Field observation on activity, life cycle and population dynamics of the yellow slug *Limax flavus* Linnaeus, 1758 at Ismailia Governorate.

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Abstract: The yellow slug *Limax flavus* Linnaeus, 1758 (Pulmonata: Stylommatophora) was recently introduce into the Southeast of Egypt. The seasonal activity and population dynamics of *L. flavus* were studied, and was related to the microclimatological conditions. The study was carried at ornamental nurseries in Ismailia city during the period from September 2007 to December 2008. Results revealed that the activity periods were found at winter and spring seasons. During hot weather and low humidity slugs are moving into the soil. From September to December the adult stage was the common and recorded highest abundant. While juvenile stage was common and recorded highly abundant during spring. Egg-laying period starts from January to March and has been recorded in square meter. Results obtained showed differences between the population ages and different degrees of temperature, humidity and rain fall.

Keyword: Terrestrial mollusks, limacidae, *Limax flavus*, population dynamics.

INTRODUCTION

Slugs are important pests of a wide range of organic vegetable crops, which are high quality products, desired by consumers. Slug problems are especially acute in comparison to conventional vegetable production because using of chemical control measures is prohibited. In the past few years the damage to agricultural crops by slugs has become increasingly apparent. If slugs are to be effectively controlled, it is essential to understand their biology and ecology. *L. flavus* has body Length 75 to 100 mm. Found in urban and suburban gardens, greenhouses, and other cultivated places. One specimen found in 1965 in Tallahassee, Florida associated with celery, lettuce, roses. *L. flavus* is native to Greece, Italy, Spain (Lionel A. Stange, *et. al.* 1999).

These gastropods are strongly dependent on moisture for feeding, reproduction and survival, so that their numbers and distribution are greatly influenced by soil moisture as well as by temperature. However populations in cereal crops have been observed to decline in certain years when soil moisture and temperature were apparently favorable (Glen and Wiltshire, 1988). This pattern suggests that natural enemies may be responsible for the marked variation in population size, but our lack of understanding of the basic biological aspects makes it difficult to predict when gastropods will be abundant. The yellow garden slug *L. flavus* is found almost exclusively in association with people. It is most common in suburban and semi-rural areas and frequently can be found in gardens, greenhouses, cellars, barns, and climbing on the outside of houses (Pilsbry, 1948). This species requires relatively humid habitats (Harry, 1951). *L. flavus* is a widespread European species, recorded in Great Britain, Ireland, the Netherlands, France, Germany, the former Yugoslavia, Austria, Slovakia, Hungary, Italy, Poland, the western former Soviet Union and Caucasus, Romania, Bulgaria, Greece and Syria. In Turkey, it is the most widespread slug M. Zeki Yilldirim & Ûkebapci, (2004). In Egypt El-Okda (1980) recorded it in Beheira Governorate and El-Deeb *et al.*, (1996a & 1996b) recorded the yellow garden slug *L. flavus* at Kafr El- Shiekh, Demiatta and Dakahlia Governorate in the field crops, vegetables, ornamental and orchards. *L. flavus* recorded for the first time in Northeast of Egypt in Ismailia Governorate by Shoieb *et. al.*,(2009). *L. flavus* considered a pest because it may damage ornamental plants and vegetables in gardens. It was also notorious in North America during the nineteenth century because specimens frequently drowned in wells, contaminating them (Taylor, 1899).

In Egypt, slugs have been largely neglected in the pest literature, and yet gastropod molluscs species currently constitute some of the most significant and intractable threats to sustainable agriculture. The increased pest status has been associated with cultivation of new crops, intensification and change of agricultural production systems, and the spread of species adapted to these modified environments by human trade and travel. Present paper is being to understanding of the life cycle and behavior of the slug under our condition. On the other hand, the greater our chance of achieving high levels of control.

MATERIALS AND METHODS

Study area:

Survey was conducted in Ismailia city at ornamental nurseries located near Ismailia lake. Nurseries for seedling production and distribution it to the gardens and public squares within the Ismailia city. The soil was sandy loam. Five localities were taken to give an indication of the extent of injury in the province.

Sampling routine:

Five sites were visited four times per month, all slugs and eggs in 10 randomly placed 1m × 1m quadrates in each locality were collected, during January and December 2008. Detailed information about temperatures and precipitation during 2008 is taken from annual report of Egyptian Meteorological Authority and shown in figure 1.

Samples were collected by hand picking. During each field visit, samples were taken by searching on the site (from beneath the bark, stones, under inverted flowerpot and the vegetation etc.). Fisher *et al.*, 1994, 1995, 1996, have studied slug densities and they

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reported that the technique, which involves using of a board, blanket, or inverted flowerpot, has been the most frequently used tool to detect slugs in crops because it's cheap and relatively fast. However slug activity can be greatly influenced by temperature, precipitation, wind, and predators. A more reliable technique that measures total slug density is the cold water floatation method (South, 1992).

Slugs collected from different localities were weighted and distinguished in two groups, immature and mature stages according to weight and body size. In each group ten animals were weighted individually. Also the egg- batches found under shelter were collected and counted also host plants were recorded.

RESULTS AND DISCUSSION

During the study period at 5 different sites, more than 16,000 individuals of yellow slug were collected. The activity and population dynamics of slug *L. flavus* are summarized in Table 1.The data indicate that yellow slug *L. flavus* was active in the field from end of September until the end of May associated with host plants *Gerbira sp., Dahlia sp, Thuja sp.,* And *Rose sp.* Slugs appeared in the field for the first time in September as adult stages. Slugs are hermaphroditic, but often the sperm and ova in the gonads mature at different times. The Slugs commonly cross fertilize and may have elaborate courtship dances (Karlin and Bacon 1961). They lay gelatinous eggs in clusters that usually average 20 to 30 in the soil in concealed and moist locations. Eggs are round to oval, usually colorless, and sometimes have irregular rows of calcium particles which are absorbed by the embryo to form the internal shell (Karlin and Naegele, 1958). Hatchlings were found during the spring, the largest part of this generation matured in the following autumn (October to December), and peaks of egg-deposition noted in the late January also early of Febraury. The mean egg batches were found during January, February and March were 41.5, 58.23 and 18.5 respectively. The number of eggs per batch ranged between 25-30 egg / batch. Eggs hatch during late February through March and April, and young slugs develop into sexually mature adults by late of the winter. Drought conditions during the summer can cause high mortality. In February greater numbers of adult slugs were 79.9 at an average temperature, R.H. and rain fall 24.1 °C, 63.13 % and 3.44 respectively. Webley (1962) found that in the autumn and winter months greater numbers of slugs were trapped when the night air temperature and morning relative humidity were high. These terrestrial molluscs are active on the soil surface throughout the year, except during hot summer. During adverse conditions, they manage to stay alive by moving down in the soil for protection. Eggs also are covered with a thick gelatinous layer, which enable them to resist extremes in temperatures and moisture. The time of egg hatch relative to growing seedling is an important determinant of economic injury of ornamental plants. Slug damage generally has a greater impact on plant. Taylor (1899) observed eggs of *limacidae* slugs were deposited from February to December in northern Louisiana, with possibly more than one generation per year. A conspicuous ecological characteristic of terrestrial pulmonate mollusks is an intense dependence of humidity, which is reflected on its behavior, activity period, habitat preference and procreation activity (Elwell and Ulmer, 1971; Dimitrieva, 1975; Pieri and Jurberg, 1981).

The juvenile slugs were appeared in the study area during late winter and early of spring and the average weight of juvenile slugs were 0.4- 0.7 gm, it found under flower pot and surrounded plants root. Juvenile slugs recorded highly abundant during April and May 83.1 & 87.85, respectively. *L. flavus* feeds on decaying plant and vegetable matter, fungi, lichens, mildew, and garbage (Quick 1960). It appears to be an occasional pest in residential and commercial areas (Barker 1999), and (Godan 1983) cited it as pestiferous on stored agricultural produce such as apples, pears, pumpkins, carrots, and potatoes. Kozlowski J., 1999 stated that in warehouses and in farm product stores, significant damages are caused by *Lehmannia valentiana, L. flavus* and *L. maximus* frequently attacks also plants grown in gardens. The lifecycle opposite shows just how quickly slugs can reproduce – being mature as early as six weeks. On the other hand, each slug capable of laying up to 800 eggs per season, at temperatures as low as 3° C, it is no surprise that the problem can quickly escalate, with devastating impact on the yield. Metcalf *et al.* (1962) had reported that *L. maximus* attacked ornamental plants, viz., geranium, marigold and snapdragon.

These are pests which entered Egypt in recent years, particularly in the Canal Zone for this studied periods of activity and stillness, and linked to the weather, which helps us to develop an integrated program to control and to reduce the spread of this pests to the rest of the governorates of Egypt. We must observe that these slug pests have adapted to our conditions. This indicates a high potential for adaptation and rapid spread. Eleven species of exotic slugs have been intercepted by USDA and FDACS-DPI quarantine inspectors, but only one is known to be established. Some of these, slug such as the gray field slug (*Deroceras reticulatum* Müller), giant garden slug (*Limax maximus L.*), and yellow garden slug *(Limax flavus L.*), are very destructive garden and greenhouse pests. Therefore, constant vigilance is needed to prevent their (Pfleger, 1999). In California, commonly find *L. flavus* species in sprinkler valve boxes and in aggregations of up to 40 individuals. Other habitats reported for *L. flavus* include cellars, outhouses, structural crevices, wood stacks, compost heaps, and gardens (Barker, 1999; Forsyth, 2004), and in Europe it is found in woodlands where it takes cover under bark and logs. Yellow garden slugs are native to temperate Europe, but have been imported to European colonies throughout the world (Pilsbry, 1948; Dundee, 1974).

We concluded that, if slugs are effectively controlled, it is essential to understand their biology and ecology. According to the present study we can recommend that during the beginning of activity of slugs in the field must take care of hand picking, because in the beginning of activity during September the numbers of slugs were small. As well as in periods

of egg laying during the months of January and February should be recommended to increase hand hoeing between plants and soil aeration. During hot months reducing hiding places allows fewer slugs to survive. The survivors congregate in the remaining shelters. We must take precautions to prevent slugs from moving toward new areas in Egypt, where they may cause further damage. Before taking plants to other places make sure all soil has been removed by washing, and inspect the material carefully to make certain there are no attached slugs. Be especially careful with live plants that have roots or lots of leaves because these can become hiding places for slug eggs or small (immature) slugs. Both the juvenile and mature forms of the yellow slug can cause significant feeding damage to plants. This slug feeds on many different native, ornamental, and agricultural plants.

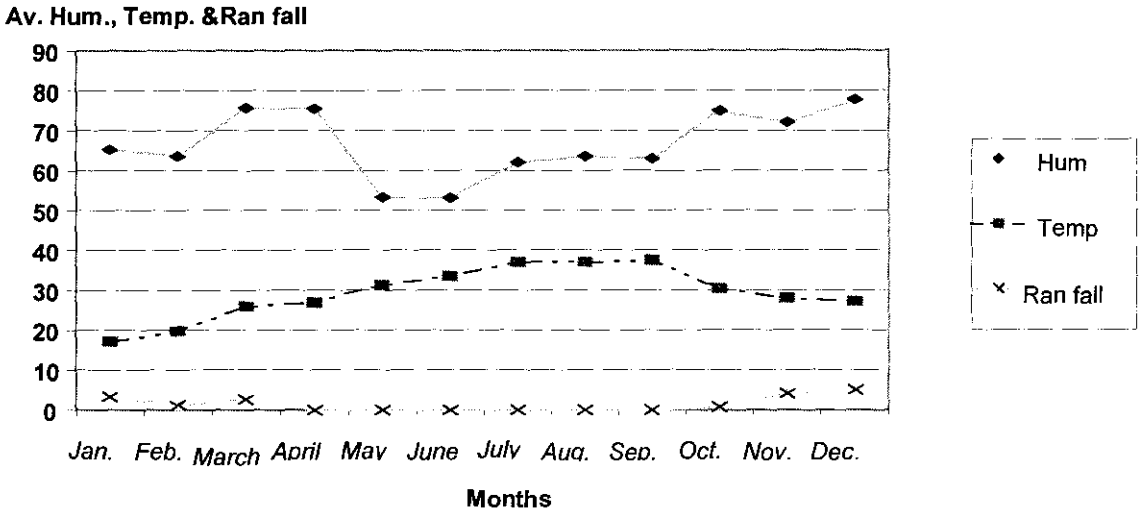

Fig. (1): Monthly meterological records during 2008 in Ismailia Governorate.

Table (1): Monthly abundance of different stages of yellow slug *L. flavus* during 2008 at Ismailia city.

Monthly	% Average collected of			Total of collected different stages
	Juveniles	Adult	Egg clutches	
January	0.0	58.5	41.5	2053
Feb.	41.76	79.9	58.23	1724
March	44.51	44.85	10.62	3293
April	52.6	47.40	0.0	2964
May	67.71	32.3	0.0	2462
June	100	0.0	0.0	107
July	0.0	0.0	0.0	0.0
August	0.0	0.0	0.0	0.0
Sep.	0.0	100	0.0	475
Oct.	0.0	100	0.0	483
November	0.0	100	0.0	1157
Dec.	0.0	100	0.0	1837

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دراسات حقلية على نشاط ودورة حياة وديناميكية العشائر للقوقع ليمكس فلافوس فى محافظة الإسماعيلية

مها أحمد شعيب

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تعد البزاقات التابعة لقبيلة الرخويات من أهم الآفات في العديد من دول العالم. حيث تصيب العديد من محاصيل الخضر و الفاكهة و نباتات الزينة. و في الأونة الأخيرة أنتشرت البزاقات في مصر خاصة في منطقة الدلتا. و يعتبر ظهور البزاقات في منطقة الأسماعيلية مؤشرا خطيرا لزيادة مساحة انتشار تلك الأفة في مصر. يعتبر الجنس اليمكس فلافيوس التابع لعائلة ليميسيدي من أكثر أنواع البزاقات أنتشارا في محافظة الأسماعيلية. و يصيب هذا النوع العديد من الزراعات و خاصة نباتات الزينة. يعتبر الجنس ليميكس فلافيوس من أهم الأنواع ضمن لائحة الأفات المحظور دخولها الي الولايات المتحدة الأمريكية. و لكي يتم وضع برنامج ناجح للمكافحة المتكاملة للبزاقات يجب أولاً إجراء دراسة حيوية وبيئية لتلك الأفة . لذا فقد تمت دراسة فترات النشاط و كذلك فترات وضع البيض مع تقدير للكثافة العددية للأعمار البالغة و الغير بالغة لهذا النوع مع ربطها بدرجات الحرارة و الرطوبة و كذلك فترات الامطار في محافظة الاسماعيلية.

و قد وجد أن الأفراد البالغة تبدء نشاطها في نهاية شهر سبتمر و تتواجد بأعداد قليلة و تتزايد في نشاطها و أعدادها مع انخفاض الحرارة و أرتفاع الرطوبة. في حين تبدء الأفراد البالغة في وضع البيض في شهر يناير و حتي بداية شهر مارس و تكون درجات الحرارة في تلك الفترة مابين ٢٥-٣٠ درجة منوية مع سقوط للأمطار. تبدء الأفراد الحديثة الفقس في الظهور أسفل النباتات و حول الجذور حيث تتغذي عليها مع منتصف شهر فبراير تتروح اوزان الأفراد في تلك الفترة ما بين ٠,٤- ٠,٧ جرام و أطوال أجسامها مابين ٣-٥ سم و تستمر في النمو الي أن تصل كامل النمو خلال شهر ديسمبر حتي تصل أوزانها الي ٧-٩ جرام و أطوال أجسامها الي ٨- ١٠ سم . تبدء الأفراد البالغة في وضع البيض في شهر يناير.

من النتائج المتحصل عليها نجد أنة في خلال شهر سبتمبر مع بداية النشاط يجب الأهتمام بالجمع اليدوي في الصباح الباكر مع التخلص من الأفراد التي تم جمعها. كذلك مع بداية فترات وضع البيض يجب الأهتمام بالعزيق بين النباتات كذلك تهوية التربة بصفة مستمرة حتي يتم تعريض البيض الموجود تحت التربة الي أشعة الشمس مما يسبب جفافه و موته. و خلال أشهر الصيف حيث تدخل الأفراد في بيات صيفي يجب اللأهتمام بنظافة المشتل و جمع اوراق النباتات و أفرع النباتات حيث تتخذها البزاقات أماكن للأختباء من أرتفاع الحرارة. كذلك يجب الحرص علي عدم نقل شتلات من الأماكن المصابة أو تربة حتي لاتنتشر الأصابة في أماكن جديدة.