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RELATIVE RESISTANCE OF SOME MAIZE CULTIVARS TO *Sitophilus zeamais* (MOTSCH.) AND *Sitotroga cerealella*(OLIV.) IN STORAGE.

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ABSTRACT

The degree of feeding resistance by *Sitotroga cerealella*, oliv.(lepidoptera) and *Sitophilus zeamais* Motsch.(coleoptera),to four Egyptian maize cultivars; Sweet grain sorghum, Triple hybrids 321, Giza 2 and Single hybrids 10 planted in two different dates was studied. The total number of emerged adults of both insect species, difference in weight loss of infested grains and percentage of grain viability, in the four cultivars,are found significant. Moreover mean weight of both emerged insects and their faeces are seperately recorded. Also,weight as well as amount of consumed and digested food by emerged insects are calculated. The result indicte that the varitey Giza 2 is the most resistant one for insect infestation.

There is a good correlation between rate of insect growth, rate of digestability, efficiency of conversion of ingested food to body matter(ECI) and also efficiency of conversion of digested food to body matter (ECD).

SDS- protein electrophoresis analysis proves that each cultivar has an Unique Band (UB) which can be used as biochemical marker to discriminate among them. .

INTRODUCTION

Egypt is suffering from substantial losses in agricultural production of cereal crops which mainly attributed to pest infestation .From an economic view point, maize is one of the most important crops and is considered staple food for majority of the Egyption farmers.

In storage maize is found to be attacked by several important cosmopolitan pests causing variable losses depending upon the period of storage (Pantenius, 1988; Markham *et al.* 1991;Kumar,2002 and recently Salama and Youssef (2004). The *S. zeamais* is found to cause heavy damage, loss in seed weight and reduce the seed viability of these hybrids under storage conditions,(Kurdikeri *et al.* 1993).

The laboratory assessment of the inherent susceptibility of some maize varieties to post –harvest insect infestation was investigated Salama and Youssef (2004).However it is found,rather fruitful to investigate some more important points in relation to susceptibility/ resistance to the same maize cultivars to post harvest insect infestation in new season.

MATERIALS AND METHODS

Estimation of damage caused by insect infestation:

Four maize cultivars: Sweet grain sorghum, Triple hybrids 321, Giza 2 and Single hybrids 10, collected in two planting dates (24th April and 28th May (2002)from experimental fields at Shalakan,Qualyubyia

Governorate.They were then stored under laboratory conditions (28±2°C and 70±5% RH) till adult emergence of the natural field infestation of the grains before storage.

From each variety, several replicates of maize grains were weight and placed in 500 cc clean glass jars . After one month , three replicates from each variety were externally examined for exit for holes counting the emerging adult species, and the grains were sieved to remove dust and frass then weighed. The percentage loss in grain weight was determined following equation:

$$\% \text{ weight loss} = (IW - FW) \times 100 / IW$$

where IW is the initial weight and FW is the final weight of tested grains.Mean number and weight of immerged insects as well as their faeces weight were recorded.

Germination tests were carried out according to International Standard Methods (ISM), (Anonymus, 1966). One hundered maize grains from each cultivar were placed in plastic trays divided into 100 sections (5 x 5 cm) containing continually moistened sandy soil.After about two weeks the number of germinated grains were recorded. The experiments were replicated three times.Furthermore, weight as well as amounts of consumed and digested food by emerged insects were calculated following the methods applied by (Mcfarlane,1985).

Statistical analysis

All data collected were subjected to statistical analysis without transformation using two way analysis of variance (ANOVA). The means were separated using the least significant Difference test (LSD).

Determination of protein fractions

Protein fractions according to their molecular weight was performed using polyacrylamide gel electrophoresis (PAGE) in the presence of sodium dodecyl sulphate (SDS) as described by Laemmli (1970) and modified by Studier (1973).

RESULTS AND DISCUSSION

Effect of maize cultivars on insect infestation:

Insect infestation in maize grains in the two planting dates and stored from one and four months are shown in Table (1). Two insect genera are only detected; *Sitotroga cerealella* Oliv. (Lepidoptera), and *Sitophilus zeamais* Mots. (Coleoptera). Considering the total numbers of both insects, it is found that Giza 2 is the least infested followed by single hybrids 10,triple hybrids321 and the most sensitive sweet grain sorghum in both April &May, stored for one month. Moreover, in April,triple hybrids321 is found to be most favourable variety to lepidopterans than coleopterans while it is vise versa with the other varieties.In May,however,coleopterans are more than lepidopterans in all cases see(Table 1).

Table 1. Percentage germination, weight of 300 grains, number of Lepidopteran and Coleopteran insects obtained from four maize varieties, planted in two dates.

Planting date	Cultivars	Weight of 300 grains	Reduction of Germination	Sample weight (gm)	Insect Infestation								
					After one month			After four month of storage					
					Mean No. of lepido.	Mean No. of Coleo.	Total	Mean No. of Lepido.	Mean No. of Coleo.	Total	% Infestation (100grains)	Grains weight	% weight loss
24/4/2001	Sweet grain sorghum	8.19	77.42	228.0	8.4	10.7	19.1	0.0	151.0	151.0	19.50	179.14	21.43
	Triplehybrids 321	99.95	60.87	212.93	12.5	6.2	18.7	72.0	53.6	125.6	18.0	193.67	9.05
	Giza 2	104.24	51.25	149.06	0.1	0.6	0.7	6.1	7.0	13.1	8.07	143.99	3.40
	Single hybrids 10	104.24	29.31	190.43	0.0	2.5	2.5	8.6	7.5	16.1	8.23	166.61	12.51
28/5/2001	Sweet grain sorghum	4.96	61.22	150.0	3.9	5.9	9.8	0.0	139.9	139.9	21.40	123.78	17.48
	Triplehybrids 321	80.39	92.31	202.69	0.0	5.2	5.2	1.3	36.8	38.1	34.0	182.30	10.06
	Giza 2	108.94	39.29	150.71	0.0	0.5	0.5	8.1	4.8	12.9	7.73	142.14	5.69
	Single hybrids 10	93.07	56.586	179.39	0.0	1.0	1.0	0.0	54.5	54.5	30.5	168.79	15.91

Number of insects emerged after four months:

1st planting date 24 April:

"F" between Lepidopteran insect =5.4641 (Significant) LSD = 28.1931

"F" between Coleopteran insect = 12.4511 (significant) LSD = 11.7641

2nd planting date 28 May:

"F" between Lepidopteron insects = 7.5100 (significant) LSD = 11.8750

"F" betwent Coleoptera insect = 13.5670(significant) LSD = 29.6971

After storage for four months,it is also found that Giza 2 is most resistant to infestation by both Lepidopterans and Coleopterans and variety sweet grain sorghum is the most sensitive one .The total numbers of infestation are 13.1,16.1,125.6 and 151.0 in Giza 2,single hybrids10, triple hybrids321 and sweet grain sorghum, respectively (Table 1). The weight of grains is also affected and the weight loss of Giza 2grains , is only reduced to 3.40 % and 5.69% for April and May plantation,respectively. While in sweet grain sorghum the percentage of weight losses are 17. 48 and 21.43 in both dates respectively. (Table 1).There is a good correlation between grain weight loss and number of emerged insects.

The above results confirm the findings of Salama and Youssef 2004,however,the present study shows that sweet grain sorghum is the most sensitive variety while salama &youssef 2004 proved that triple hybrids 321 was most susciptable one .

In the present work,also ,evidences indicate extensive feeding and reproduction of the insects on the susceptible cultivars. Kossou *et al.* (1993) and Vowotor *et al.* (1995) suggested that maize variety had a significant effect on egg incubation, mean duration,and weights of the developmental stages of *S. zeamais* and the site of weevil emergence from the kernel. Barney *et al.* (1991) and De and Sarup (1991) reported that resistance in stored maize varieties to the same weevil was believed to be related to the chemical composition of the grains.

The difference in weight loss of grains due to insect infestation is significant in the four cultivars considered. The percentage of grain viability (detected as percent germination) is also significant. In both dates of cultivation, Giza 2 give the highest viability, because, those grains do not provide an optimum niche for insect to feed and produce as freely as on the other tested cultivars.This is in agreement with the results obtained by salama &youssef (2004).

Utilization of maize cultivars as food by insect infestation :

Table 2 shows some physiological parameters:

(a)Rate of insects growth:Data indicate that the rate of growth loss of Giza 2 grains,is only reduced to 25.30% and25.00%for April and May plantation, resp.The losses range from 43.3%to 84.78% and 40.10%to 86.21% for both april and may plantation,respectively .for the other three cultivars.(Table 2)

Table2:Rate of insects growth,Rate of digestability and Efficiency of conversion of ingested and digested food to body matter (ECI),(ECD)to insects obtained from four maize varities, planted in two dates

Planting Date	Cultivars	Mean n. of insect emergence	Mean weight of insect (gm)	Mean weight of faces ,dust and frass (gm)	Rate of growth (%)	Rate digestability (%)	Efficiency of conversion ingested food to body matter (ECI) (%)	Efficiency of conversion digested food to body matter (ECD) (%)	Efficiency of conversion of digested food to energy (%)
24/4/2001	Sweet grain (sorghum)	170.1	0.8478	6.2799	84.78	87.15	3.74	4.99	95.01
	Triple hybrids 321	144.3	0.7190	4.5790	71.90	76.23	6.33	8.30	91.7
	Giza 2	19.6	0.2530	3.9130	25.30	54.39	2.09	2.47	97.53
	Single hybrids 10	16.8	0.4330	3.8230	43.30	83.95	3.82	8.17	91.83
28/5/2001	Sweet grain (sorghum)	149.7	0.8621	4.8180	86.21	81.63	3.29	4.03	95.97
	Triple hybrids 321	39.1	0.7611	5.0560	76.11	75.20	7.88	10.47	89.53
	Giza 2	13.4	0.2500	3.6400	25.00	53.69	2.18	2.92	97.08
	Single hybrids 10	59.7	0.4010	5.6610	40.10	86.59	3.78	8.12	91.88

(b)Food Digestion and Digestability:

The rate of Digestability loss of Giza2 grains,is only reduced to 54.39% and 53.69% for April and May plantation,respectively.,while the losses ranged from 76.23% to 87.15%and 75.20%to86.59%for both april and may plantation,resp.,for the other three cultivars(Table2).

(c)Efficiency of conversion of ingested food to body matter(ECI):

The Efficiency of conversion of ingested food to body matter ofGiza 2 grains,is only reduced to 2.09% and 2.18% in April and May plantation,respectively.,however,the losses range from 3.74% to 6.33% and 3.29% to 7.88% for both April and May plantation, respectively.,for the other three cultivars(Table2).

(d) Efficiency of conversion of digested food to body matter(ECD):

The percentage of (ECD)oF Giza2 grains,is only reduced to 2.47 to 2.92 for April and May plantation, resp.,while the losses in both April and May plantation ranged from 4.99% to 8.30% and 4.03% to 10.47%,respectively,for the other three cultivars.

The above evidences confirm that Giza2 cultivar is the most resistant cultivar for insect infestation . Based on these parameters, Kurdikeri *et al.* 1993 maintained that hybrid Ganga safed 2 was found to be the most tolerant to *S. zeamais* while other hybrids were highly susceptible. There is a good correlation between rate of insect growth, rate of digestability,efficiency of conversion of ingested & digested food,ECI&EDC to body matter.Basant *et al.* 1998,observed the effect of different maize varieties on the growth and development of *S. zeamais* under laboratory conditions.The lowest number of eggs was laid on maize varieties Ganga 5 and Sartaj,which posses hard covers, and emergence of adult weevils was found maximum in Harsa and minimum in prabhat(Table2).

SDS-protein electrophoresis:

In 1996, Santos *et al.* ,maintained that quality protein maize(QPM)is a new type of maize with altered protein composition,offering new prospects in human nutrition,but it is necessary to improve the genetic resistance of this maize to the stored products insect *S. zeamais*.

The buffer soluble proteins extracted from grains of the four tested cultivars were analyzed by sodium dodecyl sulphate-polyacrylamide gel electrophoresis (SDS-PAGE). As it was found by (Salama&Youssef 2004) evidences in the present study, though in different season, prove that a total of 36 bands are also characterized in the four maize cultivars and have different relative mobilities (Rm),and different molecular weights (MW) .Also Each cultivar has an unique band(s) (UB) which could be used as a specific biochemical marker. Giza 2, the most resistant,shows lower number of bands while it has a UB with Rm of 0.251and a MW of 142.20 KDa which is not found in any of the other cultivars.. The sensitive cultivar Sweet grain sorghum in this study also shows an absence of two bands with MW of 270.46 and 265.67 KDa and presence of two bands with MW of 39.44 and 27.54 KDa,(Fig.1) These results are also, in agreement with (Abdel-Tawab *et al.* 2001 and 2002).

Generally, these observations would indicate that some bands in the sensitive cultivars are not indicated in tolerant one. On the other hand, the most tolerant cultivar Giza 2 shows a new band which is not found in any of the sensitive cultivars. These protein profile differences can be used as an indicator for susceptibility in maize cultivars against insect infestation.

With regard to the date of cultivation, the four cultivars showed slight differences among the 1st and the 2nd plantation dates.

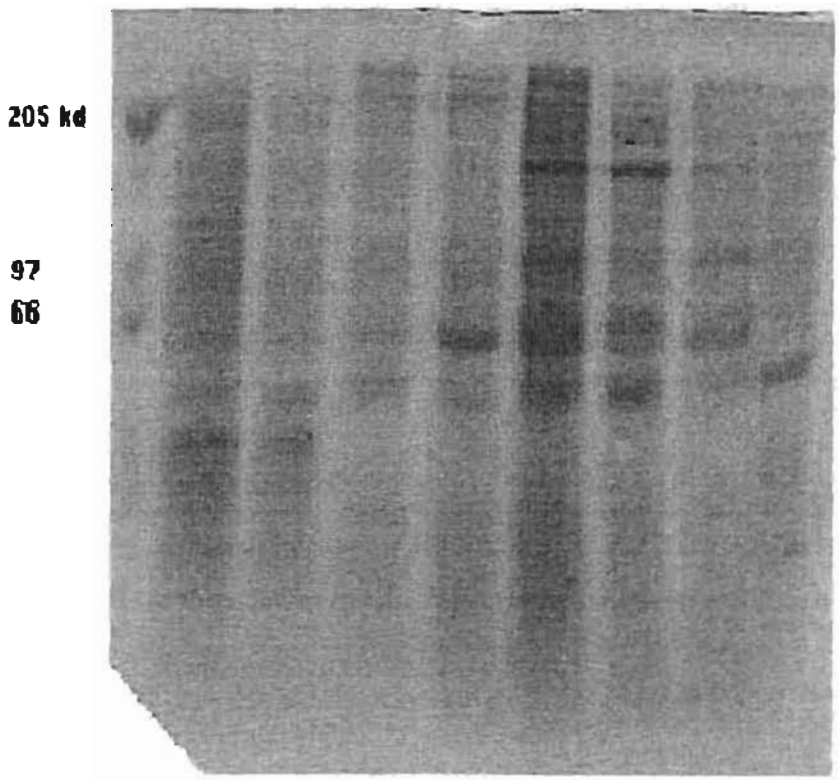

Fig. (1): SDS-PAGE profiles of total proteins of the four tested maize cultivars planted in two different dates arranged from left to right:

1, Standard Marker
2,3 Sweet grain sorghum — 1st and 2nd planting date
4,5 Triple hybrids 321 — 1st and 2nd planting date
6,7 Giza 2 — 1st and 2nd planting date
8, 9 single hybrids 10 — 1st and 2nd planting date

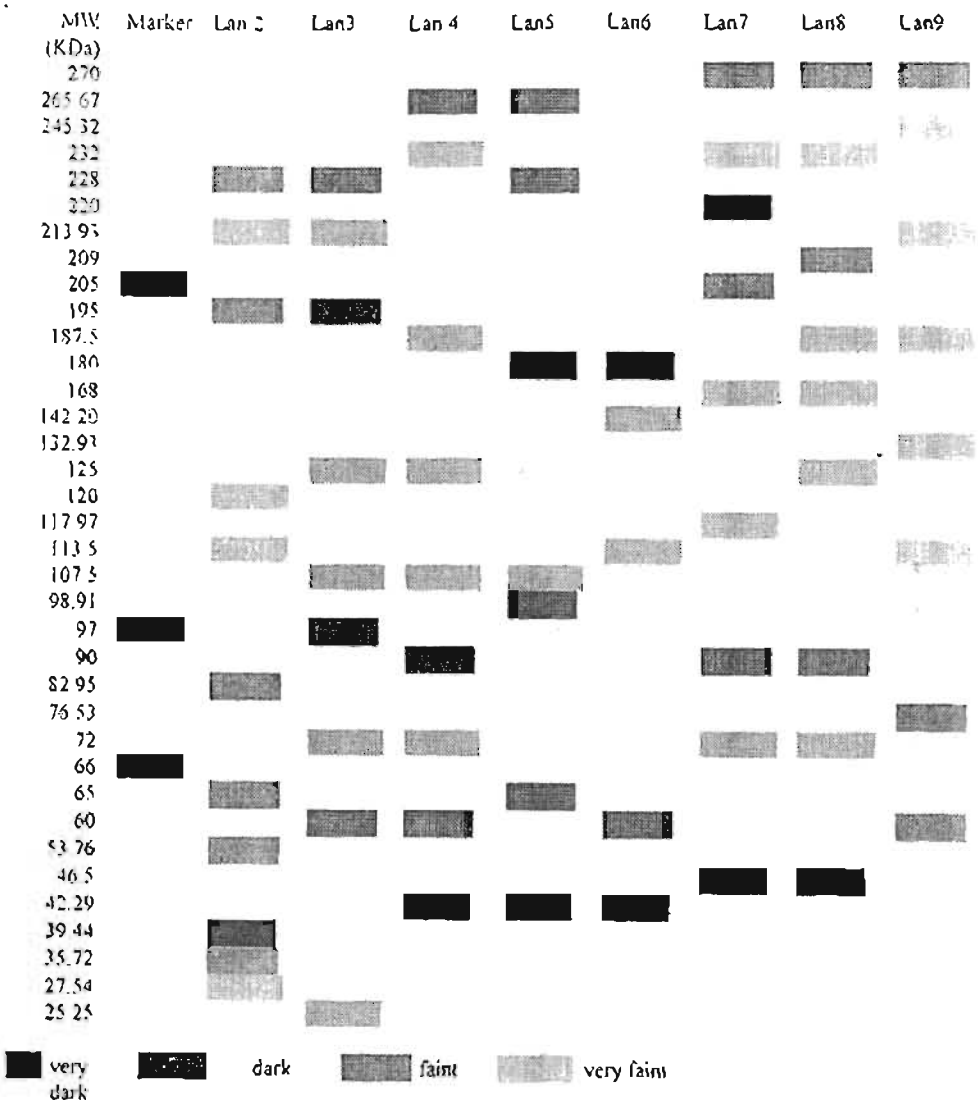

Table (3): Gel documentation analysis data of SDS-PAGE for total proteins of of thefour test ed Maize cultivars planted in two different dates aranged from left to right.

1. Standard Marker	
2,3 Sweet grain sorghum	1st and 2nd planting date
4,5 Triple hybrids 321	1st and 2nd planting date
6,7 Giza 2	1st and 2nd planting date
8, 9 single hybrids 10	1st and 2nd planting date

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المقاومة النسبية لبعض أصناف الذرة لحشرتى فراشة الحبوب وسوسة الذرة عند التخزين

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فى هذه الدراسة تم تقدير درجات مقاومة مختلفة عند تغذية حشرتى فراشة الحبوب من رتبة حرشفية الاجنحة وسوسة الذرة من رتبة غمدية الاجنحة على اربعة اصناف من الذرة المصرية وهى: الذرة السكرية – الذرة هجين ثلاثى ٣٢١- الذرة جيزة ٢- الذرة هجين فردى ١٠ عند التخزين والتى تم زراعتها في ميعادين ٢٤ أبريل و ٢٨ مايو خلال موسم عام 2002 اظهرت النتائج ان الصنف جيزة ٢هو اقل الاصناف اصابة بالحشرتين خلال الزراعة فى الميعادين المذكورين –كما وجدت فروق معنوية بين الاصناف الاربعة من حيث حساسيتها للإصابة بالحشرات وكذلك الفقد فى وزن الحبوب ونسبة انباتها.كما أظهر الصنف جيزة ٢ ايضا قدرة على خفض معدل نمو الحشرات عند التغذية عالية فى كلا الميعادين وكذلك قدرة على خفض معدل الهضم التقريبى وكذلك قدرة للحشرات على تحويل الغذاء المتناول والمهضوم الى مكونات جسمية .وعلى تحويل الغذاء المهضوم الى طاقة عالية جدا.وبالتحليل الكهربى لبروتينات الاحماض الامينية تحت الاختبار لمكن الحصول على فروق فى ترتيب الاحماض الامينية تبعا لوزنها الجزيئ مما يمكن معه التمييز بين الاصناف ومدى قابليتها للاصابة .