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Effect of releasing the parasitoid *Anisopteromalus calandrae* (Hymenoptera: Pteromalidae) on certain coleopteran stored products beetles in Egypt

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ABSTRACT

The effect of direct release (inside bags) of faba bean seeds or wheat grains with the release of *Anisopteromalus calandrae* was studied on insects populations, percentage damage seeds and percentage weight loss of stored seeds or grains due to infestation with *Callosobruchus maculates* (F.), *Callosobruchus chinensis* (L.) on faba bean seeds, *Rhyzopertha dominica* (F.) and *Sitophilus oryzae* (L.) on wheat grains at Ismalia and Sharkia governorates locations.

Results showed release of *A. calandrae* reduced the monthly rate of increase of tested beetles on faba bean at rates between 35.20 and 42.14%. These rates resulted in populations reduction at the end of 6 month storage period at rates between 31.24 and 36.71%. In case of wheat grains the monthly rate of increase was reduced at rates between 29.05 and 46.80%. These rates resulted in populations reduction at the end of storage period at rates between 31.51 and 47.98%. The relative faba bean damage after the storage period was reduced in the range of 32.71 to 40.99% as a result of the parasitoid release. In case of wheat grains the obtained reduction in grain weight ranged between 72.67 and 81.66.

Keywords: *Anisopteromalus calandrae*, Biological control, coleopteran stored products beetles, Egypt

INTRODUCTION

Beetles of the family Bruchidae are important primary insect pests of post harvest stored legumes. Legumes often are the main source of protein for people in developing countries. Legume seeds suffer heavy losses quantitatively and qualitatively from the attack of *Callosobruchus* species during storage (Abd El-Gawad and Abd El-Aziz 2004).

Cereal grains should be handled and stored under conditions that minimize the opportunity for stored product pests to cause economic damage. This could be achieved by good design and maintenance of stores, regular inspection and quality control of stored commodities, good storage practices and performance of appropriate pest control measures (El-Lakwah and Abdel-Latif 1998).

Many methods have been used to prevent these post harvest losses. Chemicals insecticides are currently used. Also some plant materials as insecticides or repellent agents are used. Synthetic insecticides are subject to dynamic trends. Target insects are able to develop resistance against some insect pesticides. This can also enhance the development of non target pests, allowing a secondary pest in the past to be an important one with high tolerance towards popular pesticides. Therefore, more sustainable measures are required to reduce pests' resurgence and to enhance the incidence of natural enemies in crop protection strategies (Baker *et al*., 1999).

A complex of parasitoids and predators is associated with stored-grains ecosystem. These beneficial insects exert some level of natural control on most

stored-grain pest insect populations. However, the best use of these natural enemies in pest management programs in grain stores is through augmentative release. Optimal release strategies have not been determined for most of the relevant parasitoids. Small cardboard cards containing parasitized eggs have been used for release of *Trichogramma* spp. However, in most large-scale pilot tests that have been conducted in stores of whole grain, adult parasitoids have been released directly into storage facilities. This is particularly true for parasitoids of internal feeders, such as weevils and borers (Ngamo *et al*., 2007).

Hymenopteran parasitoids could serve as biological control agent of coleopteran pests as lesser grain borer, *Rhyzopertha dominica* (F.)**,** rice weevil *Sitophilus oryzae* (L.), legume beetles, *Callosobruchus* maculates (F.) and *Callosobruchus chinensis* (L.) (Ahmed, 1996; Lucas & Riudavets, 2002; Qumruzzaman & Islam, 2005 and Ngamo *et al*., 2007).

The present work was carried out to study certain responses of the *C. maculates*, *C. chinensis*, *R. dominica* and *S. oryzae* on faba bean seeds and wheat grains to release of the parasitoid *Anisopteromalus calandrae* (Howard) (Hymenoptera: Pteromalidae) that may be safe in integrated pest management for combating these insect pests.

MATERIAL AND METHODS

To obtain main cultures, faba bean variety balady seeds and wheat variety Skha 193 grains were treated with the fumigant fostoxin at 3 tablets for 5 days. One day old adults of *C. maculatus* & *C. chinensis* were used to infest faba bean seeds and seven to fourteen days old adults of *R. dominica* & *S. oryzae* were used to infest wheat grains. All insects were reared under laboratory conditions at 26 ± 2ºC and 60 ± 5% RH. The parasitoid *A. calandrae* was cultured in the laboratory according to the method described by Ngamo *et al.,* 2007.

Plastic bags (16 X 24 cm) were filled with 1/2 Kg of either seeds or grains of the newly harvested crops and kept in storage conditions. The moisture content of the grains or seeds was approximately 13-14% at the beginning of the experiment. Three replicates were used for both seeds or grains at Ismalia and Sharkia governorates locations in wire cages 50x50x50cm under open-storages from April to October/2009.

Eight adults (mixed males and females) of each of the *C. maculatus* and *C. chinensis* were released inside each replicate of faba bean seeds bags. Also eight adults (mixed males and females) of each of the *R. dominica* and *S. oryzae* were released inside each replicate of wheat grains bags. The parasitoid *A. calandrae* at the rate of 50 adults (mixed males and females) was release into each bag at 3, 45 and 90 days after releasing insects inside the bags.

After 1.5, 3, 4.5 and 6 months of storage, the number of alive *C. maculatus* and *C. chinensis*, inside faba bean seeds replicates were inspected. Also after the same intervals of storage, the number of alive *R. dominica* and *S. oryzae*, inside wheat grains replicates were inspected. Samples were returned back to bags after inspection. The efficacy of the parasitoid *A. calandrae* release in reducing infestation and population of the *C. maculatus*, *C. chinensis*, *R. dominica* and *S. oryzae* were calculated as percentage reduction of adult population in the faba bean seeds and wheat grains samples at the various storage periods as follows:

% Reduction=100 X (Adults No. in control – Adults No. in the treatment)/Adults No. in control

Percentage seeds damaged by feeding of *C. maculatus*, and *C. chinensis* as emergency holes were recorded after the completion adults emergence at storage periods (Abd El-Gawad and bd El-Aziz 2004).

Percentage weight loss was calculated from the weight difference after insect infestation and changed to dry percentage weight loss after subtracting the contained water (Gharib and Abd Al-Aziz 2005), as follows:

Weight loss (%) = 100 X (Initial dry weight – Final dry weight) / Initial dry weight

Obtained data was subjected to linear regression and analysis of variance (ANOVA) in SAS program (Anonymous, 1988).

RESULTS AND DISCUSSION

Results concerning the effect of *A. calandrae* release as 50 adults (mixed males and females) on adult populations of the *C. maculates*, *C. chinensis*, *R. dominica* and *S. oryzae* are illustrated in Figs. 1 and 2 and percentage reduction for stored faba bean seeds and wheat grains at Ismalia and Sharkia governorates locations. Sharkia governorate locations recorded higher but not significantly different population than Ismalia governorate locations for the *C. maculates*, *C. chinensis*, *R. dominica* and *S. oryzae* to stored faba bean seeds and wheat grains.

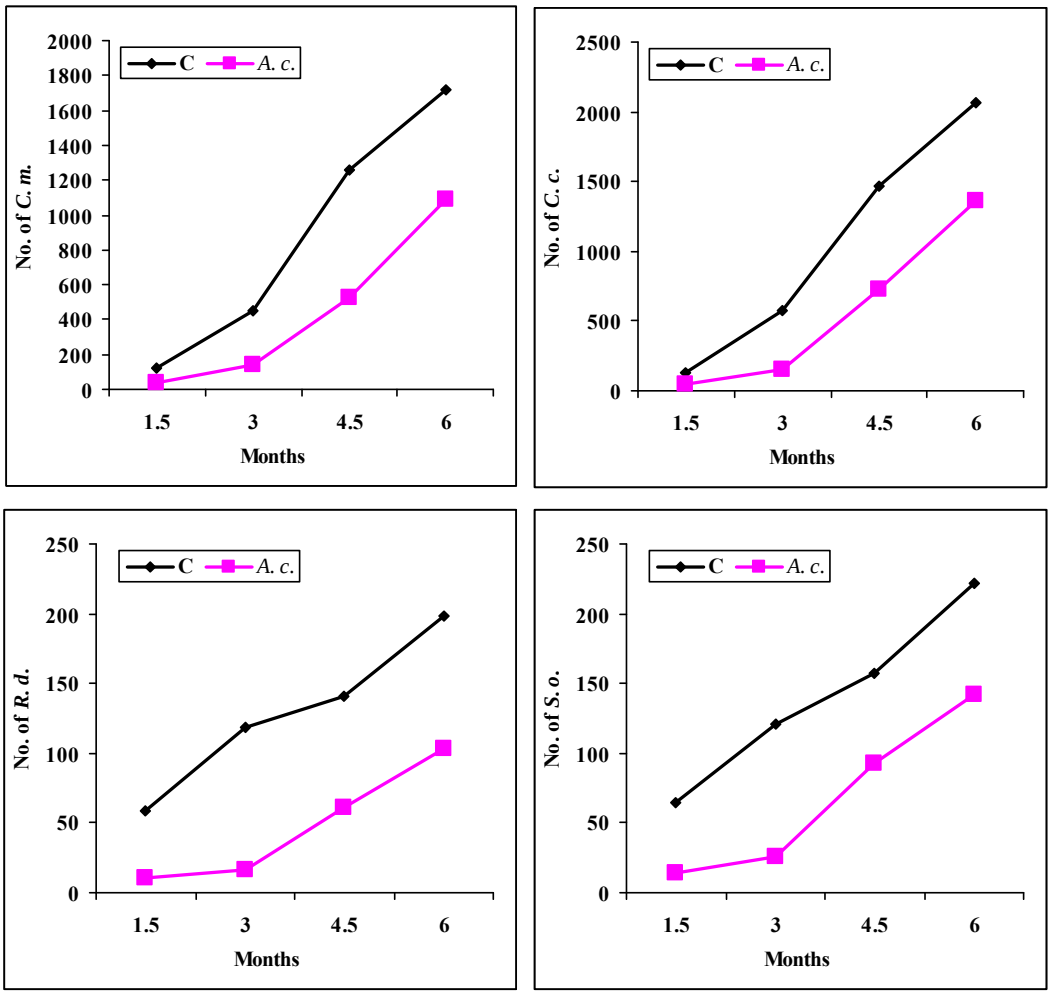

Fig.1: Mean numbers of *C. maculatus* (*C. m.*) & *C. chinensis* (*C. c.*) inside bags of faba bean seeds and *R. dominica* (*R. d.*) and *S. oryzae* (*S. o.*) inside bags of wheat grains as result of *A. calandra*inside *(A. c.)* release compared with control (C) at Ismailia Governorate.

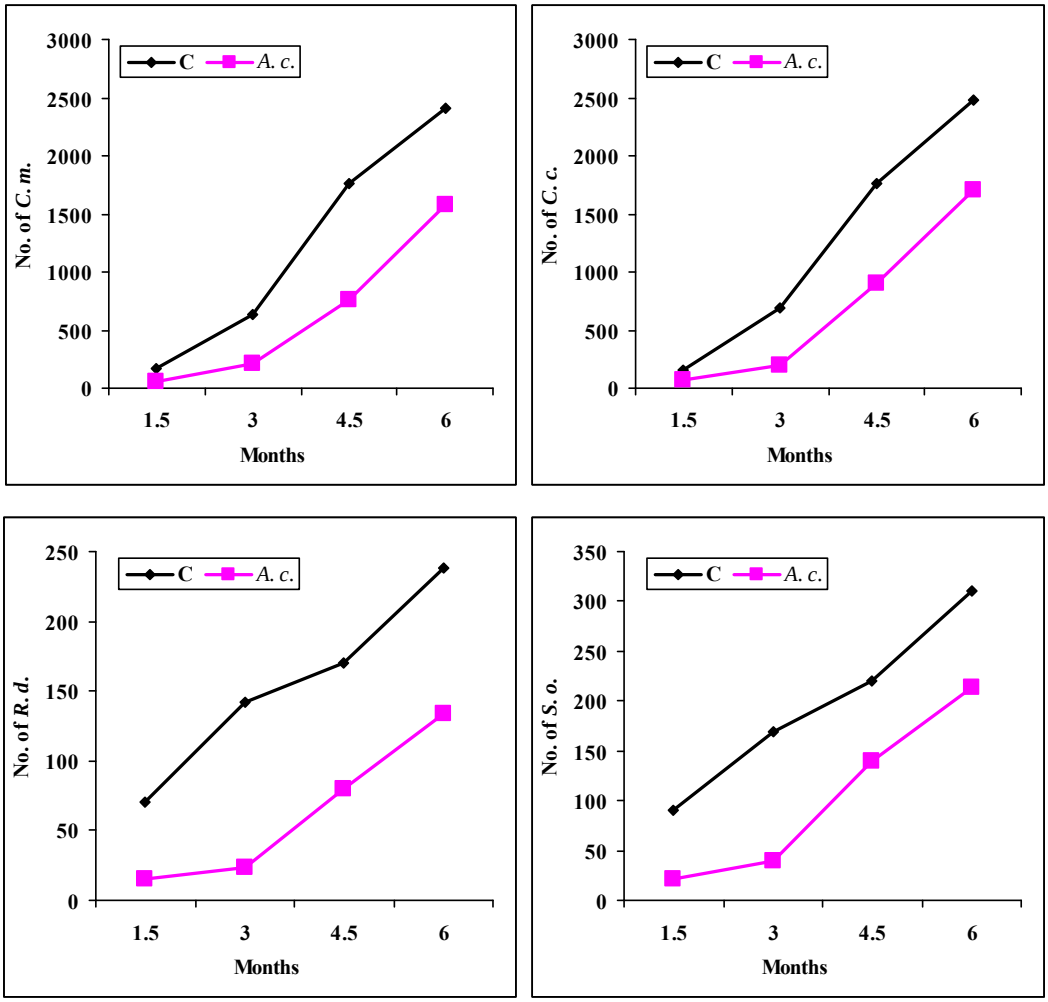

Fig.2: Mean numbers of *C. maculatus* (*C. m.*) & *C. chinensis* (*C. c.*) inside bags of faba bean seeds and *R. dominica* (*R. d.*) and *S. oryzae* (*S. o.*) inside bags of wheat grains as result of *A. calandra*inside *(A. c.)* release compared with control (C) at Sharkia Governorate.

Results revealed that the number of the *C. maculates*, *C. chinensis*, *R. dominica* and *S. oryzae*, per faba bean seeds and wheat grains samples were obviously reduced as result of *A. calandrae* release at the used rate at different storage periods compared to the control.

At Ismalia location mean population of *C. maculates* on faba bean seeds increased to 1716 and 1086 per bag for the control and parasitoid release, respectively over the storage period of 6 months (36.71 % reduction). The rate of increase over the storage time was (42.14% reduction) 303.73 and 175.73/month for the control and parasitoid release, respectively. For *C. chinensis*, mean population increased to 2070 and 1365 per bag for the control and parasitoid release, respectively (34.06 % reduction). The rate of increase was 363.73 and 225.37/month, respectively (37.94% reduction) (Table 1).

At Sharkia location mean population of *C. maculates* on faba bean seeds increased to 2403 and 1576 per bag for the control and parasitoid release, respectively over the storage period (34.42% reduction). The rate of increase over the storage time was 425.73 and 255.53/month for the control and parasitoid release, respectively (39.98% reduction). For *C. chinensis*, mean population increased to 2484 and 1708 per bag for the control and parasitoid release, respectively (31.24% reduction). The

rate of increase was 436.37 and 282.76/month, respectively (35.20% reduction) (Table 1).

At Ismalia location mean population of *R. dominica* on wheat grains increased from 8 adults to 198 and 103 per bag for the control and parasitoid release, respectively over the storage period (47.98% reduction). The rate of increase over the storage time was 30.08 and 16/month for the control and parasitoid release, respectively (46.80% reduction). For *S. oryzae*, mean population increased to 222 and 142 per bag for the control and parasitoid release, respectively (36.04% reduction). The rate of increase was 34.73 and 23.13/month, respectively (33.40% reduction) (Table 1).

Table 1: Regression values for control and released parasitoid in bags over 6 months of storage.

Crop	Insect	Location	Status	Regression values			Insects/bag after 6 months
				a	b	P	
Faba bean seeds	*C. maculates*	Ismalia	Control	-200.4	303.73	0.0001	1716
			Release	-166.8	175.73	0.0001	1086
		Sharkia	Control	-282.6	425.73	0.0001	2403
			Release	-244.0	255.53	0.0001	1567
	C. chinensis	Ismalia	Control	-242.4	363.73	0.0001	2070
			Release	-216.8	225.37	0.0001	1365
		Sharkia	Control	-291.6	436.37	0.0001	2484
			Release	-272.2	282.76	0.0001	1708
Wheat grains	*R. dominica*	Ismalia	Control	12.4	30.08	0.0001	198
			Release	-8.0	16.00	0.0001	103
		Sharkia	Control	14.0	37.27	0.0001	238
			Release	-11.4	21.13	0.0001	134
	S. oryzae	Ismalia	Control	10.2	34.73	0.0001	222
			Release	-12.8	23.13	0.0001	142
		Sharkia	Control	12.4	49.70	0.0001	311
			Release	21.6	35.26	0.0001	213

At Sharkia location mean population of *R. dominica* on wheat grains increased to 238 and 134 per bag for the control and parasitoid release, respectively over the storage period (43.70% reduction). The rate of increase over the storage time was 37.27 and 21.13/month for the control and parasitoid release, respectively (43.31% reduction). For *S. oryzae*, mean population increased to 311 and 213 per bag for the control and parasitoid release, respectively (31.51% reduction). The rate of increase was 49.07 and 35.26/month, respectively (29.05% reduction) (Table 1).

Results of percentages seeds damage by the feeding of C. *maculates* and *C. chinensis* on faba bean seeds after release of *A. calandrae* at the used rate over inspections were given in Fig.3**.** Results show clearly that the release of *A. calandrae* resulted in considerable drop in seed damage tested compared to control. Sharkia governorate locations recorded higher number but not significantly different percentage of in percentages of seed damage than in Ismalia governorate locations for both C. *maculatus* and *C. chinensis*. The mean final percentages of seeds damage were [(46.96 & 79.28) and (57.55 & 84.58)] and [(51.46 & 87.21) and (63.11 & 93.04)] per 1/2 Kg of faba bean seeds at Ismalia and Sharkia governorates locations, respectively after storage periods of 6 months for release of *A. calandrae* at the used rate and control, respectively. Meanwhile, a pronounced increase in seeds damage was recorded with increasing storage period and insect population in the seeds. The obtained data revealed clearly that percentage of seed damage of faba bean seeds was

positively related to the population density of insects in the seeds and the length of storage period. The results are in agreement with Raja *et al.* (2001) and Abdel- Latif (2003).

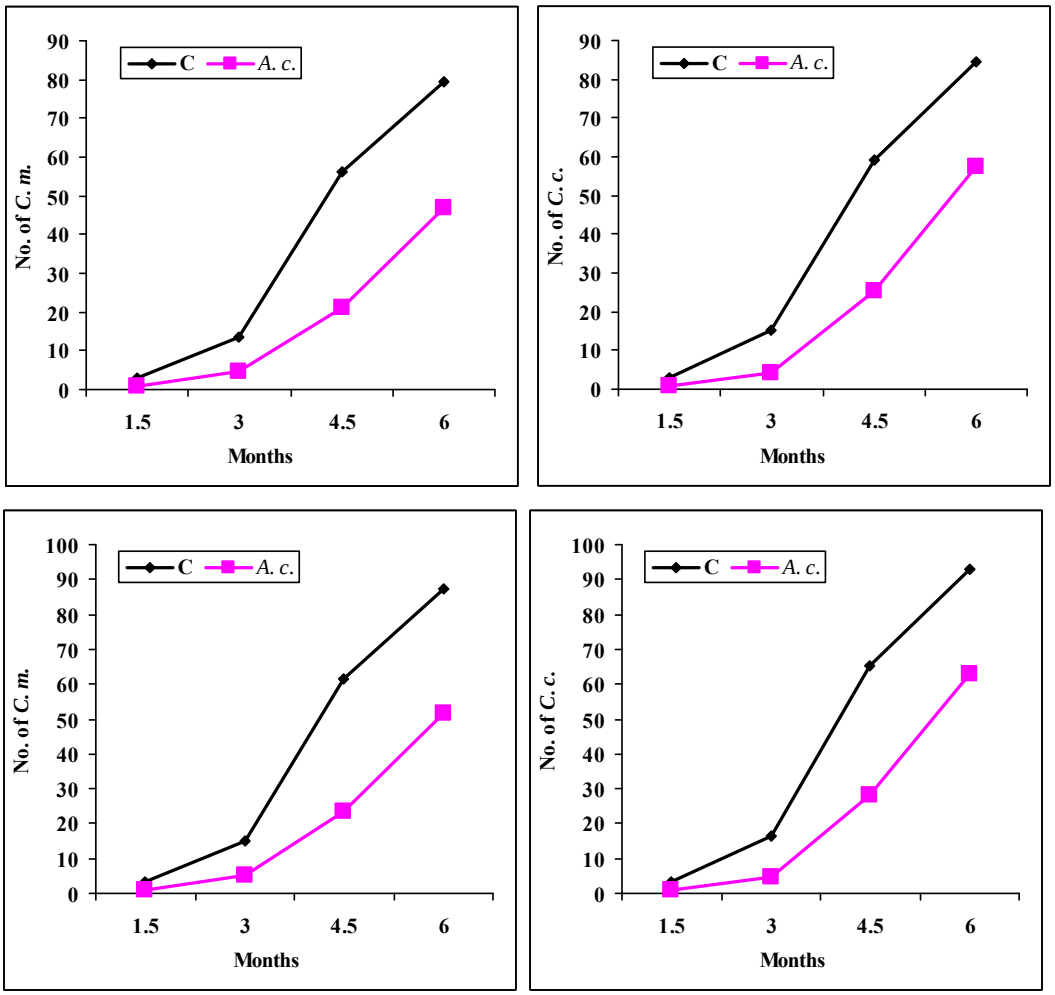

Fig. 3: Mean seed damage percent due to infestation with different tested pests over inspections of faba bean seeds under *A. calandra*inside *(A. c.)* released inside bags of faba bean seeds at Ismailia and Sharkia Governorates. C: Control

Results of percentages weight loss by feeding of *R. dominica* and *S. oryzae* on wheat grains after release of *A. calandrae* at the used rate over inspections are given in Fig. 4. Results showed clearly that the release of *A. calandrae* at the used rate resulted in considerable drop of the losses in wheat grains tested compared with control. Sharkia governorate locations recorded higher number but not significantly different percentage in percentages of weight loss than in Ismalia governorate locations for both *R. dominica* and *S. oryzae*. The mean final percentages weight loss were [(2.57 & 9.72) and (2.7 & 9.88)] and [(2.91& 13.61) and (2.38 & 12.84)] per 1/2 Kg of wheat grains at Ismalia and Sharkia governorates locations, respectively after storage periods of 6 months for release of *A. calandrae* at the used rate and control, respectively. Meanwhile, a pronounced increase in weight loss was recorded with increasing both storage period and insect population in the grains. The obtained data revealed clearly that percentage of weight loss of wheat grains was positively related to the population density of insects in the grains and the length of storage period. These results are in agreement with El-Lakwah and Abd El-Latif 1998, Abd El- Latif

2003, Abd El-Gawad and Abd El-Aziz 2004, Abd El-Aziz and Abd El-Gawad 2005 and. Abd El-Gawad and Abd El-Aziz 2005.

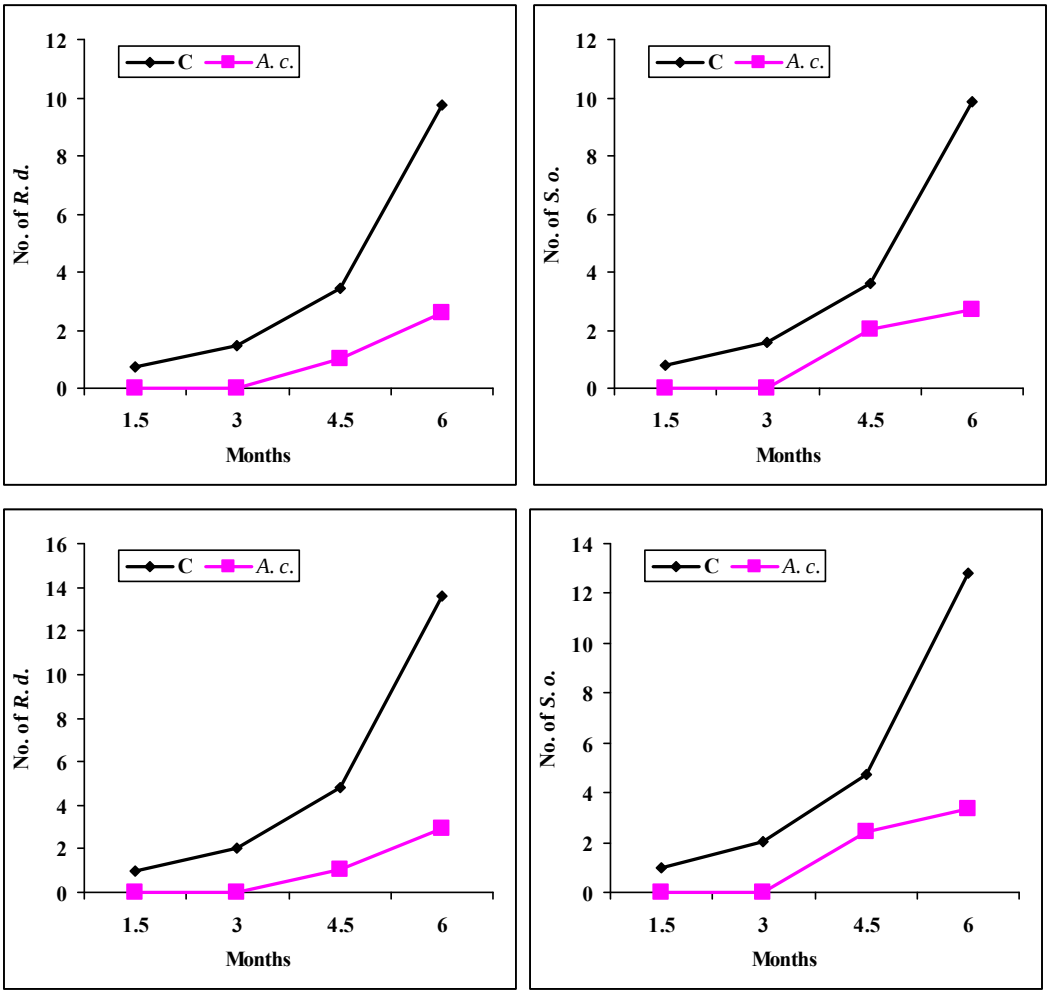

Fig. 4: Mean weight loss percent due to infestation with different tested pests over inspections of wheat grains under *A. calandra*inside *(A. c.)* released inside bags of wheat grains at Ismailia and Sharkia Governorates. C: Control

In conclusion obtained results revealed that releasing *A. calandrae* at the used rate was potential factors for *C. maculates*, *C. chinensis*, *R. dominica* and *S. oryzae* on faba bean seeds and wheat grains under storage conditions.

Obtained results are in agreement with published results in this manner (*i.e.* Ahmed, 1996; Lucas and Riudavets, 2002; Biswas *et al*., 2004; Mahal *et al*., 2005; Qumruzzaman and Islam, 2005; Ahmed *et al*., 2006; Ghimire and Phillips, 2007 and Ngamo *et al*., 2007).

In general, using of such natural enemies in IPM programmers can be useful with other safe alternative control methods that decrease the application of harmful pesticides.

REFERENCES

Abd El-Aziz, A. E. and Abd El-Gawad H. A. S. (2005). Use of different natural control agents in management of the lesser grain borer, *Rhyzopertha dominica* (F.) and rice

weevil *Sitophilus oryzae* (L.) on wheat and maize grains. Bull. ent. Soc. Egypt, Econ. Ser. 31:125-141.

Abd El-Gawad, H. A. S. and Abdel-Aziz A. E. (2004). Evaluation of different integrated pest management concepts for controlling the legume beetles, *Callosobruchus maculatus* (F.) and *Callosobruchus chinensis* (L.) on faba bean and cow pea seeds. Bull. ent. Soc. Egypt, Econ. Ser., 30:105-122.

Abd El-Gawad, H. A. S. and Abd El-Aziz A. E. (2005). Use of some biological control agents for controlling the angoumois grain moth, *Sitotroga cerealella* (Olivier) on wheat and maize grains (Lepidoptera: Gelchiidae). Bull. ent. Soc. Egypt, Econ. Ser. 31, 143:155.

Abdel-Latif, A. M. (2003). Effect of some plant oils as protectants of stored legumes against cowpea beetle, *Callosobruchus maculatus* (F.) infestation. Fayoum J. Agric., Res. and Dev., 17, 2: 98-106.

Ahmed, K.S. (1996). Studies on the ectoparasitoid, *Anisopteromalus calandrae* (Hymenoptera: Pteromalidae) as a biological agent against the lesser grain borer *Rhyzopertha dominica* (F.) in Saudi Arabia. J. Stored Product Res. 32 (2): 137-140.

Ahmed, K.N.; Praman S.H.A.; Nargis A. and Khatun M. (2006). Interspecific competition between *Anisopteromalus calandrae* (Howard) (Pteromalidae) and *Dinarmus basalis* (Rond.) (Pteromalidae) on *Callosobruchus chinensis* (L.). J. Biological Science 14: 103-106.

Anonymous (1988). SAS/STAT, User`s Guide, Ver. 6.03. SAS Institute Inc., Cary, North Carolina.

Baker, J.E.; Dowell F.E. and Throne J.E. (1999). Detection of parasitized rice weevils in wheat kernels with near-infrared spectroscopy. Biological control 16: 88-90.

Biswas, L.; Islam W. and Mondal K.A.M.S.H. (2004). Potentiality of *Anisopteromalus calandrae* (Howard) and *Choetospila elegans* (Westwood) against the rice weevil, *Sitophilus oryzae* (Linnaeus). J. Biological Control 18 (2): 141-145.

El-Lakwah, F. A. and Abdel-Latif A. M. (1998). Effect of surface treatment of grain bags with the botanical insecticide Neemazal-T and certain plant extracts on weight loss of stored wheat and maize grains due to infestation with *Sitophilus oryzae* (L.). Egypt. J. Agric. Res., 76 (3): 1003-1016.

Gharib, M.S.A. and Abd El-Aziz A. E. (2005). Post harvest infestation of some Egyptian barley varieties with *Trogoderma granarium* everts. Ann. Agric. Sc., Moshtohor, 43(1):477-484.

Ghimire, M.N. and Phillips T.W. (2007). Suitability of five species of stored product insects as hosts for development and reduction of the parasitoid *Anisopteromalus calandrae* (Hymenoptera: Pteromalidae). J. Econ. Entomol. 100 (5): 1732-1739.

Lucas, E. and Riudavets J. (2002). Biological and mechanical control of *Sitophilus oryzae* (Coloptera: Curculionidae) in rice. J. Stored Product Res. 38 (3): 293-304.

Ngamo, T. S. L.; Kouninki H.; Ladang Y. D.; Ngassoum M. B.; Mapongmestsem P. M. and Hance T. (2007). Potential of *Anisopteromalus calandrae* (Hymenoptera: Pteromalidae) as biocontrol agent of *Callosobruchus maculatus* (F.) (Coleopetera: Bruchidae). African J. Agric. Res. 2(4), pp. 168-172.

Mahal, N.; Islam W.; Parween S. and Mondal K.A.M.S.H. (2005). Effect of *Anisopteromalus calandrae* (Hymenoptera: Pteromalidae) in controlling residual populations of *Rhyzopertha dominica* (Coloptera: Bostrichidae) in wheat store. Interaction J. Tropical Insect Science 25: 245-250.

Raja, N., S. Albert, Ignacimuthu S. and Dorn S. (2001). Effect of plant volatile oils protecting stored cowpea *Vigna unguiculata* (L.) Walpers against *Callosobruchus maculatus* (F.) (Coleoptera: Bruchidae) infestation. J. Stored Prod. Res. 37: 127-132.

Qumruzzaman, A.H.M. and Islam W. (2005). Interaction between *Dinarmus basalis* and *Anisopteromalus calandrae (*Hymenoptera: Pteromalidae) at different parasitoid densities on *Callosobruchus chinensis* (Coloptera: Bruchidae) in red lentil seeds. Interaction J. Tropical Insect Science 25 (1): 6-11.

ARABIC SUMMARY

تأثير إطلاق الطفيل *Anisopteromatus calandrae* على بعض خنافس غمدية الأجنحة للمواد المخزونة فى مصر

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معهد بحوث وقاية النباتات- مركز البحوث الزراعية

تم إجراء هذا البحث بغرض دراسة تأثيرالأطلاق المباشر(الأجولة من الداخل) لبذور الفول او حبوب القمح وذلك بإطلاق طفيل *Anisopteromalus calandrae* على تعداد الحشرات ونسبة اصابة بذور الفول ونسبة فقد الوزن فى حبوب القمح نتيجة لإصابتها بحشرات *C. maculates C. chinensis*, *R. dominica* and *S. oryzae* فى محافظتى الاسماعيلية والشرقية خلال موسم ٢٠٠٩. واوضحت النتائج ان اطلاق الطفيل *Anisopteromalus calandrae* يؤدى إلى خفض معدل الزيادة الشهرى بالنسبة للخنافس المختبرة على الفول البلدى وهذا المعدل يتراوح مابين ٣٥.٢-٤٢.١٤% وهو ناتج من خفض تعداد الحشرات فى نهاية فترة التخزين لمدة ستة شهور بمعدل يتراوح مابين ٣١.٢٤-٣٦.٧١%. اما فى حالة حبوب القمح فان معدل الزيادة الشهرى ينخفض بمعدل يتراوح مابين ٢٩.٠٥-٤٦.٨٠% وهذا المعدل ناتج من خفض تعداد الحشرات فى نهاية فترة التخزين لمدة ستة شهور بمعدل يتراوح مابين ٣١.٥١-٤٧.٩٨% . ويؤخذ فى الاعتبار ان اصابة بذور الفول البلدى خلال فترة التخزين تنخفض مابين ٣١.١٧-٤٠.٩٩% نتيجة لعملية اطلاق الطفيل . وفى حالة حبوب القمح فان الفاقد فى الوزن يتراوح انخفاضه مابين ٧٢.٦٧-٨١.٤٦%.