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COMBINED EFFECT OF BIO-ORGANO-FERTILIZATION AT DIFFERENT N-LEVELS ON: 2-THE DEGREE OF INSECT INFESTATION BY *Sitophilus oryzae* L. AND *Rhizopertha dominica F.*

Zein, F.I.* and R.B. Abo-Arab**

*** Soil, Water and Environment Research Inst. Agric., Res. Center, Egypt**

**** Dept. of Stored Product Pests., Inst. of Plant Protection, Agric. Res. Center, Egypt**

ABSTRACT

Laboratory experiments were carried out to study the degree of infestation by *Sitophilus oryzae* and *Rhizopertha dominica* on two wheat varieties, Sakha 8 and Sakha 92 priorly treated in the filed with bio-organo- fertilizers [Azotobacter inoculation (of grains) and/or farmyard manure (FYM) treatments (1% by weight)] under three levels of nitrogen fertilization (20%, 60% and 100% of recommended N dose, 70 kg N/fed), during 1997/98 and 1998/99 seasons.

The obtained results showed that the degree of infestation and the mean of emerged adults of *S. oryza* affected by the variety of wheat grain. On the other side, wheat variety had no effect on the mentioned parameters of *Rhizopertha dominica*.

There were significant effect on the degree of infestation and the number of progeny of both *S. oryzae* and *R. dominica* as a result of different levels of nitrogen fertilization and combination of bio-organofertilizers on both tested varieties of wheat, Sakha 8 and Sakha 92. *R. dominica* caused the highest infestation on both wheat varieties, comparing with *S. oryzae*.

These findings show that the level and the kind of fertilizer had some effect on the degree of infestation and number of progeny of the two tested insects for the two used wheat varieties. Further studies are needed to assure these findings.

INTRODUCTION

Wheat is considered as one of the main cereal crops in Egypt. Great efforts were made for increasing its yield and improving its quality. Many research workers studied its nutritional requirements, where they found that chemical composition and technological characters responsed to the different levels and the kind of chemical and biofertilizers (Balba, 1968; Lavoy and Hgeman, 1970; Ghanbari and Mamessh, 1971; Loneragan and Chaudhry, 1971 and Youssef and Salem, 1976. The relationship between insect infestation and chemical composition of grains was investigated by many authors, Caswell, 1961; Prevetts, 1961; Koura *et al.,* 1971; Bato and Sanchez, 1972; El-Banby *et al.*, 1985; Warchalewski *et al.,* 1993 and Irshad *et al.,* 1988.

Wherever grain is stored, it is subject to infestation by different insect pests. Main four species which cause most of the damage to grain in storage are; the granary weevil (*Sitophilus granarius* L., the rice weevil (*Sitophilus oryzae* L.), the lesser grain borer (*Rhizopertha dominica* F.) and the Angoumois grain moth (*Sitotroga cerealella* Olive) (El-Nahal *et al.,* 1982

and Daglish *et al.,* 1996). The future directions for research related to stored product insects and mites should include studying the detailed interactions in ecosystems in both the laboratory and the field and it should be broaden our boundaries of stored product ecosystems for a more complete understanding of pest activity (Noel, 1995). The information gained from this study could be important for avoiding the miss or over use of different fertilizers which would lead to produce more susceptible wheat grain varieties to infestation with the two tested insects (*S. oryzae* and *R. dominica*). So, as a first step in this line of research, the goals of the present work were: to study the effect of different levels of nitrogen and bio-organo-fertilizers applied to two wheat varieties in the field on the degree of infestation with *S. oryzae* and *R. dominica* in lab. The work also, involved the study of change in the chemical composition and its relation to the degree of infestation with the mentioned insects.

MATERIALS AND METHODS

Field experiments were carried out at Sakha Agric. Res. Station during 1997/98 and 1998/99 seasons. They aimed to study the combined effect of biological fertilization: Azotobacter inoculation (of grains) and/or farmyard manure (FYM) treatments (1% by weight), added at the first season 1997/98 only, at three levels of nitrogen fertilizer (20, 60 and 100% of the recommended N dose; 70 kg N/fed.) on grain and straw yields, grain quality, viability and α-amylase activity. Two wheat varieties Sakha 8 and Sakha 91 were chosen for the study.

All experimental units were dressed with P by 30 kg P_2O_5/fed. as superphosphate and K by 15 kg of K_2O as potassium sulphate. Nitrogen fertilizer was dressed with N by 14 kg N/fed. (20% recommended; 70 kg N/fed) at planting for all plots, the second dose by 28 kg N/fed; 40% of recommended, at tellering for plots of N_2 and N_3 treatments and the rest of recommended; 28 kg N/fed. was dressed at potting stage for plots of N_3 treatment.

The soil samples of experimental location are collected. Chemical and physical properties of the soil surface layer (0-30 cm) are presented in Table (1) and some chemical characteristics of applied farmyard manure are illustrated in Table (2).

Table (1): Some chemical and physical properties of the surface layer (0-30 cm) of the soil.

ECe	Soluble cations meq/L				Soluble anions meq/L				SAR	Soil pH 1: 2.5	OM %	Total $CaCO_3$ %	Available nutrients mg/kg			Clay, %	Silt %	Sand %	Texture %
DS/m	Na^+	K^+	Ca^{++}	Mg^{++}	$CO^{=}_3$	HCO_3	Cl^-	$SO^{=}_4$					N	P	K				
4.65	26.2	1.0	16.7	7.3	0.6	4.1	21.6	24.9	7.57	8.1	1.86	2.29	48.9	28.3	197	57.8	21.77	20.43	Clayey

Table (2): Some chemical characteristics of applied farmyard manure

EC dS/m 1: 10 ext.	pH 1: 10 ext.	Organic carbon	Total N (%)	Total P %	Total K (%)	Available P (ppm)	C/N Ratio
1.85	7.6	32.68	1.65	0.69	1.49	389	19.81

All collected data were subjected to the usual technique of analysis of variance (ANOVA) for the split-split plot design in four replicates as mentioned by Steel and Torrie (1980). Statistical analysis was carried out using IRRISTAT Software version 3/93 (Biometric Unit International Rice Research Institute, Manila, Philippine). Duncan's (1955) multiple range test was used to compare means at 0.05 level of probability.

The wheat cultivar (Sakha 61) was used for rearing the rice weevil, *S. oryzae* L. and the lesser grain borer, *R. dominica* F. under laboratory conditions at 25 $\pm$ 5°C and 65 $\pm$ 5% RH.

2. Susceptibility and preferability to infestation:

Two experiments were conducted as following:

a. For each trial, 25 insects (2-3 weeks old) were placed into a 250 ml glass jar containing 50 g of Sakha 8 and Sakha 92 wheat grains (4 replicates for each variety). A cheese cloth was used to cover the jar tops. The parent adults were removed after 20 days of infestation. Emergence off-spring was observed 7 weeks after initial infestation and emerging adults were removed on alternate days until emergence was completed within 60 days (Ivbijaro *et al.,* 1985). The number of emerging adults was used as an indicator for the susceptibility of tested wheat varieties to infestation with *S. oryzae* and *R. dominica*.
b. To study the preferable wheat treatments for tested insects, four separate choice chambers (4 replicates) for both tested wheat cultivars were made using glass jars (60 x 60 x 20 cm in height) covered with a lid. Number of petri dishes (9 cm dia.) according to the number of treatments each contains 50 g of tested wheat varieties were placed into the jar. Nine hundreds unsexed adults of both *S. oryzae* and *R. dominica* (2-3 weeks old) were released in each test chamber to give the insects a free choice to mating and oviposit on any treatment. When emergence of offspring from the wheat seeds that had been infested was completed in 60 days, damage to seeds was assessed by the number of exit holes observed in each 50 g. grain. The percent of damage was used as an indicator for the preferability of tested wheat varieties for *S. oryzae* and *R. dominica.* The two experiments were conducted under the same conditions of insect rearing.

3. Chemical composition of grains:

The chemical analysis of grains was carried out, the percentage of crude protein, ether extract, ash, crude fiber and nitrogen free extract (NFE) content were determined according to the procedures outlined in AOAC (1990).

An analysis of variance, Duncan's multiple range test (1955) and simple correlation coefficients were calculated.

RESULTS AND DISCUSSION

Results in Table (3) indicated that the degree of infestation and mean of emerged adults of *S. oryzae* were highly affected by the variety of wheat grain. On the other side, the variety of wheat grain had no effect on the same mentioned parameters of *R. dominica*. There were significant differences between the degree of damage and/or the numbers of adults emerged for *S. oryzae* and *R. dominica* at the different levels of nitrogen fertilizer. At the different nitrogen fertilizer levels there was a significant effect on the mean number of emergence progeny and the level of infestation of both *S. oryzae* and *R. dominica* as a result of wheat varieties. Results also clearly showed that the bio-organo-fertilizer had highly significant effect on the tested parameters of both *S. oryzae* and *R. dominica* (Table 3). When the bio-organo fertilizer was combined with nitrogen one, highly significant differences were found between the two wheat varieties Sakha 8 and Sakha 92 for the percentages of damage and the number of emergence of both tested insects.

Table (3): Analysis of variance for the number of offspring and percentages of damage by *S. oryzae* (S.O) and *Rhizopertha dominica* (R.D.) in the tested wheat grains.

		MS			
S.V	d.F	S.O		R.D.	
		N. offspring	% infestation	N. Offspring	% infestation
Rep. (R)	3	0.916667	0.2039264	5.67540	1.775414
Varieties (V)	1	804.115267**	22.0225042**	20.80413	1.960817
Error (a)	3	6.250000	0.0479153	5.13041	1.012775
N level (N)	2	216.365804**	5.5312760**	224.62550**	124.323950**
V x N	2	43.081154*	5.5379698**	1968.67256**	187.912717**
Error (b)	12	7.247396	0.1208688	7.92471	3.269165
Organ level (O)	3	61.141622**	5.6059819**	55.26658**	14.345128**
V x O	3	94.879711**	15.7361486**	618.29415**	66.352283**
N x O	6	246.532610**	18.1064788**	203.57841**	30.943194**
V x N x O	6	85.541849**	8.1291142**	691.80109**	43.103250**
Error (c)	54	6.806134	0.1555981	3.93157	2.735753

Number of offspring = Number of offspring.

Susceptibility and preferability of infestation:

Data in Table (4) indicated that Sakha 8 wheat seeds were more susceptible for insect infestation than Sakha 92 with 5.63 and 4.29% damage and 27.06 & 23.11 number of offspring by ***S. oryzae*** on both varieties, respectively at N_1 level. At N_2 and N_3 levels, percent of damage and number of offspring (number of offspring) for both varieties had the same trend. Generally, the percentage of damage and number of offspring of *S. oryzae* at N_1 level were the highest among the three levels of N fertilizer.

Over all mean showed that Sakha 8 wheat grain was 1.24 and 1.29 time more than Sakha 92 wheat grain for percent of damage and number of offspring, respectively. For *R. dominica* Table (5) showed that the highest

insect infestation was found at the second level of N fertilizer, where the percent of damage and number of offspring were 9.54 and 25.68, respectively as averages on the two wheat varieties. At the third level of N. fertilizer Sakha 92 wheat variety was more susceptible for insect infestation than Sakha 8 wheat grain. Data in Table (5) showed that Sakha 8 wheat variety was 1.04 time more than Sakha 92 in respect the percent of damage and number of offspring at all levels of N fertilizer on both varieties. Results also indicated that the differences between control and treatments for insect infestation by the two insect species had no fixed direction, where there was a flactuation between treatments and control in this respect. Highly significant negative correlation was found between (CP) and the number of offspring of *S. oryzae* (r = - 0.568**), while a significant positive correlation was found between NFE and the number of offspring (r = 0.480*) Table (6).

Table (4): Interaction between wheat varieties, nitrogen and bio-organo- fertilizers as means for % damage and number of offspring of *S. oryzae*.

Organ level	Varieties (V)			
	Sakha 8		Sakha 92	
	% damage	Number of offspring	% damage	Number of offspring
$N = N_1$				
Cont.	4.76 c	21.98 c	2.97 c	18.30 c
A	4.75 c	21.75 c	3.43 c	20.88 c
O	5.71 b	26.75 b	6.78 a	28.63 a
AO	7.28 a	37.75 a	3.99 b	24.63 b
Mean	5.63	27.06	4.29	23.11
$N = N_2$				
Cont.	4.6 ab	26.84 b	3.88 ab	20.90 b
A	6.31 a	36.25 a	5.41 a	25.88 a
O	3.82 ab	21.63 c	5.12 a	20.25 b
AO	2.12 b	18.88 d	2.41 b	16.50 c
Mean	4.21	25.83	4.21	20.88
$N = N_3$				
Cont.	9.80 a	29.20 a	2.35 b	12.37 b
A	7.09 a	29.00 a	3.82 ab	14.25 b
O	2.23 b	16.25 c	2.89 ab	14.75 b
AO	3.04 b	22.25 b	4.96 a	21.75 a
Mean	5.04	24.18	3.51	15.78
Mean overall	4.96	25.71	4.00	19.92

In each column, means followed by a common letter are not significantly different at the 5% level according to DMRT.
Where : A=Azotobacter, O=Farmyard manure, AO=Azotobacter + Farmyard manure.

Data in Table (6) also indicated that except for CP and NFE with the number of offspring of *S. oryzae* there was no significant correlation between the other tested parameters and both of infestation percentages and offspring number with the two tested insect species on the two wheat varieties. Results in Table (6) also, showed that there was a positive correlation between damage percentage and number of offspring at all tested parameters for *S. oryzae* and *R. dominica* on Sakha 8 and Sakha 92 wheat

varieties. There were negative correlations between DM and both of damage percentage and offspring number for *S. oryzae* and between CF and the insect infestation for the two insect species on both wheat varieties but these correlations were not significant. Finally, results in Table (7) indicated that there were significant differences between *S. oryzae* and *R. dominica* concerning the degree of infestation and the number of offspring on both wheat varieties, in other words, *R. dominica* caused the highest infestation on both wheat varieties. These findings are in agreement with those obtained by Chunni and Singh (1996) who evaluated 64 wheat varieties for resistance to rice weevil *S. oryzae* using no-choice progeny tests. They found that the susceptibility to rice weevil was found to be correlated positively with grain size and negatively with hardness, crude fibre and protein contents of the grains. Hassouna and Hassanein (1996) found that inoculation of Egyptian wheat varieties with a mixture of azotobacters in the form of powdered broth (HALEX) significantly increased grain and straw yield, as well as total nitrogen of grain and straw. In many other experiments, the increase percent in nitrogen in wheat tissues by azotobacter inoculation was reported by Madkour, 1972; Mahmoud *et al.,* 1982; Zambre *et al.,* 1984; Madkour *et al.,* 1987 and Sobh *et al.,* 1987.

Table (5): Interaction between wheat varieties, nitrogen and bio-organo-fertilizers as means for the percentage of damage and number of offspring of *R. dominica*.

Organ Level	Varieties (V)			
	Sakha 8		Sakha 92	
	% damage	Number of offspring	% damage	Number of offspring
$N = N_1$				
Cont.	5.90 bc	19.50 c	3.80 b	14.00 c
A	6.75 b	27.00 b	3.00 b	12.00 c
O	9.50 a	38.00 a	5.00 b	20.00 b
AO	4.25 c	13.00 d	8.50 a	24.00 a
Mean	6.60	24.38	5.08	17.50
$N = N_2$				
Cont.	12.16 b	33.25 b	6.60 b	19.14 b
A	11.00 b	30.00 c	13.75 a	24.00 a
O	8.75 c	23.00 d	2.75 c	16.00 c
AO	15.01 a	42.00 a	6.25 b	18.00 bc
Mean	11.73	32.06	7.34	19.29
$N = N_3$				
Cont.	6.62 b	20.21 b	10.61 b	26.17 c
A	2.00 c	3.00 d	15.00 a	51.00 a
O	9.50 a	30.53 a	8.00 c	15.00 d
AO	7.25 b	14.00 c	12.00 b	43.00 b
Mean	6.34	16.94	11.40	33.79
Mean overall	8.22	24.46	7.94	23.53

In each column, means followed by a common letter are not significantly different at the 5% level according to DMRT.
A=Azotobacter, O=Farmyard manure, AO=Azotobacter + Farmyard manure.

Table (6): Simple correlation matrix for several parameters of two wheat varieties related to percent of damage and number of offspring.

Insect	Parameter	DM	C.P.	E.E	Ash	C.F	NFE
S. oryzae	% damage	-0.056	-0.378	0.024	0.315	-0.107	0.321
	Number of offspring	-0.075	-0.568**	0.071	0.288	-0.090	0.480*
R. dominica	% damage	0.185	0.248	0.139	0.079	-0.119	-0.198
	Number of offspring	0.069	0.120	0.215	0.137	-0.249	-0.075

Table (7): Percentage of infestation and number of offspring for *S. oryzae* and *R. dominica* on the two tested wheat varieties as overall means.

Insect	% damage	Number of offspring
S. oryzae	4.48	22.82
R. dominica	8.08	23.99
L.S.D.	3.68	1.11

In conclusion, inoculation of bio-organo fertilizer and/or chemical fertilizer, nitrogen changed some physical and chemical characters of tested wheat varieties compared with control. Therefore, the differences for susceptibility of insect infestation under the different levels of nitrogen fertilizer may be due to this cause. So, there is a probability to that fertilization have an effect on the degree of insect infestation. Further studies are needed to assure these findings.

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التأثير المشترك للتسميد الحيوى والعضوى عند مستويات تسميد نيتروجينية مختلفة على درجة الاصابة الحشرية بواسطة سوسة الارز وثاقبة الحبوب الصغرى

فاروق أبراهيم زين* ، رأفت بدر سعد أبوعرب* *

*** معهد بحوث الاراضى والمياه والبيئة - مركز البحوث الزراعية - الجيزة - مصر**

**** قسم بحوث آفات المواد المخزونة - معهد وقاية النباتات - مركز البحوث الزراعية - الجيزة - مصر**

أجريت تجارب معملية لدراسة درجة الاصابة بحشرتى سوسة الارز *Sitophilus oryzae L.* وثاقبة الحبوب الصغرى *Rhizopertha dominica F.* لصنفين من القمح هما سخا 8 ، سخا 92 ، سبق معاملتهما فى الحقل بالتسميد الحيوى (تلقيح الحبوب بالازوتوباكتر) والمادة العضوية 1% بالوزن كل على حده أو خلطهما معا عند مستويات مختلفة من التسميد النيتروجينى 20% N_1 ، 60% N_2 ، 100% N_3 من معدل التسميد الموصى به وهو 70 كجم نيتروجين/فدان ، مواسم 98/97 ، 1999/1998.

- وأوضحت النتائج المتحصل عليها أن صنف حبوب القمح قد أثر على نسبة الاصابة وتعداد الحشرات الناتجة من سوسة الارز. وعلى الجانب الآخر فإن نوع الصنف لم يكن له أى تأثير على القياسات السابقة لثاقبة الحبوب الصغرى.
- كان هناك تأثير لمستويات التسميد النيتروجينى المختلفة وكذا تأثير مشترك للتسميد الحيوى والمادة العضوية على درجة الاصابة والتعداد الناتج من سوسة الارز وثاقبة الحبوب الصغرى على كلا الصنفين سخا 8 ، سخا 92.
- أحدثت ثاقبة الحبوب الصغرى أعلى نسبة أصابة على كلا الصنفين مقارنة بسوسة الارز.
- توضح هذه النتائج أن مستوى ونوع السماد كان له تأثير على درجة الاصابة والتعداد الناتج للحشرات المختبرة على الصنفين محل الدراسة.
- هذه النتائج تحتاج الى دراسات مستقبلية لتأكيدها.