87.00	11.82	3.98	35.86	5.71	26.17	1.20	1.49	24.28	3.04	2.20	0.13
		D2	89.33	86.67	11.82	4.35	33.53	5.55	29.33	1.14	1.45	23.64	3.05	2.10	0.16
	Second	D1	98.83	96.67	12.23	4.35	33.44	5.74	28.83	1.15	1.51	24.97	3.99	2.40	0.12
		D2	90.50	85.83	12.11	3.80	33.98	6.05	26.83	1.22	1.53	23.69	3.11	2.30	0.15
	Third	D1	100.00	87.17	12.81	4.08	33.80	5.67	27.50	1.23	1.29	27.11	3.00	2.35	0.18
		D2	91.17	88.33	12.51	3.52	31.70	6.75	25.50	1.16	1.34	25.22	2.86	2.25	0.23
Bashair-13	First	D1	94.83	87.67	12.23	3.73	34.69	5.73	30.00	1.16	1.22	25.17	2.80	2.40	0.12
		D2	97.67	82.00	12.09	4.30	31.64	5.88	25.50	1.22	1.24	21.77	2.73	2.20	0.20
	Second	D1	98.00	86.00	12.12	4.46	34.19	6.03	29.67	1.08	1.80	22.13	3.30	2.50	0.18
		D2	91.67	88.50	13.06	4.52	31.79	7.15	29.17	1.21	1.23	21.20	3.00	2.35	0.23
	Third	D1	95.50	86.50	13.80	4.52	31.38	6.86	30.00	1.10	1.33	22.78	3.03	2.40	0.21
		D2	91.50	83.83	13.93	5.05	29.95	7.75	25.33	1.09	1.21	21.32	2.74	2.20	0.30
G2	First	D1	98.33	79.50	12.51	4.81	33.41	6.71	32.00	1.20	1.32	24.95	2.74	3.00	0.18
		D2	95.83	85.17	12.49	4.51	30.08	6.89	27.83	1.14	1.45	22.34	2.64	2.80	0.25
	Second	D1	99.17	91.67	12.67	4.72	32.13	6.07	30.17	1.22	1.38	23.42	3.30	3.30	0.24
		D2	90.17	84.50	13.81	4.84	29.06	7.07	24.83	0.99	1.43	22.79	2.60	3.30	0.32
	Third	D1	90.00	82.17	14.49	5.15	31.15	7.54	31.00	1.05	1.31	20.77	3.00	3.35	0.29
		D2	86.33	86.83	15.45	5.39	28.50	8.25	29.33	1.00	1.27	19.08	2.60	3.20	0.38
Baladv	First	D1	85.00	73.17	13.42	4.80	34.26	6.66	32.33	1.14	1.42	24.89	2.65	3.01	0.20
		D2	91.33	85.00	12.99	4.67	28.89	7.36	26.50	1.08	1.57	23.59	3.00	2.95	0.25
	Second	D1	91.33	86.17	13.77	4.35	32.24	7.05	28.83	1.08	1.63	23.03	3.50	3.20	0.26
		D2	91.00	85.33	14.43	4.99	28.87	7.60	26.00	1.08	1.68	21.32	3.00	3.00	0.36
	Third	D1	88.33	84.17	15.10	5.39	29.51	8.26	29.00	1.00	1.55	19.20	3.04	3.10	0.31
		D2	83.50	79.83	15.84	5.93	26.21	9.54	28.50	1.00	1.36	18.51	2.81	3.00	0.41
L.S.D at (5%)			4.81	6.98	0.658	0.394	1.34	0.447	1.17	0.036	0.169	1.274	0.251	0.301	0.110

dates in susceptible varieties). The increment of total protein in the count of infection, could be attributed to the contribution of the causal agent., on the other hand, the increase in total protein may be due to the consumption of sugars and or carbohydrates of the host by the pathogen. The previous results obtained by Fahim et al (1982) and Prasad et al (1988) confined that, the highest activity of protein decomposition and cellulytic activity was recorded due to the infection of maize grain with *A. niger* and *A. flavus*. These fungi also stimulated the activities of pectic enzyme complex, proteases and some amino acids dehydrogenases.

Concerning the fat %, free fatty acids (F.F.A) % and pH value in infected maize grain, the data in Table (2), (3), (4) and (5) indicated that, the tested fungi caused a significant increase in free faty acid content and pH value in infected grains, especially at late sowing date and late harvest date under high plant density in susceptible maize grains. The increase in pH value of the seed which reached it's maximum during to *A. flavus* infection, may be due to accumulation of total free amino acids (T.F.A.A) and fatty acids in the infected seeds, as reported by Prasad et al (1988).

As for standard germination, the presented results in Tables (2), (3), (4) and (5) and illustirated in Fig. (2) demonstrated that, the seeds infected by tested fungi especially *A. flavus* and *F moniliforme* at late sowing and harvest date under high plant density, led to stimulating seed respiration and resulting in net loss in dry weight of the seed and loss in viability as manifested by poor germination. These results were in the same line with that recorded by Prasad et al (1988).

Concerning the correlation between the infection by Kernel rot fungi and grain contents, the presented data in Table (6) showed that, the percentage of fungal infection positively correlated with grain content of free fatty acids, acidity, crude protein % and fat %. In the reverese, the percentage of fungal infection negatively correlated with grain contents of endosperm %, moisture % and ash %. Moreover, the presented data in Table (6) also showed negative correlation between percentage of fungal infection and 100- kernel weight, density of kernels and percentage of germination. These results were in the same trend with the rest of results obtained within this study.

From results obtained in this study, it could be concluded that, the ear and kernel rot diseases increased in grain yield of late sowing date (1 st July) and late harvest date (135 days from sowing). The high plant density caused high severity with tested disease, due to the increase of the relative humidity around the plants. Initial kernel infection by *F. moniliforme* may serve as an important deterrent to subsequent kernel invasion by other seed-infecting molds.

Figure (1): Means of maize genotypes, date of sowing, date of harvest and plant density and effect of them on development of ear and kernels rot fungi

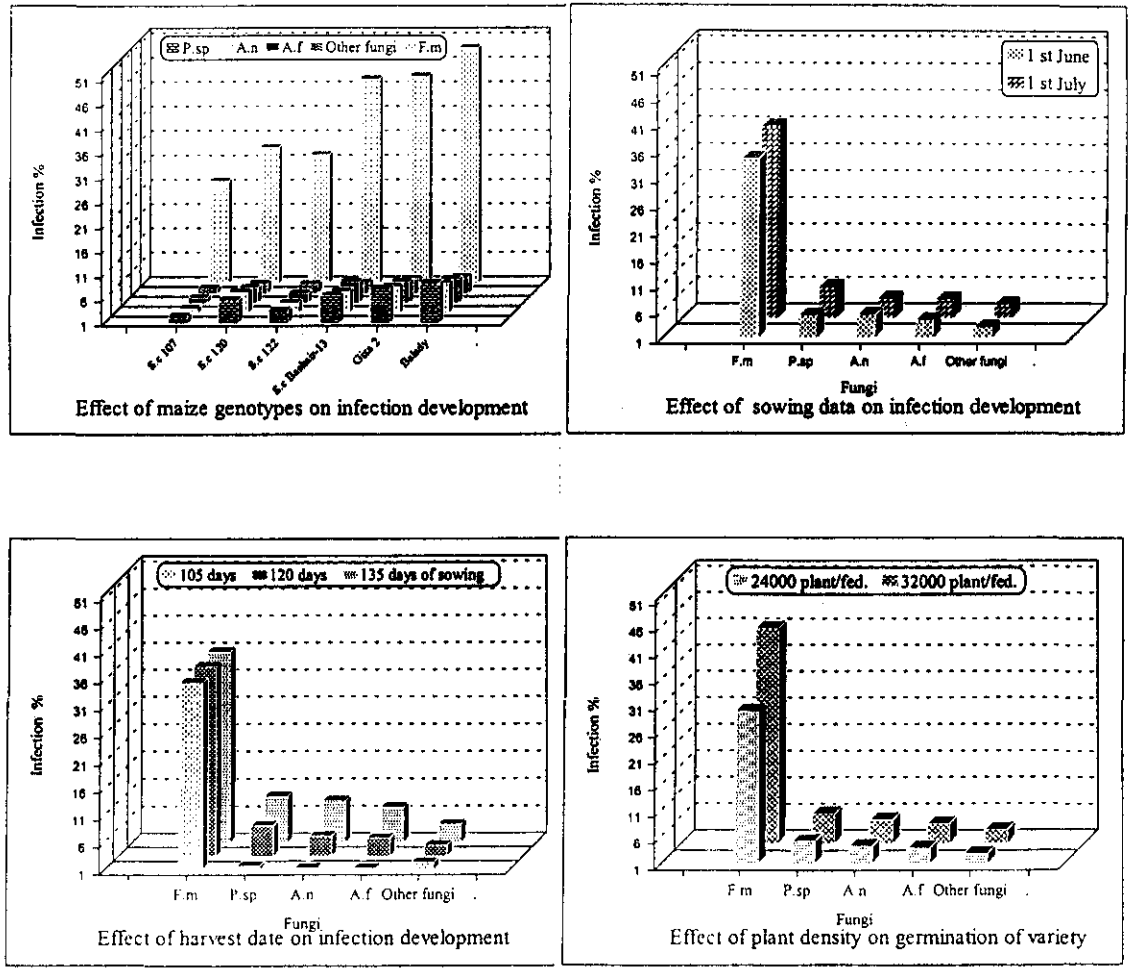

Figure (2): Means of *Fusarium* moniliforme infection, sowing date, harvest date and plant density and effect of them on germination percentage of six maize genotypes.

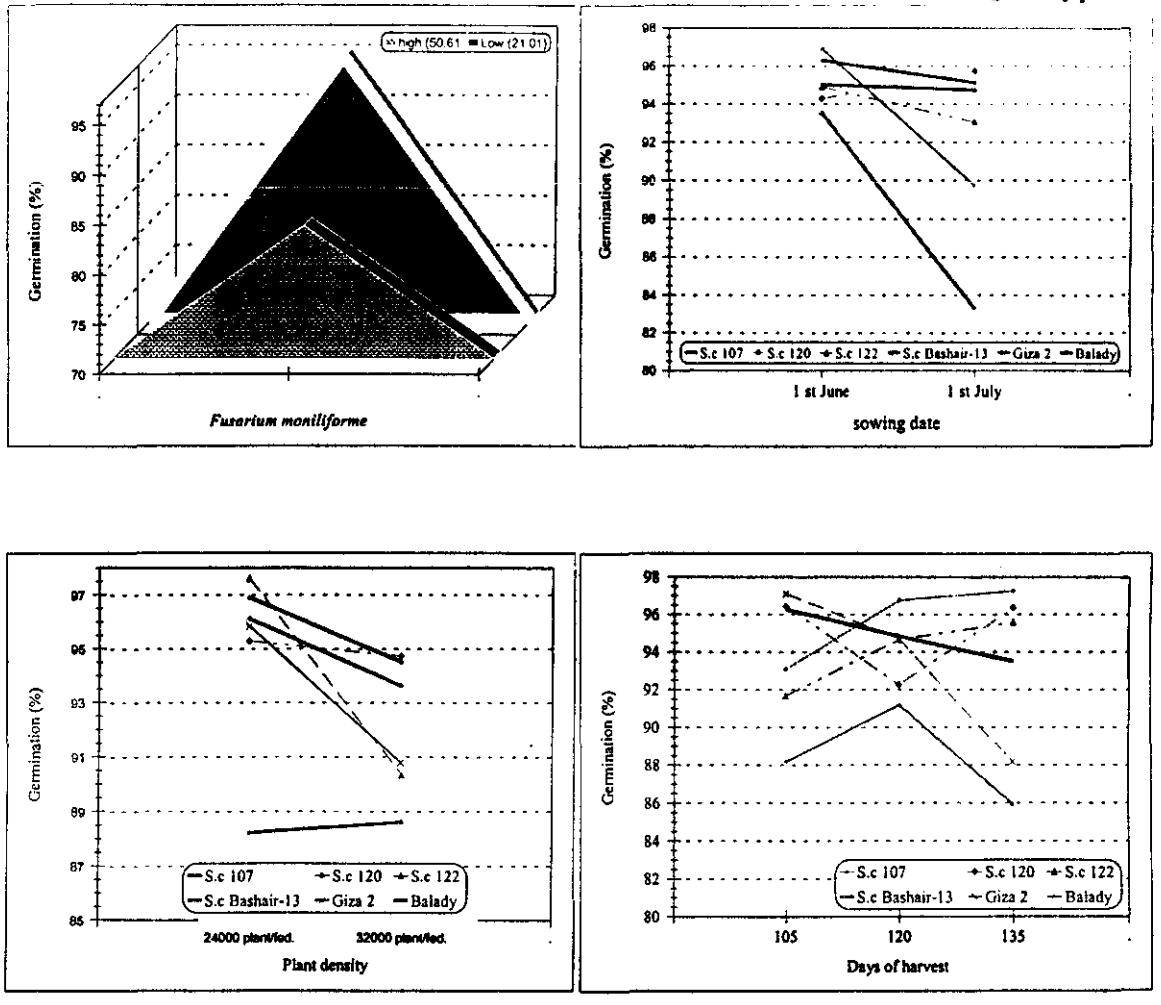

Table (6): Correlation coefficients between means both of tested ear and kernel rot fungi and component of maize grain.

Variables	F.m	P.sp	A.n	A.f	Other fungi.	Germination	Cold Test	Endosperm	Embryo	Lemma	F.F.A	Acidity	Density	Volume 100 kernel	Weight 100 kernel	Protein	Fat	Moisture	Crude ash
F.m	1.00	0.500	0.420 * *	0.402 * *	0.407 * *	-0.281 * *	-0.149 *	-0.402 * *	-0.049	-0.244 * *	0.393 * *	0.619 * *	-0.589* *	109	-0.375* *	0.389 * *	0.454 * *	0.207 * *	-0.011
P.sp		1.00	0.861 * *	0.832 * *	0.459 * *	-0.236 * *	-0.009	-0.333 * *	0.135 *	-0.136 *	0.430 * *	0.634 * *	-0.512* *	0.039	-0.253* *	0.520 * *	0.408 * *	-0.360* *	-0.094
A.n			1.00	0.897 * *	0.420 * *	-0.123	0.018	-0.197 * *	0.129	-0.115	0.406 * *	0.489 * *	-0.487* *	0.104	-0.135 *	0.527 * *	0.376 * *	-0.354* *	-0.047
A.f				1.00	0.321 * *	-0.092	-0.006	-0.235 * *	0.170 *	-0.087	0.428 * *	0.505 * *	-0.473* *	0.102	-0.158 *	0.498 * *	0.396 * *	-0.364* *	-0.064
Other fungi.					1.00	-0.399 * *	-0.054	-0.254 * *	0.085	-0.179 *	0.161 *	0.462 * *	-0.425* *	-0.026	-0.277* *	0.360 * *	0.270 * *	-0.072	-0.043
Germination						1.00	0.274 * *	0.299 * *	-0.116	0.159 *	-0.171 *	-0.432* *	0.343 * *	0.004	0.118	-0.361* *	-0.193* *	-0.087	-0.023
Cold Test							1.00	0.052	0.063	0.127	-0.099	-0.168 *	0.177	-0.088	-0.018	-0.074	-0.062	0.232 * *	0.027
Endosperm								1.00	0.017	0.294 * *	-0.346 * *	-0.438* *	0.310 * *	-0.024	0.256 * *	-0.268* *	-0.486* *	0.053	0.083
Embryo									1.00	0.101	-0.0038	0.076	-0.105	0.177	0.120	0.183 * *	0.067	-0.285* *	0.252 * *
Lemma										1.00	-0.160	-0.237* *	0.265 * *	0.026	0.182 * *	-0.099	-0.195* *	-0.089	0.176 *
F.F.A											1.00	0.440 * *	-0.486* *	0.055	-0.234* *	0.433 * *	0.491 * *	0.0176	-0.049
Acidity												1.00	-0.586* *	0.060	-0.377* *	0.610 * *	0.473 * *	-0.126	-0.083
Density													1.00	0.227 * *	0.393 * *	-0.535* *	-0.446* *	0.074	-0.129
Volume 100 kernel														1.00	0.388 * *	0.151 *	0.067	0.002	0.165 *
Weight 100 kernel															1.00	-0.160 *	-0.315* *	0.041	0.202 * *
Protein																1.00	0.438 * *	-0.186* *	0.089
Fat																	1.00	-0.042	-0.024
Moisture																		1.00	-0.011
Ash																			1.00

* and * * = Significant at 0.05 and 0.01 levels, respectively.

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الملخص العربي

تأثير مرض عفن الحبوب والكيزان علي الحيوية والمكونات الكيمائية لحبوب ستة طرز وراثية من الذرة الشامية تحت معاملات زراعية مختلفة.

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*معهد بحوث أمراض النبات–محطة بحوث سخا
** قسم بحوث تكنولوجيا البذور–معهد بحوث المحاصيل الحقلية– مركز البحوث الزراعية– مصر

تـــم زراعة تجربتان في كل من محافظتي كفر الشيخ والغربية في ميعادين لـــلزراعة (أول يونيو وأول يوليو) وتم الحصاد علي ثلاث مواعيد وهي بعد ١٠٥، ١٢٠، ١٣٥ يـــوم من الزراعة لدراسة العلاقة مابين مرض عفن الحبوب والكيزان وكـــل مـــن ميعـــاد الزراعة وميعاد الحصاد وتأثير ذلك علي الإنبات والمكونات الكيماوية للحبة.

بينت النتائج المتحصل عليها من تقيم ستة أصناف من الذرة الشامية لمرض عفن الحبوب والكيزان أن الهجين الفردي بشا ير–١٣ والأصناف المفتوحة التلقيح جيـــزه ٢ وبـــلدي كـــانت عاليـــة الاصابه بالمرض وذلك تحت ظروف الكثافتان

المختبرتان. بينما كان الهجين الفردي ١٠٧، ١٢٢ أقلهم اصابه بالمرض تحت نفس الكثافتان المختبرتان.

سجلت أعلي نسبه اصابه بالمرض عند الميعاد المتأخر للزراعة (أول يوليو) وكذلك عند ميعاد الحصاد المتأخر (١٣٥ يوم من الزراعة) وأيضا تحت ظروف الكثافة النباتيه العاليه (٣٢ الف نبات للفدان).

لوحظ أن الفطر فيوزاريوم مونيلفيورم يتواجد مبكرا على كيزان الذرة قبل الحصاد وكذلك فأنه يصيب الحبوب قبل فطريات ا لبنسيليوم والاسبرجلس ومسببات الأعفان الأخرى مع ملاحظة أن فطريات البنسيليوم والأسبرجس تزيد بصوره كبيره عند ميعاد الزراعه المتأخر وأيضا عند ميعاد الحصاد المتأخر.

وجود الفطريات السابق ذكرها وخاصة فطر فيوزاريم مونيليوفورم في حبوب الذرة أدى إلى انخفاضا معنويا للحيوية وخاصة في الأصناف القابلة للأصابه، وكذلك أدى إلى قله مكونات الحبوب من الأندوسبرم والرماد ووزن الحبوب والكثافة النوعية للحبوب بينما نسبة الدهن والبروتين الخام والأحماض الدهنية الحرة ودرجة أل PH ازدادت.

الإقلال من نسبه الأندوسبرم بالحبوب المصابة من الذرة ربما ترجع إلي تغذيه هذه الفطريات وكذلك قد ترجع إلى تشجيع التنفس في الحبوب نتيجة للأصابه بالفطريات وهذا يؤدى بدوره إلى قله الحيوية للحبوب الذي يؤدى بدوره إلى قله في نسبه الإنبات. وفوق ذلك فأن الزيادة في نسبه البروتين والدهن في الحبوب المصابة ربما يرجع إلى وجود بروتين الفطر نفسه داخل الحبة.