EXPERIMENTAL RESULTS

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- Survey and frequencies of different fungi isolated from maize grains :

Results of survey of fungi isolated from different localities of Egypt are presented in Table 2.

The most dominant ten fungi on maize grains isolated from different localities of A.R.E. could be arranged descendingly as follows : Fusarium moniliforme, Nigrospora oryzae, Fusarium graminearum, Penicillium spp., Aspergillus niger, Aspergillus flavus, Helminthosporium spp., Rhizopus spp., Mucor spp., and Alternaria spp.

Data also indicated that Fusarium moniliforme was the most important fungus causing moulding of maize grains in all tested locations, whereas Nigrospora oryzae came next to it in this respect.

As regards the distribution of Fusarium moniliforme, it was found to be most dominant in Sohag followed by Menufiya Governorates. In this respect, yellow American maize varieties showed the lowest infection frequencies by this fungus.

As regards, Nigrospora oryzae it caused the highest infection in Giza Governorate followed by Fusarium moniliforme.

Table (2): Survey and frequencies of different fungi isolated from diseased maize grains in different localities of Egypt.

Fungi Order, genus and species	Exposted yellow american varieties	Governorates				
		Giza	Sohag	Menu-fiya	Kalu-bia	Total
Moniliales :						
Fusarium moniliforme	10	16	21	18	11	76
Fusarium graminearum	7	9	6	5	9	36
Fusarium spp.	2	1	3	1	3	10
Nigrospora oryzae	1	20	6	12	9	48
Helminthosporium spp.	1	10	5	5	2	23
Alternaria spp.	2	5	-	6	1	14
Cephalosporium sp.	-	4	-	1	-	5
Trichothecium roseum	-	-	-	3	-	3
Eurotiales :						
Aspergillus niger	4	5	5	7	6	27
Aspergillus flavus	7	3	2	8	4	24
Aspergillus spp.	3	2	1	1	2	9
Penicillium oxalicum	6	3	5	6	4	24
Penicillium spp.	19	2	1	8	5	35
Mucorales:						
Rhizopus spp.	1	4	-	8	10	23
Mucor spp.	2	3	1	6	4	16
Mycelia sterillia :						
Rhizoctonia sp.	-	1	-	-	2	3
Melanospora sp.	-	2	-	-	-	2
Unidentified	1	-	1	-	-	2
Total	66	90	57	95	72	370

However, as for the isolated fungi from moulded yellow American maize grains taken from different localities of Egypt could be arranged descendingly according to their frequencies of isolation as follows: Penicillium spp., Fusarium moniliforme, Fusarium graminearum, Aspergillus flavus, Penicillium oxalicum, Aspergillus niger, Fusarium spp., Alternaria spp., Mucor spp., Nigrospora oryzae, Helminthosporium spp., and Rhizopus spp.

In this regard it is worthy to mention that, Cephalosporium spp., Rhizoctonia spp. and Trichothecium roseum were isolated in negligible frequencies.

* Effect of infested maize grains with Fusarium moniliforme and Nigrospora oryzae under different temperatures, moisture content percentages and storage intervals on the percentage of disease (Pathogenicity) and disease severity :

Healthy maize grains were artificially infested by spore suspensions from either Fusarium moniliforme or Nigrospora oryzae selected as the most two dominant fungi on stored maize grains in different localities of Egypt.
These grains were stored for 30, 60 and 90 days intervals under various moisture content percentages 11, 13 and 15 % (the grains were soaked in water for a certain time to obtain each of the tested moisture percentages) and degrees

of temperatures 18, 25 and 30°C. Results are tabulated in Table 3 (a & b).

It is clear that maize grains infection increased by prolonging storage intervals on 18°C. Similarly the increase in moisture percentage contents increased grain infection under all tested temperature degrees, 25°C, and 30°C. Also, it was obvious that the increase of moisture percentage content in diseased grains was more effective in increasing the percentage of disease as a great increase was recorded by increasing moisture from 11 % to 15 %.

It is also clear that Fusarium moniliforme was more destructive than Nigrospora oryzae specially at the lowest degree of temperature (18°C.), this difference almost was depleted by prolonging the period of storage.

Similar results were noticed by storage on 25°C. and 30°C. Thus it could be concluded that the damage of grains increased by increasing the temperature degrees , moisture percentage contents and time of storage, specially by Fusarium moniliforme and Nigrospora oryzae.

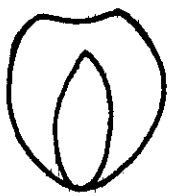
Table (3a): Effect of infested maize grains with Fusarium moniliforme and Nigrospora oryzae under different temperatures, moisture content percentage and storage intervals on the percentage of disease (Pathogenicity).

Temperature (°C)		18°C			25°C			30°C		
Moisture content # %		11 %	13 %	15 %	11 %	13 %	15 %	11 %	13 %	15 %
Treatments	Storage intervals (days)									
Control	30	0	0	0	0	0	0	0	0	0
	60	0	0	0	0	0	0	0	0	0
	90	0	0	1	0	3	3	0	1	5
Mean		0	0	0.33	0	1	1	0	0.33	1.67
Fusarium moniliforme	30	5	50	80	25	65	60	80	98	85
	60	10	85	100	35	85	95	90	98	99
	90	60	100	100	80	100	100	100	100	100
Mean		25	78.33	93.33	46.67	83.33	85	90	98.67	94.67
Nigrospora oryzae	30	5	10	20	75	92	85	50	40	15
	60	15	35	65	90	95	88	90	95	90
	90	70	90	100	100	100	100	100	100	100
Mean		30	45	61.67	88.33	95.67	91	80.00	78.33	68.33

Moisture content of grains.

Table (3 b): Effect of infested maize grains with Fusarium moniliforme and Nigrospora oryzae under different temperatures, moisture content percentages and storage intervals on the disease severity.

Temperature (°C.)		18°C.			25°C.			30°C.		
Moisture content %		11 %	13 %	15 %	11 %	13 %	15 %	11 %	13 %	15 %
Treatments	Storage intervals (days)									
Control	30	-	-	-	-	-	-	-	-	-
	60	-	-	-	-	-	-	-	-	-
	90	-	-	-	-	-	-	-	-	-
Fusarium moniliforme	30	+	++	+++	+	+	+	++	+++	++
	60	+	++	+++	+	+	+++	++	+++	+++
	90	++	+++	+++	+++	+++	+++	+++	+++	+++
Nigrospora oryzae	30	+	+	+	++	+++	++	+	+	+
	60	++	+	+	+++	+++	+++	+++	+++	+++
	90	++	++	++	+++	+++	+++	+++	+++	+++



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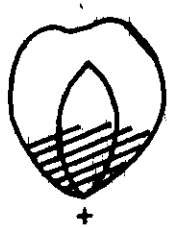
Healthy



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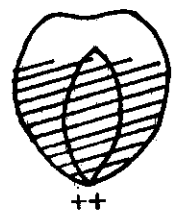
30 - 60 % infection



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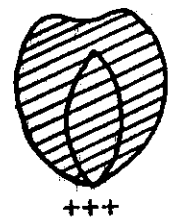
60 - 90 % infection



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more than 90 % infection

- Effect of infested maize grains with Fusarium moniliforme or Nigrospora oryzae, under different temperatures, moisture content percentages and storage intervals on the percentage of maize grains components (germ, hull and endosperm) :

Results tabulated in Table (4), indicated that prolonging storage periods at 18°C, generally resulted in reducing the percentages of both the germ and hull in 11 % or 13 % moisture content in healthy grains and all percentages of moisture content in infected grains with Nigrospora oryzae. Whereas, as regards corn grains infected with Fusarium moniliforme an increase is noticed in those with 11 % and 15 % moisture content only.

As for the effect of the period of storage and infection on endosparm, healthy grains showed considerable increases by prolonging the period of storage and by increasing the percentage of moisture content. On the other hand infection with Fusarium moniliforme caused a high reduction especially with the increase in moisture content and prolonging the period of storage at 11 % and 15 % moisture content percentage.

As for the case of infection with Nigrospora oryzae considerable increases were noticed by prolonging the period

of storage especially in case of 15 % moisture content and a great decrease was noticed at the same level of moisture in the short period of storage.

When grains were stored at 25°C, it was found that diseased grains by both fungi resulted in reducing germ values by prolonging storage period, whereas the hull showed reverse results. On the other hand, in healthy grains it was found that both germ and hull percentages increased by prolonging storage periods in all moisture percentage contents.

The effect of higher storage temperature of 30°C. was noticed clearly as a decrease in the percentage of endosperme reaching about 5 % with the increase in moisture content after 30 days and nearly 2 % after 60 days storage in grains infected with Fusarium moniliforme. As for those infected with Nigrospora oryzae an increase of about 2 % was noticied by increasing the moisture content to 15 % after 30 days storage and 2 % decrease was noticed after 60 days storage.

Table (4): Effect of infested maize grains with Fusarium moniliforme and Nigrospora oryzae under different temperatures, moisture content percentages and storage intervals on the percentage of maize grains components (germ, hull and endosperm).

Treatments			Healthy grains		Fusarium moniliforme		Nigrospora oryzae	
	Storage intervals (days)							
Tempera-tures	Moisture percentage contents	Grain components	30 days	60 days	30 days	60 days	30 days	60 days
18°C.	11 %	Germ	10.92	8.85	9.96	11.59	10.64	8.12
		Hull	6.78	7.35	6.67	8.45	7.42	7.87
		Endosperm	82.28	83.72	83.28	80.85	81.83	83.94
	13 %	Germ	10.53	8.62	13.62	10.04	9.66	9.45
		Hull	7.20	5.55	11.20	13.04	8.34	8.26
		Endosperm	82.99	85.80	75.11	76.79	81.93	82.10
	15 %	Germ	8.77	11.13	8.81	9.46	14.03	9.57
		Hull	7.19	7.06	10.63	14.11	8.48	8.30
		Endosperm	83.91	81.75	80.47	76.76	77.42	82.02
25°C	11 %	Germ	9.03	13.00	11.32	9.02	9.95	8.13
		Hull	8.70	8.39	7.59	9.75	8.80	11.24
		Endosperm	82.10	78.49	80.99	81.13	81.18	80.45
	13 %	Germ	10.43	11.71	9.91	7.91	8.23	8.04
		Hull	7.80	8.54	7.96	9.08	8.11	10.97
		Endosperm	81.62	79.61	82.01	82.93	83.66	80.98
	15 %	Germ	10.56	12.38	8.84	8.71	9.01	8.50
		Hull	7.63	9.62	7.89	9.00	8.87	11.64
		Endosperm	81.61	77.79	83.07	82.16	82.06	79.70
30°C	11 %	Germ	11.05	9.08	7.42	6.34	8.43	5.81
		Hull	6.89	9.81	8.97	6.98	7.18	8.50
		Endosperm	81.86	81.09	83.43	86.50	84.20	85.58
	13 %	Germ	6.95	8.86	10.42	5.70	8.20	5.46
		Hull	8.43	8.79	11.10	9.23	5.99	9.61
		Endosperm	84.43	82.18	78.31	84.95	85.64	84.76
	15 %	Germ	11.10	10.16	8.18	6.28	6.81	6.73
		Hull	6.20	8.65	13.41	8.99	6.14	9.40
		Endosperm	82.51	81.12	78.31	84.57	86.88	83.95

As regards germ percentage, it was noticed that increasing storage periods resulted in decreasing its percentage in both healthy and diseased grains on contrast with hull percentage. In this respect it seems that there was little effect of moisture percentage contents on either hull or germ percentages in both healthy and diseased grains.

- The effect of infection of maize grains with Fusarium moniliforme or Nigrospora oryzae under different temperature degrees, storage intervals and moisture percentage contents on fat content of maize grains :

The effect of infection of maize grains with Fusarium moniliforme or Nigrospora oryzae as affected by moisture percentage contents (11%, 13%, and 15%) and temperature degrees (18°C, 25°C, and 30°C.) on the percentage of fat content was studied using healthy and infected grains. Results are recorded after 30, 60 and 90 days of storage and tabulated in Table (5) and Figure(1).

It is clear that infection by the tested fungi resulted in increasing the percentage of fat in maize grains, specially in case of infection with Nigrospora oryzae after 90 days storage.

Table (5): Effect of infection of maize grains with Fusarium moniliforme or Nigrospora oryzae under different of temperature degrees, moisture contents of grains and storage periods on the percentage of fat.

Temperatures (°C.)		18°C.			25°C.			30°C.		
Moisture contents * %		11 %	13 %	15 %	11 %	13 %	15 %	11 %	13 %	15 %
Treatments	Storage intervals (days)									
Healthy grains	30	3.63	3.47	3.39	3.50	3.41	3.56	2.73	2.56	2.06
	60	3.63	3.47	3.39	3.50	3.41	3.56	2.73	2.56	2.06
	90	3.63	3.47	3.39	3.50	3.41	3.56	2.73	2.56	2.06
Mean		3.63	3.47	3.39	3.50	3.41	3.56	2.73	2.56	2.06
Fusarium moniliforme	30	3.93	4.29	4.71	3.92	4.17	3.81	3.50	3.81	4.55
	60	3.56	6.19	4.66	3.51	4.42	5.19	3.68	3.91	5.06
	90	3.45	5.42	4.60	4.11	4.70	4.83	3.09	3.77	4.26
Mean		3.65	5.30	4.66	3.85	4.43	4.61	3.42	3.83	4.62
Nigrospora oryzae	30	4.26	3.83	3.57	3.67	4.13	3.94	3.96	5.26	4.33
	60	3.77	2.92	3.69	6.53	4.64	4.70	3.89	4.43	4.53
	90	4.03	5.35	4.91	5.32	5.69	6.64	5.88	9.87	6.35
Mean		4.02	4.03	4.06	5.17	4.82	5.09	4.58	6.52	5.07

* Moisture contents of grains.

Table (5):

A) Effect of temperature and infection of maize grains on fat percentage:

Degrees of temp.	Healthy grains	Grains infected with *Fusarium moniliforme*	Grains infected with *Nigrospora oryzae*
18°C.	3.50	4.54	4.04
25°C.	3.49	4.30	5.03
30°C.	2.45	3.96	5.39

B) Effect of moisture content and infection of maize grains on fat percentage:

Moisture content percentage	Healthy grains	Grains infected with *Fusarium moniliforme*	Grains infected with *Nigrospora oryzae*
11 %	3.29	3.64	4.59
13 %	3.15	4.52	5.12
15 %	3.00	4.63	4.74

C) Effect of storage intervals and infection of maize grains on fat percentage:

Storage intervals (days)	Healthy grains	Grains infected with *Fusarium moniliforme*	Grains infected with *Nigrospora oryzae*
30	3.15	4.08	4.11
60	3.15	4.46	4.34
90	3.15	4.25	6.00

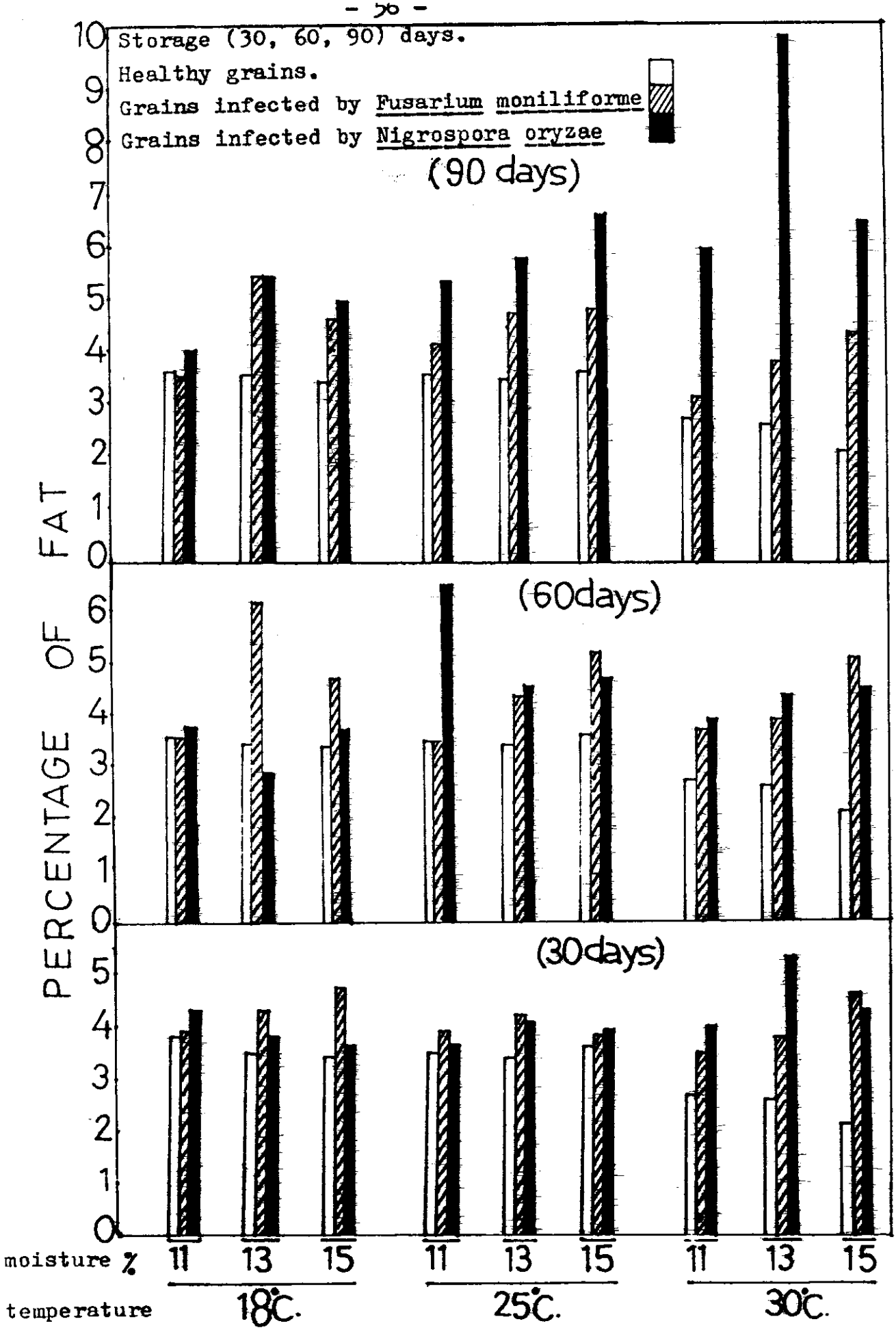


Figure (1): Effect of infection of maize grains with Fusarium moniliforme and Nigrospora oryzae under different temperature degrees, moisture percentages and storage intervals on fat percentage.

However, results indicated that the percentage of fat increased in infected grains with both fungi by increasing the moisture percentage content and time of sotrage. Generally the infected maize grains with Nigrospora oryzae contained more fat than those infected with Fusarium moniliforme.

- Effect of infection of maize grains with Fusarium moniliforme or Nigrospora oryzae under storage intervals, temperature degrees and moisture percentage contents of maize grains on free fatty acids :

Free fatty acids in maize grains could be affected to a large extent, by environmental conditions of storage. The effect of temperature degrees, moisture percentage contents of the grains and storage periods on free fatty acids of healthy and infected maize grains were studied. Free fatty fatty acids were estimated as oleic acid and results are tabulated in Table (6) and Figure (2).

As regards the effect of temperature degrees in case of healthy grains, it was found that the percentage of free fatty acids increased by the increase in temperature degrees, and the highest percentages were obtained in both healthy and infected grains stored at 30°C.

Table (6): Effect of infection of maize grains with Fusarium moniliforme or Nigrospora oryzae under different temperature degrees, moisture percentage contents of the grains and storage periods on the percentage of free fatty acids (calculated as oleic acid).

Temperature °C.		18°C			25°C			30°C.		
Moisture contents* %		11 %	13 %	15 %	11 %	13 %	15 %	11 %	13 %	15 %
Treatments	Storage intervals (days)									
Healthy grains	30	0.760**	0.870	1.400	1.041	0.810	0.880	1.424	3.143	2.734
	60	0.760	0.870	1.400	1.041	0.810	0.880	1.424	3.143	2.734
	90	0.760	0.870	1.400	1.041	0.810	0.880	1.424	3.143	2.734
Mean		0.760	0.870	1.400	1.041	0.810	0.880	1.424	3.143	2.734
Fusarium moniliforme	30	0.480	0.590	0.534	1.122	0.720	0.660	2.330	2.970	0.938
	60	0.106	1.930	2.510	1.790	2.330	0.830	2.320	3.920	1.465
	90	0.179	1.690	3.495	1.740	2.210	0.750	4.140	5.870	2.595
Mean		0.255	1.403	2.180	1.551	1.753	0.747	2.930	4.253	1.666
Nigrospora oryzae	30	0.354	0.427	0.352	1.200	0.610	0.570	0.440	0.286	0.416
	60	0.599	1.417	1.005	1.160	1.190	0.670	2.750	2.222	1.664
	90	2.123	1.596	2.815	1.750	0.990	0.960	1.750	2.390	1.537
Mean		1.025	1.147	1.391	1.370	0.930	0.733	1.647	1.633	1.206

* Moisture contents of grains.

** g./ 100 g. fat.

Table (6):

A) Effect of temperature and infection of maize grains on free fatty acids :

Degrees of temp.	Healthy grains	Grains infected with Fusarium moniliforme	Grains infected with Nigrospora oryzae
18°C	1.01	1.28	1.19
25°C.	0.91	1.35	1.00
30°C.	2.43	1.95	1.50

B) Effect of moisture content and infection of maize grains on free fatty acids :

Moisture content percentage	Healthy grains	Grains infected with Fusarium moniliforme	Grains infected with Nigrospora oryzae
11 %	1.08	1.58	1.35
13 %	1.61	2.47	1.24
15 %	1.67	1.53	1.11

C) Effect of storage intervals and infection of maize grains on free fatty acids :

Storage intervals (days)	Healthy grains	Grains infected with Fusarium moniliforme	Grains infected with Nigrospora oryzae
30	1.45	1.15	1.77
60	1.45	1.91	1.41
90	1.45	2.52	0.52

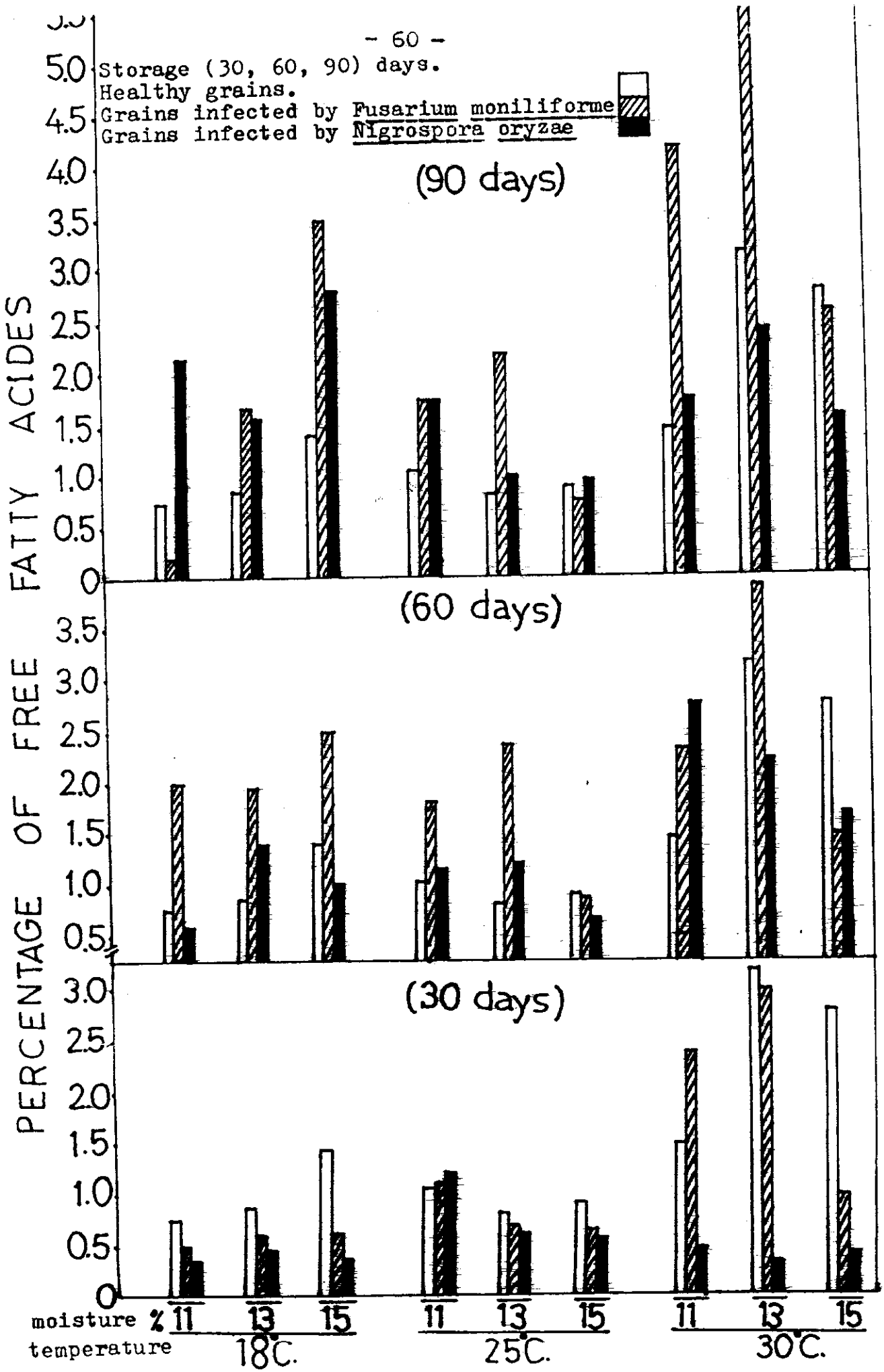


Figure (2): Effect of infection of maize grains with Fusarium moniliforme and Nigrospora oryzae under different temperature degrees, moisture percentages and storage intervals on free fatty acids percentages.

Whereas the increase in time of storage was not effective in this respect. Similarly the increase in moisture percentage content was not effective.

As regards infected grains with Fusarium moniliforme and Nigrospora oryzae, data in Table (6) clearly show that except 15 % moisture content of the grains, infected with Fusarium moniliforme caused great increase in the percentage of free fatty acids compared with other treatments (healthy one and infected with (Nigrospora oryzae), however, storage periods. Also, grains infected with Fusarium moniliforme showed reduction in free fatty acids at 30 days storage then greatly increased by prolonging the period of storage to 90 days. Whereas, Nigrospora oryzae showed contrast results and greatly decreased till 90 days.

However, except in case of 13 % and 15 % moisture grain contents and after 30 days in grains infected with Fusarium moniliforme and Nigrospora oryzae all the other treatments showed high increases in free fatty acids by the increase in moisture percentage content of the grains, temperature degrees and period of storage.

Effect of infection of maize grains with Fusarium moniliforme or Nigrospora oryzae under storage intervals, temperature degrees and moisture percentage contents of maize grains on fatty acid values :

Fatty acid values in both healthy maize grains and infected ones by either Fusarium moniliforme or Nigrospora oryzae stored for different periods under conditions of different grain moisture contents as well as different temperatures, are shown in Table (7)and Figure (3).

It is clear that infection of maize grains by the abovementioned fungi produced obvious increase in the mean values of fatty acids at all temperature degrees, except at 30°C, after 30 days storage under all percentages of tested moisture for those infected with Nigrospora oryzae, compared with healthy grains. As for maize grains infected with Fusarium moniliforme, it was noticed that the mean values of fatty acids were higher than those infected with Nigrospora oryzae. Similarly, this increase in fatty acid values was noticed by the increase of the degree of temperature specially at 30°C. The same trend was also noticed as regards the prolonging of the period of storage. In regards to moisture percentage content of the grains, however, a

Table (7): Effect of infection of maize grains with Fusarium moniliforme or Nigrospora oryzae under different temperature degrees, storage periods and moisture percentage content on fatty acid value (m. eq./ 100 g fat)*.

Temperatures (°C.)		18°C.			25°C.			30°C.		
Moisture contents** %		11 %	13 %	15 %	11 %	13 %	15 %	11 %	13 %	15 %
Treatments	Storage intervals (days)									
Healthy grains	30	2.690	3.080	4.970	3.690	2.868	3.121	5.040	11.121	9.677
	60	2.690	3.080	4.970	3.690	2.868	3.121	5.040	11.121	9.677
	90	2.690	3.080	4.970	3.690	2.868	3.121	5.040	11.121	9.677
Mean		2.690	3.080	4.970	3.690	2.868	3.121	5.040	11.121	9.677
Fusarium moniliforme	30	1.696	2.070	1.890	3.970	2.550	2.330	8.250	18.496	3.320
	60	3.750	6.830	8.870	6.340	8.240	2.950	8.200	13.860	5.190
	90	6.320	5.990	12.373	6.160	7.830	2.970	14.670	20.780	9.190
Mean		3.922	4.960	7.711	5.490	6.207	2.750	10.373	17.712	5.900
Nigrospora oryzae	30	1.250	1.510	1.245	2.250	2.150	2.030	1.570	1.014	1.472
	60	2.120	5.015	3.556	4.110	4.210	2.370	8.730	7.866	5.890
	90	7.830	5.648	3.964	6.190	3.520	3.410	9.200	8.463	5.440
Mean		3.733	4.058	2.922	4.150	3.293	2.603	6.500	5.781	4.267

* The fatty acid value is defined as the number of milli equivalents of NaOH used for the neutralization of 100 g fat.

** Moisture contents of grains

Table (7):

A) Effect of temperature and infection of maize grains on fatty acid value :

Degrees of temp.	Healthy grains	Grains infected with *Fusarium moniliforme*	Grains infected with *Nigrospora oryzae*
18°C.	3.58	5.53	3.57
25°C.	3.23	4.78	3.58
30°C.	8.61	11.33	5.29

B) Effect of grain moisture content and infection of maize grains on fatty acid value :

Moisture content percentage	Healthy grains	Grains infected with *Fusarium moniliforme*	Grains infected with *Nigrospora oryzae*
11 %	3.81	6.60	4.80
13 %	5.69	9.63	4.38
15 %	5.92	5.42	3.26

C) Effect of storage periods and infection of maize grains on fatty acid value :

Storage intervals (days)	Healthy grains	Grains infected with *Fusarium moniliforme*	Grains infected with *Nigrospora oryzae*
30	5.14	4.95	1.83
60	5.14	7.14	4.99
90	5.14	9.55	5.63

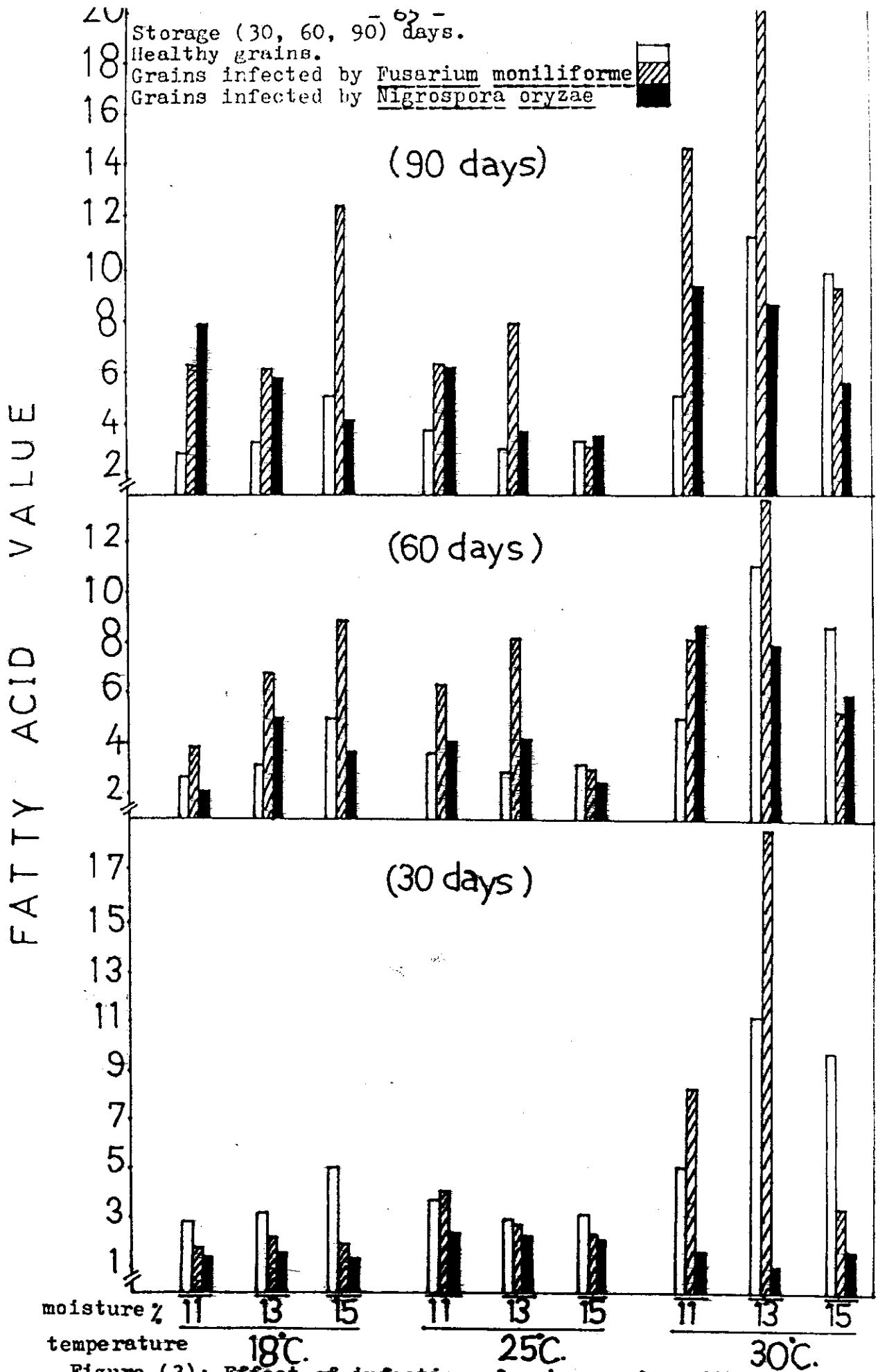


Figure (3): Effect of infection of maize grains with Fusarium moniliforme and Nigrospora oryzae under different temperature degrees, moisture percentages and storage intervals on fatty acid value.

greate decrease in the values of fatty acids in infected grains by both fungi was noticed after 30 days storage in all treatments concerning the moisture percentages and degrees of temperature compared with the control, however, these values, increased by prolonging the period of storage to reach it's maximum after 90 days. It was found that infection with Fusarium moniliforme increased fatty acids value till 13 % moisture content then decreased again, whereas, in case of Nigrospora oryzae a gradual reduction was noticed by increasing the grains moisture content over 11 %.

--Effect of infection with Fusarium moniliforme or Nigrospora oryzae under different storage intervals, temperature degrees and moisture percentage contents of maize grains on reducing sugars :

Maize grains exhibits various changes in a great number of chemical compounds, for instance, reducing sugars, depending on the environmental conditions under which they are stored. Some of these environmental conditions are moisture percentage content of grains, degrees of temperature and period of storage.

The influence of these treatments on reducing sugars in the tested grains are presented in Table (8) and Figure (4).

Table (8): Effect of infection of maize grains with Fusarium moniliforme and Nigrospora oryzae, under different temperatures, moisture content percentages and storage intervals on reducing sugars percentages.

Temperature (°C.)		18°C.			25°C.			30°C.		
Moisture content x %		11 %	13 %	15 %	11 %	13 %	15 %	11 %	13 %	15 %
Treatments	Storage intervals (days)									
Healthy grain	30	0.1143	0.1747	0.1378	0.1277	0.1478	0.1142	0.1109	0.0672	0.1344
	60	0.1143	0.1747	0.1378	0.1277	0.1478	0.1142	0.1109	0.0672	0.1344
	90	0.1143	0.1747	0.1378	0.1277	0.1478	0.1142	0.1109	0.0672	0.1344
M e a n		0.1143	0.1747	0.1378	0.1277	0.1478	0.1142	0.1109	0.0672	0.1344
Fusarium moniliforme	30	0.1646	0.2654	0.5678	0.3629	0.1646	0.2453	0.3394	0.4469	0.3125
	60	0.1340	0.1949	0.1646	0.1310	0.1406	0.1243	0.2050	0.2016	0.2990
	90	0.1848	0.5275	0.5376	0.2218	0.2016	0.1781	0.1210	0.5040	0.2688
M e a n		0.1611	0.3293	0.4233	0.2386	0.1689	0.1826	0.2218	0.3842	0.2934
Nigrospora oryzae	30	0.2251	0.2822	0.2117	0.3326	0.3864	0.4234	0.2251	0.2755	0.1243
	60	0.1142	0.1949	0.2419	0.2218	0.2721	0.2184	0.2822	0.4166	0.3024
	90	0.3629	0.3360	0.2150	0.1445	0.2443	0.2016	0.1746	0.3024	0.1848
M e a n		0.2341	0.2710	0.2229	0.2310	0.3009	0.2811	0.2273	0.3316	0.2038

x Moisture contents of grains.

Table (8):
A) Effect of infection of maize grains and different temperatures on reducing sugars.

Degrees of temp.	Healthy grains	Grains infected with Fusarium moniliforme	Grains infected with Nigrospora oryzae
18°C.	0.1423	0.3046	0.2427
25°C.	0.1299	0.1967	0.2710
30°C.	0.1042	0.2998	0.2542

B) Effect of infection of maize grains and moisture content percentages on reducing sugars.

Moisture content percentage	Healthy grains	Grains infected with Fusarium moniliforme	Grains infected with Nigrospora oryzae
11 %	0.1176	0.2072	0.2308
13 %	0.1299	0.2941	0.3012
15 %	0.1288	0.2998	0.2359

C) Effect of infection of maize grains and storage intervals on reducing sugars.

Storage intervals (days)	Healthy grains	Grains infected with Fusarium moniliforme	Grains infected with Nigrospora oryzae
30	0.1254	0.2844	0.2763
60	0.1254	0.1772	0.2516
90	0.1254	0.3050	0.2407

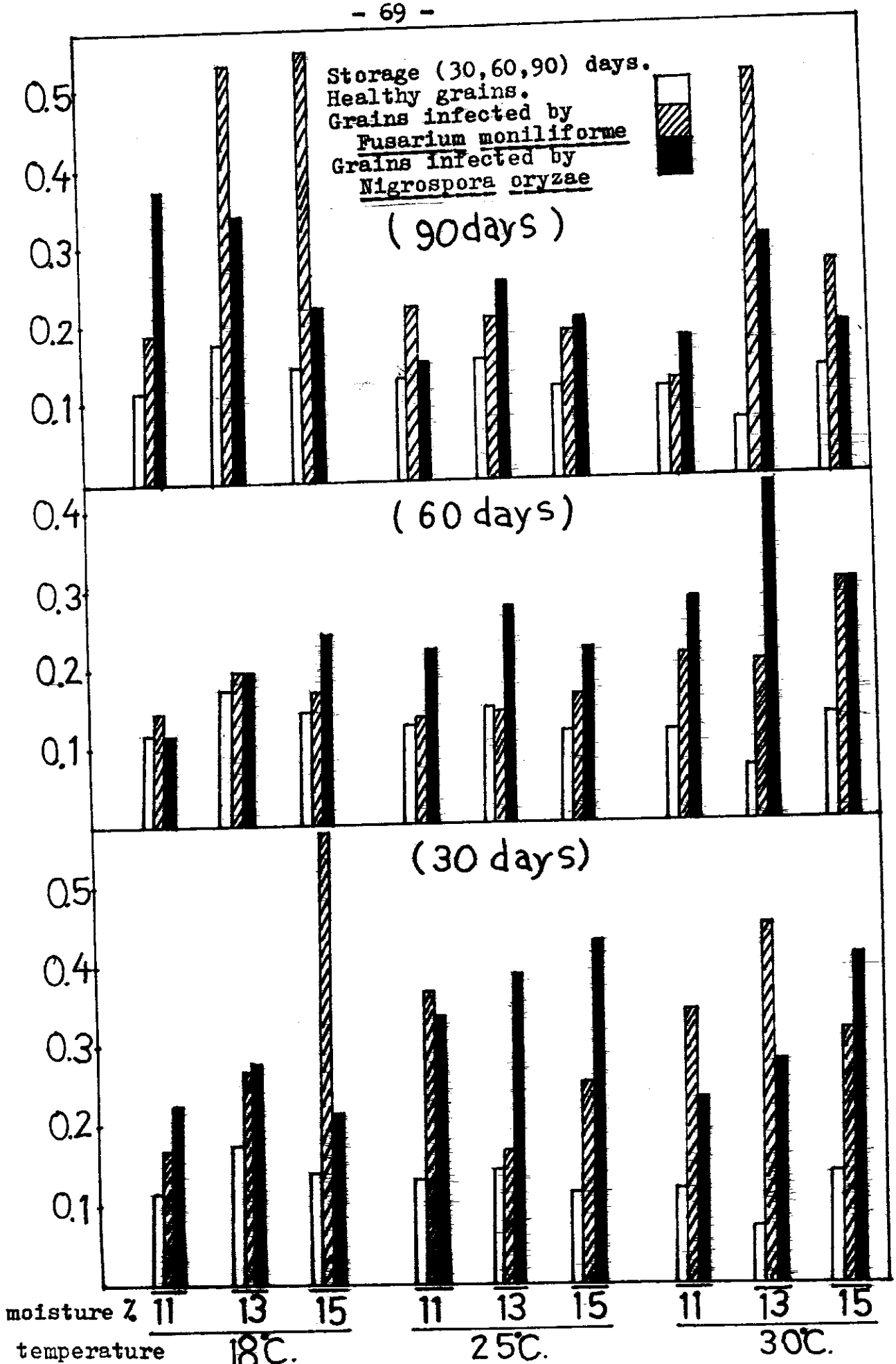


Figure (4): Effect of infection of maize grains with Fusarium moniliforme and Nigrospora oryzae under different temperature degrees, moisture percentages and storage intervals on reducing sugars percentages.

As regards healthy grains, reducing sugars increased to reach it's maximum mean at 13 % moisture content then decreased, however, still higher than 15 % moisture content, by increasing moisture at 18°C. Whereas, at 25°C. it increased at 13 % moisture content then decreased at 15 %, than 11% moisture content, In this regard contrast results were noticed at 30°C. as it decreased at 13 % moisture content and increased again at 15 % moisture content.

However, infection of the grains with Fusarium moniliforme increased greatly the percentage of reducing sugars than the control by the increase in moisture. As for the effect of storage period a reduction than 30 days storage in the percentage of reduced sugars was recorded after 60 days storage but a great increase was noticed after 90 days, this is true at 18°C. and 25°C., but at 30°C. a gradual decreased was noticed by prolonging the period of storage. However, it is clear that infection with Fusarium moniliforme increased the percentages of reduced sugars in all treatments than the control.

As regards infection with Nigrospora oryzae, similar results were noticed at 18°C. as Fusarium moniliforme but at 25°C. gradual decrease was noticed by the increase in storage period. Whereas it increased after 60 days

storage then decreased again at 30°C. which means a contrast effect with Fusarium moniliforme in this respect.

Generally infection with Nigrospora oryzae caused higher percentages of reducing sugars at 18°C. and 25°C. than Fusarium moniliforme and the contrast was noticed at 30°C. and also in all treatments than the control.

= Effect of infection of maize grains with Fusarium moniliforme or Nigrospora oryzae under different storage intervals, temperature degrees and moisture percentage content on non-reducing sugars :

Non-reducing sugars percentages in healthy and infected maize grains by either Fusarium moniliforme or Nigrospora oryzae as affected by different moisture percentage contents (11 %, 13 % and 15 %) and periods of storage, (30, 60 and 90 days) at different degrees of temperature (18, 25 and 30°C.) were determined. Results are shown in Table (9) and Figure (5).

The percentage of non-reducing sugars in healthy grains was higher at 18°C. and decreased at 25°C. then increased again at 30°C., however, remaining less than 18°C As for the effect of moisture the percentage of non-reducing sugars reduced gradually by the increase of moisture content percentage this is clear at 18°C., and 25°C., whereas , it decreased at 13 % moisture then increased again with the

Table (9): Effect of infection of maize grains with Fusarium moniliforme or Nigrospora oryzae under different temperatures, moisture content percentages and storage intervals on non-reducing sugars.

Temperatures (°C.)		18°C.			25°C.			30°C.		
Moisture content* %		11 %	13 %	15 %	11 %	13 %	15 %	11 %	13 %	15 %
Treatments	Storage intervals (days)									
Healthy grains	30	2.6276	2.0832	1.2734	0.9811	0.9546	0.9274	1.2331	1.2096	1.3776
	60	2.6276	2.0832	1.2734	0.9811	0.9546	0.9274	1.2331	1.2096	1.3776
	90	2.6276	2.0832	1.2734	0.9811	0.9546	0.9274	1.2331	1.2096	1.3776
Mean		2.6276	2.0832	1.2734	0.9811	0.9546	0.9274	1.2331	1.2096	1.3776
Fusarium moniliforme	30	0.7762	1.0114	0.5214	1.0483	1.2466	1.1003	0.5342	1.4939	0.7627
	60	0.8554	1.7539	1.4482	1.3810	1.9038	1.3189	1.0718	0.6720	1.1122
	90	0.5540	0.6821	0.5376	0.9878	1.2096	1.0135	1.0886	0.7728	1.0752
Mean		0.7285	1.14913	0.8357	1.1390	1.4530	1.1442	0.8982	0.6462	0.9834
Nigrospora oryzae	30	1.3205	1.2634	1.1323	1.0706	1.0248	0.6518	1.1861	0.5309	0.7493
	60	2.7754	1.7459	1.9005	1.4246	1.1727	1.1727	0.9194	0.9866	1.1088
	90	0.7123	1.6128	1.1370	1.0651	0.5981	0.9408	0.9010	0.7056	0.4200
Mean		1.6027	1.5407	1.3899	1.1868	0.9319	0.9285	1.0022	0.7410	0.7794

* Moisture contents of grains.

Table (9):
A) Effect of infection of maize grains and different temperatures on non-reducing sugars percentage.

Degrees of temp.	Healthy grains	Grains infected with Fusarium moniliforme	Grains infected with Nigrospora oryzae
18°C.	1.9947	0.8656	1.5111
25°C.	0.9544	1.2454	1.0157
30°C.	1.2734	0.8426	0.8342

B) Effect of infection of maize grains and moisture content percentages on non-reducing sugars percentage.

Moisture content percentage	Healthy grains	Grains infected with Fusarium moniliforme	Grains infected with Nigrospora oryzae
11 %	1.6139	0.9219	1.2639
13 %	1.4158	1.0828	1.0712
15 %	1.1928	0.9489	1.0259

C) Effect of infection of maize grains and storage intervals on non-reducing sugars percentage.

Storage intervals (days)	Healthy grains	Grains infected with Fusarium moniliforme	Grains infected with Nigrospora oryzae
30	1.4075	0.7939	0.9922
60	1.4075	1.2797	1.4674
90	1.4075	0.8822	0.8992

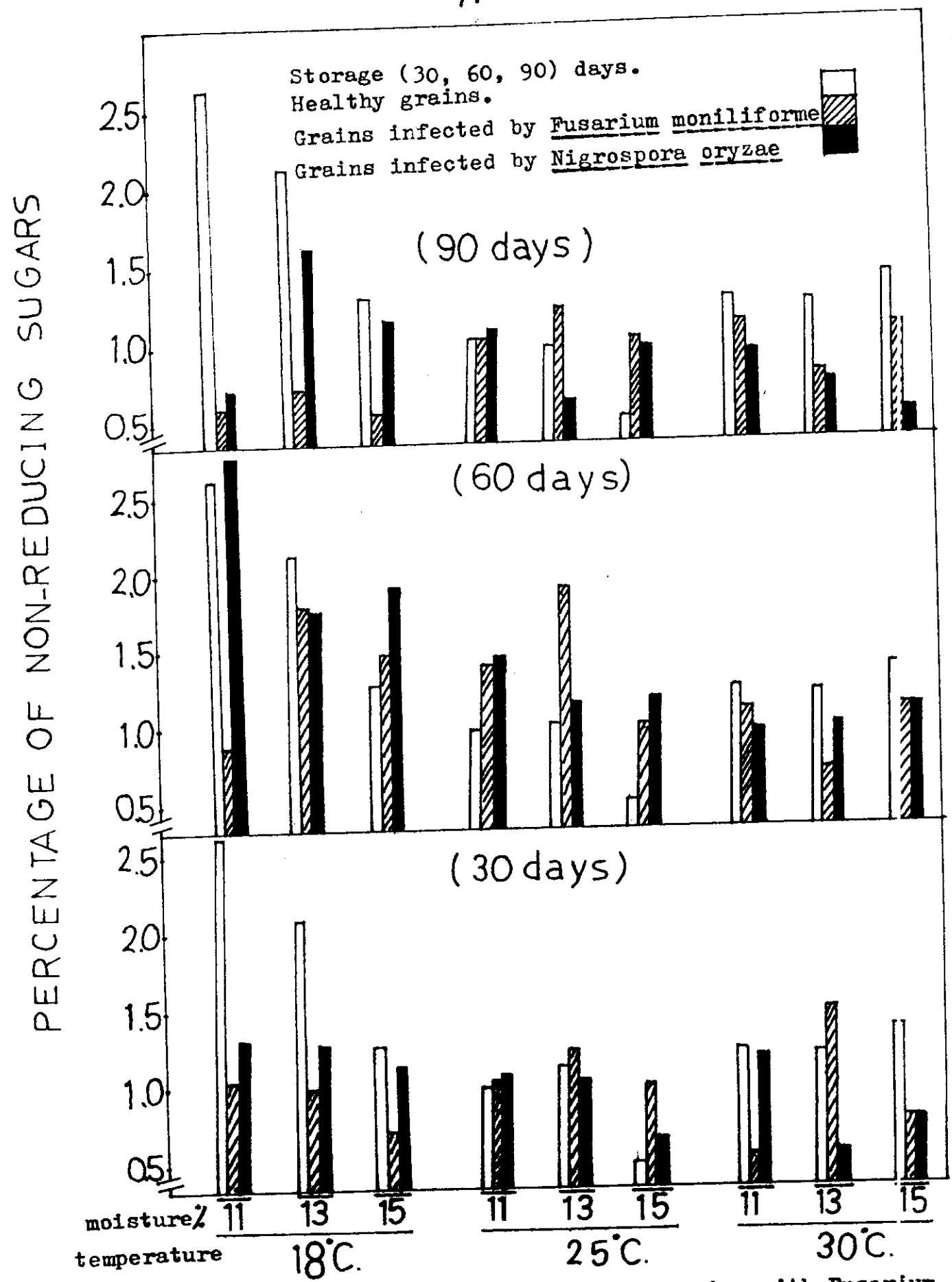


Figure (5): Effect of infection of maize grains with Fusarium moniliforme and Nigrospora oryzae under different temperature degrees, moisture percentages and storage intervals on non-reducing sugars percentage.

increase of moisture content at 30°C. to become more than 11 % moisture content.

As for the effect of infection with Fusarium moniliforme, the percentage of non-reducing sugars increased by increasing the moisture percentage content of the grains to 13 %, moisture content, then decreased at 15 % at both 18°C. and 25°C., whereas it decreased at 13 % moisture content, then increased at 15 % on 30°C. In this respect as regards the time of storage non-reducing sugars increased after 60 days storage then reduced again after 90 days. However, compared with the control the non-reducing sugars percentages were less than the control on 18°C. and 30°C. and were higher at 25°C.

As regards the infection with Nigrospora oryzae, the percentages of non-reducing sugars decreased by increasing the percentage of moisture content on all temperature degrees. However, these percentages decreased generally by increasing the degree of temperature. As for the effect of intervals of storage these percentages increased after 60 days storage then decreased again.

Generally Nigrospora oryzae caused higher percentages of non-reducing sugars than Fusarium moniliforme in all treatments.

- Effect of infection of maize grains with Fusarium moniliforme or Nigrospora oryzae under different storage intervals , temperature degrees and moisture percentage content on total sugars :

A detailed summary of total sugars, as percentage, of maize grains as function of infection by either Fusarium moniliforme or Nigrospora oryzae stored for various periods under different temperature degrees as well as moisture percentage contents compared with healthy grains is presented in Table (10) and Figure (6).

As regards, it is clear that total sugars percentage decreases greathy by increase of temperature till 25°C then increased slightly at 30°C. Also a reduction in these percentages was noticed by the increase in moisture percentage content at 18°C., whereas it increased at 13 % moisture content then decreased at 15 % moisture at 25°C. , whereas at 30°C. a reduction was noticed at 13 % moisture content then increased at 15 % moisture content more than 11 % moisture content.

As for maize grains infected with Fusarium moniliforme a general decrease was noticed at 18°C. and 30°C. at all moisture percentage contents compared with the control and the contrast was noticed at 25°C. Also these

Table (10): Effect of infection of maize grains with Fusarium moniliforme and Nigrospora oryzae under different temperatures, moisture content percentage and storage intervals on total sugars.

Temperatures (°C.)		18°C.			25°C.			30°C.		
Moisture content * %		11 %	13 %	15 %	11 %	13 %	15 %	11 %	13 %	15 %
Treatment	Storage intervals (days)									
Healthy grains	30	2.7418	2.2579	1.4112	1.1088	1.1424	1.0416	1.3440	1.2768	1.5120
	60	2.7418	2.2579	1.4112	1.1088	1.1424	1.0416	1.3440	1.2768	1.5120
	90	2.7418	2.2579	1.4112	1.1088	1.1424	1.0416	1.3440	1.2768	1.5120
Mean		2.7418	2.2579	1.4112	1.1088	1.1424	1.0416	1.3440	1.2768	1.5120
Fusarium moniliforme	30	0.9408	1.2768	1.0892	1.4112	1.4112	1.5456	0.8736	0.9408	1.0752
	60	1.0688	1.9488	1.6128	1.5120	1.9744	1.2432	1.2768	1.4736	1.4112
	90	0.7392	1.2096	1.0752	1.2046	1.4112	1.2096	1.2046	1.2768	1.3440
Mean		0.9163	1.4784	1.2591	1.3776	1.5989	1.3328	1.1200	1.2304	1.2768
Nigrospora oryzae	30	1.5456	1.5456	1.3440	1.4032	1.4112	1.0752	1.4112	0.8064	0.8736
	60	2.8896	1.9408	1.1424	1.6464	1.4448	1.4112	1.2016	1.4032	1.4112
	90	1.0752	0.9488	2.3520	1.2096	1.1424	1.1424	1.5456	1.0080	0.6048
Mean		1.8368	1.4784	1.6128	1.4197	1.3328	1.2096	1.3861	1.0725	0.9632

* Moisture contents of grains.

Table (10) :
A) Effect of infection of maize grains and different temperatures on total sugars percentages.

Degrees of temp.	Healthy grains	Grains infected with Fusarium moniliforme	Grains infected with Nigrospora oryzae
18°C.	2.1370	1.1790	1.6427
25°C.	1.0976	1.4364	1.3207
30°C.	1.3776	1.2091	1.1406

B) Effect of infection of maize grains and moisture content percentage on total sugars percentage.

Moisture content percentage	Healthy grains	Grains infected with Fusarium moniliforme	Grains infected with Nigrospora oryzae
11 %	1.7315	1.1380	1.5475
13 %	1.5590	1.4359	1.2946
15 %	1.3216	1.2507	1.2619

C) Effect of infection of maize grains and storage intervals on total sugars percentage.

Storage intervals (days)	Healthy grains	Grains infected with Fusarium moniliforme	Grains infected with Nigrospora oryzae
30	1.5374	1.1349	1.2684
60	1.5374	1.5024	1.4990
90	1.5374	1.1861	1.3365

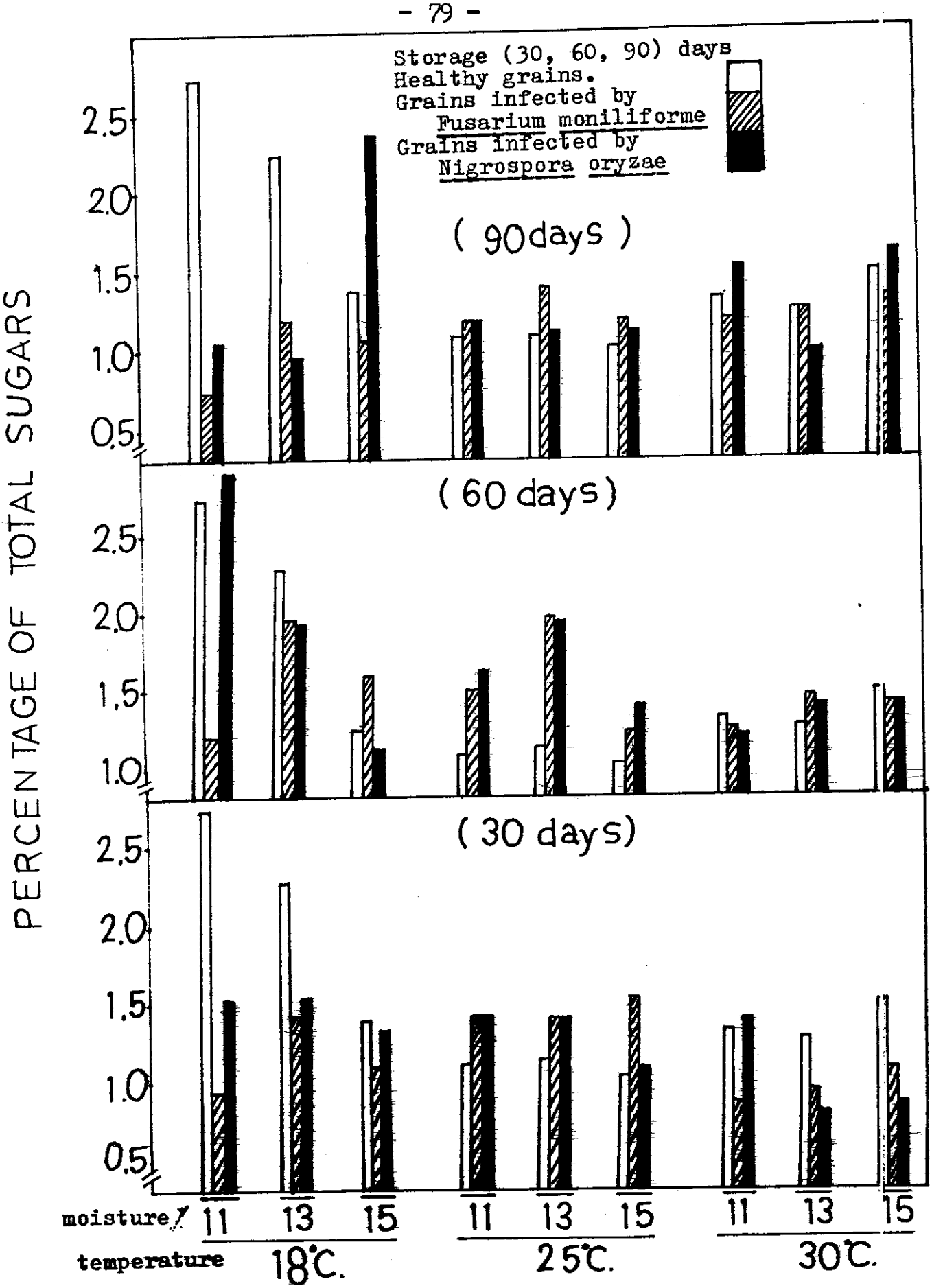


Figure (6): Effect of infection of maize grains with Fusarium moniliforme and Nigrospora oryzae under different temperature degrees, moisture percentages and storage intervals on total sugar percentage.

percentages increased till 60 days storage then reduced again at 90 days storage.

Almost similar results were obtained as regards maize grains infected with Nigrospora oryzae, however, generally, these percentages are higher than those obtained for Fusarium moniliforme.

- The effect of infection of maize grains with Fusarium moniliforme or Nigrospora oryzae under different storage intervals, temperature degrees and moisture percentages content on free phenol percentage :

The results of Table (11) and Figure (7), represent the response of free phenol, in maize grains as affected by moisture percentage contents, infection by either Fusarium moniliforme or Nigrospora oryzae, at different degrees of temperature and periods of storage.

In healthy grains free phenols increased by the increase of moisture percentage at 18°C. and 30°C, whereas, it decreased at 13 % moisture content then increased again at 15 % moisture at 25°C.

As regards, infected grains with Fusarium moniliforme, the percentages of free phenols increased by increasing the moisture percentage content and also the degree of temperature.

Table (11): Effect of infection of maize grains with Fusarium moniliforme and Nigrospora oryzae under different temperatures, moisture content percentages and storage intervals on free phenols.

Temperatures (°C.)		18°C.			25°C.			30°C.		
Moisture content x %		11 %	13 %	15 %	11 %	13 %	15 %	11 %	13 %	15 %
Treatments	Storage intervals (days)									
Healthy grains	30	0.0935	0.1506	0.3975	0.1191	0.1063	0.1338	0.0864	0.1515	0.1506
	60	0.0935	0.1506	0.3975	0.1191	0.1063	0.1338	0.0864	0.1515	0.1506
	90	0.0935	0.1506	0.3975	0.1191	0.1063	0.1338	0.0864	0.1515	0.1506
Mean		0.0935	0.1506	0.3975	0.1191	0.1063	0.1338	0.0864	0.1515	0.1506
Fusarium moniliforme	30	0.1368	0.2106	0.3287	0.1584	0.2185	0.2076	0.2155	0.2962	0.3949
	60	0.1989	0.2583	0.4736	0.1301	0.1479	0.2732	0.2696	0.2601	0.3940
	90	0.2574	0.4006	0.4856	0.1807	0.2143	0.2863	0.3143	0.2574	0.3768
Mean		0.1977	0.2898	0.4293	0.1564	0.1936	0.2557	0.2665	0.2712	0.3886
Nigrospora oryzae	30	0.1604	0.1712	0.2598	0.2303	0.2194	0.2460	0.1840	0.2232	0.2854
	60	0.2246	0.2516	0.3350	0.1955	0.2011	0.2724	0.3145	0.3138	0.3277
	90	0.3799	0.4147	0.4958	0.2203	0.2265	0.2956	0.4956	0.3143	0.3746
Mean		0.2550	0.2792	0.3635	0.2544	0.2154	0.2713	0.3314	0.2838	0.3292

x Moisture contents of grains.

Table (11):
A) Effect of infection of maize grains and different temperatures on free phenols percentage.

Degreese of temp.	Healthy grains	Grains infected with Fusarium moniliforme	Grains infected with Nigrospora oryzae
18°C.	0.2187	0.3148	0.2676
25°C.	0.1197	0.1797	0.2319
30°C.	0.1295	0.3209	0.3141

B) Effect of infection of maize grains and moisture content percentages on free phenols percentage.

Moisture content percentage	Healthy grains	Grains infected with Fusarium moniliforme	Grains infected with Nigrospora oryzae
11 %	0.0997	0.2716	0.2637
13 %	0.1361	0.2515	0.2676
15 %	0.2321	0.2923	0.2824

C) Effect of infection of maize grains and storage intervals on free phenols percentage.

Storage intervals (days)	Healthy grains	Grains infected with Fusarium moniliforme	Grains infected with Nigrospora oryzae
30	0.1560	0.2186	0.2142
60	0.1560	0.2440	0.2477
90	0.1560	0.3529	0.3517

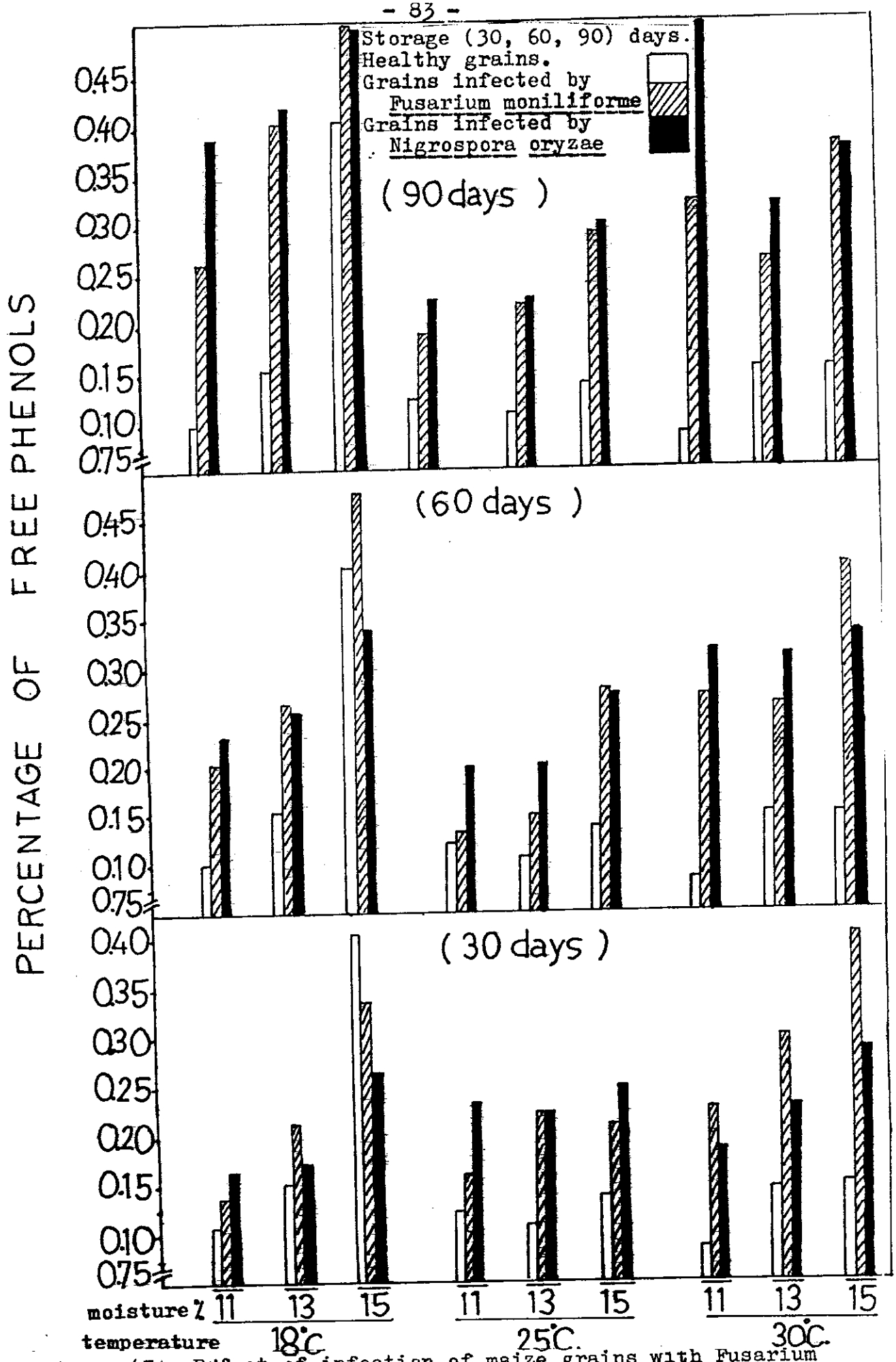


Figure (7): Effect of infection of maize grains with Fusarium moniliforme and Nigrospora oryzae under different temperature degrees, moisture percentages and storage intervals on free phenols percentage.

As for the effect of storage period, it is clear that free phenol percentages increased gradually by increasing the interval of storage at 18°C. and 30°C, whereas, it decreased at 60 days then increased again afterwards at 25°C.

In this respect almost similar results were noticed in grains infected with Nigrospora oryzae.

However, a general increase in free phenols percentages was noticed in infected grains than healthy ones.

-The effect of infection of maize grains with Fusarium moniliforme or Nigrospora oryzae, under different storage intervals, temperature degrees and moisture percentages content on conjugated phenol percentage :

The effect of temperature, moisture percentage content of the grains and storage period on conjugated phenols of maize grains infected with the abovementioned fungi was tabulated in Table (12) and Figure (8).

In healthy grains it was noticed that the conjugated phenols percentage have the same trend at all degrees of

Table (12): Effect of infection of maize grains with Fusarium moniliforme and Nigrospora oryzae under different temperatures, moisture content percentages and storage intervals on conjugated phenols percentage.

Temperature (°C.)		18°C.			25°C			30°C.		
Moisture contents* %		11 %	13 %	15 %	11 %	13 %	15 %	11 %	13 %	15 %
Treatments	Storage intervals (days)									
Healthy grains	30	0.0669	0.2273	0.0561	0.0649	0.1092	0.0856	0.0642	0.1122	0.0748
	60	0.0669	0.2273	0.0561	0.0649	0.1092	0.0856	0.0642	0.1122	0.0748
	90	0.0669	0.2273	0.0561	0.0649	0.1092	0.0856	0.0642	0.1122	0.0748
Mean		0.0669	0.2273	0.0561	0.0649	0.1092	0.0856	0.0642	0.1122	0.0748
Fusarium moniliforme	30	0.0433	0.0620	0.1407	0.0630	0.0610	0.1460	0.0846	0.0758	0.0413
	60	0.0710	0.1549	0.1468	0.0421	0.0337	0.1048	0.0318	0.0505	0.0543
	90	0.1899	0.1320	0.1684	0.0618	0.0665	0.0608	0.0281	0.0608	0.0179
Mean		0.1014	0.1163	0.1520	0.0556	0.0537	0.1039	0.0482	0.0624	0.0445
Nigrospora oryzae	30	0.0118	0.0561	0.0197	0.0747	0.0807	0.0295	0.0640	0.0690	0.0433
	60	0.0562	0.0618	0.0197	0.0421	0.0320	0.0215	0.0178	0.0643	0.0656
	90	0.0123	0.1301	0.0749	0.0421	0.0334	0.0374	0.0702	0.0365	0.0990
Mean		0.0268	0.0827	0.0381	0.0530	0.0487	0.0295	0.0507	0.0566	0.0693

* Moisture contents of grains.

Table (12):
A) Effect of infection of maize grains and different temperatures on conjugted phenols percentage.

Degrees of temp.	Healthy grains	Grains infected with Fusarium moniliforme	Grains infected with Nigrospora oryzae
18°C.	0.1168	0.1888	0.0492
25°C.	0.0866	0.0576	0.0437
30°C.	0.0837	0.0495	0.0589

B) Effect of infection of maize grains and moisture content percentages on conjugated phenols percentage.

Moisture content percentage	Healthy grains	Grains infected with Fusarium moniliforme	Grains infected with Nigrospora oryzae
11 %	0.0653	0.0684	0.0435
13 %	0.1496	0.1087	0.0627
15 %	0.0722	0.1187	0.0456

C) Effect of infection of maize grains and storage intervals on conjugated phenols percentage.

Storage intervals (days)	Healthy grains	Grains infected with Fusarium moniliforme	Grains infected with Nigrospora oryzae
30	0.0957	0.0909	0.0499
60	0.0957	0.0800	0.0483
90	0.0957	0.1496	0.0595

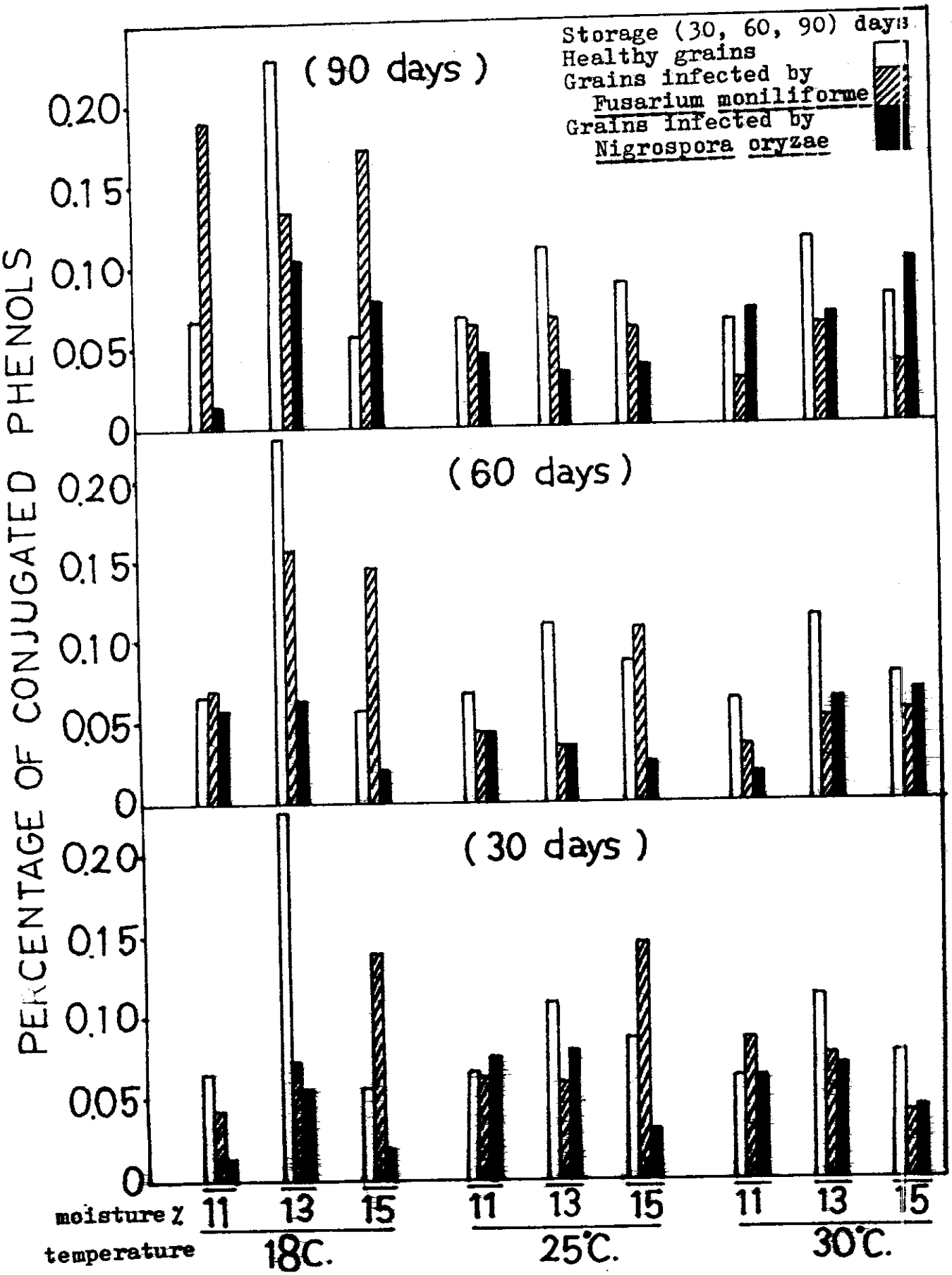


Figure (8): Effect of infection of maize grains with Fusarium moniliforme and Nigrospora oryzae under different temperature degrees, moisture percentages and storage intervals on conjugated phenols percentage.

temperature, i.e. it increased at 13 % moisture then decreased at 15 % moisture.

As regards the infected grains with Fusarium moniliforme the percentage of conjugated phenols increased by the increase in grain moisture and also by the increase in period of storage at 18°C,, whereas at 25°C. a reduction was noticed after 60 days storage then increased again after 90 days storage. As for 30°C. these percentages decreased by prolonging the period of storage from 30 to 90 days.

In case of infection with Nigrospora oryzae the percentage of conjugated phenols increased by the increase of moisture content percentage to 13 % then decreased again at 15 % at 18°C., whereas the decrease was noticed by the increase in moisture percentage at 25°C. on contrast with the trend at 30°C.

As for the effect of period of storage, the percentages of conjugated phenols increased at 60 days storage then decreased after 90 days.

However, generally there was a clear increase in conjugated phenols in infected grains than healthy ones and in those infested with Fusarium moniliforme than Nigrospora oryzae.

- The effect of infection of maize grains with Fusarium moniliforme or Nigrospora oryzae, under different storage intervals, temperature degrees and moisture content percentage on total phenols :

Total phenols were determined by adding conc. HCl to the sample, heated rapidly to boiling over a free flame and then placed on a boiling water-bath. After that cooling, then adding Folin-Ciocalteu reagent and sodium carbonate. The mixture was diluted and the developed colour was estimated at 520 nm against a reagent blank..

Data presented in Table (13) and Figure (9) , showed clearly that as regards healthy grains it was clear that total phenols increased by the increase in both moisture content percentage and temperature degrees.

Generally grain infection with both Fusarium moniliforme and Nigrospora oryzae increased total phenols specially those infected with Nigrospora oryzae than the control (healthy grains).

As for the effect of storage period, it was found that total phenols percentages were reduced after 60 days storage of grains infected with Fusarium moniliforme then increased again after 90 days.

Table (13): Effect of infection of maize grains with *Fusarium moniliforme* and *Nigrospora oryzae* under different temperatures, moisture content percentages and storage intervals on total phenols percentage.

Temperatures (°C.)		18°C.			25°C.			30°C.		
Moisture contents* %		11 %	13 %	15 %	11 %	13 %	15 %	11 %	13 %	15 %
Treatments	Storage intervals (days)									
Healthy grains	30	0.1604	0.3779	0.4536	0.1840	0.2155	0.2194	0.1506	0.2637	0.2254
	60	0.1604	0.3779	0.4536	0.1840	0.2155	0.2194	0.1506	0.2637	0.2254
	90	0.1604	0.3779	0.4536	0.1840	0.2155	0.2194	0.1506	0.2637	0.2254
Mean		0.1604	0.3779	0.4536	0.1840	0.2155	0.2194	0.1506	0.2637	0.2254
Fusarium moniliforme	30	0.8101	0.2726	0.4694	0.2214	0.2795	0.3536	0.3001	0.3720	0.4362
	60	0.2699	0.4132	0.6204	0.1722	0.1816	0.3780	0.3014	0.4106	0.4483
	90	0.4473	0.5326	0.6540	0.2425	0.2808	0.3470	0.3424	0.3182	0.4147
Mean		0.2991	0.4061	0.5813	0.2120	0.2473	0.3595	0.3146	0.3360	0.4331
Nigrospora oryzae	30	0.1722	0.2273	0.2795	0.3050	0.3001	0.2755	0.2480	0.2922	0.3287
	60	0.2808	0.3134	0.3547	0.2275	0.2331	0.2939	0.3323	0.3781	0.3933
	90	0.3922	0.5448	0.5707	0.2537	0.2799	0.3330	0.2658	0.2808	0.4736
Mean		0.2817	0.3618	0.4016	0.2621	0.2710	0.3008	0.2820	0.3504	0.3985

* Moisture contents of grains.

Table (13):
A) Effect of infection of maize grains and different temperatures on total phenols percentage.

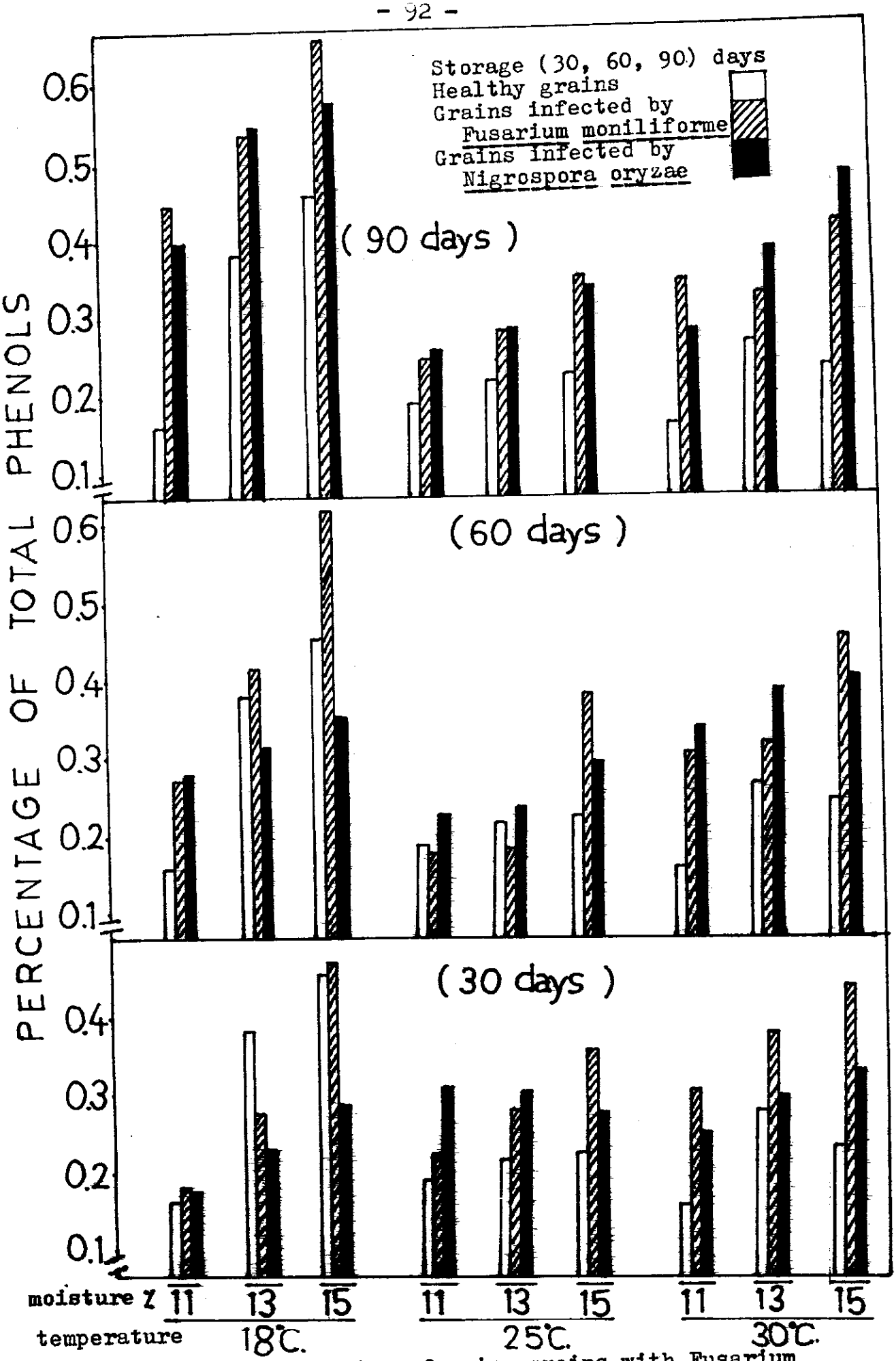
Degrees of temp.	Healthy grains	Grains infected with Fusarium moniliforme	Grains infected with Nigrospora oryzae
18°C.	0.3306	0.3071	0.3484
25°C.	0.2063	0.2595	0.2880
30°C.	0.2465	0.3456	0.3325

B) Effect of infection of maize grains and moisture contents percentages on total phenols percentage.

Moisture content percentage	Healthy grains	Grains infected with Fusarium moniliforme	Grains infected with Nigrospora oryzae
11 %	0.1650	0.2313	0.2753
13 %	0.2857	0.3089	0.3344
15 %	0.2994	0.3720	0.3592

C) Effect of infection of maize grains and storage intervals on total phenols percentage.

Storage intervals (days)	Healthy grains	Grains infected with Fusarium moniliforme	Grains infected with Nigrospora oryzae
30	0.2611	0.3071	0.2698
60	0.2611	0.2444	0.3330
90	0.2611	0.3607	0.3661



Figure(9): Effect of infection of maize grains with Fusarium moniliforme and Nigrospora oryzae under different temperature degrees, moisture percentages and storage intervals on total phenols percentage.

On the other hand, Nigrospora oryzae caused increase in total phenols of the infected grains by prolonging the time of storage.

- Effect of artificial inoculation with Fusarium moniliforme and Nigrospora oryzae on protein percentage after 10 and 20 days using Giza 2 and Pioneer varieties :

Healthy grains of Giza 2 and Poineer maize varieties were superficially sterilized by dipping in hydrogen peroxide(40 %) for 2 minutes, then dried and artificially inoculated by dipping them in a spore suspension of each of Fusarium moniliforme or Nigrospora oryzae for 5 minutes after which they were inoculated for either 10 or 20 days on 25°C. Protein percentage was determined using A.O.A.C 1980, the following method, one gram from the pre-dried samples of maize grains was digested using a mixture of sulphuric acid con. and hydrogen peroxide (40%) A mixture of potassium sulphate and mercuric oxide was used as a catalyst. Digestion was carried out for 5 minutes. The digest was distilled in a solution of boric acid containing methyl red and methyl blue indicator. After distillation for 6 minutes the distillate (150 ml) was titrated against sulphuric acid (1 %). The resulted

volume was multipled by a factor calculated according to a standard of ammonium sulphate to give crude protein percentage.

It is clear from data tabulated in Table (14) and Figure (10), that infection with both fungi increased the crude protein percentage of both cultivars. This increase is more noticed after 20 days. Also, infection with Nigrospora oryzae cause more increase in crude protein percentage than Fusarium moniliforme.

- Identification of different spores adhering on the outer surfaces of stored maize grains :

One hundred grams of a stored maize grains taken at random were dipped in a hundred millitres of sterilized distilled water with few drops of methanol alcohol , were shacken by electric shacker for ten minutes then left for 15 minutes, and filtered through sterile cheese cloth. The filtered liquied was divided in four tubes and cintrifuged for 5 mimutes at 6000 rpm minutes. The consensed precipitates were gathered together and examined microscopically.

Many microscopic fields of grains washing twere examined both at the low (x 10) and the high (x 40) magnitutedes to recognise the genera of spores found on the outer surfaces of the stored grains.

Table (14): Effect of artificial inoculation of maize grains with *Fusarium moniliforme* and *Nigrospora oryzae* on protein percentage after 10 and 20 days using Giza 2 and Pioneer varieties.

Variety	Giza 2		Pioneer	
Storage intervals (days)	10	20	10	20
Healthy grains	9.95	9.95	9.95	9.95
Grains infected of with *Fusarium moniliforme*	10.25	10.65	10.15	11.14
Grains infected with *Nigrospora oryzae*	11.24	11.94	10.25	12.24

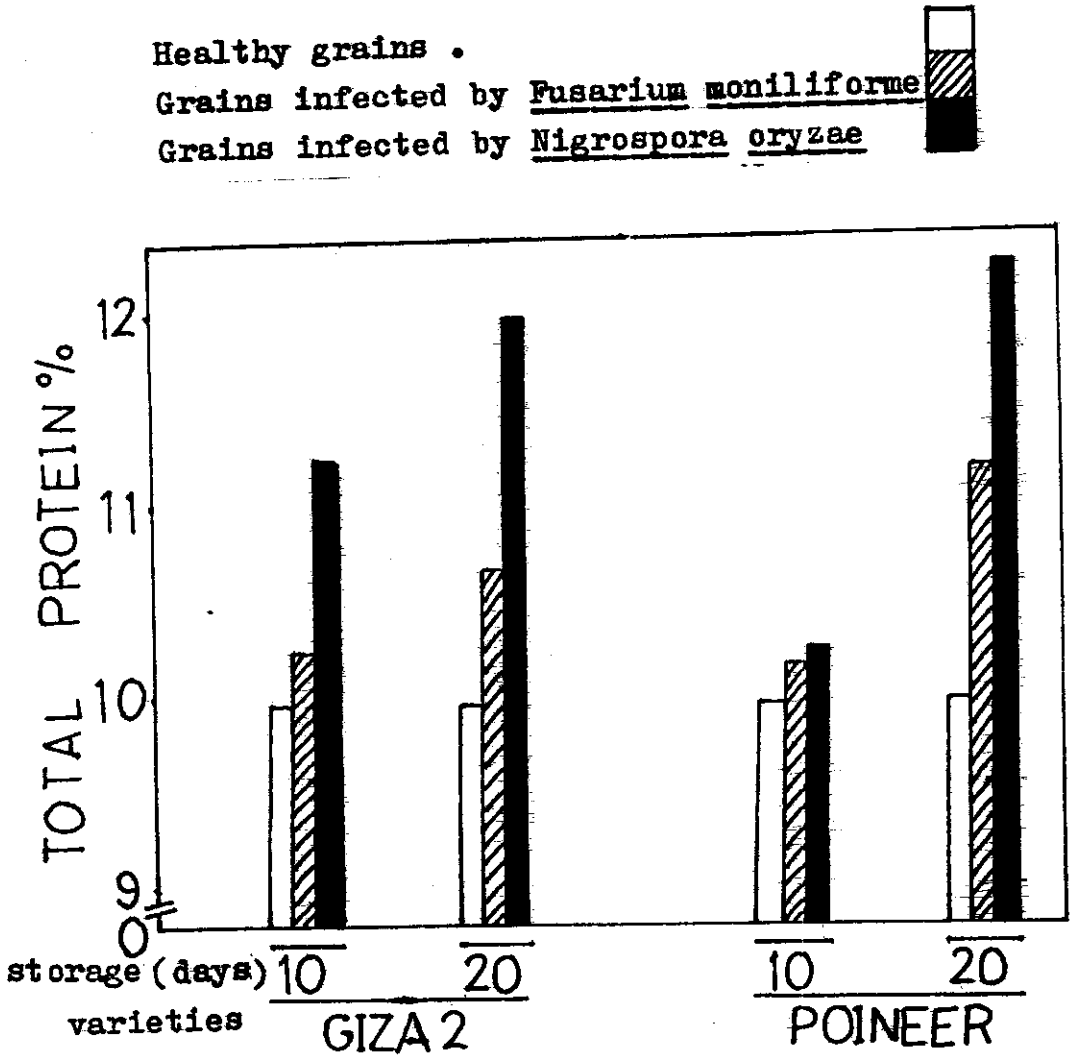


Figure (10): Effect of artificial inoculation with Fusarium moniliforme and Nigrospora oryzae on protein percentage after 10 and 20 days using Giza 2 and Poineer varieties .

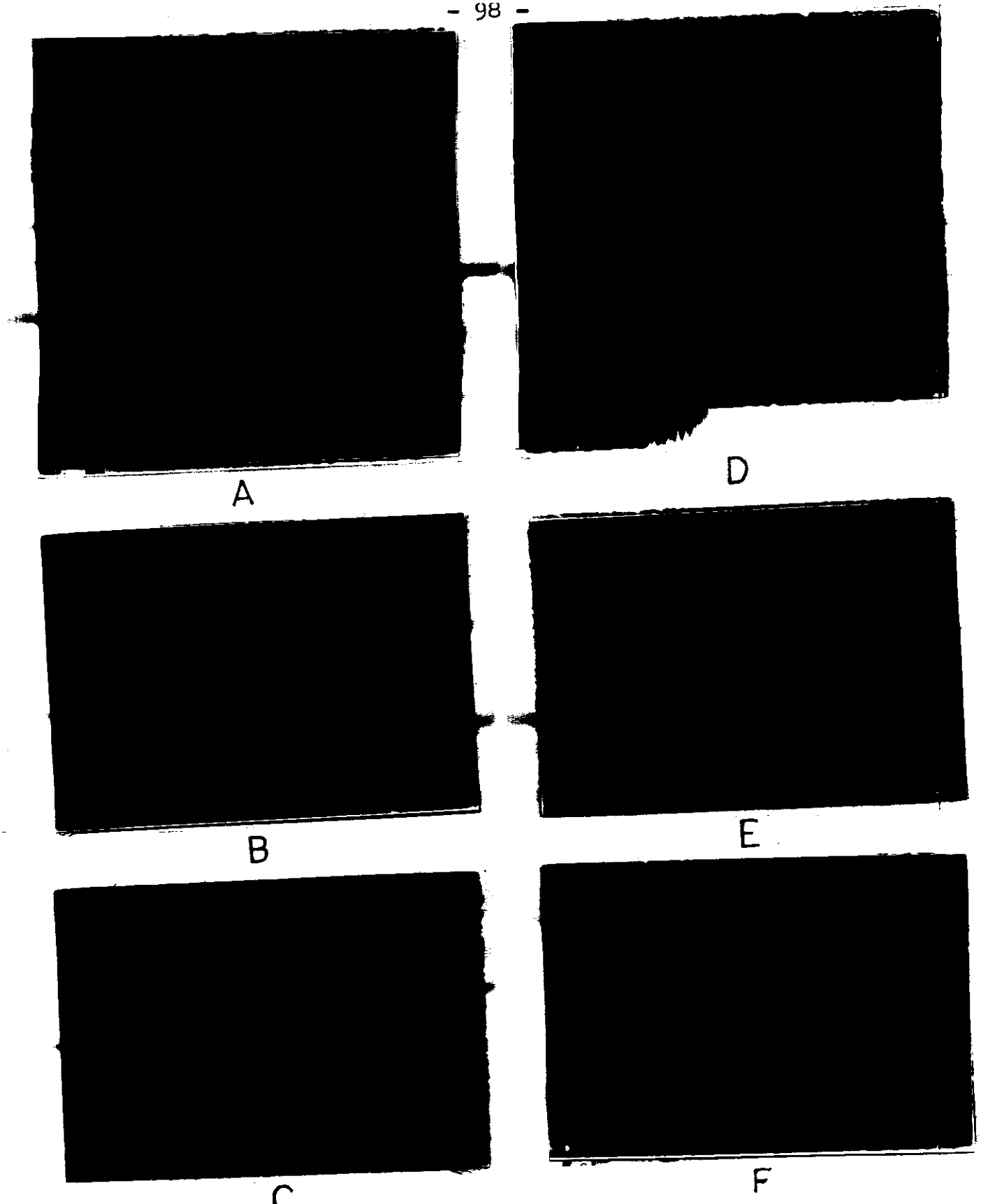


Figure (11):

(A): A general view of different spores as seen by the low magnitude (x 10).

(B): Spores of genera Fusarium sp. and Melanospora sp. (x 40).

(C): Spores of genera Fusarium sp. and Diplodia sp. (x 40).

(D): Spores of genera Fusarium sp. and Nigrospora sp. (x 40).

(E): Spores of genera Fusarium sp., Nigrospora sp. and Diplodia sp. (x 40).

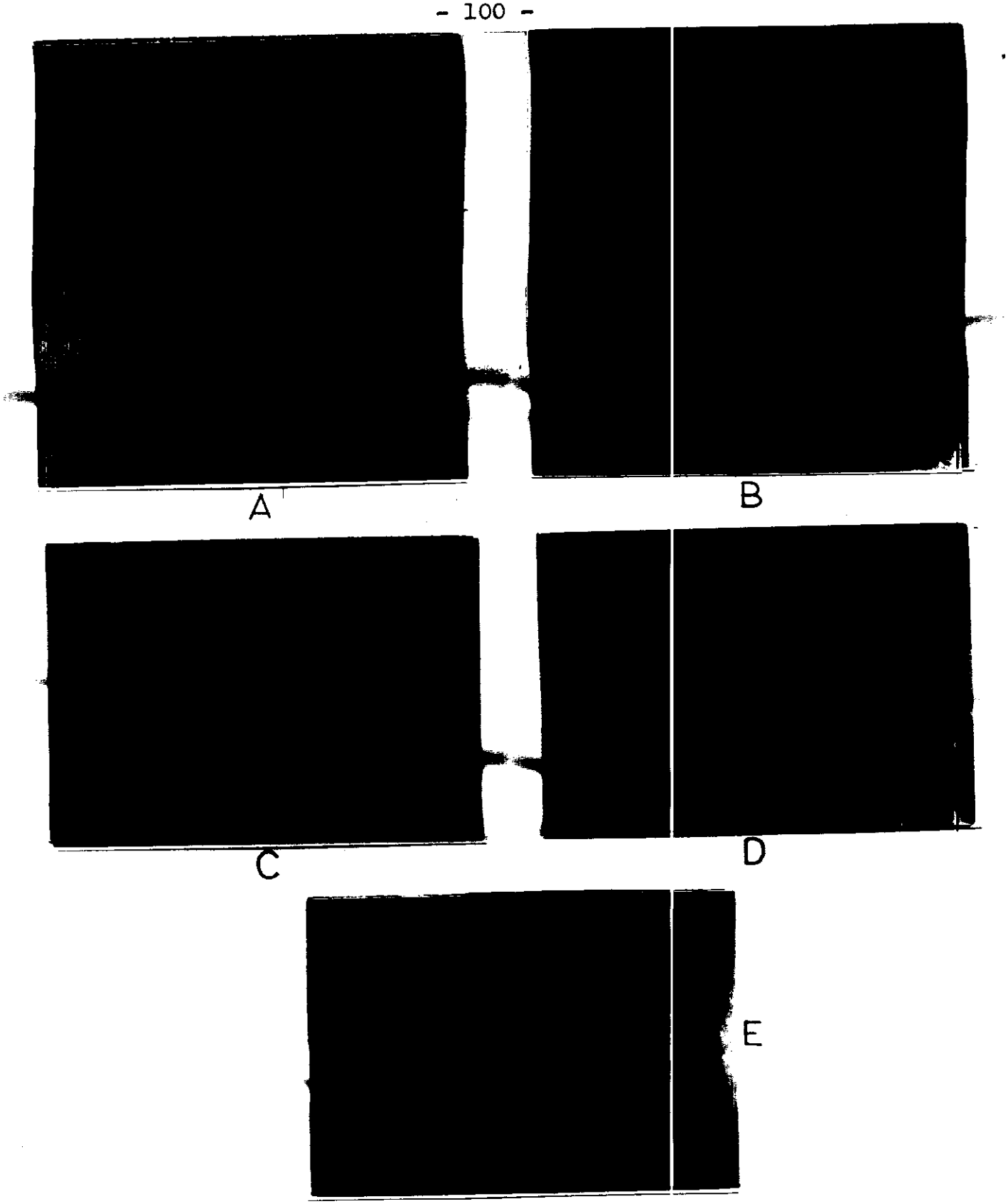
(F): Spores of genera Fusarium sp., Diplodia sp. and Melanospora sp. (x 40).

Each was blotted in moisted blotter paper and incubated at 25°C. in an incubator and left for one week. The growing fungus (i) were examined microscopillay and a part was used for purifying, indendified and used for artificially infecting the grains for obtaining the first symptoms.

Investigation of diseased and/ or discolored seeds showed that rosy coloured grains with dark red strips are infected with Fusarium moniliforme (Figures 12 and 13), yellow shrinked grains with small black spots on the part of attachment with the cob showed to be infected with Drechslera sp. (Figures 14), whereas yellow shrinked grains with dark spots sunken in the grain tissues .

Thus it could be concluded that yellow shrinked grain with dark black spots sunken in the grain tissues at the place of attackment with the cob are infected with Diplodia zeae, (Figure 15). Grains with dark black spots dspreadding on all parts of the grains are infected with Nigrospora oryzae, (Figure 16).

Other types of grain discolorations were shown in Figures (17 - 19), where species of Penicillium, Melanospora, Aspergillus and Diplodia could be detected.



Figures (12):

(A & B) : Maize grains becoming rosy coloured with dark red strips.

(C) : Showing a progressed part of infected grain with darker reddend spot.

(D) : More progressed infection.

(E) : The mycelium turning violet and black coloured.

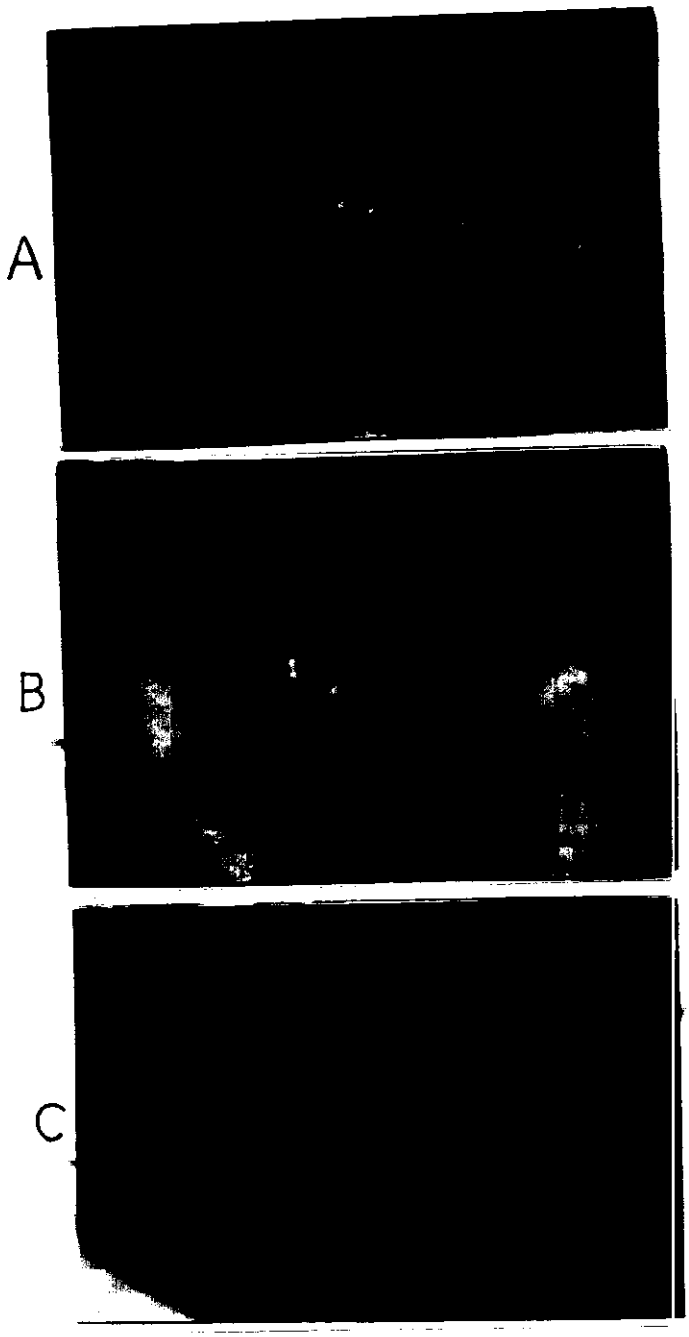


Figure (13):

(A) : Affected on the embryo

(B) : Ablotted grain showing the fungal growths of Fusarium moniliforme.

(C):: Enlarged part of the above (B).

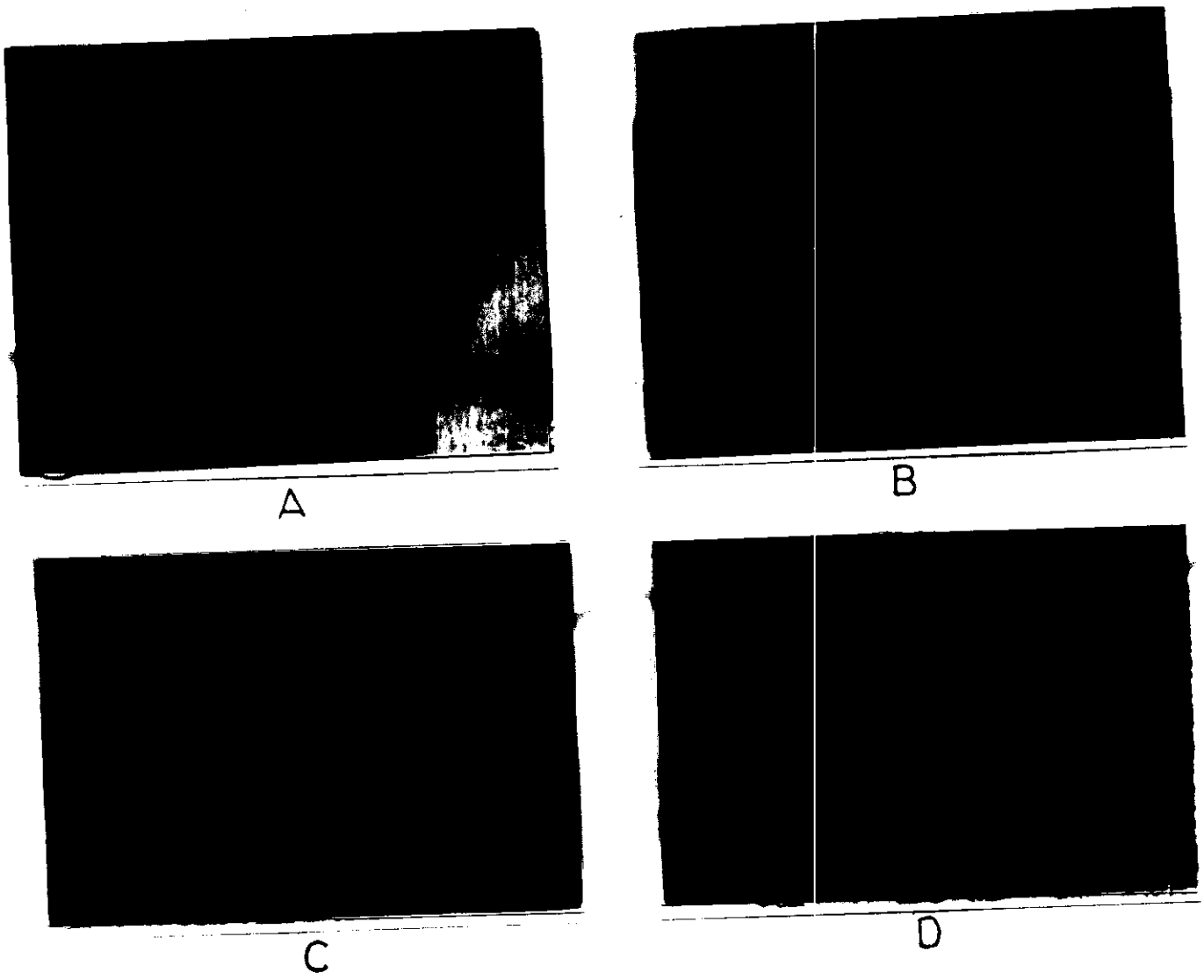


Figure (14):

(A) : Grain shrinked yellow coloured with small black spots specially on the back of the grain.

(B) : General view of the originating fungus of (A) .

(C) : Enlarged part of mycelium and spores of Drechslera sp.

(D) : Enlarged part of (C) .

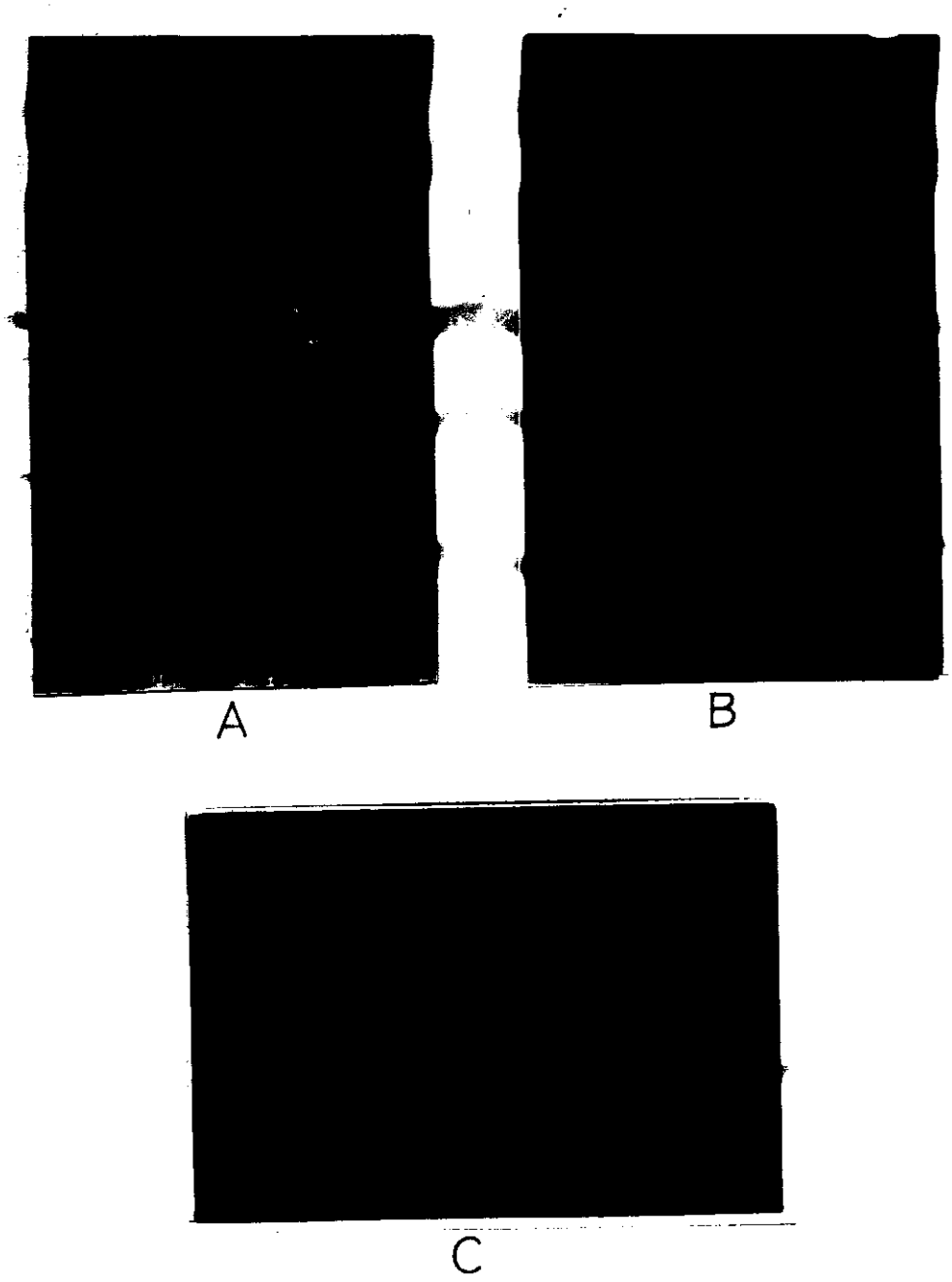


Figure (16):

(A) : Grain with black spots on all parts of the grain.

(B) : The growing mycelium white coloured at the beginning.

(C) : Dark mycelium with enlarged conidiospores of Nigrospora oryzae.

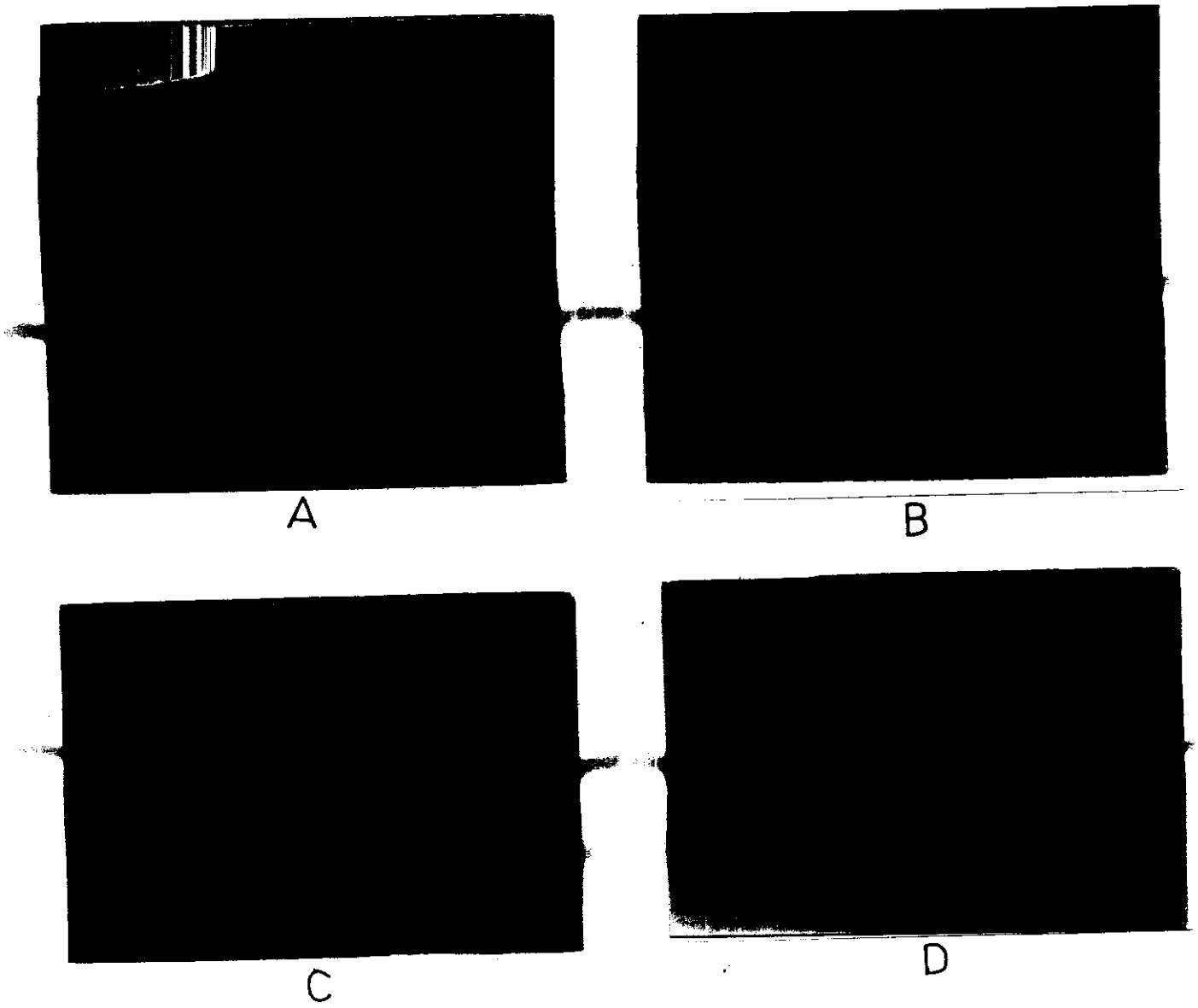


Figure (17):

(A) : Showing hull with green grey spot of Penicillium sp.

(B) : Mixed spores of Aspergillus sp. and Nigrospora oryzae.

(C) : A mixed growth of Melanospora sp. and Penicillium sp.

(D) : Enlarged part of grain infected with Penicillium sp. showing mycellium and spores of Penicillium sp.

It is clear from the above figures that Fusarium moniliforme, Nigrospora oryzae, Malanospora sp. and Diplodia zeae could be isolated from any part of the grain either the hull or endosperm or the embryo, whereas Penicillium sp. grows superficially only.

The indentification of the abovementioned fungi were kindly under taken by Prof. Dr. Abdel- Fattah A. El-Wakil of the Plant Pathology Institute, Agric. Research Institute, Ministry of Agric., Giza.

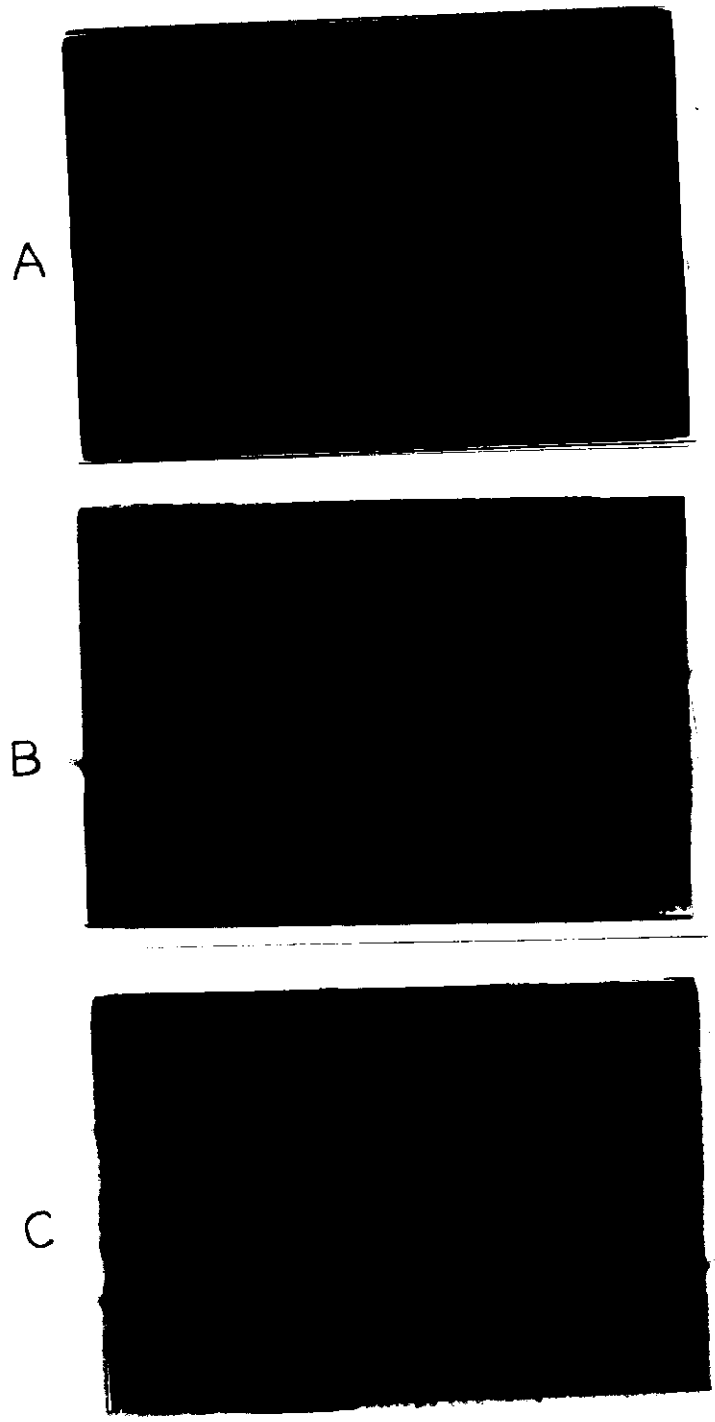


Figure (18) :

(A) : Mycelial growth and spores of Nigrospora oryzae and Fusarium moniliforme growing from the endosperm.

(B) : Pycinidia and spores of Diplodia zeae on the embryo.

(C) : Showing the mycillial growth of Diplodia zeae growing on the hull of the infected grains.

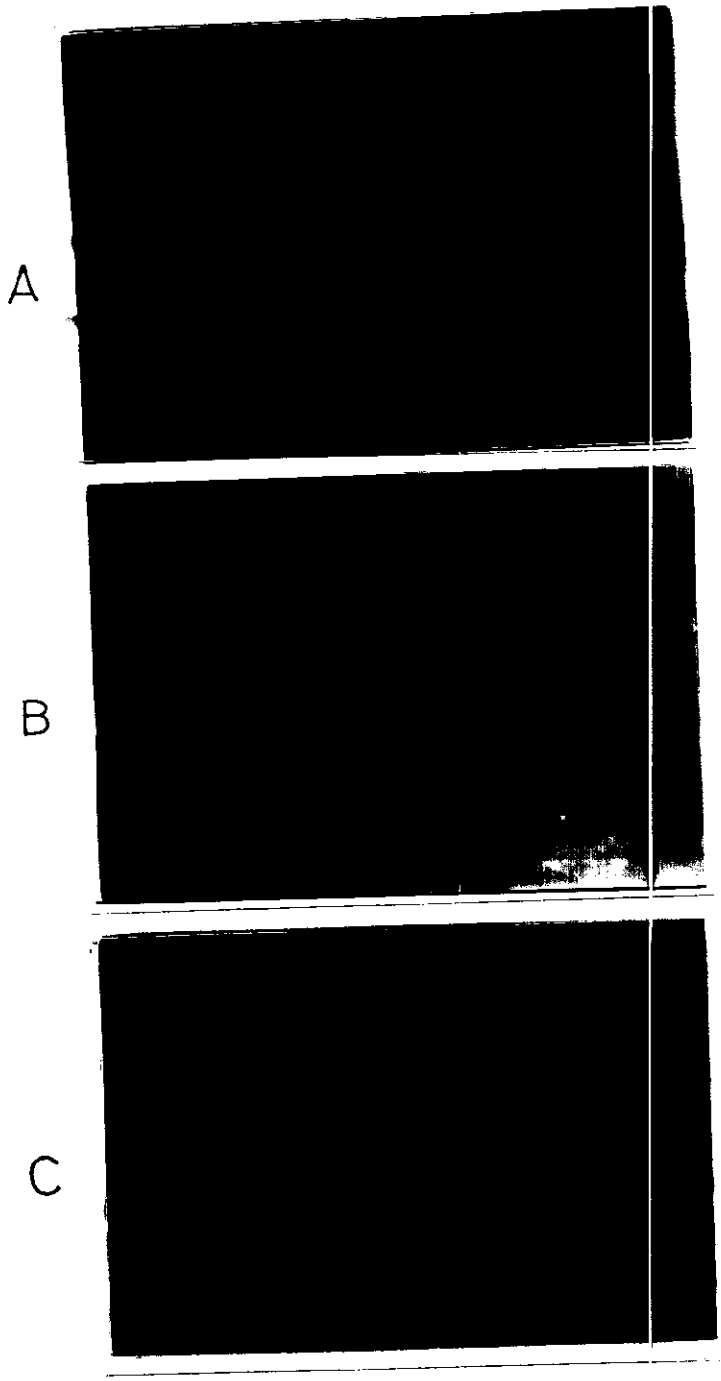


Figure (19):

(A) : Melanospora growing on the germinating embryo.

(B) : Enlarged mycellium and pericthecium of Melanospora sp.

(C) : Pericthecium of Melanospora and spores of Penicillium sp.

The effect of different fungicides on the infection of stored maize grains :

In this experiment healthy maize grains of two varieties i.e., Giza 2 and Double hybrid 186 were treated with fungicides as seed-dressing and artificially infested with spore suspension of each of the aforementioned fungi and stored for 60 days. Results as percentages of infected grains were estimated at the end of the experiment and tabulated in Table (15).

Fusarium moniliforme caused the highest damage to grains of both varieties Giza 2 and Double hybrid 186 .

On the other hand Nigrospora oryzae was more virulent to Double hybrid 186 variety, than to Giza 2.

Generally, it was found that treating the grains with fungicides reduced infection of the grains.

In this respect the best two fungicides in protecting maize grains were Captan and Tecto. However, it was clearly noticed that Rovral was the least effective fungicide in this respect.

Treating the grains after artificial infection by either Fusarium moniliforme or Nigrospora oryzae was more effective than the reverse which clearly ensure the importance of grain dressing before storage.

Table (15): Effect of different seed dressings on the percentage of infection of grains stored, for 60 days.

Treatments		Varieties	Giza- 2	Double-hybrid 186
Untreated grains (Control)			12	25
Infested by Fusarium moniliforme (untreated grains)			88	89
Infested by Nigrospora oryzae (untreated grains).			19	78
Treated by fungicides		Vitavax	0	11
		Vitavax/ Captan	0	1
		Captan	0	0
		Tecto	0	5
		Rovral	0	5
Treated by fungus then infested with fungicides	Fusarium moniliforme	Vitavax	31	30
		Vitavax/ Captan	22	95
		Captan	0	68
		Tecto	25	54
		Rovral	31	48
	Nigrospora oryzae	Vitavax	32	23
		Vitavax/ Captan	16	64
		Captan	4	23
		Tecto	2	72
		Rovral	75	72
Treated by fungicides then infested with fungus	Fusarium moniliforme	Vitavax	14	25
		Vitavax / Captan	1	2
		Captan	0	5
		Tecto	0	7
		Rovral	25	46
	Nigrospora oryzae	Vitavax	1	8
		Vitavax / Captan	0	3
		Captan	0	2
		Tecto	0	10
		Rovral	3	27
L.S.D.				

DISCUSSION

Aspergillus flavus, Alternaria tenuis, Fusarium oxysporum and Trichotecium roseum recorded high frequency of the total fungi isolated from maize grains stored for 9- 12 months when plated on PDA medium.

Concerning works of Mohamed and Fathi (1965), Fathi (1966), and Mohamed et al. (1967, 1968 a and 1968 b) belong princpaly to the field fungi carried by corn seeds and their significance as pathogens to the host plant. In case of storage, they reported that Fusarium moniliforme (Gibberella fujikuroi), Fusarium graminearum (Gibberella zeae), Cephalosporium sp. were the important fungi causing maize grains rot.

In this work, a survey carried out to detect the kind and frequency of occurrence of fungi associated with stored corn grains.

This survey led to the conclusion that Fusarium moniliforme on the grain samples collected from different localies except yellow American varieties on which the dominant fungus were Penicillium spp. As regards the locality the highest number of fungal spp. was isolated from samples collected from Menufiya followed by Giza, then Kalubia followed by yellow American varieties and lastly Sohage Governorate

These results are in conformance with the findings of Barron and Lichwardt (1959) who stated that when conditions are suitable, any grain associating fungi might have the major responsibility in its deterioration. It is more usual, however, for several fungi to be active as co-dominants in the majority of deterioration complexes.

Degree and percentage of pathogenicity occurring in healthy corn grains due to either Fusarium moniliforme or Nigrospora oryzae took place which indicated the ability of them in inducing disease in corn grains depending upon a lot of factors, i.e., moisture content, storage intervals, and the temperature of storage. It was found that the severity and percentage of pathogenicity increased by increasing the percentage of moisture in the grains. This is in full agreement with the fact that moisture is one of the primary determinants of spore germination and mycelial growth This is, in conformance with results reported by (Clayton (1942), Delp (1954), Gottlieb (1950), Siu (1951)). Also , Christensen and Linko (1963) who found that a relatively small difference in moisture content made a great difference in the rate of invasion of fungi in storage and the amount of damage done by these fungi.

Results indicate that increasing storage time is of great importance in increasing the ability of the tested fungi i.e. Fusarium moniliforme and Nigrospora oryzae to attack maize grains. This holds fairly good with Saur and Christensen (1968) who reported that decreasing grain germination by increasing storage intervals was due to invading grains by storage fungi.

As for the effect of different grain components on infection with either Fusarium moniliforme or Nigrospora oryzae, it could be concluded that the interaction between the factors, conditions on which the grains were stored in, did not seem to be a definite trend. But these environmental factors influenced the distribution of corn grain components especially the germ and hull. This finding is similar to those recorded by Qasem (1959), Qasem and Christensen (1960), Saur and Christensen (1969), Christensen (1972), Popov (1974), and Bothast et al. (1981).

The physiological state of the host may have an effect on the ability of the pathogens to attack it or on the extent to which a pathogen may harm it (Stroble and Mathre (1970). So, it is of importance to study the changes occuring in host metabolism when subjected to invasion by fungi. One of the substance reflict the activity in metabolism is oil.

Oil increase in grains was found to be associated with

infection by fungi, this may be explained as a result of tissue destruction by the pathogens which indicates that the pathogen possess's enzymes that decrease the structural components of the host (Stroble and Mathre 1970). Also, they added that intermediate break down products in the pathways of respiration, serve's as carbon skeletons for synthesis of important compounds such lipids. This is, the aerobic breakdown of carbohydrates requires oxygen where found that fungi enhance the uptake of oxygen which reflect in an increase of oil synthesis in corn grains. The other factors (moisture content percentage, temperature and storage intervals) grains subjected to did not seem to have a definite trend. The investigated mold fungi either Fusarium moniliforme or Nigrospora oryzae, could attack and hydrolyse corn oil and convert the fat into fatty acids and their hydrolytic efficiency was detected and it was found that Fusarium moniliforme is more active in this regard than Nigrospora oryzae, similar findings were obtained by Nagel and Semeniuk (1947), Goodman and Christensen (1952) and Abd El-Gawad (1968). It is clear from the results that fungi may differ in their capabilities of physiological activity in relation to environmental factors under which the grains were stored.

Fat acidity value could be used as an index of grain deterioration, where the fat acidity value (FAV) was associated with deterioration of corn grains by fungi. This was

true as grain invaded by either Fusarium moniliforme or Nigrospora oryzae. These results are in full agreement with the findings of Zeleny and Coleman (1938), which was later agreed by Goodman and Clyde (1952). The results show that this index was more clear in grains damaged by Fusarium moniliforme.

When a grain is diseased, many or all of its critical biochemical functions may be affected. Some of these functions include starch metabolism, respiration , sugar metabolism. Generally, at the culmination of compatible host parasite relationship, respiration is enhanced, there is a shift from the EMP pathway of glucose catabolism to pentose phosphate pathway and abarrent starch phenol metabolism may occur (Strobel and Mathre (1970). This could cast a light on the results indicating the increase in phenols in infected grains with Fusarium moniliforme and Nigrospora oryzae.

Results established that grain stored under conditions proper deterioration by mold fungi, i.e., Fusarium moniliforme and Nigrospora oryzae accompanied by increasing of reducing sugars. This could explain the fact that the mold fungi posses the enzymatic acitivity to attack sucrose, converting it to glucose and fructose and then absorbing glucose from the media, grain subjected to attacked to be

utilized in mycelial building up beside other activities (Tolba and Salama 1958). Parasites are able to induce quantitative changes in the normal constituents of grains (Storble and Mathre (1970). Also, results indicate that fungi differ in ability to derive reducing sugar may be due to a degree of enzymatic activities of the fungus.

Needless saying ,the presense of a negative correlation between non-reducing and reducing sugars when grains of corn were deteriorated by fungi. Results led to a marked decrease in non-reducing sugars in diseased grains as it match against non-infected corn grains. Similar results were reported by Bottomley et al. (1950) and Olafson et al. (1954). Results ensure that the catogery of the non-reducing sugar content of grains, may be a better indicator of moldines degree, and perhaps of over all deterioration, than fat acid value, (Zeleny 1954). This established the idea that the mold fungi had the enzymatic activities to attack sucrose, converting it to glucose and fructose (Tolba and Salama 1958).

The decreasing in total sugars of the grains associated with the infection by fungi compared to healthy ones could be explained on the base that carbohydrates are the main product (starch) to be used later when there is a demand for energy production. Intermediate breakdown

products in the pathways of respiration serve as carbon skeletons for synthsis of important compounds such as lipids and this explains the increase in fat in infected grains by both the tested fungi especially Nigrospora oyrzae.

Changes in the metabolic of phenols compounds in infacted grains have been observed. Since these changes have a direct bearing on the defense mechanism of the host. The attacked corn grain by fungi showed a marked increase in free phenols. These increase were parallel to the increase in moisture content in the grains and prolongating storage time. These results have the similar trend of findings of Goodman et al. (1967).

The increase in free phenols lead in turn, to decrease in conjugated phenols as shown in the results when grains were damaged by fungi. Ghosal et al. (1979) in their detection found that infection with Fusarium moniliforme increased the phenols content in maize plants. The results of total phenol produced in diseased grains are similar to those obtained by Radwan (1980), and indicate that total phenols was higher in diseased grains by fungi compared to healthy ones.

In respect of the role of proteins in plant tissues, Tanaka and Katsuki (1953), Rubin and Artsikhovskaya (1963), Gangopadhyay and Wyllie (1973) and Mostafa (1980) indicated that in diseased plants proteins may be synthesized by the fungus itself with the development of the infection and the increase in its mycelium.

Results in this study indicated that the amount of protein increased with the development of infection in maize grains.

It is of importance to protect corn grains from damaging by fungi by treating the grains by chemical compounds fungi, due to their composition. Howevers the best fungicides were captan and tecto especially before storage. These results are in agreement with Mohamed et al. (1968) and Moreno and Vidal (1981).