THE BLISTER BEETLE , *MELOE PROSCARABAEUS* L. , A NEW INSECT PEST THREARTENS LEGUME CROPS IN EL FARAFRA OASIS , 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 Nov.until late May . 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 shed light on food plants , symptoms of infested crops, adult activity , environmental effects , and sexual behavior of the blister beetle *M.proscarabaeus* under the circumstances of El – Farafra oasis .

INTRODUCTION

Blister beetles or oil beetles are members of the family Meloidae (Coleoptera) . This family includes over 300 species in the United States and more than 2,500 worldwide (Odegaard & Lingaard , 2000 ; Bologna , 1988 ; Selander & Bouseman , 1960 ; Stebnicka , 1987) . The genus *Epicuta* is the largest and contains many species that concern forage producers in semi – arid regions of the western United States . In Egypt , Alfieri (1976) recorded 9 species belonging to family Meloidae collected from different desert localities vicinity to Cairo .

Adult beetles are phytophagous, feeding especially on plants in the families Amaranthaceae,Compositae,Leguminosae, and Solanaceae . Most adults eat only floral parts , but some , particularly those of *Epicuta spp.* , eat leaves.Ali *et al.*(2005) observed

that beetles belonging to *Meloe proscarabaeus* L. eat leaves and flowers of faba bean plants. A few adults are noctural ; most are diurnal or show no distinct diel cycle (Selander & Fasulo,2000). However, except for first instar larvae (triunglins) frequenting flowers or clinging to adult bees , larval blister beetles are seldome seen . So far as known , all larvae are predators . Larvae of most genera enter the nests of wild bees , where they consume both immature bees and the provisions of one or more cells (Luckmann & Kuhlman , 1997 ; Klaushitzer & Rauch , 2000 ; Stebnicka , 1987) .

Blister beetles produce cantharidin , which is toxic to people and animals (Ward , 1985 ; Ray *et al.* , 1980) . For centuries , cantharidin was prescribed as a cure for variety of animals . Spanshfly or cantharis , a oreparation of dried beetles , was thought to cure gout , carbuncles , rheumatism and many other medical disorders , in addition to its use as an aphrodisiac (Kinney *et al* ., 1998) .

El – Farafra oasis lies in the western desert , south part of Egypt, belonging to New Valley Governorate ; it is 600 km far from Giza . Farafra oasis is rich with submersible water which facilitates reclamation of many thousand hectares. Many different field crops has grown successfully with high yields,especially winter legume crops . One of the most common cultivated crops there is faba bean (*Vicia faba* L.),its cultivated area amounts approximately 5000 feddans , however , this crop is threatened by the attack of the blister beetle , *M. proscarabaeus* , the most serious pest .

The present article sheds light on the occurrence of the blister beetle *M.proscarabaeus* , population dynamics and bionomic observations in the faba bean fields and other legume crops as being recorded for the first time in El–Farafra oasis .

MATERIALS AND METHODS

Field observations on the blister beetle , *Meloe proscarabaeus* L. (Coleoptera : Meloidae) including beetle emergence , distribution , sexual behavior , feeding habits , and dial activity were carried out throughout the years 2002 /2003 and 2003 /2004 in El – Farafra oasis , western desert of Egypt. Observations commenced from mid–November till late May ; activity period of beetles in the field .

The field observations included the study of emergence period , population ecology of the beetles at different times and sexual behavior . This was carried out in two ways :

(a) In the year 2002 , oviposition sites of the newly emerged female beetles were recognized in the field and marked ; these were separated into eight groups , three sites each , according to date of egg laying . Each site contained one egg mass (2000 – 2150 eggs) . Wire – wooden cages , 35 x 50 x 50 cm each , were fixed on each site . Daily observations of cages were continued until beetles emergence . The number emerged beetles of each group was recorded as well as time of emergence and related environmental prevailing temperature .

(b) In El–Farafra as a whole adult *M.proscarabaeus* have been recognized in the months Nov., Dec.,Jan., Feb. and March . Freshly emerged beetles were marked with a color code (Whitehead ,1991) . This proved that emergence took place in synchronous waves during Nov.and Dec. Similarly number of emerged beetles were correlated with prevailing temperature of the environment .

Population dynamics of newly emerged beetles and adult abundance in relation to prevailing temperature and relative humidity were conducted in faba bean fields during two successive seasons 2002 /2003 and 2003 /2004 .

Density of beetles was assessed as direct count in 100 m of faba bean plants.Counting of beetles was carried out in the different directions of the field at weekly intervals , and as well as at different distances far from the field boarder : 1 , 2 , 4 , 6 , 8 , and 10 m . The micro-climatic conditions of the air as temperature and relative humidity were also measured .

The life–span and the fecundity of adult were determined by confinement freshly emerged beetles in pairs (female & male) on faba bean plants inside wire – wooden cages (35 x 50 x 50 cm) fixed in the field . Daily observations on sexual behavior , feeding habits periodicity and egg laying were started from mi –Nov. (first beetle emergence) to the beginning of Feb. (last date of beetle emergence).Data were derived from 24 field cages .

RESULTS AND DISCUSSION

1 . *Food and Feeding Habits*

Adults of *M.proscarabaeus* were observed feeding on leaves and flowers of faba bean (*Vicia faba*) , peas , alfalfa , Egyptian clover , onion and the wild weed *Meliolotus indica* (Ali *et al.* 2005) . Ozbek and Szaloki (1998) identified *Micromerus erivanicus* (Meloidae : Coleoptera) as a pest of flowers of *Vicia spp.* , *Onobrychis sativa* and *Mylabris quadripunctata* (Meloidae) as pests of soft wheat grains in Turkey . Adults of *Meloe varigatus* was recorded as insect pest of sugar beet , cabbage and winter rye (Stebnicka , 1987) .

Immediately after adults emergence of *M.proscarabaeus*,newly emerged beetles were seen moving in swarms from range – land to faba bean fields where they disperse and starting feeding for a period of up to 50 days . Faba bean was seeded in early Nov. and beetles emergence time convene with arising of faba bean seedlings of about 10–12 days with 2–3 leaflets . These young plants are the most preferable food . Newly emerged beetles have strong mandibles and long fore legs were seen masticate and attack faba bean seedlings feeding on leaves and plant stems and finally completely destroy the whole plants .Through feeding beetles secrete a yellow fluid from coxal and antennal joints ; this fluid blistering non – injured leaves which bear brownish and finally die .

Plants severely attacked may fail to produce flowers and beans , so the cropyield is completely lost . Feeding of beetles occurs during the whole day- light and never seen feeding during day – night . Coleman (1983) recorded a female *Meloe proscarabaeus* grazing on *Ranuchus sp .* in Cornwall . Ward (1985) reported that blister beetles feed on plant materials,particularly flowers of such plants as alfalfa,careless weed (Pigweed),punchrevine (goathead) , peanuts , soybeans and many other species . It seems that faba bean is not recorded in the diet of *Meloe* as indicated by Pinto & Selander (1970),therefore our record of this food plant as a diet of *Meloe proscarabaeus* becomes first record . Beetles were generally more numerous on the field side nearest to range – land and irrigation canals .

2 . *Seasonal Activity of Beetles*

In El–Farafra oasis as a whole adult *M. proscarabaeus* have been recognized in the months of Nov.,Dec., Jan.,Feb. and March in 2003 and 2004 , we observed the emergence and dispersal of freshly emerged beetles in faba bean fields.Weekly assessment of adult density in different parts of the faba bean field indicate November 14th as the earliest activity of adults , and March 28th as the latest (Table 1).

Adults developed from aestival diapaused larvae emerged from the soil in mid-November with low numbers ranged between 26 and 30 beetles / 100 bean plants in the years 2002 and 2003 at air and soil temperatures , and relative humidity averages 28.5 C , 29.1 C and 38 % , respectively . Density of beetles population increased gradually with a distinct peak in the end of Jan.; adult density averaged 150 and 140 beetles / 100 plants (38 and 35 beetles / m) in 2003 and 2004 .With lowering air and soil temperatures , beetles number gradually decreased during February and drastically in March (Tables 1 & 2) . Adult activity greatly diminished during March , the average weekly catch is about 34 beetles (9 beetles / m) . The period extending from December to February had the highest population of beetles . Environmental factors prevailed during the season 2002 / 2003 and 2003 / 2004 did not significantly varied , accordingly the population size of *M . proscarabaeus* adults insignificantly differed in 2002 /2003 (94.6 beetles) and 2003 /2004 (86.6 beetles) .

Results derived from weekly follow up of the insect population reveal the stability behavior of *M . proscarabaeus* adults under El – Farafra conditions and this species is a monovoltine (monocyclic species) with aestival larval diapause and has only one generation per annum .

3 . *Mating*

Pairs of beetles were several time observed in copulation during our periodic inspection of infested faba bean fields . Copulation occurred during day–light . Beetles that reached its sexual maturity (50 days post emergence) showed evidences of mating . It is true that males are attracted to females by sex pheromone emitted by females . Male was observed searching for the female at early morning and when they meet each other , courtship may start Primarily , male touches the antennae of the female partner , faced

her side and when female exhibits response , male touches her abdomen by its antennae . Repeated touches might take place until the female stopped calmly ; this acts for about 90 minutes . The male jumped on the female dorsal side rapidly and held female by thorax fore legs while female abdomen was held by male mid and hind legs . Because female abdomen is more longer than that of male , female withdraws its abdominal segments (telescope movement) to cope male abdominal end . Male abdominal tip flexed below the abdominal tip of the female , the highly chitinized male genitalia protruding and a great part of it was inside the female body , widely opening the female genitalia aperture for the entrance of the apical fleshy part of aedeagus . After this , the male rolled up to the opposite direction (tail to tail position) and mating was carried out .The maximum period of the act of copulation lasted for about one hour . When the male and female are disturbed during copulation , they soon separate from one another . Bologna and Marangoni (1986) reached to similar sexual behavior on *M . proscarabaeus* and *M . violaceus* when courtship was always short , but the subsequent dorsal phase was protracted ; during this phase , males touched the antennae of their partners , and areas of cuticular pores on the antennae of these males appear to be connected with emission of contact pheromone .

4 . *Oviposition Habits*

Egg – laying by *M . proscarabaeus* has been observed once in Jan. 2003. Female spent three hours excavating an egg chamber of 5 x 5 cm diameter and 4 x 6 cm deep in the closed boundary strips of 10 cm height near to irrigation canals and this time seems to be acceptable since the sediments and soil texture at El – Farafra oasis are sandy requiring minimal excavation labor . A female of *M. rugosus* spent 30 hours excavating an egg chamber and that long time may be regarded to the soil texture of oviposition sites at Waltshire (Whitehead,1991).Female of *M.proscarabaeus* spent two hours searching for the appropriate ovipositing site and used mandibles , fore and hind legs in excavating the ovipodition chamber . Oviposition lasted four hours. Eggs are laid in a longitudinal mass . Female moves after egg laying and continue feeding until death . More than one egg chamber and one egg mass per female have never been witnesses in *M. proscarabaeus* . Similar oviposition habits are characteristic of *Meleo* species . Selander and Fasulo (2000

) found eggs of Meloinae are deposited in masses in the ground or under stones , while beetles belonging to Nemognathinae lay eggs on the food plants of adults , however females of our species never laid eggs on their food plants . Although females of *M. proscarabaeus* lay eggs once during January , females of *M . rugosus* deposite their eggs once in November and twice in December (Whitehead , 1991) . The female of *Meloe variegates* digs holes between 2 and 3 cm deep in the ground and lays several batches of yellow eggs (Bohac and Winkler , 1964) .

5 . *Fecundity*

Females of the blister beetles showed conspicuous variation in the number of eggs laid by a female according to insect species , locality and environmental factors effects . Female of *M. proscarabaeus* deposited number of eggs varying according to season and thermal conditions . Females of 2003–population deposited number of eggs ranged between 1990 and 2150 eggs per female with an average of 2054.4 eggs / female , while the minimum and maximum number of eggs laid by 2004 – females were 1975 and 2160 eggs per female (av. 2044.4 eggs / female) . generally , the maximum number of deposited eggs (2136.7 eggs / female) was shown by female beetles emerged in December 4th and the lowest (1983 eggs / female) was achieved by females emerged in December 13th .

Fecundity of *M.proscarabaeus* females seems to be very low if compared with the number of eggs laid by *M . variegates* females (more than 10,000 eggs / female) and that could be attributed to insect species , locality and environmental conditions . The vast number of eggs laid by this species is necessary to ensure the survival of the species for very few larvae survive to develop into adult beetles (Bohac & Winkler , 1964) .

6 . *Significance of the Blister Beetles*

Field and laboratory observations proved that adults of the beetle , *M. proscarabaeus* exuded copiously a yellow fluid from the joints of their legs. This fluid is often secreted by reflexive bleeding when an adult beetle pressed or rubbed .This phenomenon was commonly noticed in most species of Meloid beetles (Ward 1985 ; Edwards *et al.* 1989 ; Whitehead 1991) . Like other blister beetle species , *M .*

proscarabaeus contains a large quantity of oily , yellow hemolymph which they exude when disturbed . This fluid was identified as cantharidin (a bicyclic terpenoid C10 H12 O4) . It is found in hemolymph and gonads of beetles . *Lytta resicatoria* (L.) (Meloidae) contains more cantharidin than any other member of the family ; cantharidin is found mainly in elytra but it has also been shown to exist in the genitalia and the hemolymph (Bohac & Winkler 1964) . Males have the highest levels of cantharidin and they transfer it to females during copulation .

Adults of blister beetles feed on leaves , flowers of alfalfa in the United States causing leaf loss which is not of economic importance . The real problem with blister beetles lies in their toxicity to livestock , especially horses , when accidentally consumed in feed due to their containing cantaridin (Schmitz 1989) .

Many of the common species of blister beetles contain cantaridin (Spanish-fly) , a substance that will cause blisters when applied to the skin
(Beasley *et al.*1983). Ward (1985) reported that cantharidin is a stable chemical and long-term health threat to nearly all livestock , particularly horses that are fed contaminated alfalfa hay . Research reports indicate cantharidin toxicosis can be induced in dairy and beef cattle , goats and sheep ; other reports include rapist , hedgehogs , mice and dogs (Graziano *et al.*1987) . Cases of human death also have been reported . However , horses appear to be more susceptible to toxic effects of this potent chemical than other livestock . Although the toxic effects of cantharidin to all livestock and human,blister beetles use this fluid and related analogs as defensive compounds against larger herbivores and predators .

According to the previously mentioned results , the presence of the blister beetle *M. proscarabaeus* as a new insect pest in El – Farafra oasis may bring us to ring the dangerous bell about the great loss and damage that threat our legume crops and all livestock in such new reclaimed and cultivated areas in Egypt .

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Table (1): Mean numbers of the blister beetles , *M. proscarabaeus* (L.) adult emerged in EL-Farafra Oasis 2002,2003 in relation to air & soil temperatures and relative humidity.

Date	Mean no. of beetles /100 plants	Climatic factors		
		Air temp.c^0	Soil temp. c^0	Relative humidity %
November 14/2002	30	28.5	29.1	38
21/2002	44	25.2	24.3	45
28/2002	56	23.3	23.2	53
December 5/2002	104	22.1	22.1	45
12/2002	108	17.6	20.5	46
19/2002	116	16.9	19.6	54
26/2002	120	16.3	19.7	52
January 02/2003	124	17.5	19.3	54
09/2003	128	19.3	20.2	55
16/2003	138	20.3	21.5	58
23/2003	144	16.5	19	62
30/2003	150	16.1	19.3	60
February 06/2003	140	16.9	20	50
13/2003	130	13.9	19.3	40
20/2003	118	17.8	20.9	43
27/2003	102	17.8	20.7	45
March 06/2003	74	17.9	22.9	46
13/2003	44	17.5	23.4	47
20/2003	22	20.2	24.5	43
27/2003	0	20.6	25.3	40
Total	1892	382.2	434.8	976
Mean	94.6	19.11	21.74	48.8

Table (2): Mean numbers of the blister beetle , *M. proscarabaeus* (L.) adult emerged in EL-Farafra oasis 2003,2004 in relation to air & soil temperatures and relative humidity

Date	Mean no. of beetles /100 plants	Climatic factors		
		Air temp. C°	Soil temp. C°	Relative humidity %
November 15/2003	26	27.3	26.5	64
22/2003	40	25.5	25.8	69
29/2003	58	24.2	24.6	69
December 6/2003	88	22.3	22.8	70
13/2003	96	18.6	22.7	55
20/2003	108	17	22.5	64
27/2003	116	17.5	18.1	54
January 3/2004	120	16.9	18	53
10/2004	124	14.3	20	51
17/2004	128	14.7	20.1	62
24/2004	138	15.4	20.5	58
31/2004	140	14.4	20.1	59
February 7 /2004	132	17	22.9	57
14/2004	110	19.6	23.4	60
21/2004	94	14.7	21.4	51
28/2004	80	21.2	26.1	43
March 7/2004	66	26.8	30.3	44
14/2004	50	18.6	24.6	40
21/2004	18	17.9	25.1	56
28/2004	0	19.3	26.8	44
Total	1732	383.2	462.3	1123
Mean	86.6	19.16	23.115	56.15

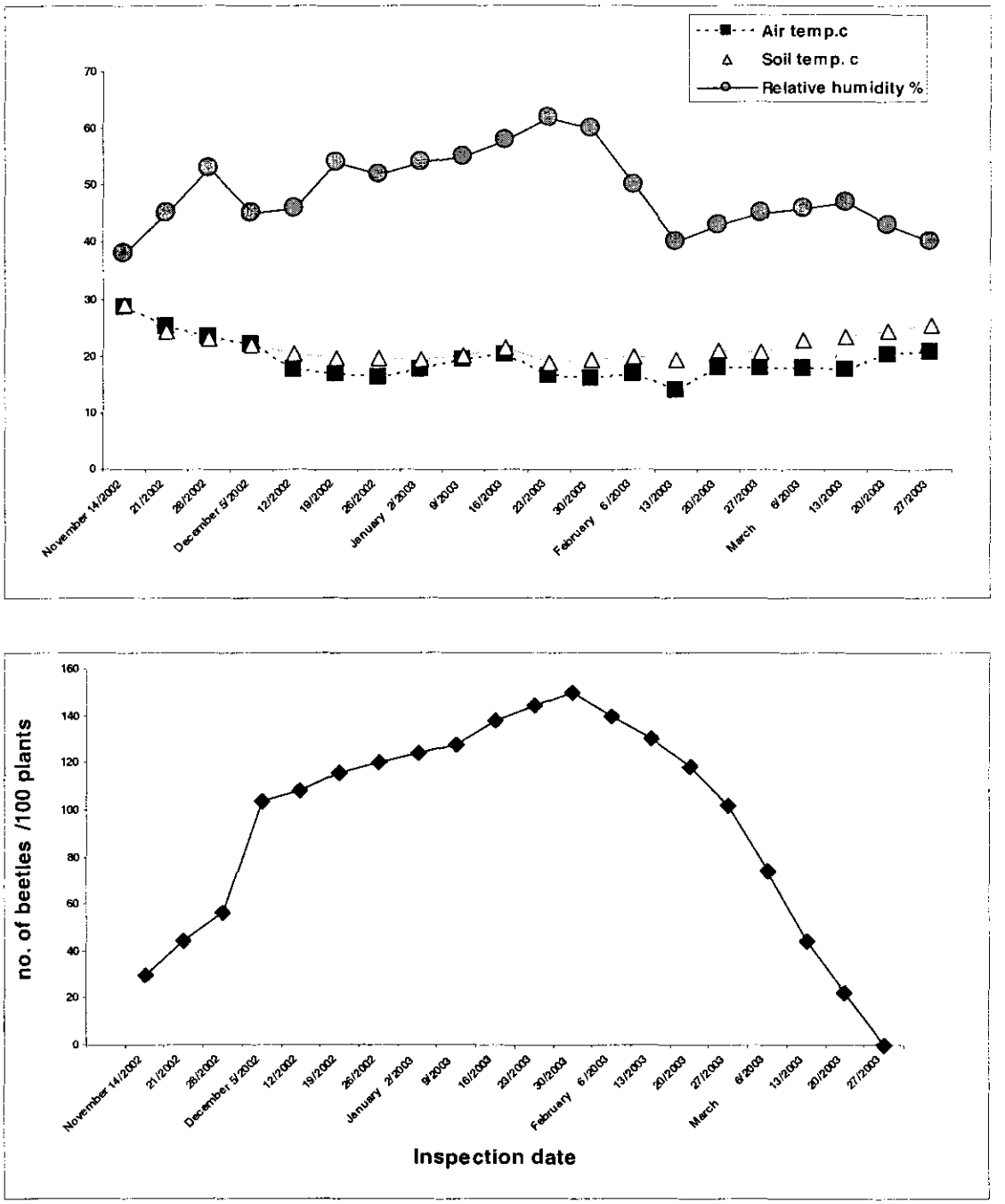

Fig. (1): Emergence of imagines of *M. proscarabaeus* (L.) in EL-Farafra Oasis 2002,2003 in relation to air & soil temperatures and relative humidity

(El- Okda *et al.*, 1989; Radwan and El Wakil, 1991; El- Shahaat *et al.*, 1995; Abo Bakr, 1997 and Eshra, 2004).

Because, these toxicants are in direct contact with soil, it becomes of interest to study their impact upon organisms that existing soil system. These habitants may include terrestrial gastropods, 3rd larval instar stage (pre pupal stage) of the Mediterranean fruit fly; *Ceratitis Capitata* (Wied) or 6th larval instar stage of the cotton leaf worm; *Spodoptera littoralis* (Boisd.) Therefore, this study is carried out to evaluate the side effects of Basamide microgranular formulation (91% dazomet) and its dazomet EPA standard as well as methomyl wheat bran bait on the non – target pests mentioned above. Also, the side effects on some biological activities in soil are investigated.

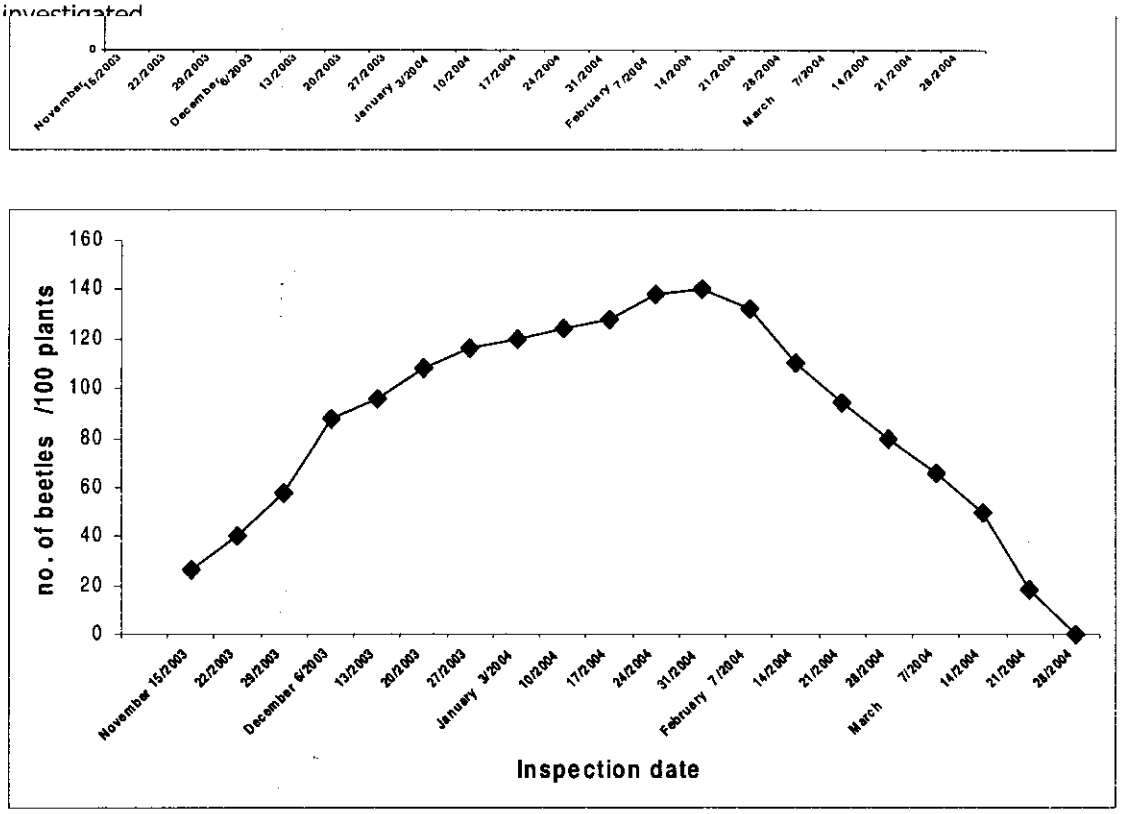

Fig. (2): Emergence of imagines of *M. proscarabaeus* (L.) in EL-Farafra Oasis 2003,2004 in relation to air & soil temperatures and relative humidity