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DETERIORATION OF STORED WHEAT GRAINS
2- FIELD FERTILIZATION, SPRAYING WITH SOME MICROELEMENTS OR FUNGICIDES ON MOULD INFECTION AND AFLATOXIN PRODUCTION

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ABSTRACT

The percentage of infection in freshly harvested grains was higher in Giza 163 cv. than Sakha 69 cv. in season 1994 but the opposite was noticed in season 1995. Grain infection was increased during storage. In 1994, applying 40 Kg N/feddan in Sakha 69, or 40 Kg N+16 Kg P/feddan in Giza 163, reduced infection in wheat grains stored for 6 months, however, 16 Kg P/feddan was quietly promising for both cvs., in 1995 season. All fertilization treatments lead to decrease aflatoxins production by *Aspergillus flavus* in grains of both tested cultivars. Applying 80 kg N+16 kg P_2O_5/fed minimized the total amount of aflatoxins in grains of Giza 163 and Sakha 69 cvs. Treatments including phosphorus showed fewer amounts of aflatoxins than those containing nitrogen alone.

In Sakha 69 cv., grain infection was clearly decreased at zero time by using Fe+Mn+Cu in both seasons and Fe+Zn+Cu, Mn+Fe+Zn, and Fe+Mn+Zn+Cu in season 1995. In Giza 163 cv., grain infection at zero time was reduced by all tested treatment, except Fe+Mn+Zn+Cu, in season 1994 and Mn+Fe+Zn only in season 1995. Meanwhile, % grain infection in both wheat cvs., Sakha 69 and Giza 163, was also decreased, particularly in season 1995, by applying Fe+Mn+Cu, Fe+Zn+Cu, Mn+Fe+Zn and Fe+Mn+Zn+Cu. Among tested combinations of microelements, Fe+Mn+Cu, and Mn+Fe+Zn were the best for minimizing averages of % grain infection in both wheat cvs., during both season. Aflatoxins production by A. flavus inoculation in wheat grains stored for 6 months was decreased when growing wheat plants were sprayed once at tillering stage with any combination of the tested microelements compared to the control (plants not sprayed). Among microelements combination, Fe+Mn+Zn+Cu resulted in production of the lowest amount of total aflatoxins.

Field-fungicide treatments had no significant effect on germination of stored grains. Applying ammonium sulphate at 1000 ppm gave the lowest mould infection in freshly harvested grains, however, after storage for 6 months 500 ppm of Sumisclex 50 gave the lowest infection percentage. Moisture content in freshly harvested grains was decreased with all fungicide treatments and was almost the same in both seasons. The lowest decrease in moisture content was obtained with 500 ppm of both Tecto and Sumisclex 50, after storage period. Spraying wheat plants at milk stage with any of the tested chemical treatments reduced the production of aflatoxins by *A. flavus*. The highest reduction was achieved by Rovral 50, while the lowest reduction was for Sportek 45%.

INTRODUCTION

Wheat is a highly versatile food product, which provided one fifth of the calories for the world's population. It is widely grown all over the world in five of the six continents therefore it was the major grain growing area of North America, Europe, Asia and North Africa (Bushuk and Rasper, 1996).

However, many mould fungi are attacking the grains and change their characters during transporting methods and stored houses (Sinha and Sinha, 1991 and Sauer and Pomerany, 1992). Effect of macro- and microelements as well as fungicides treatments under field conditions on production properties and quality of wheat grains was studied by many workers (Salet *et al.*, 1992; Bonfil *et al.* 1998; Pavlov, 1998 and Savitri *et al.*, 1998). No studies concerning post-harvest effect of these treatments during storage on wheat grains characters and percentage of grains infection with mould associated fungi. Therefore, the present investigation was planned to studying the possible changes in percentage of grains infection, some grain characters after storage period and aflatoxins production in wheat grains infected by *A. flavus* during storage as affected by some field practices i.e. fertilization with macro- and microelements as well as field spray with some fungicides or ammonium sulphate.

MATERIALS AND METHODS

Complete randomized block design with 3 replicates was used to perform the following field experiments during 2 successive seasons 1994 and 1995. The plot area was 3X3.5 m^2. Two wheat cultivars *i.e.* Sakha 69 and Giza 163 were used.

1- Macroelements applications:

Five fertilizer treatments including 2 levels of N- (40 and 80 kg N/fed) fertilizer, each alone or combined with single level of P-fertilizer (16 kg P_2O_5/fed) in addition to control "without fertilizer" were used. Nitrogenous and phosphorus fertilizers were applied in form of calcium nitrate (15.5% N) and calcium super phosphate 15% P_2O_5, respectively. Amounts of fertilizers were added in two equal doses, one half at first irrigation and the other half at the second of irrigation.

2- Microelements applications:

Micronutrient solutions containing Mn, Cu, Fe, and Zn were prepared by using (g/l distilled water) 0.012 g Manganese sulphate ($MnSO_4.2H_2O$); 0.025 g Copper sulphate ($CuSO_4.5H_2O$); 0.004 g Ferrous sulphate ($FeSO_4.7H_2O$); and 0.088 g Zinc sulphate ($ZnSO_4.7H_2O$), respectively. Combined solutions containing Fe+Mn+Cu; Fe+Zn+Cu; Mn+Fe+Zn; Zn+Mn+Cu; and Fe+Mn+Zn+Cu were sprayed on plants at tillering stage at rate of 600 l/feddan. Distilled water was used for spraying plants in control treatment. Concentrations of the 4 tested microelements were selected within the physiological range suggested by Marschner, (1995), which have no toxicity for treated plants.

3- Chemical-control treatments:

In this experiment, plants of Sakha 69 cv. were sprayed once at milk stage with any of two concentrations i.e. 500 and 1000 ppm of six chemical compounds included five fungicides namely, Tecto[1] 41.8%, Sumisclex[2] 50%, Rovral[3] 50%, Sportak[4] 45% and Topsin-M[5] 70%, and the laboratory chemical compound ammonium sulphate.

1-**(Thiabendazole)** 2-(4-thiazolyl) benzimidazole
2-**(Procymidone)** N (3,5 dichlorophenyl) 1,2-dimethyl cyclopropane- 1,2 dicarboxymide
3-**(Iprodione)**1- isopropyl carbomyl 3-3 (3,5 - dichlorophenyl) hydration
4-**(Prochoraz)** 1-(N-propyl-N-(2,4,6-trichlorphenyl) ethyl carbamoyl) imidazole
5-**(Thiophanate methyl)** 1,2-bis(3-methoxycarbonyl-2-thioureido) benzene.

Grain samples (approximately 2 kg) were randomly taken (after harvest) from each treatment and stored for 6 months in plastic bags under laboratory conditions. Then, three small sub-samples (replicates) withdrawn from each, at zero time and at the end of storage period and subjected to the following estimates as affected by the tested field trials:

1- Percentage of infected grains was calculated by the aid of dissecting microscope according to the following equation (Eisa *et al.*, 1996a):

$$\text{Infection \%} = \frac{\text{Number of infected grains}}{\text{Total number of grains}} \times 100$$

2- Percentage of grain-moisture was determined by using Motamco apparatus Serial No. K 2668 USA.

3- Percentage of grain germination was evaluated on blotter paper and calculated after 7 days at 25° C.

As for effect of the tested field trials on production of aflatoxins, preparation of grain samples (from season 1995), infestation with *A. flavus*-spore suspension, incubation and other steps necessary for determination of aflatoxins in grains were carried out as described by Abdel-Mageed, *et al.*, (2001) "In Press"

Data obtained were subjected to the proper analysis of variance according to (Snedecor and Cochran, 1989).

RESULTS AND DISCUSSION

Effect of N- and P- fertilization:

A- On percentage of grain mould infection 6 months after storage:

It is clear from data presented in Table (1) that the percentage of grains infection at zero time was higher in Giza 163 cv. than Sakha 69 cv. in season 1994 but the opposite was noticed in season 1995. At zero time in 1994 season, percentage of grain infection showed quite decrease, compared with control, by applying 80 kg N/fed and 80 kg N/fed + 16 kg P_2O_5/fed for Sakha 69 and Giza 163 cvs., respectively. In 1995 season, all fertilization treatments caused noticeable increase in infection of grains of both cvs., compared with control one.

The same data in Table (1) showed that, % grain infection particularly in 1994 season was greatly increased 6 months after storage compared with infection at zero time. This was true in all tested fertilization treatments. On the other hand, in season 1994, % infection in Sakha 69 cv., was remarkably decreased after 6 months from 18.7% "in control" to 13.3%, 15.3% and 17.7% by using 40"N", 16"P" and 80"N"+16"P", respectively. In case of Giza 163 cv., % grain infection was decreased from 21.3% to 15.3%, 15.0%, and 17.7% by using 80"N", 40"N"+16"P", 80"N"+16"P", respectively. Meanwhile, in 1995 season, the fertilization treatments 16"P" only caused appreciable reduction in % grain infection after 6 months of storage of both cvs. ompared with control.

Table (1): Effect of some fertilization treatments on percentage of grains infection of harvested wheat grains of two cvs. at zero time 6 months after storage "in two successive seasons 1994 and 1995".

Fertilization treatment "Kg "N" and/or "P"/Feddan	% infection in 1994					% infection in 1995				
	At zero time		After 6 months		Mean	At zero time		After 6 months		Mean
	Sakha 69 cv.	Giza 163 cv.	Sakha 69 cv.	Giza 163 cv.		Sakha 69 cv.	Giza 163 cv.	Sakha 69 cv.	Giza 163 cv.	
Control	8.2	9.4	18.7	21.3	14.40	8.6	7.1	9.9	8.8	8.60
40 "N"	9.9	10.0	13.3	27.3	15.13	9.9	8.6	10.0	9.3	9.45
80 "N"	6.3	10.0	28.0	15.3	14.90	10.1	9.2	10.3	9.9	9.88
16 "P"	9.1	11.9	15.3	23.3	14.90	9.7	9.3	9.6	8.2	9.20
40 "N" + 16"P"	8.0	9.1	21.3	15.0	13.35	9.2	8.7	9.7	9.8	9.35
80 "N" + 16 "P"	10.9	7.9	17.7	17.7	13.55	10.4	10.0	10.2	10.2	10.20
Mean	8.73	9.72	19.05	19.98	14.37	9.65	8.82	9.95	9.37	9.45

L.S.D. at 5% for	1994	1995
Cultivar (C)	0.567	0.03
Fertilizer (F)	1.243	0.06
C x F	1.758	0.08

Table (2): Effect of N, P and N/P fertilizers and wheat cultivars on production of aflatoxins in grains stored for 6 months and infested with *A. flavus*.

Treatments	Cv.	Aflatoxins conc. (µg/kg Wheat)				
		B_1	B_2	G_1	G_2	Total
Control (zero)	Sakha 69	5.22	3.93	4.34	5.96	19.45
	Giza 163	4.45	3.78	5.69	3.84	17.76
40 N	Sakha 69	4.19	3.72	5.15	3.26	16.32
	Giza 163	4.04	3.64	5.13	3.12	15.93
80 N	Sakha 69	4.05	3.47	5.02	2.15	14.69
	Giza 163	3.92	3.52	5.17	3.19	15.80
16 kg	Sakha 69	2.92	2.21	2.37	1.59	9.90
	Giza 163	2.81	2.29	2.62	2.63	10.35
40 N + 16 P	Giza 163	2.93	2.14	2.56	2.41	10.04
	Sakha 69	3.01	2.01	2.43	2.52	9.97
80 N + 16 P	Sakha 69	2.64	1.91	2.96	1.99	9.50
	Giza 163	2.31	1.53	2.45	1.81	8.10

B- On productivity of aflatoxins by *A. flavus* in grains stored for 6 months:

Data in Table (2) indicate that, all fertilization treatments lead to decrease aflatoxins production in grains of both tested cultivars compared to the control. Treatment with 80 kg N+16 kg P_2O_5/fed gave the best result and decreased the total amount of aflatoxins to 8.10 and 9.50 µg/kg grains compared with 19.45 and 17.76 µg/kg grains in control treatments of Sakha 69 and Giza 163 cvs., respectively. It is also clear that treatments including phosphorus showed good results and gave fewer amounts of aflatoxins than those containing nitrogen alone. Treatment with 40kg N/fed gave the highest amount of aflatoxins in both cultivars, which was, however, less than the control in aflatoxins B_1, B_2 or G_1 and G_2, while aflatoxins B_1 and G_1 less than aflatoxins B_2 and G_2 under all treatments. Prasad and Pathak (1987) found that aflatoxin B_1 was produced in varying amounts in the 7 rice, 11 wheat and 3 maize cultivars infected with a toxigenic strain of *A. flavus*. Payne (1992) reported that aflatoxin B_1 produced in corn grains is potentially hepato-carcinogen. *Aspergillus flavus* can grow and produce this aflatoxin in corn either in field and storage. Also, Eisa *et al.* (1996b) found that the production of aflatoxins by *A. flavus* was affected by grain moisture content also the concentration of aflatoxin B_1 was higher than aflatoxin B_2. The production of aflatoxin was increased by increasing storage temperature, grains moisture content and storage period.

Effect of spraying wheat plants at tillering stage with different combinations of microelements

A- On percentage of grain mould infection 6 months after storage:

The data in Table (3) indicated clearly that, the tested micronutrient treatments exerted different effects on % grain infection of both examined wheat cvs during both seasons. In Sakha 69 cv., grain infection was clearly decreased at zero time by using Fe+Mn+Cu in both seasons and Fe+Zn+Cu, Mn+Fe+Zn, and Fe+Mn+Zn+Cu in season 1995. In Giza 163 cv., grain infection at zero time was reduced by all tested treatment, except Fe+Mn+Zn+Cu, in season 1994 and Mn+Fe+Zn only in season 1995. Average % infection during both seasons either at zero time or 6 months after storage was, in general, relatively lower in Sakha 69 than Giza 163 cv.

Meanwhile, % grain infection in both wheat cvs., Sakha 69 and Giza 163, was clearly decreased particularly in season 1995 by applying Fe+Mn+Cu, Fe+Zn+Cu, Mn+Fe+Zn and Fe+Mn+Zn+Cu. Among tested combinations of microelements, Fe+Mn+Cu, Fe+Zn+Cu, and Mn+Fe+Zn were the best for minimizing averages of % grain infection in both wheat cvs., during both season. Applying Fe+Mn+Zn+Cu in season 1994, and Zn+Mn+Cu in season 1995 induced the highest percentage of grain infection compared with control either at zero time or 6 months after storage. In fact, all the tested microelements i.e. Fe, Mn, Zn, and Cu, might be important, in general, as micro nutrients for growth and sporulation of several fungi when present at relatively smaller concentrations in growth substrate. In the present work, the residue of these microelements, remained adhered on surface or absorbed inside grains, may be higher than those needed for optimum fungal activities "growth, sporulation" and consequently the infection by storage mould fungi was decreased. Thus, the varied reduction in % infection of stored wheat grains, after applying these microelements under field conditions, could be attributed directly to their toxicity or indirectly to the antagonism between their ions. Bilgrame and Verma (1981) mentioned that, higher concentrations of Zn often prove toxic and may even lead to mutagenic changes in the fungal organism. In the past, Apparao, (1959) observed that the toxic effect of copper was almost counteracted by Fe and Mn ions, whereas zinc appeared to enhance the toxicity of copper. The toxic effect of copper and its antagonism by ions was also noted by Koffler *et. al.*, (1947) in penicillin production by *Penicillium chrysogenum*.

Table (3): Effect of microelements as field treatment on percentage of wheat grains infection of two cvs. stored for 6 months in 2 successive seasons 1994 and 1995.

Micronutrient treatments	% infection in 1994					% infection in 1995				
	At zero time		After 6 months		Mean	At zero time		After 6 months		Mean
	Sakha 69 cv.	Giza 163 cv.	Sakha 69 cv.	Giza 163 cv.		Sakha 69 cv.	Giza 163 cv.	Sakha 69 cv.	Giza 163 cv.	
Control	6.70	10.06	21.0	25.7	15.87	8.91	8.17	9.26	8.63	8.74
Fe+Mn+Cu	5.98	9.68	12.0	16.0	10.92	7.24	8.26	7.11	7.77	7.60
Fe+Zn+Cu	10.13	9.75	22.3	12.0	13.55	6.47	9.88	6.82	8.10	7.82
Mn+Fe+Zn	6.70	5.95	19.0	10.7	10.59	5.29	7.91	5.19	7.26	6.41
Zn+Mn+Cu	8.63	9.41	21.7	28.0	16.94	10.81	10.11	9.95	9.73	10.15
Fe+Mn+Zn+Cu	10.11	11.81	25.0	35.0	20.48	8.21	9.31	8.85	8.12	8.62
Mean	8.04	9.44	20.17	21.23	14.73	7.82	8.94	7.86	8.27	8.22

L.S.D. at 5% for	1994	1995
Cultivar (C)	2.100	0.01
Fertilizer (F)	N.S.	0.012
C x F	4.513	0.02

B- On productivity of aflatoxins by *A. flavus* in grains stored for 6 months:

Data in Table (4) showed that, aflatoxins production in wheat grains stored for 6 months was decreased when growing wheat plants were sprayed once at tillering stage with any combination of the tested microelements compared to the control (plants not sprayed). Amounts of aflatoxins produced in grains in control treatments reached to 19.45 and 17.76 µg/kg grains of Sakha 69 and Giza 163 cvs., respectively. Among microelements combination, Fe+Mn+Zn+Cu resulted in production of the lowest amount of total aflatoxins, which reached 10.57 and 9.48 µg aflatoxins/kg of Giza 163 and Sakha 69 cvs., respectively meanwhile spraying with Fe+Mn+Cu produced the highest amount of aflatoxins in grains of both cultivars, but it was still less than the control.

In fact, formation of aflatoxins may be influenced by several physical and chemical factors such as temperature, moisture, and chemical composition of the air, internal environmental factors (content of nutrients and growth factors) and the chemical nature of the substrate. Biological factors such as host species, physiological condition of the host at time of infection, host age, protective barriers in the host, inoculum size, microbial competition and difference in genetic make up of both the host and infecting strain, also affected aflatoxin formation. (Hesseltine, 1983 and Spicher, 1989).

Table (4): Effect of spraying plants of 2 wheat cultivars with different combination of microelements on aflatoxins produced in grains infected with *A. flavus* after 6 months from storage.

Treatments	Cv.	Aflatoxins conc. (µg/kg Wheat)				
		B_1	B_2	G_1	G_2	Total
Control (zero)	Sakha 69	5.22	3.93	4.34	5.96	19.45
	Giza 163	4.45	3.78	5.69	3.84	17.76
Fe+Mn+Cu	Sakha 69	3.77	3.27	4.98	3.22	15.24
	Giza 163	3.99	3.20	4.55	3.34	15.08
Fe+Zn+Cu	Sakha 69	3.10	2.31	3.34	1.99	10.74
	Giza 163	3.02	2.33	4.09	2.14	11.58
Mn+Fe+Zn	Sakha 69	3.39	2.34	3.75	1.59	11.07
	Giza 163	3.54	2.01	4.00	2.74	12.29
Zn+Mn+Cu	Sakha 69	2.46	2.14	3.63	1.42	9.65
	Giza 163	2.34	2.12	3.99	2.60	11.05
Fe+Mn+Zn+Cu	Sakha 69	2.49	2.09	3.54	1.36	9.48
	Giza 163	2.25	2.08	3.81	2.43	10.57

Effect of spraying wheat plants with some chemical compounds:

A- On percentage of grain mould infection 6 months after storage:

Data in Table (5) show that all fungicide treatments have no significant effect on the germination percentage of grains during the 2 seasons. However, germination percentage was high especially in case of ammonium sulphate at 500 ppm. Hunje *et al.* (1991) found that there was no decrease in germination of seeds treated with fungicides during 6 months of storage. Germination of untreated seed was markedly decreased after 3 months of storage, which could be attributed to seed infection.

With regards to the percentage of grain infection, it was clearly higher in the second season than the first one especially after storage period. The lowest infection (2.6%) was obtained with 1000 ppm of ammonium sulphate and the highest one (7.3%) with 500 ppm of the same salt in the first season (at zero time), while 6 months after storage 500 ppm of Sumisclex 50 gave the lowest infection percentage (20.7). On the other hand, 500 ppm of Rovral caused the highest one (42.7%). The highest percentage was obtained with 500 ppm of ammonium sulphate and the lowest one with 500 ppm of Sumisclex 50. The same trend was obtained in the second season. Gupta *et al.* (1990) found that Bavistin, Compogran-M, Captan and Dithane M-45 reduced the incidence of fungi and increased germination rates, after 24 months storage of wheat grains, compared with untreated one (control). Ali (1992) concluded that application of benomyl or thiourea can decrease grain infection and its deterioration during storage and maintain high grain quality.

Table (5): Effect of spraying plants of wheat Sakha cv., with some chemical compounds on % grain-mold infection, % grain moisture content, and % germination at zero time and 6 months after storage in 2 successive seasons 1994 and 1995.

Chemical treatment	Conc. PPM.	% of mold infection		Grain Moisture content%		% germination	
		At Zero time	After 6 months	At Zero time	After 6 months	At Zero time	After 6 months
Season 1994							
Tecto 41.8 %	500	4.0	21.3	10.10	11.10	97.3	99.1
	1000	4.2	31.3	10.23	10.20	96.3	94.5
Sumisclex 50 %	500	3.2	20.7	10.10	11.11	94.3	95.2
	1000	4.8	40.3	10.33	10.20	94.3	94.5
Rovral 50 %	500	3.3	42.7	10.93	11.00	91.7	92.6
	1000	3.2	30.0	10.43	10.90	95.5	96.7
Sportak 45%	500	5.2	29.3	10.87	10.40	95.5	96.5
	1000	6.4	32.0	11.43	11.80	97.7	95.8
Topsin	500	4.7	33.7	11.73	12.00	94.7	95.4
	1000	4.0	41.0	11.03	11.50	93.0	92.3
Ammonium sulphate	500	7.3	42.0	11.40	11.90	99.0	97.0
	1000	2.6	38.7	11.90	12.10	94.3	96.5
Control		4.5	33.0	12.10	10.10	94.0	96.0
L.S.D at 5%		1.31	12.36	0.625	0.591	N.S	N.S
Season 1995							
Tecto 41.8 %	500	4.13	26.13	10.39	13.91	98.1	99.3
	1000	4.60	32.60	10.48	14.21	96.3	97.1
Sumisclex 50 %	500	3.70	21.82	10.61	12.18	94.9	95.2
	1000	4.24	40.96	10.92	14.98	94.3	94.7
Rovral 50 %	500	3.92	41.36	10.71	15.20	94.6	95.4
	1000	3.16	33.14	10.26	14.38	97.1	98.2
Sportak 45%	500	4.93	28.15	10.18	13.95	95.5	96.3
	1000	5.14	35.91	11.83	14.44	97.8	96.7
Topsin	500	3.21	37.25	11.16	14.58	95.1	94.3
	1000	4.10	42.63	11.78	15.61	94.7	94.7
Ammonium sulphate	500	5.91	44.54	11.46	15.86	98.7	99.1
	1000	2.83	39.69	11.61	14.92	97.3	98.3
Control		4.50	35.14	12.16	14.11	93.0	96.0
L.S.D at 5%		0.13	0.21	0.02	0.05	0.20	N.S.

Grains moisture content was decreased with all treatments and was almost the same in both seasons before storage, while increased in all treatment in both seasons except in case of Tecto (41.8), Sumisclex-50 and Sportak 45% in 500 ppm concentrations in the second season. The lowest decrease in moisture content was obtained with 500 ppm of both Tecto and Sumisclex 50, while 1000 ppm of ammonium sulphate gave the highest moisture content after storage period.

B- On productivity of aflatoxins by *A. flavus* in grains stored for 6 months:

Effect of spraying wheat plants at milk stage with some fungicides and ammonium sulphate on aflatoxins production is shown in Table (6). Data obtained show that all fungicides and ammonium sulphate reduced the production of aflatoxins by *A. flavus* compared with the control except in case of G_2 with Rovral 50% (500 ppm), which was higher than the control. The highest reduction was achieved by Rovral 50 with its both concentration (500 and 1000 ppm), while the lowest reduction was for Sportek 45% with its 2 concentrations. It is remarkable that the highest concentration (1000 ppm) of all tested fungicides and ammonium sulphate was better than the lowest concentration (500 ppm) in reducing the amount of aflatoxins produced by the fungus *A. flavus*.

Wilson *et al.* (1983) showed that, several alcohols and aldehydes exhibited high effect on both *A. flavus,* which severely restricted growth, sporulation and aflatoxin production. Several natural and chemical compounds such as chamomile, cinnamon, potassium benzoate, mycocurb, sodium bisulfite, amonia and propionic acid were also effective in preventing or reducing aflatoxin production on maize grain (Bangkok, 1986; Ilangatntilek *et al.*, 1987); Cardona *et al.*, 1992 and Sinha *et al.*, 1993).

Table (6): Effect of fungicides as field treatments on aflatoxins produced in Sakha 69 wheat cultivar inoculated with *A. flavus*.

Treatments	Conc. PPM	Aflatoxins conc. (µg/kg wheat)				
		B_1	B_2	G_1	G_2	Total
Control		4.21	3.73	5.35	3.46	16.75
Tecto 41.8	500	2.52	1.67	3.97	2.11	10.27
	1000	2.34	1.53	3.41	2.01	9.29
Sumisclex 50	500	3.72	2.50	4.96	2.98	14.16
	1000	3.53	1.90	3.98	2.64	12.05
Rovral 50	500	2.31	0.95	2.33	1.52	7.11
	1000	2.25	0.81	2.01	1.43	6.5
Sportek 45%	500	3.77	2.54	4.81	3.98	15.1
	1000	2.79	2.28	4.24	3.25	12.56
Topsin	500	2.73	2.83	3.53	2.17	11.26
	1000	3.01	2.01	3.75	2.45	11.22
Ammonium sulphate	500	3.03	2.04	3.90	2.56	11.53
	1000	2.94	1.99	3.74	2.12	10.79

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تدهور حبوب القمح المخزونة
٢ – تأثير التسميد أو رش بعض العناصر الصغرى أو المطهرات الفطرية تحت ظروف الحقل على الإصابة بفطريات العفن وإنتاج الأفلاتوكسينات

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في موسم ١٩٩٤ كانت النسبة المئوية للحبوب المصابة بعد الحصاد أعلى في الصنف جيزة ١٦٣ منه في الصنف سخا ٦٩ بينما لوحظ العكس في موسم ١٩٩٥وقد زادت نسبة الإصابة أثناء التخزين. وفي الموسم ١٩٩٤ أدى التسميد بـ ٤٠ كجم نيتروجين /فدان للصنف جيزة ١٦٣ ، أوعند التسميد بـ ٤٠ كجم نيتروجين + ١٦كجم فو$_2$أ$_5$ للفدان في حالة الصنف سخا ٦٩ إلى نقص واضح في نسب الإصابة بعد ٦ شهور من التخزين. أما في الموسم ١٩٩٥ فقد أدى التسميد الفوسفاتي بمفرده (١٦كجم فو$_2$أ$_5$ للفدان) إلى أقل نسبة إصابة في كلا الصنفين. وعموما فقد أدت جميع معاملات التسميد المستخدمة خاصة التسميد ب ٨٠ كجم نيتروجين + ١٦كجم فو$_2$أ$_5$ للفدان إلى تقليل كمية الأفلاتوكسينات في الحبوب المصابة صناعيا بالفطر أسبرجيللوس فلافوس. وكان النقص أكثر وضوحا في المعاملات المحتوية على الفوسفور مقارنة بتلك المحتوية على النيتروجين فقط.

أدى رش نباتات القمح أثناء نموها في الحقل بخليط يحتوي توليفات مختلفة من عناصر الحديد ، المنجنيز ، النحاس ، والزنك إلى التأثير على إصابة الحبوب بالفطريات المسببة لأعفان وتدهور الحبوب سواء بعد حصادها مباشرة أو بعد تخزينها – وفي هذا الخصوص أدى رش النباتات بخليط يتضمن عناصر الحديد + المنجنيز + النحاس أو المنجنيز + الحديد + الزنك إلى أقل معدلات الإصابة في كل من الحبوب حديثة الحصاد أو المخزنة لمدة ٦ شهور في كلا الصنفين سخا ٦٩ وجيزة ١٦٣ أثناء الموسمين ١٩٩٤ ، ١٩٩٥. وقد لوحظ أن رش النباتات بأي من تلك المخاليط خاصة المحتوية على العناصر الأربعة (الحديد ، المنجنيز ، الزنك ، النحاس) قد قللت من تكوين الأفلاتوكسينات في الحبوب المخزنة لمدة ٦ شهور لدى حقنها بالعزلة رقم ١ من الفطر أسبرجيللوس فلافس المسجلة في البحث الأول تحت النشر.

أدى رش النباتات عند الطور اللبني بتركيز ١٠٠٠ جزء في المليون من كبريتات الأمونيوم إلى نقص واضح في نسبة إصابة الحبوب حديثة الحصاد بفطريات تدهور الحبوب بينما أدى رشها بتركيز ٥٠٠ جزء في المليون من المطهر الفطري سومسكلكس – ٥٠ إلى أقل نسبة إصابة في للحبوب المخزنة لمدة ٦ شهور. ولم يؤثر أي من المركبات المستخدمة في رش النباتات تأثيرا معنويا على نسبة إنبات الحبوب حتى بعد تخزينها. كما أدى استخدام المبيدات تكتو أو سومسكلكس – ٥٠ بتركيز ٥٠٠ جزء في المليون إلى خفض نسبة الرطوبة في كل من الحبوب حديثة الحصاد أو المخزنة لمدة ٦ شهور. ومن ناحية أخرى أدت جميع المبيدات المستخدمة خاصة المبيد روفرال ٥٠% إلى خفض كمية الأفلاتوكسينات التي أنتجها الفطر أسبرجيللوس فلافوس عند حقنه في الحبوب الناتجة من النباتات المعاملة لكلا الصنفين تحت الدراسة بعد تخزينها لمدة ٦ شهور. بينما كان أقلها في التأثير على إنتاج الأفلاتوكسينات المبيد سبورتيك ٤٥%