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EVALUATION OF DIFFERENT SAMPLING METHODS TO ESTIMATE THE POPULATION DENSITY OF BLISTER BEETLE, *MELOE PROSCARABAEUS* L. (COLEOPTERA: MELOIDAE) IN NEW-VALLEY GOVERNORATE, EGYPT.

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ABSTRACT

The blister beetle, *Meloe proscarabaeus* L. (Coleoptera: Meloidae) was recorded for the first time as a serious insect pest attacking faba bean (*Vicia faba* L.), peas, alfalfa, onion and wild weeds in El-Farafra Oasis, (Western Desert), Egypt. Beetles feed on foliage and flowers of injured plants causing defoliation and crop loss. Adults occurred in the fields from early November until late March. Beetles secrete a cantharidin fluid, a potent blistering agent which burns plant leaves and flowers and at the same time, it is strong poison to all livestock and domestic animals feeding on contaminated plants.

The present work was conducted to evaluate different sampling methods to estimate the population of *M. proscarabaeus* under field conditions of El–Farafra Oasis. Three methods were tested during two seasons (2009-20010) and (2010-2011). Results revealed that the most effective method was direct count technique followed by pitfall traps and at last was wooden frames. Direction wise the north direction was significantly efficient over other directions.

Keywords: Assessment, surveying methods, Faba bean, population, Fields, ecology.

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INTRODUCTION

Faba bean *Vicia faba* L. is one of the most common field crops cultivated in El-Farafra oasis. It occupied the largest area of cultivated crops (52%), followed by alfalfa (37%), while peas occupied the smallest area (11%). However, these crops are threatened through growth season by many insect species. One of the most dangerous and common is the blister beetle, *Meloe proscarabaeus* L. (Coleoptera: Meloidae). As the adults greatly feed on plant leaves, flowers and seeds causing considerable damage and crop loss (Ali *et al*. 2005 a & b). Under El–Farafra Oasis adults occurred in the fields from early Nov. until late Mar.

Different species of blister beetles were reported in United States and Europe as key pest of legume crops particularly alfalfa and faba bean (Coppock, 1981, Bladgett & Sutherland, 1984, Ward, 1985, Whitehead, 1991 and Kinney *et al*. 1998). In Africa, blister beetles (Meloidae) became the key pest of food crops in Mali and Senegal (Gahuker *et al*. 1989).

The serious problem of the presence of blister beetles attacking forage and legume crops does not restricted for crop damage and yield loss only but arises from their secretion of Cantharidin (a potent blistering agent

and poisoning of live stock) particularly horses when feeding on alfalfa (Lucerne) contaminated with this fluid or dead blister beetles (Capinera *et al.,* 1985; Buntin, 1989; Schmitz, 1989 and Polettini *et al*. 1992).

The prevalence of the blister beetle, *M. proscarabaeus* adults as serious pest of faba bean and alfalfa in El-Farafra Oasis is quite substantial and calls for effective management. Successful design of suitable management options would rely on the understanding of pest species distribution patterns and their response to environmental gradient. This study was conducted to compare the blister beetle sampling methods efficiency to estimate its population abundance and distribution in the various field cardinal directions. Three methods as direct count technique, blue pitfall traps and wooden frame were evaluated. El-Sheikh (2007) reported that blue pitfall attracted the greatest number of *M. proscarabeus* beetles.

MATERIALS AND METHODS

Assessment of different surveying methods to estimate the population density of Blister Beetles in the field:

Direct count technique: At El-Kefah village (EL-Farafra Oasis), random monitoring process was performed at regular intervals (7 days). Direct count (plant inspection) technique was applied for both 2009/2010 and 2010/2011 seasons. This technique started from 16/11/2009 to 31/3/2010 during the first season and from 17/11/2010 to 29/3/2011 for the second one. One-hundred plants from different field directions (east, west, north, and south) were chosen randomly and wholly inspected in about half feddan for sampling.

Pitfull traps: Five blue traps / location were placed on the surface of the soil. Fallen adults were counted every 7 days. Each trap was about 20 X 15 cm. with about 1 m. in between traps in about half feddan. Traps were inspection dates were similar to the previous technique.

Wooden frame: As this species of terrestrial motion behaviour (non-flying insect), wooden quadrates of about 50X50 cm. were used to count the number of adult beetles that fall within it. In each cardinal direction, 3 replicates were placed every 7 days and inspection dates was comparable to the previous technique.

Data analysis:

Results concerned the collected population of blister beetles through using different sampling techniques (direct count, pitfall traps and wooden frames) was analyzed using SAS program (Anonymous 1988). Average number of beetles for different cardinal sites and field depth were also computed and compared using analysis of variance (ANOVA) and significantly different means (< 0.05) separated using LSD in the same program.

RESULTS

*** Direct count technique:**

Obtained results are graphically illustrated at Tables (1 and 2). North direction was the most favorable direction for adult stage of *M.*

proscarabaeus beetles during both seasons represented by 1934 and 1758 total collected individuals during 2009/2010 and 2010/2011 seasons, respectively. East direction was presented by 155 and 123 collected beetles during both seasons and occupied the second rank. South and west directions were represented by lower numbers of beetles (Tables 1 and 2). The total seasonal number of beetles was 143 and 126 beetles at southern and western directions, respectively in 2009/2010 season, while, 116 and 111 beetles were captured at the two previous mentioned directions, respectively in the second season (2010/2011). Center of the field was the least preferred site for adults of *M. proscarabaeus* where no insect was observed at this position throughout the whole investigated period (Fig. 1 and 2).

Table (1): Average numbers of the blister beetles; *M. proscarabaeus* adult occurred in faba bean field, EL-Farafra Oasis, 2009-2010.

Date	Mean no. of beetles /100 plants			
	N	S	W	E
November 16/2009	35	6	1	3
23/2009	48	2	3	7
30/2009	60	5	4	5
December 7/2009	98	6	5	6
14/2009	110	7	6	3
21/2009	124	3	2	6
28/2009	132	6	4	8
January 4/2010	139	5	4	7
11/2010	143	8	6	8
18/2010	148	10	8	10
25/2010	151	10	10	14
31/2010	160	13	12	18
February 7/2010	145	17	18	14
14/2010	128	15	16	13
21/2010	112	12	15	10
29/2010	81	9	6	8
March 8/2010	65	5	4	7
16/2010	40	3	2	5
24/2010	15	1	0	3
31/2010	0	0	0	0
Total	1934	143	126	155
Mean ± S.E.	96.7 ±11.15 a	7.15 ±1.3 b	6.3 ±1.8 b	7.75 ±1.1 b

L.S.D.: 11.824 F value: 84.27 d.f.: 23 P: significant < 0.01
Means followed by the same letters are not significantly different [P = 0.05; Multiple range test (Duncan, 1955)].

Table (2): Average numbers of the blister beetles; *M. proscarabaeus* adult occurred in faba bean field, EL-Farafra Oasis, 2010-2011.

Date	Mean no. of beetles /100 plants			
	N	S	W	E
November 17/2010	31	2	1	0
24/2010	40	0	4	2
30/2010	49	3	6	4
December 8/2010	62	2	5	3
15/2010	80	4	4	6
22/2010	99	6	2	4
29/2010	118	5	7	5
January 5/2011	125	7	8	6
12/2011	130	3	5	7
18/2011	139	7	3	10
25/2011	145	10	9	9
31/2011	150	12	10	12
February 8/2010	143	16	13	14
15/2011	134	13	11	13
22/2011	110	10	9	11
28/2011	84	8	7	9
March 9/2011	70	6	4	6
15/2011	39	2	3	1
22/2011	10	0	0	1
29/2011	0	00	00	00
Total	1758	116	111	123
Mean ± S.E.	87.9 ±10.7 a	5.8 ±1.2 b	5.55 ±1.1 b	6.15 ±1.4 b

L.S.D.: 10.731 F value: 78.27 d.f.: 23 P: significant < 0.01
Means followed by the same letters are not significantly different [P = 0.05; Multiple range test (Duncan, 1955)].

*** Pitfull traps:**

Obtained results are graphically illustrated at Tables (3 and 4). Captures were significantly greater in north direction; as 654 and 598 beetles were trapped through Nov.-Mar., 2009/2010 and 2010/2011 seasons, respectively. Western side traps was presented by 83 and 96 beetles through the two seasons, respectively and the least favorable direction. The other two directions throughout the whole study season showed an intermediate catches (353 and 334 in the east direction during 2009/2010 season, respectively and 182 and 189 in the south one during the second season) (Figs.3 and 4).

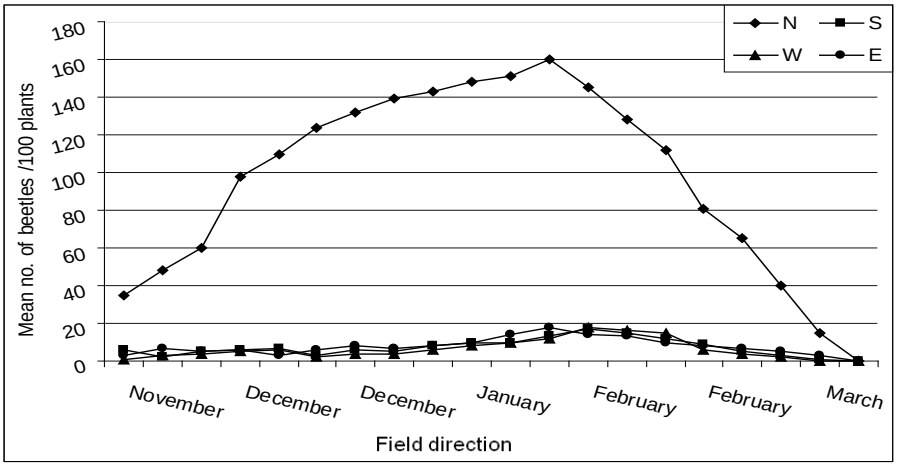

Fig. (1): Monthly numbers of *M. proscarabaeus* adult using direct count in faba bean field, EL-Farafra Oasis, 2009- 2010.

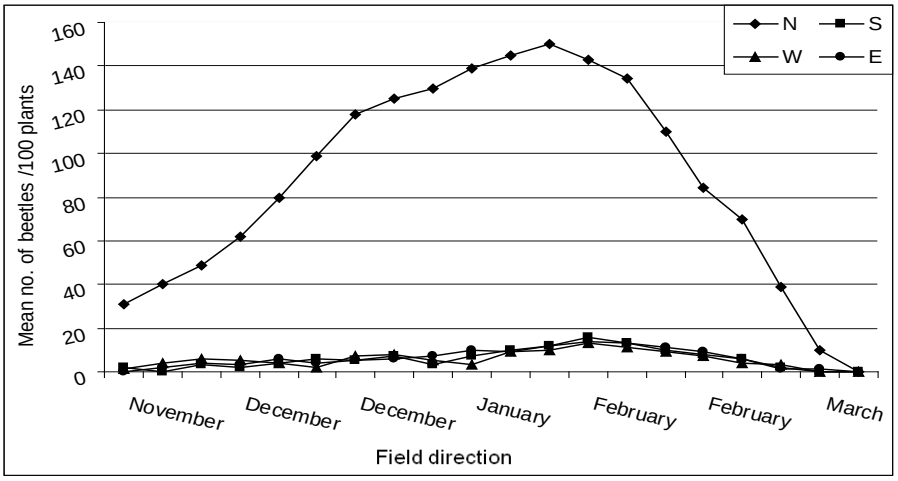

Fig. (2): Monthly numbers of *M. proscarabaeus* adult using direct count in faba bean field, EL-Farafra Oasis, 2010-2011.

Date	N	S	W	E

November 16/2009	15	4	2	7
23/2009	18	3	1	8
30/2009	20	5	3	11
December 7/2009	25	7	4	13
14/2009	27	8	4	16
21/2009	30	10	5	19
28/2009	35	11	3	21
January 4/2010	40	13	6	23
11/2010	46	15	7	26
18/2010	50	18	8	30
25/2010	58	16	6	33
31/2010	65	20	9	35
February 7/2010	56	16	8	32
14/2010	46	12	5	25
21/2010	37	10	5	19
29/2010	32	8	4	15
March 8/2010	25	4	2	10
16/2010	19	1	1	7
24/2010	10	1	0	3
31/2010	0	0	0	0
Total	654	182	83	353
Mean ± S.E.	32.7±4.3 a	9.1±3.9 b	4.15±1.6 c	17.65±3.1 a

Table (3): Number of trapped *M. proscarabaeus* adults in blue pitfall traps in faba bean field, 2009/2010 season.

L.S.D.: 15.862 F value: 65.89 d.f.: 23 P: significant < 0.01

Means followed by the same letters are not significantly different [P = 0.05; Multiple range test (Duncan, 1955)].

Table (4): Number of trapped *M. proscarabaeus* adults in blue pitfall traps in faba bean field, 2010/2011 season.

Date	N	S	W	E
November 17/2010	13	3	1	6
24/2010	16	5	3	9
30/2010	19	7	4	10
December 8/2010	22	9	1	13
15/2010	26	11	4	16
22/2010	30	12	5	18
29/2010	32	13	3	20
January 5/2011	35	16	5	22
12/2011	40	16	7	25
18/2011	44	19	10	31
25/2011	51	21	12	31
31/2011	57	23	15	34
February 8/2010	54	15	11	31
15/2011	43	10	8	26
22/2011	36	5	2	16
28/2011	32	3	3	10
March 9/2011	23	1	0	9
15/2011	15	0	1	5
22/2011	9	0	1	2
29/2011	1	0	0	0
Total	598	189	96	334
Mean ± S.E.	29.9±3.4 a	9.45±2.5 b	4.8±2.8 b	16.7±2.3 b

L.S.D.: 12.271 F value: 84.27 d.f.: 23 P: significant < 0.01

Means followed by the same letters are not significantly different [P = 0.05; Multiple range test (Duncan, 1955)].

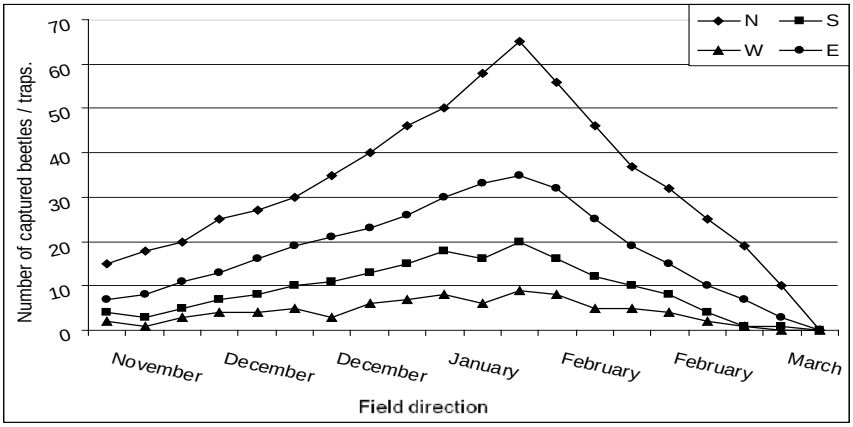

Fig. (3): Monthly numbers of *M. proscarapaeus* adults captured in blue pit-fall traps on faba bean field, EL-Farafra Oasis, 2010-2011.

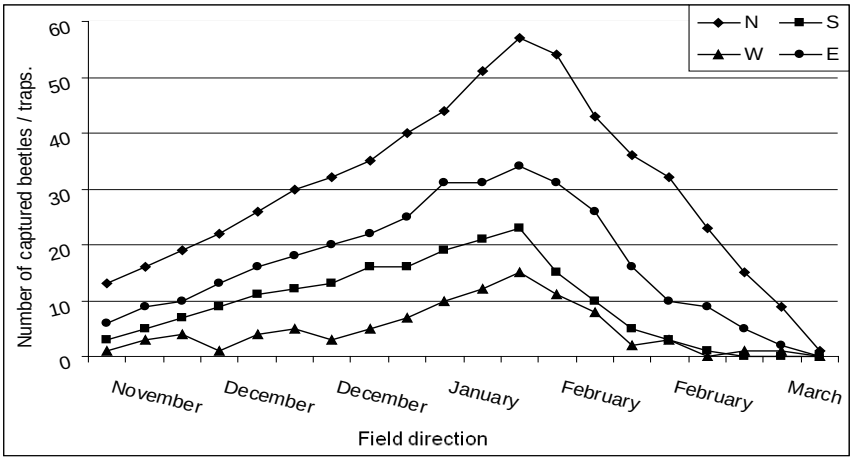

Fig. (4): Monthly numbers of *M. proscarapaeus* adults captured in blue pit-fall traps on faba bean field, EL-Farafra Oasis, 2010- 2011.

*** Wooden frames:**

Obtained results are graphically illustrated at Tables (5 and 6). Results indicated clarify that beetles activity was concentrated on plants located at northern side. Beetles number averaged 168 and 167 in the first and second seasons, respectively. However, these values drastically were lower to 45 and 42 beetles during both seasons when beetles were counted at the western side. This represented the least direction to which adult beetles were oriented. Both south and east directions exhibited intermediate adult capturing. Counts the southern side were 50 and 62 individuals during both seasons, respectively. Counts were 73 and 75 ones in the eastern direction during both seasons (Figs.5 and 6).

Date	N	S	W	E

November 16/2009	3	1	0	2
23/2009	2	0	0	1
30/2009	5	2	1	0
December 7/2009	6	1	3	1
14/2009	6	3	2	3
21/2009	7	2	4	2
28/2009	9	0	5	3
January 4/2010	10	4	3	5
11/2010	11	5	4	4
18/2010	12	6	3	3
25/2010	14	7	2	6
31/2010	15	8	4	8
February 7/2010	17	4	5	10
14/2010	13	3	4	8
21/2010	11	2	3	6
29/2010	10	0	1	5
March 8/2010	8	1	0	4
16/2010	6	1	1	2
24/2010	3	0	0	0
31/2010	0	0	0	0
Total	168	50	45	73
Mean ± S.E.	8.4±3.6 a	2.5±1.4 b	2.25±1.7 b	3.65±2.8 b

Table (5): Average numbers of the blister beetles; *M. proscarabaeus* adult captured in wooden frames in faba bean field, EL-Farafra Oasis, 2009- 2010.

L.S.D.: 11.931 F value: 75.56 d.f.: 23 P: significant < 0.01
Means followed by the same letters are not significantly different [P = 0.05; Multiple range test (Duncan, 1955)].

Table (6): Average numbers of the blister beetles; *M. proscarabaeus* adult captured in wooden frames in faba bean field, EL-Farafra Oasis, 2010- 2011.

Date	N	S	W	E
November 17/2010	2	0	1	2
24/2010	4	1	0	3
30/2010	3	3	2	1
December 8/2010	6	3	1	1
15/2010	8	4	3	3
22/2010	10	5	2	4
29/2010	9	3	2	2
January 5/2011	8	4	6	5
12/2011	12	2	4	6
18/2011	13	6	5	7
25/2011	14	7	1	8
31/2011	15	8	3	6
February 8/2010	16	5	4	9
15/2011	13	4	3	7
22/2011	10	3	2	4
28/2011	8	2	0	3
March 9/2011	6	1	1	2
15/2011	5	1	1	1
22/2011	3	0	1	0
29/2011	2	0	0	1
Total	167	62	42	75
Mean ± S.E.	8.35±2.5 a	3.1±2.2 b	2.1±1.4 b	3.75±2.8 b

S.D.: 12.543 F value: 79.467 d.f.: 23 P: significant < 0.01
Means followed by the same letters are not significantly different [P = 0.05; Multiple range test (Duncan, 1955)].

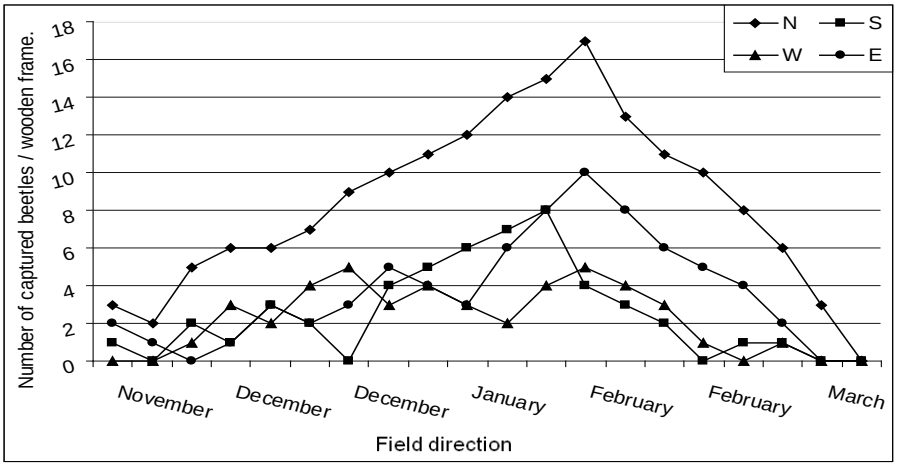

Fig. (5): Monthly numbers of *M. proscarapaeus* adults captured in wooden frame on faba bean field, EL-Farafra Oasis, 2009-2010.

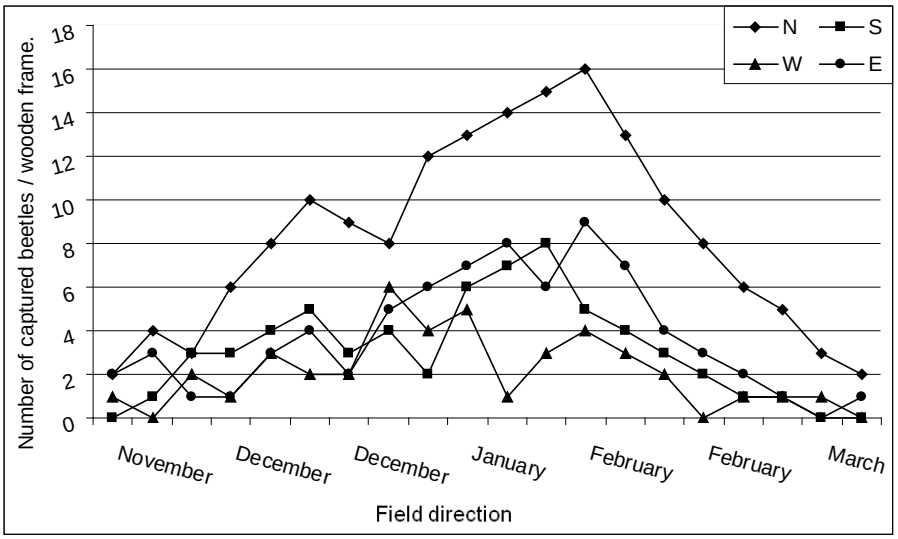

Fig. (6): Monthly numbers of *M. proscarapaeus* adults captured in wooden frame on faba bean field, EL-Farafra Oasis, 2010-2011.

*** Comparing different sampling methods for estimating *M. proscarapaeus* adult population:**

In this manner the significant effect of three factors affected this study ere considered. These factors were the sampling season, the sampling method and field direction. Obtained results are presented in Table (7). Results indicated no significant differences between the two seasons. The direct count sampling method was far more significantly efficient followed by pitfall traps and wooden frames were the least. Direction wise, the north one

was more significantly superior to other ones, with no significant between them (Table 7).

Table (7): Factorial analysis of obtained results for different methods and directions over the two seasons

Factor	Level	n	Mean
Season	2009-2010	240	16.525a
	2010-2011	240	15.296a
Method	Direct count	160	27.913a
	Pitfall trap	160	15.556b
	Wooden frame	160	4.263c
Direction	North	120	43.992a
	South	120	6.183b
	East	120	9.275b
	West	120	4.192b

Means in the same column with the same litter within each factor are not significantly different (P > 0.05).

DISCUSSION

Direct count method was the most efficient one in this study. Similar results were reopreted by Buntin (1989) for *Epicauta* spp., in 1987 and 1988. The obtained data revealed that *E*. *pestifera* was the most abundant in 1987, but *E*. *pennsylvanica* was the most abundant in 1988. Densities of *E. pestifera* and *E. pennsylvanica* peaked on 25 Aug. and 22 Sep., respectively, in both years. In synchrony, Evans (1990) recorded the aggregation of *Epicauta fabricii* adults on the legume *Baptisia australis* using the direct count procedure. Males were more abundant than females throughout the period of aggregation. The seasonal timing of aggregations resulted in early-opening flowers having the greatest chance of escaping destruction by the beetles. Through the direct count method, seasonal incidence of *Mylabris pustulata* was studied by Patnaik *et al*. (1993) in India. Beetle activity began with the initiation of flowering of pigeon peas in September and continued until the end of Dec. Beetle incidence reached a peak during Oct.

Colour factor plays a greater role in orientation and attracting insects in the environment to food, shelter and oviposition. This phenomenon was incorporated with different trap devices for monitoring and estimation the insect populations. Ali (1993) reported that traps painted green captured highly numbers of *Tropinota squalida* beetles while red ones had no attraction effect. Although yellow trap was reported as efficient tool for capturing many insect spices (Blodgett & Sutherland, 1984), the present results proved that this color is unsuitable for the blister beetle. Data also suggest that green pitfall trap proved its suitability as a new method for studying dynamics and forecasting *M. proscarabaeus* beetles.

In order to detect the movement of arthropod, including *Lygus hesperus* Bologna (1979) designed a trap consisted of aluminum T-bar with wooden slate which form the frame. This trap provided good evidence of *Lygus* movement from alfalfa to cotton when it was placed between the two fields. In harmony Anto *et al*. (2009) used the wooden quadrate frame to

study the seasonality of litter insects. The reported results revealed that all insect orders with the exception of Psocoptera were present during all four seasons with the domain of Coleoptera (42%) in all seasons. Bologna and Marangoni (1986) monitored the dynamic of saproxylic beetles (Scolytidae, Cerambycidae, and Buprestidae) with two different trap types; wooden frame and yellow buckets traps. The maximum numbers of saproxylic species were trapped in Jun. /early Jul. The first group reaching peak were the Scolytidae, followed by the *Buprestidae* and then by the *Cerambycidae*. Ips *typographus* was the most important bark beetle peaked in the third season after the storm. The controversy about protecting the forest and promoting biodiversity is discussed.

Generally although direct count sampling method of *M. proscarapaeus* population is the best, it is time and labor consuming. Accordingly, pitfall traps method can be used instead of the previous method as time and labor saving method. On contrary, wooden frame isn't recommended.

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تقييم طرق أخذ العينات المختلفة لتقدير جمهور الخنفساء الحارقة ، *Meloe proscarabaeus* L. (Coleoptera: Meloeidae) فى محافظة الوادى الجديد مصر

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سجلت لأول مرة الخنفساء الحارقة باعتبارها الآفة الحشرية الخطيرة التى تهاجم محصول الفول البلدي، والبسلة، والبرسيم الحجازى والبصل والأعشاب البرية في واحة الفرافرة ، الصحراء الغربية مصر، الخنفساء الحارقة يتغذى الطور البالغ وهو الطور الضار بشراهة على أوراق وزهور النباتات وتسبب تساقط الأوراق وفقد المحصول المصاب. شوهد الطور البالغ في الحقول من اول نوفمبر حتى أواخر شهر مارس.الخنفساء الحارقة تفرز سائل الكانثريدين، وهى مادة قوية تتسبب فى حرق أوراق وزهور النبات، وفي الوقت نفسه، فإن هذة المادة سامة لجميع المواشي وحيوانات المزرعة التي تتغذى على النباتات الملوثة بالكانثريدين.
العمل الحالي يسلط الضوء على تقييم طرق الحصر المختلفة لتقدير جمهور الخنفساء الحارقة تحت ظروف واحة الفرافرة.
فى هذة الدراسة تم تطبيق ثلاثة طرق لتقدير الخنفساء الحارقة فى حقول الفول البلدى خلال موسمى الدراسة ٢٠٠٩/ ٢٠١٠ - ٢٠١٠/٢٠١١ وكشفت النتائج أن الطريقة الأكثر فعالية في تقدير الخنفساء الحارقة فى الحقل هى طريقة العد المباشر على النبات ثم جاءت فى المرتبة الثانية طريقة الاطباق الملونة وأخيرا طريقة الاطار الخشبى خلال موسمى الدراسة.

قام بتحكيم البحث

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