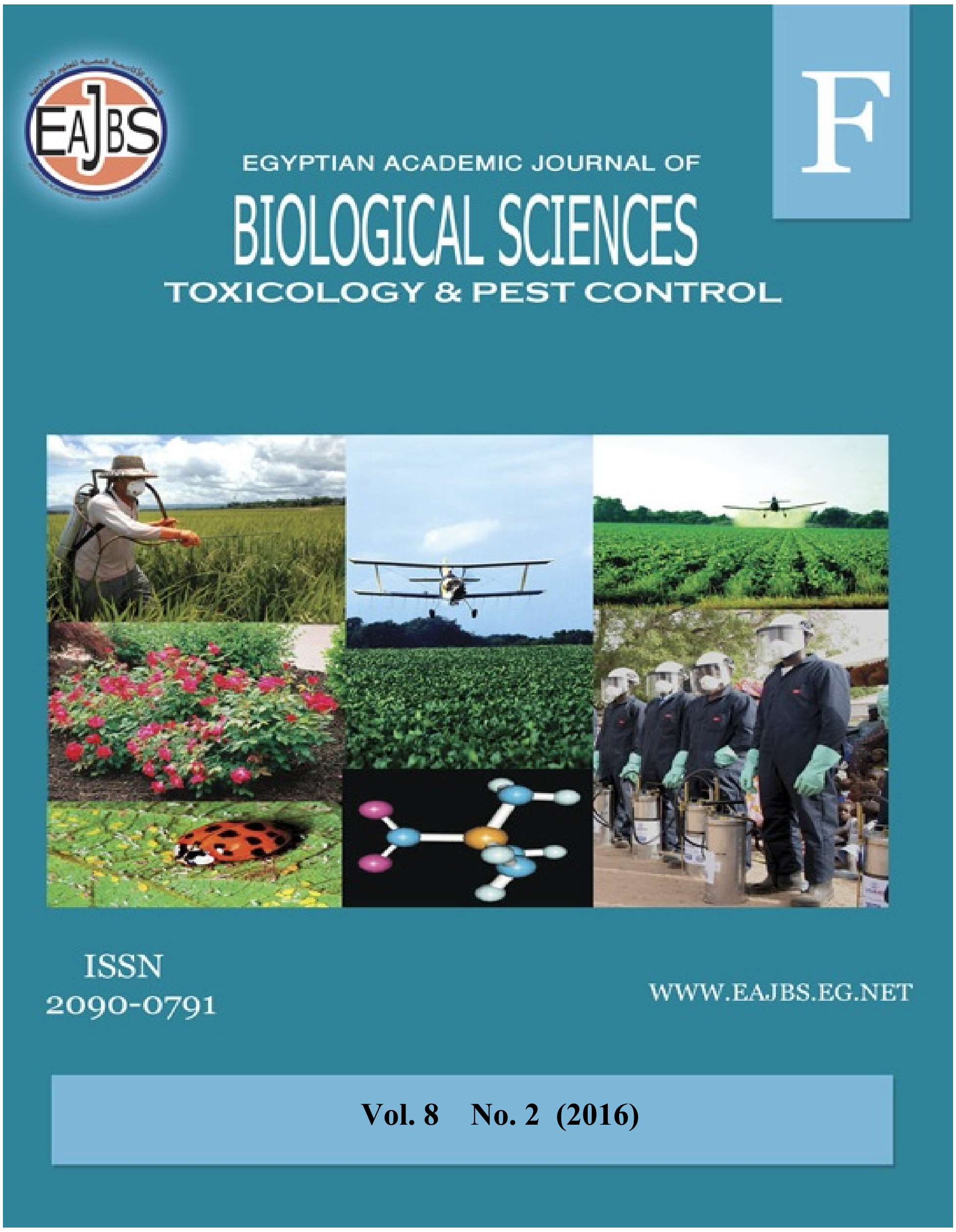

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Quick Lime is an Effective Rice Grains Protectant Against the First Instar Larvae of *Sitotroga cerealella* (oliver) (Lepedoptera: Gelichiidae) in Stored Rice Grains under Laboratory and Store Conditions.

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ABSTRACT
Laboratory and store assessments were carried out to investigate the efficiency of the quick lime as natural component with non chemical residues and harmful side effects. Great energy produced when acts with water insect gut, caused death. The two pathogenic fungal strains *Metarhizium anisopliae* (Metsch) and *Beauveria bassiana* (Balsam) were tested on the first instar larvae of *Sitotroga cerealilla* on stored unhusked rice grains udder laboratory and store conditions. The quick lime powder was used at the quantities of 100, 150 and 200 g. / kg. rice grains Giza178,and the two fungal pathogenic strains, each at the concentrations of $1x10^8$, $1.25\ x10^8$ and $1.5\ x\ 10^8$spores/ml. Malathion 5% super dust was applied at the quantities of 0.125, 0.250 and 0.5 g. / kg. infestation free of unhusked rice grains. Higher mortality percentages were obtained with quick lime at the quantity of 200 g. / kg. was 97.75 followed by Malthion super dust 82.75 % at the quantity of 0.5 /kg. on rice grains after 72 h. *M. anisopliae* was the third at the concentration of $1.5\ x\ 10^8$ spores / ml. was 81.75 % while *B. bassiana* was the least at $1.5\ x\ 10^8$ spores / ml. was 75.5 % after 7 days in the laboratory conditions. In the store conditions, quick lime also achieved higher mortality percentage at the concentration of 300 g / kg. and the average mortality percentage was 91.46 followed by Malathion 85.41% at 1.0 g / kg.. *M. anisopliae* and *B. bassiana* achieved 71.27 and 61.39 %, respectively.

Quick lime powder and the insecticide Malathion 5% super dust represents quick and higher mortality percentages after 24, 48and 72 h. in the laboratory while *M. anisopliae* has considerable mortality percentages and *B. bassiana* was the least mortality percentages after 3, 5 and 7 days.

INTRODUCTION
Angoumois grain moth, *Sitotroga cerealella* (Oliver) (Lepidoptera: Gelechiidae) is a primary colonizer of stored grain in subtropical and warm temperate regions of the world (Germanov, 1982). Rice (*Oryza sativa* L.) is the most important cereal crop and staple food in some Governorates in Egypt.

The farmers store more than 60% of the total produced rice till the next season for their food, feed and seed purposes. Insect pests damage different types of stored grains including rice causing serious loss to national economy. Among them Angoumois grain moth is one of the most serious pests of stored rice (unhusked) at post harvest level. A large quantity of unhusked rice is stored at farmer's level which is badly damaged by *S. cerealella*, which is an extremely efficient grain penetrator (Cogburn 1975). It is estimated that 5-10% of world's grain production is lost due to ravages of insects (Adam, 1998). The losses may reach 50% in tropical countries where summer is hot and humid and storage facilities are improper and inadequate (Ahmad and Ahmad, 2002). Fletcher and Ghosh (1919) observed that a female laid 120-350 eggs on paddy grains and other cereals and also on depressions, cracks, crevices and holes of storage structures and godowns. The newly hatched caterpillar bores directly into the grain and typically remains inside the grain for both larval and pupal development. The larvae of this pest tunnel inside the kernels are causing substantial damage and are rendering the grain more susceptible to secondary insect pests (Weston and Rattlingourd 2000). Before pupation the larva constructs a chamber just under the grain coat, forming a small circular translucent window. Pupation takes places within the chamber inside a delicate cocoon. Adults fly well and cross-infestation occurs readily, but they are short-lived and generally survive only for 5-12 days, and in suitable stores breeding may be continuous throughout the year (Hill 1990).

The aim of the present investigations is to provide an alternative natural material of nonchemical toxicant residues and environmental safe against *S. cerealella* first instar larvae in stored rice grains.

MATERIALS AND METHODS

The investigations were undertaken in the laboratory of the department of Entomology, Faculty of Agriculture, Fayoum University from May 2015 to April 2016. Samples of Giza 178 unhusked rice grains were collected from several farm store houses at Fayoum Governorate in plastic bags, transferred to the laboratory. The grains were conditioned in the laboratory for 20 days at (27 ± 1ºC and 70-72 % R.H.).

Laboratory studies.

Insect mass rearing technique.

Stock culture of *S. cerealilla*.

Samples of infested and infestation-free of unhusked rice grains were divided into100 g. each and kept in transparent plastic Jars (30 x 25 cm.), covered by muslin for aeration, was maintained in the laboratory at the 27 ± 1◦C and 70 – 72 R.H. for rearing as stock culture. Emerged adults were collected and kept in a glass cylinder (18 cm ht. X 10 cm dia.). For ensuring supply of fresh eggs, mass rearing of *S. cerealella* was done by using wheat grain as diet. The top of the cylinder was covered by 32 mesh net. Adults were kept in the cylinder for one day for mating and subsequent laying egg. The laid eggs on the wall of the cylinder were brushed, collected and sifted to collect fresh eggs along with body parts of moth. Collected eggs were kept in glass tubes of (12 cm. ht. X 3 cm. dia.) labeled and stored in the refrigerator at 4◦C to ensure continuous supply for further studies. (Akter *et al.* 2013).

S. cerealella eggs were placed on Petri dishes for hatching on absorbent paper to develop into first instar larvae for further studies. For providing infested-free rice grains for the present studies, quantities of 250 g. of unhusked rice grains were bagged in jute bags of

(25 x 20 cm.). The disinfestations process involved rapid heating followed by rapid cooling to safe handling and storage temperatures. Bags of rice grains were placed on ovens racks at 80°C for 4 min. each and quickly replaced in cold water for one min. and left for drying, Rashid and Jonathan (2000).

Quick lime experiments.

Stones of the quick lime were crushed into fine powder. Unhusked sound rice grains of Giza 178varaiety were obtained from Field Crop Research Institute. 100s of unhusked sound rice grains each were placed in Petri dishes of (2 cm ht. X 10 cm dia.). The grains were dusted and adequately mixed well with the pulverized quick lime fine powder at quantity rates of 100, 150 and 200 g. / kg. EL-Garhy and Ahmed, (2012).

Spore suspensions experiments:

Pathogenic fungal strains, *Metarhizium anisopliae* and *Beauveria bassiana* were isolated from soil.The spore suspension with the desired spore count was prepared using a haemocytometer. The spore suspension were prepared at the concentrations of 1 x 10^8, 1.25 x 10^8 and 1.5 x 10^8 spores / ml. + 0.05% Tween 80 were suspended in potato broth at PH of 6.9 and tested against the first instar larvae of *S. cerialella* in rice crop, Ekesi *et al*. (2000).

Preparation of Malathion 5% super dust.

Recommended insecticide Malathion super dust 5 % was applied at the respective rates of 0.125, 0.250 and 0.5 g. / kg. The insecticide quantities were calculated on weight by weight bases of powder/grain weight (w/w).Malathion super dust was mixed at the previous quantities each, Fekadu *et al*. (2013).

Laboratory tests:

Efficiency of quick lime

One 100 first instar larvae of *S. cerealella* were introduced per Petri dish (2 cm ht. X 10 cm dia.) by camel hair brush with the help of stereomicroscope with 100 unhusked sound rice grains treated with quick lime at the aforementioned quantities each, covered with cloth sheet, tighten with rubber band, Akter *et al* (2013). Ten Petri dishes represent replicate; four replicates were prepared as control. Grains were inspected after 24, 48and 72 h. and the mortality percentages were recorded by cutting infested grains with the help of a blade and observed under the microscope and corrected by Abbott's formula.Quick lime testes were operated four times per each quantity. Germination percentage of infest treated rice grains were calculated per each treatment.

Efficiency of *M. anisopliae* and *B. bassiana* spore suspensions:

One100 of unhusked infestation-free rice grains per Petri dish were spread with one of each pathogenic spore's suspension at the abovementioned concentrations separately. Treated Petri dishes were naturally dried under aseptic conditions. One hundred first instar larvae were released to the treated rice sound rice grains per each spore suspensions. Ten Petri dishes represent replicate as control. Four replicates per each concentration were prepared. The grains were inspected after 3, 5 and 7 days. and the mortality percentages were recorded as abovementioned and corrected by Abbott's formula.*M. anisopliae* and *B. bassiana* tests were operated four times per such concentration. Germination percentages of infest treated rice grains were calculated per each concentration.

Efficiency of Malathion super dust 5 %:

One 100 third instar larvae were introduced with 100 unhusked sound dusted rice grains with Malathion in Petri dish. Every Ten Petri dishes represent replicate; four replicates were prepared as control. The dishes were inspected after 24, 48 and 72h. and the mortality percentages were corrected by Abbott's formula. Malathion tests were operated four times per such concentration and the germination percentage of infest treated rice grains were also calculated per each treatment.

Statistical analysis:

Data were subjected to analysis of variance (ANOVA) and the means were compared by L.S.D. test, at 0.05 level, using SAS program (SAS Institute, 1988).The data were analyzed using Probit analysis (Finny, 1952) and LT_{50} values were estimated for each of tested material, bioagents and chemical insecticide.

Storage grains applications:

Grains applications treatments were laid-out in Completely Randomized Design with four replications per such treatment as control. The storage grain applications were undertaken at separate room in the department of Entomology laboratory beyond May 2015 to April 2016.

Double quantities and/or concentrations were applied to the test Unhusked sound rice grains were used in the treatments. Samples of 100 treated rice grains per each treatment were inspected in mid of each month. For keeping the store room free from any other insects and avoiding *S. cerealella* adults attack, new Pyrosol, the flying insect killer (product of El-Nasr Company for intermediate chemicals-Egypt) was weekly spread for five seconds and the store door was tightly closed.

The average of monthly germination percentage of the infested rice grains for each treatment were calculated.

Quick lime applications:

Quantities of 500 g. unhusked sound rice grains were treated by quick lime fine powder at the quantities of 200, 250 and 300 g. / kg., each in plastic bags of (30 x 20 cm.), well mixed, tightly closed by plastic rubber. Five batches of 100 of *S. cerialilla* eggs were applied to each bag. Four bags represent replicate; four replicates were prepared as control. Randomized samples of 100 treated rice grains per each concentration were monthly inspected.

Mortality percentages of *S. cerealella* first instar larvae were calculated to each quantity. In order to evaluate the germination percentages, others of 100 infested rice grains were kept on sterilized medical cotton and also covered with other cotton material in Petri dishes with water till the germination occur.

Entomopathogenic fungi applications:

500 g. of unhusked sound rice grains were treated with one of each of the two pathogenic fungal strains of *M. anisopliae* and *B. bassiana* at the concentrations of 2 x 10^8, 2 x 1.25 x 10^8 and 2 x 1.5 x 10^8 spore / ml. each in sterilized aluminum pans and left for naturally drying under aseptic conditions.Treated grains were kept in plastic bags of (30 x 20 cm). Five batches of 100 eggs each of *S. cerialilla* were applied to rice grains bag each, which was tightly closed. Four bags represent replicate and four replicates were prepared as control per each concentration of *M. anisopliae* and or / *B. bassiana* spores suspensions separately. Randomized samples of 100 treated rice grains per each concentration were monthly inspected.

Mortality percentages per each concentration were calculated and the germination percentages were also evaluated by choosing 100 infested rice grains. Infested rice grains were kept on sterilized medical cotton in Petri dishes and covered by the same material. The dishes were supplied with water and kept till the germinations occur.

Malathion super dust 5% applications:

The same work was operated with Malathion 5 % super dust. It was used at the rates of 0.25, 0.50 and 1.0 g / kg., each. Four bags of 500 g. treated rice grains represent one replicate. Four replicates were prepared per each quantity as control. Mortality percentages and infested rice grains germination were evaluated as abovementioned.

RESULTS AND DISCUSSIONS

Laboratory tests:

As shown in Tables (1&2) and Fig. (1) quick lime powder achieved higher mortality percentages against *S. cerealella* first instar larvae were 76.5, 83.25 and 86.75 and 79.75, 84.25 and 89.50 and 82.75, 88.75 and 97.75 % at the quantities of 100, 1.25 and 150 g / kg. rice grains while it was 0.0 % in the control treatment. Estimated rice grains germinations were, 70.25, 72.50 and 75.75 and 72.50, 74.25 and 76.50 and 80.25, 81.00 and 82.50 and 62.25 % in the check treatments after 24, 48 and 72 h. post treatment under laboratory conditions. Calculated $L.T_{50}$ was 26.99, 20.65 and 19.98, respectively.

El-Garhy and Ahmed (2012) stated that quick lime is effective natural bait in controlling insects of cut mouth parts based on *Agrotisypsilon.*

As well as, Malathion 5 % super dust achieved mortality percentages of 71.25, 75.25 and 76.25 and 75.25, 76.50 and 81.75 and 78.75, 80.75 and 82.75 % at the quantities of 0.125, 0.25 and 0.5 g / kg. rice grains with an average grain germinations of 67.5, 69.00 and 70.25 and 68.75, 71.5 and 71.75 and 70.75, 70.75 and 72.50 and the rice grains germination was 62.25 % in the check treatments. Calculating $L.T_{50}$ were 22.4, 21.2 and 19.3 after 24, 48 and 72 h.post treatment, respectively.

Table 1: Efficiency of quick lime, *M. anisopliae*, *B. bassiana*,and Malathion insecticide on *S. cerealella*firstinstar larvae and the infested grains germination after 24, 48 and 72h.in the laboratory.

Strain / insecticide	Conc. / kg.	Mortality	Exposed / h.			LSD / 0.05			$L.T_{50}$ / 95% Confidence Limits		
			24 ± SE	48 ± SE	72 ± SE	24	48	72	24	48	72
Quick lime	100 g.	Aver. Dead No.	306± 2.5	333 ±3.9	347±4.2	6.10*	7.54*	9.03*	26.99	20.65	19.98
		Mort. %	76.50	83.25	86.75						
	125 g.	Aver. Dead No.	319 ±3.3	337 ±3.8	358±4.1						
		Mort. %	79.75	84.25	89.50						
	150g	Aver. Dead No.	331 ±3.8	355 ± 2.2	391±0.6						
		Mort. %	82.75	88.75	97.75						
Slope									0.133201, 2.371076	0.127127, 2.553450	-24.647432, 32.942570
Malatiom dust 5%	0.125 g.	Aver Dead No..	285 ±6.4	301 ±0.8	305 ±2.1	6.20*	11.61**	13.30**	22.4	21.2	19.3
		Mort. %	71.25	75.25	76.25						
	0.25 g.	Aver. Dead No.	301 ±2.6	306±2.6	327±2.0						
		Mort. %	75.25	76.50	81.75						
	0.5 g.	Aver. Dead No.	305 ±1.9	323±2.8	331±2.5						
		Mort. %	78.75	80.75	82.75						
Slope									-0.055324, 0.569411	-0.015003, 0.627640	0.056718, 0.719336
M. anisopliae	Conc./ ml.	Mortality	Exposed / days			LSD / 0.05			$L.T_{50}$ / 95% Confidence Limits		
			3± SE	5± SE	7± SE	3	5	7	3	5	7
	1.0×10^8	Aver. Dead No.	247±3.8	259 ± 0.8	282±4.1	11.9**	5.31	5.43	2.7	2.5	1.8
		Mort. %	61.75	64.75	70.50						
	1.25×10^8	Aver. Dead No.	259 ±4.5	275 ± 4.3	298±2.8						
		Mort. %	64.75	68.75	74.50						
	1.5×10^8	Aver. Dead No.	293±3.9	305±5.1	327±2.6						
		Mort. %	73.25	76.25	81.75						
Slope									0.939678, 2.95261	0.821952, 2.899519	0.942131, 3.102138
B. bassiana	1.0×10^8	Aver. Dead No.	223 ±2.8	251±1.8	266 ±1.3	7.80*	7.75*	4.91	2.9	2.8	2.6
		Mort. %	55.75	62.75	66.50						
	1.25×10^8	Aver. Dead No.	250 ±2.7	259 ±1.3	291±1.1						
		Mort. %	62.50	64.75	72.75						
	1.5×10^8	Aver. Dead No.	275± 4.0	287 ± 2.3	302 ±3.4						
		Mort. %	68.75 8	71.25	75.50						
Slope									0.939678, 2.952619	-0.055344, 0.569451	-0.015003, 0.727644
Control		Aver. Dead No	-	-	-	-	-	-	-	-	-
		Mort. %	0.00	0.00	0.00						
L.S.D 0.05			7.0**	6.8*	6.8*	--			-		

N.B: 100 first instar larvae were introduced.

Mort.%: Mortality percentages.

Aver. Dead No : Average dead number.

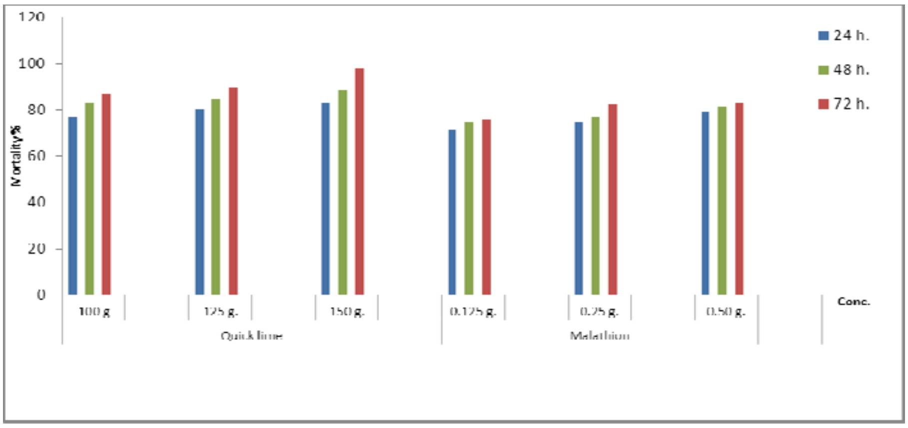

Fig. 1: Efficiency of quack lime powder and Malathion 5% super dust on *S. cerealella* first instarlarvaeat24, 48 and 72 h. in the laboratory conditions.

Feng-Lian *et al*. (2011) reported that synthetic chemical insecticides cause many problems including high persistence, poor knowledge of application, increasing costs of application, pest resurgence, genetic resistance by the insect and lethal effects on non-target organisms in addition to direct toxicity to users.

Data presented in Tables (1&2) and Fig. (2) emphasized that *M. anisopliae* achieved considerable mortality percentages of 61.75, 64.75 and 70.50 and 64.75, 68.75 and 74.50 and 73.25, 76.25 and 81.75 % at the concentrations of 1.0 x 10^8, 1.25 x 10^8 and 1.5 x 10^8 spores / ml. and 0.0% in the check treatment with an average rice grain germinations of 62.25, 62.50 and 66.25 and 61.25, 63.25 and 64.25 and 65.50, 67.75 and 70.50 and 60.50 % in the check treatments. Calculating $L.T_{50}$ were 2.7, 2.5 and 1.8 after 3, 5 and 7 days post treatment, respectively.

Table 2: Average of monthly germination percentages in infested rice grain treated with quick lime and Malathion super dust after 24, 48 and 72 h. and after 3, 5 and 7 days to others treated with *M. anisopliae* and *B. bassiana* in the laboratory and monthly inspected rice grains germination in the store conditions.

Strain / insecticide	Conc./ kg	Mean germination of infested rice grains %					
		Laboratory / h.			Stored rice grains		
		24	48	72		Conc.	
Quick lime	100 g.	70.25	72.50	75.75	Quick lime	200 g.	70.75
	125 g.	72.50	74.25	76.50		250 g.	74.25
	150 g.	80.25	81.00	82.50		300 g.	79.75
Malathion	0.125 g.	67.50	69.00	70.25	Malathion	0.25 g.	68.50
	0.25 g.	68.75	71.50	71.75		0.50 g.	69.50
	0.50 g.	70.75	70.75	72.50		1.00 g.	70.25
Control		62.25					
Laboratory / days							
		3	5	7	*M. anisopliae*	2.0 x 10^8	66.25
M. anisopliae	1.0 x 10^8	62.25	62.50	66.25			
	1.25 x 10^8	61.25	63.25	64.75		2.5 x 10^8	64.50
	1.5 x 10^8	65.50	67.75	70.50		3.0 x 10^8	66.25
B. bassiana	1.0 x 10^8	60.25	60.75	63.50	*B. bassiana*	2.0 x 10^8	60.50
	1.25 x 10^8	60.75	61.0	62.50		2.5 x 10^8	60.75
	1.5 x 10^8	62.50	64.75	66.75		3.0 x 10^8	64.25
Control		60.50			Control	52.75	

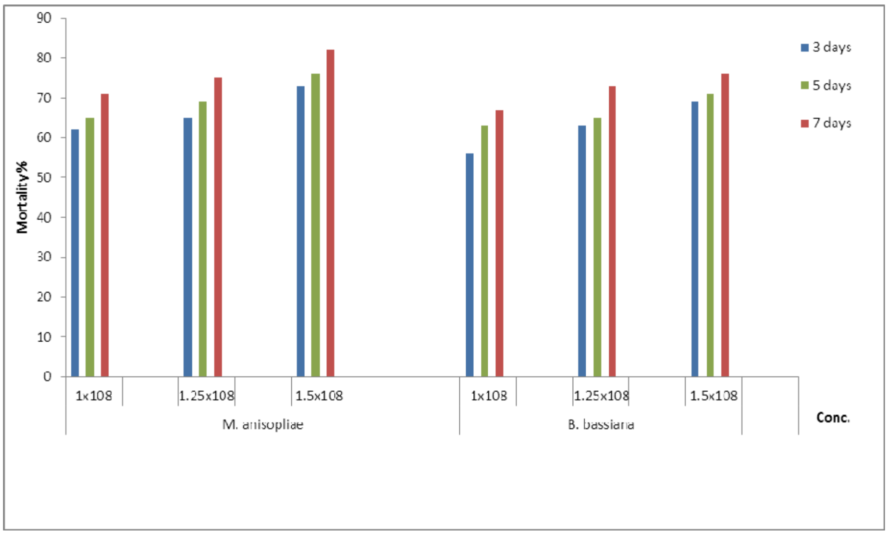

Fig. 2: Efficiency of quack lime Powder and Malathion dust on *S. cerealella* firstinstar larvae at 24, 48 and 72 h. in the laboratory conditions.

On the other hand, *B. bassiana* spore suspensions achieved the least mortality percentages on *S. cerealella* first instar larvae and were 55.75, 62.75 and 66.50 and 62.50, 64.75 and 72.75 and 68.75, 71.25 and 75.50 at the concentrations of 1.0 x 10^8, 1.25 x 10^8 and 1.5 x 10^8 spores / ml. and 0.0% in the check treatment with an average rice grain germinations of 60.25, 60.75 and 63.50 and 60.75, 61.0 and 62.50 and 62.50, 64.75 and 66.75 and the rice grains germination was 60.50 % in the check treatments, Tables (1), (2) and Fig. (2). Calculating L.T_{50} were 2.9, 2.8 and 2.6 after 3, 5 and 7 days post treatment, respectively.

Ekesi, *et al*. (2000) stated that the pathogenicity of 3 *Metarhizium anisopliae* isolates, 3 *Beauveria bassiana* isolates and 1 *Nomuraea rileyi* isolate to adult grain moths (*Sitotroga cerealella*) was evaluated in the laboratory. The most pathogenic isolate was *M. anisopliae* CPD 6 (89-100% mortality), followed by *M. anisopliae* CPD 5 (42-94%), *B. bassiana* CPD 3 (48-96%) and *N. rileyi* CPD 1 (33-95%) at 7 days after treatment. The mortalities caused by all these isolates at the highest concentration (2600 million spores/50 g. of sorghum) did not differ significantly from mortality caused by a chemical insecticide (pirimiphos-methyl) at 10 ppm. At the same concentration of spores, *M. anisopliae* isolate CPD 6 had a more rapid action than the other isolates with an LT_{50} of 2.1 days at 7 days post treatment.

Statistical analysis showed significant differences in reducing *S. cerealella* first instar larvaeinfestation to the rice grains at different quantities of quick lime, Malathion 5% super dust and / or other concentrations of the two entomopathogic fungal strains after 24, 48 and 72 h.

Store applications:

Mortality percentages of *S. cerealella* first instar larvae were varied according to the applied materials and /or entomopathogenic spore concentrations.

For quick lime, tabulated data in Tables (2&3) and Fig. (3) showed that mortality percentages were gradually increased from mid of May to the mid of August (63.60, 64.5, 64.60 and 65.90 %) and decreased from mid of September to the mid of February (65.40, 63.60, 62.10, 61.10, 60.40, 61.10 and 60.60%) and also increased from mid of March to the mid of April(62.20 and 63.50 %) and

(75.70,76.90, 77.20 and 78.80 %) and (78.70, 76.70, 71.50, 71.25, 70.90 and 70.00 %) and 72.40 and 73.50 and (94.60, 95.40, 96.80 and 96.80) and (94.75, 90.90, 89.80, 89.50, 88.60 and 88.00 %) and (95.80 and 99.40 %). The average of mortality percentage were 63.20, 74.46 and 93.36% while it was (0.00 %) in the check treatments to all months.

The average of infested rice grain germinations were70.75, 74.25 and 79.75% at the applied quantities of 200, 250 and 300 g. / kg. and 52.75% in the check treatments, respectively.

Tahmina Akter (2013) reported that *S. cerealella* (Olivier) insect is more or less active throughout the year but less active during the period from mid December to first part of March. During July to August the population of the pest reaches its peak.

As well as, for Malathion 5% super dust, *S. cerealella* first instar larvae mortality percentages were increased from mid of May to the mid of August (60.50, 61.50, 61.70 and 62.50 %) and decreased from mid of September to mid of February (62.25, 60.00, 60.00, 59.80, 59.50 and 59.20 %) and increased from mid of March to mid of April (61.70 and 62.90) and (70.90, 71.0, 71.40 and 72.80 %) and (72.70, 70.90, 70.40, 69.80, 69.50, and 69.40 %) and (70.40 and 70.60 %) and (76.90, 78.90, 80.50 and 82.90 %) and (81.80, 81.00, 79.90, 78.60, 76.50 and 75.90 %) and (80.50 and 91.50%). The average of mortality percentages were 60.96, 71.27 and 80.41% at the quantities of 0.25, 0.50 and 1.00 g. / kg.

Table 3: Efficiency of quick lime, Malathion, *M. anisopliae* and *B. bassiana* on *S. cerealila* first instar larvae on stored unhuskedrice grains beyond May 2015 and April 2016.

Strain insecticide	Conc./ kg	Mortality percentages / Month												Average % ± SE
		May 2015	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan. 2016	Feb.	Mar.	Apr.	
Quick lime	200 g.	63.60	64.50	64.60	65.90	65.40	63.60	62.10	61. 40	61.10	60.60	62.20	63.50	63.20.± 0.5
	250 g.	75.70	76.90	77.20	78.80	78.70	76.70	71.50	71.25	70.90	70.00	72.40	73.50	74.46± 0.9
	300 g.	94.60	95.40	96.80	96.80	94.75	90.90	89.80	89.50	88.60	88.00	95.80	99.40	93.36± 1.1
Malatiom dust 5%	0.25 g.	60.50	61.50	61.70	62.50	62.25	60.00	60.00	59.80	59.50	59.20	61.70	62.90	60.96± 0.4
	0.50 g.	70.90	71.0	71.40	72.80	72.70	70.90	70.40	69.80	69.50	69.40	70.40	70.60	71.27± 0.5
	1.00 g.	76.90	78.90	80.50	82.90	81.80	81.00	79.90	78.60	76.50	75.90	80.50	91.50	80.41± 1.2
M. anisopliae	2.0 x 10^8	56.50	58.80	59.70	60.25	60.00	59.40	57.25	56.50	56.50	56.25	56.70	57.70	57.96± 0.4
	2.5 x 10^8	63.60	63.80	63.90	64.20	62.50	61.60	61.50	60.00	60.00	59.75	63.70	64.50	62.42± 0.4
	3.0 x 10^8	70.80	71.25	72.20	72.90	72.00	71.25	70.25	69.90	69.50	69.40	70.00	70.40	70.82± 0.3
B. bassiana	2.0 x 10^8	50.25	51.25	54.00	57.70	56.80	56.50	55.80	55.25	55.00	55.00	56.80	56.90	55.10± 0.7
	2.5 x 10^8	50.90	53.90	54.25	59.25	58.40	56.90	56.50	56.00	54.60	54.00	55.00	55.75	55.45± 0.6
	3.0 x 10^8	54.50	61.50	61.70	61.90	60.80	60.50	60.25	60.00	59.75	59.50	61.25	62.50	60.35± 1.1
Control		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L.S.D. 0.05		6.0**	4.2*	7.1**	7.6**	2.26	6.0**	4.2*	7.1**	7.6**	2.26	6.25**	4.50*	-

Fig. 3: Efficiency of quick lime, Malathion 5% super dust, *M. anisopliae* and *B. bassiana* spore suspensions on *S. cerealella* frist instar larvae in storeconditions.

In the check treatment, mortality percentages were (0.00 %) in all inspected months. Estimated of germination percentages of the infested rice grain were 68.50, 69.50 and 70.25% at the quantities of 0.25, 0.50 and 1.0 g. / kg. of Malathion 5% super dust and 52.75% in the check treatments, Tables (2&3) and Fig. (3), respectively.

John (1961) found that various dosages and two different dust formulations of premium grade Malathion were tested against *S. cerealella* in stored maize grains. An 89.4% average reduction in damage was obtained for all treatments during the two seasons (1959 – 1960) of tests.

Meanwhile, obtained data in Tables (2&3) and Fig. (3) explicated that *M. anisopliae* has considerable mortality percentages at the concentration of 2.0 x 10^8 spores / ml. and were gradually increased from mid of May to the mid of August and were (56.50, 58.80, 59.70 and 60.25%), gradually decreased from mid of September to the mid of February (60.00, 59.40, 57.25, 56.50, 56.50 and 56.25%). The same percentages increased from mid of March to the mid of April (56.70 and 57.70 %) and the average of the mortality percentages was 57.96 %. In the control treatment the average of mortality percentages was (0.0%) and the average of the infested rice grain germinations was 62.25and 52.75% in the check treatment.

Whereas, the mortality percentages on *S. cerealella* first instar larvae at the concentration of 2.5 x 10^8 spores / ml. were (63.60, 63.80, 63.90 and 64.20 %) from mid of May, June, July and August. Mortality percentages were slightly decreased from mid of September, October, November, December, January and mid of February and were (62.50, 61.60, 61.5, 60.00, 60.00 and 62.25 %). Recorded mortality percentages were increased in the mid of March to the mid of April (63.70 and 64.50) and the average of mortality percentage were 62.42%, respectively.

In the control treatment the average of mortality percentages was (0.0%) and the average of the infested rice grain germinations was 64.50% and 52.75% in the check treatment.

Concerning *M. anisopliae* spore suspensions at the concentration 3.0 x 10^8 spores/ml., recorded mortality percentages on *S. cerealilla* first instar larvae were (70.80, 71.25, 72.20 and 72.90 %) in mid of May, June, Jul and mid of August and decreased from mid of September, October, November, December, January and February and were (72.00, 71.25, 70.25, 69.90, 69.50,and 69.4 %). Mortality percentages increased from mid of March and mid of April (70.00 and 70.40 %)

and the average mortality percentage was 70.82% at the concentration of 3.0 x 10^8 spores / ml. Mortality percentages were (0.00) and the average was (0.00 %) in the check treatment, respectively.

In the control treatment the average of mortality percentages was (0.0%) and the infested rice grain germinations was 66.25 and 52.75% in the check treatment, Tables (2&3) and Fig. (3).

Regarding *B. bassiana* spores suspensions, it is obvious that *S. cerealella* first instar larvae were the least infested by *B. bassiana* spore suspensions, mortality percentages were (50.25, 51.25, 54.00 and 57.70%) in mid of May to the mid of August and decreased from mid of September to the mid of February (56.80, 56.50, 55.80, 55.25, 55.00 and 55.00 %) and increased from mid of March to the mid of April (56.80 and 56.90 %).The average of mortality percentages was 55.10 % at the concentration of 2.0 x 10^8 spores / ml. Tables (2&3) and Fig. (3).

In the check treatment the average of mortality percentages was (0.0%) and the germination percentages of the infested rice grain was 60.50 and 52.75%.

However, the mortality percentages were (50.90, 53.90, 54.25 and 59.25 %) from mid of May to the mid of April and decreased from mid of September to the mid of February (58.40, 56.90, 56.50, 56.00, 54.60 and 54.00 %). Mortality percentages increased from mid of March to the mid of April (55.00 and 55.75 %) and the average of mortality percentages was 55.45 % at the concentration of 2.5 x 10^8 spores / ml.

In the check treatment, the average of mortality percentages was (0.0%) and germination percentages were 60.75 and 52.75%, respectively.

Furthermore, Mortality percentages at the concentration of 3.0 x 10^8 spores/ ml. were highly increased from mid of May – August (54.50, 61.50, 61.70 and 61.90 %) and decreased from mid of September to the mid of February (60.80, 60.50, 60.25, 60.00, 59.75 and 60.00 %) and increased in mid March and April (61.25 and 62.5 %). Calculated average mortality percentages were 63.55%.

In the control treatment the average of mortality percentages was (0.0%) and the germination percentages were 64.25 and 52.75%, Tables (2& 3) and Fig. (3), respectively.

Kavallieratos *et al*. (2014) reported that the entomopathogenic fungi *Beauveria bassiana, Metarhizium anisopliae*, and *Isaria fumosorosea* were tested against the stored-grain pest *Sitophilus oryzae*.at the concentrations of 2.11 × 10^7 and 2.11 × 10^8, 1.77 × 10^7 and 1.77 × 10^8, and 1.81 × 10^7 and 1.81 × 10^8 spores per ml of *B. bassiana, M. anisopliae*, and *I. fumosorosea*, respectively, Both in the highest and the lowest concentrations of fungi, the mortality of *S. oryzae* adults was higher when the fungi were applied on adults than when they were applied on food.

In this respect, these investigations revealed that quick lime fine powder and Malathion 5% super dust have great potential effect on *S. cerealilla* first instar larvae both at the highest and lowest concentrations.*M. anisopliae* spore suspensions achieved considerable mortality percentages and *B. bassiana* spores suspensions was the least one.

CONCLUSION

It could be concluded that the quick fine powder, Malathion 5 % super dust,and the entomopathogens, *M. anisopliae* and *B. bassiana* spore suspensions could be arranged according to their efficacy on *S. cerealella* first instar larvae in this regard in descending order: Quick lime fine powder, Malathion 5 % super dust, *M. anisopliae* and *B. bassiana* was the least one.

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ARABIC SUMMERY

الجير الحي واقي آمن وفعال ضد الطور اليرقي الأول لحشرة فراشة الحبوب *Sitotrogacerealella* علي محصول الأرز المخزن تحت الظروف المعملية ومخازن الحبوب

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أجريت هذه الدراسة لتقييم دور الجير الحي كمادة طبيعية في مكافحة الطور اليرقي الأول لحشرة فراشة الحبوب علي محصول الأرز والذي ليست له أضرار مباشر أو غير مباشرة علي الإنسان والبيئة مقارنة بالمبيد الكيماوي ملاثيون والسلالات الفطرية الممرضة التي تم عزلها من التربة.

في هذه الدراسة تم استخدام مسحوق الجير الحي بكميات ١٠٠و١٢٥و٢٥٠ جم / كجم حبوب أرز غير مبشور كل علي حدة بالإضافة للكونترول حيث تم وضع كل ١٠٠ حبة أرز غير مبشور معاملة في طبق بتري وتم إدخال عدد ١٠٠ طور يرقي أول بكل طبق لمدة ٢٤و ٤٨ و ٧٢ ساعة وبنفس الطريقة تم أستخدام الملاثيون ٥% بكميات٢٥. و٥٠. و١.٠٠ جم / كجم حبوب أرز غير مبشور كل علي حدة. وكان لكل معاملة مكررة أربع مرات بالأضافة للكونترول الذي تم فيه وضع عدد ١٠٠ حبة أرز غير مبشور غير المعامل وإدخال عدد ١٠٠ من الطور اليرقي الأول لنفس المدد السابقة.

وفي معاملة السلالات الفطرية *Metahizium anisopliae* و*Beauveriae bassiana* بتركيزات١.٠ x١٠^٨ و ١.٢٥ x١٠^٨ و ١.٥ x١٠^٨ جراثيم / مل تم إدخال عدد ١٠٠ حبة أرز غير مبشور معاملة بأحد هذه التركيزات وتم إدخال عدد ١٠٠ من يرقات الطور الأول افراشة الحبوب لمدة ٣ و ٥ و٧ أيام بالأضافة للكنترول

دلت النتائج المعملية أن النسبة المئوية للموت حققت أعلي نسبة بعد مرور ٧٢ ساعة لكل من معاملتي الجير الحي والمبيد الكيماوي حيث كانت ٩٧.٧٥و ٨٢.٧٥ % للكميات ٢٥٠ جم /كجم و ٠.٥ جم / كجم أرز غير مبشور علي التوالي. وأيضا لمعاملتا *M. anisopliae*و*B. bassiana*حيث كانت نسبة القتل ٨١.٧٥ و ٧٥.٥٠% عند تركيز ١.٥ x١٠^٨ جراثيم / لتر بعد مرور سبعة أيام مقارنة بالكنترول (٠.٠) %.

ولدراسة تأثير هذه المعاملات علي النسبة المئوية للأنبات تم أخذ عدد ١٠٠ حبة معاملة ومصابة بالطور اليرقي الأول من كل معاملة وتم أستنباتها.

أظهرت النتائج أن النسبة المئوية للأنبات هي ٨٢.٥ و ٧٢.٥ %في معاملتا الجير الحي والمبيد الكيماوي ملاثيون بعد ٧٢ ساعة لنفس التركيزان السابقان وبلغت النسبة النوية للأنبات ٦٢.٢٥% بينما كانت ٧٠.٥ و ٦٦.٧٥ % في معاملتا *M. anisopliae*و*B. bassiana* للتركيز١.٥ x١٠^٨بعد سبعة أيام من المعاملةكما كانت ٥٢.٧٥ في الكنترول.

عند دراسة تأثير هذه المعاملات علي حبوب الأرز غير المبشور بالمخزن والتي أجريت من شهر مايو ٢٠١٥ وحتي أبريل ٢٠١٦ ، حيث استخدم ضعف التركيز، دلت النتائج أن الجير الحي **يليهالمبيد** الكيماوي ملاثيون حققا أعلي نسبة للموت حيث كانت ٩٣.٣٦ و ٨٠.٤١% لكميات ٣٠٠ جم / كجم و ١٠٠ جم / كجم حبوب أرز غير مبشورعلي التوالي. أما في معاملتا *M. anisopliae* و *B. bassiana* حيث كانت النسبة المئوية للقتل ٧٠.٨٢ و ٦٠.٣٥ % عند التركيز ٣ x١٠^٨ جراثيم / مل لكليهما علي التوالي مقارنة بالكنترول (٠.٠) %.

أظهرت النتائج أن النسبة المئوية للأنبات في الحبوب المصابة بالطور اليرقي الأول في المخزن هي ٧٩.٧٥ و ٧٠.٢٥ %في معاملتا الجير الحي والمبيد الكيماوي ملاثيون بينما كانت ٦٦.٢٥ و ٦٤.٢٥ % في معاملتي*M. anisopliae* و*B. bassiana*.