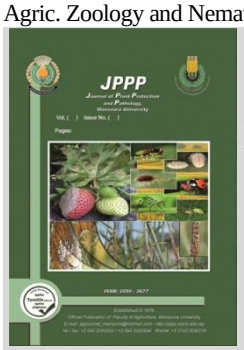
Journal of Plant Protection and Pathology

Journal homepage & Available online at: www.jppp.journals.ekb.eg

Evaluation of some Biological Aspects of Slug, *Leidyula floridana* (Leidy, 1851) in the Laboratory, and its Control in the Field

Awwad, M. H.* and A. S. Bashandy

Agric. Zoology and Nematology Dept., Faculty of Agric., Al-Azhar Univ., Egypt.



ABSTRACT

Due to the slug's recent fast growth in Egyptian fields and development as a pest of horticultural and field plants, this study sought to focus on some of its biological characteristics in a lab setting over the course of four seasons with field control. In terms of the biological component, the findings indicated that the winter had higher pre-egg, egg quantity, incubation, and post-ovulation periods. while the spring had the greatest hatching rate of 95.1±0.47%. Even yet, the incubation period in the summer was the shortest at 12.26±0.40 days, while the longest was 35.2±0.98 days in the winter. The findings for containing this slug in a field showed that the fungicide (carbendazim 50% SC) generated a high mean mortality rate of 71.84±6.20% at the conclusion of the experiment. Additionally, it had a significant residual impact on slug aggregation, with a drop of (87.69±3.60%) in field circumstances. Therefore, using carbendazim as a molluscicide is advised.

Keywords: *Leidyula floridana*, biological aspects, control, carbendazim

INTRODUCTION

In many areas of Egypt, the slug, *L. floridana* has spread to gardens and nurseries, becoming a pest that reduces agricultural productivity. This particular slug was first discovered in Egypt together with another member of the same family, which multiplies rapidly and harms plants severely, (Herbert and Kilburn, 2004; Brodie and Barker, 2012a; 2012b; Das and Parida, 2015; Ali. 2017 and Awwad 2021). Particularly important as intermediate hosts of nematodes in this species are *Angiostrongylus cantonensis* (Chen, 1935) (Strongylida: Meta-strongylidae) and *A. costaricensis* (Diaz, 2010; Wang, *et al*. 2008 and Rueda, *et al*. 2002). According to Morera and Cespedes (1971), consumption of mollusks containing *A. cantonensis* can cause eosinophilic meningoencephalitis in monkeys and abdominal an-giostrongylosis in humans. The mucus discharges (slime) of slugs have also been discovered to contain *Angiostrongylus cantonensis* (Qvarnstrom, *et al*. 2007, suggesting yet another possible pathway for human infection). Slugs move by leaving a trail of mucus behind them, which if they climb up onto vegetable plants, might be ingested. The subsequent spread through populations of resident (both indigenous and nonindigenous) molluscs poses a greater threat to humans because this and other invasive molluscs are frequently found in association with humans, who are at risk of contracting the disease (Campbell and Little, 1988 and Teem, *et al*. 2013). It describes *L. floridana*'s biology, in particular how food and habitat relate to one another. Given that this slug has a long lifespan, surviving for over 20 months in a lab setting, and that testing the metaldehyde-containing bait induced mortality quickly and led to a higher level of mortality (Capinera and Rodrigues, 2015), it is essential to understand the history of its life and control. Further research on the biology and life cycle of the slug species *L. floridana* is required. Some of the species in this category have undergone little biological and environmental research.

Complementing these studies, some biological aspects of this slug were shed light in four seasons (winter, spring, summer, and autumn) in a lab setting. Additionally, control it in the field using fungicide (carbendazim 50% SC).

MATERIALS AND METHODS

1.Biological experiment

To start a breeding colony, slug samples were conducted at the nursery in the Zagazig district. They were grown in wet potting soil that included 2% clay, 1% silt, and 1% sand in plastic containers that measured 18×13×4 cm (L×W×D). Romaine lettuce: *Lactuca sativa* L., was given to the slugs under laboratory circumstances. In plastic boxes, 20 newly hatched slugs were placed. Each plastic box produced ten replicas with two people in each. The pre-oviposition duration, number of eggs, hatching rate, post-oviposition, and incubation period were a few biological features that were examined in the lab. The slugs received more than enough lettuce at intervals of 2-3 days to satiate their desire.

2.Field investigation

In May 2022, a fungicide (carbendazim 50% SC) was tested against the slug *L. floridana* in a nursery for ornamental plants in the Zagazig area. For the required concentration of carbendazim (60 gm/100L) under field circumstances, the research area was split into ten plots (50*50 cm) for the spray technique. Additionally, as a check and control, another was not given any therapy (Mortada, 2002). Before application, one, three, seven, and fourteen days following treatment, the number of slugs was counted in a half-meter square in the check and treatment area (Ismail and Shetaia, 2009). According to the Henderson and Tilton (1955) formula, the decrease % was determined as follows.

* **Corresponding author.**
E-mail address: mohmedhamza452@gmail.com
DOI: 10.21608/jppp.2023.233644.1173

$$\% \text{ Reduction} = \left[1 - \frac{t2 \times r1}{t1 \times r2}\right] \times 100$$

Where:

t1 = number of a live snails before treatment in treated plots.
t2 = number of a live snails after treatment in treated plots.
r1 = number of a live snails before treatment in untreated plots.
r2 = number of a live snails after treatment in untreated plots

RESULTS AND DISCUSSION

1.Some biological aspects under lab. conditions

Data in Table (1) demonstrated certain biological features in four seasons under lab settings. The newly hatched eggs were divided into plastic containers after hatching, and they were monitored every day until maturation and oviposition. It was challenging to distinguish between young and old slugs based on their exterior size or form. As a result, the life cycle, which includes the pre-oviposition stage, lasted 53–115 days from hatching to juvenile maturity, with an average of 83.5±1.04, 78.26±7.47, 80.96±3.71 and 85.3±3.13 days in the winter, spring, summer, and autumn, respectively. While the typical number of eggs in the four seasons was (144.1±249.58), (153.1±15.018), 125.13±11.45, and (139.06±6.33) eggs, respectively, in the winter, spring, summer, and fall. These findings concur with those of Herbert and Kilburn (2004). They claimed that *L. alte* produces batches of up to 100 eggs at a time. In contrast, *Laevicaulis stuhlmanni aegypti* was able to lay eggs in culture boxes in clutches of up to 190 (Ali, 2017). The hatching rate was 91.86±1.16%, 88.86±3.51%, and 92±1.28% in the three seasons (winter, summer, and fall), respectively. However, the spring saw the greatest rate of egg hatching at 95.1±0.47%. Furthermore, this slug's post-oviposition phase lasted for 32.6±0.95, 26.03±3.07, 18±1.70 and 31.3±0.11 days, respectively. In addition, the Incubation time was noted in the seasons of winter, spring, and fall (35.2±0.98, 23.3±5.98, and 31.7±0.66) days, respectively. In contrast, according to Ali (2017), the Incubation period throughout the summer was 12.26± 0.40 days, acting as the shortest amount of time. But according to Nagabhushanam and Kulkarni (1970a), it took around 17 days. In addition, the average number of egg masses in the winter, spring, summer, and autumn were (10±0.00, 16.66±3.33, 20±0.00, and 10±0.00 egg masses, respectively). Reproduction often takes place over four seasons, according to Herbert and Kilburn (2004). They said that during the rainy season, there is a high rate of reproduction, and that sexual maturity happens after about five months. *Leidyula floridana* is a hermaphrodite species, meaning that each individual has both male and female sexual organs. They also discovered reproduction after seven months (Brodie and Barker, 2012a; 2012b). The slug may self-fertilize if kept in isolation. In addition, they said that maturity was attained at 2.5 months and that reproduction is higher during the rainy season (Rueda, *et al*., 2002; Garcia, *et al*., 2007, and Ali, 2017).

Table 1. Average of some features of biology for slug, *L. floridana* during four seasons (mean ±SD.).

Season	Pre-oviposition period (days)	Number of eggs	Hatching %	Post-oviposition (days)	Incubation period (days)	Number of egg Masses
Winter	83.5±1.04	144.1±249.58	91.86±1.16	32.6±0.95	35.2±0.98	10±0.00
Spring	78.26±7.47	153.1±15.018	95.1±0.47	26.03±3.07	23.3±5.98	16.66±3.33
Summer	80.96±3.71	125.13±11.45	88.86±3.51	18±1.70	12.26±0.40	20±0.00
Autumn	85.3±3.13	139.06±6.33	92±1.28	31.3±0.11	31.7±0.66	10±0.00

SD = standard deviation

Figs.1: (a, b, and c) stated that the first mass of eggs is small, while the second mass increases in the number of eggs that appear of species *L. floridana* in the form of a series. These results are like those (Ali, 2017).

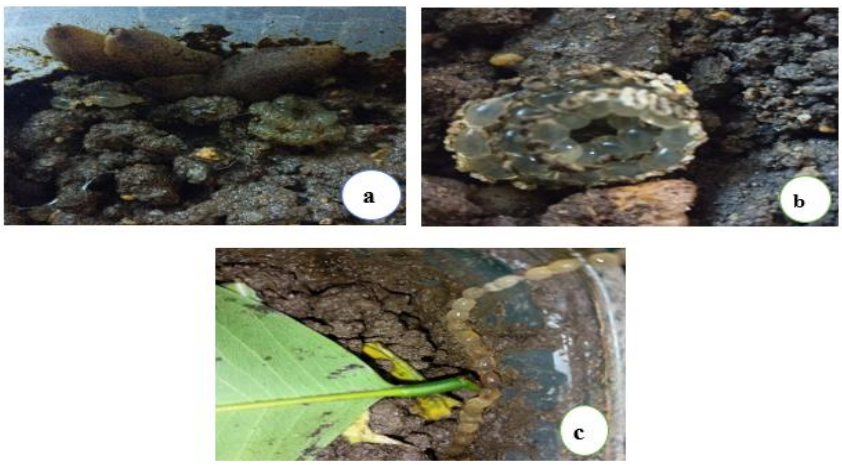


Fig. 1. (a) The first egg mass contains a small number of eggs. (b) An egg mass during the laying period contains many eggs. (c) The mass of eggs is interconnected in the form of a chain.

2.Toxicological studies

The efficacy of the Fungicide carbendazim 50%SC was evaluated against the slug, *Leidyula floridana* under field conditions.

The Fungicide efficiency of carbendazim was evaluated as a spray method against the slug, *Leidyula floridana* infested ornamental plants under field conditions of a nursery in the Zagazig district during May 2022. Data in Table (2) revealed that carbendazim was more toxic for this slug. Since it gave a high residual effect on the slug population with a% reduction of (87.69±3.60)%. Regarding the general means, carbendazim was the most in reducing the population density of individuals slug, it achieved (71.84±6.20)% reduction. Generally, it could be reported that the recommended Fungicide pesticide carbendazim was the most effective in controlling *Leidyula floridana* under

field conditions. Our finding is in harmony with those which obtained by carbendazim (fungicide) Affected radula and feeding activity of different ages of land slug, *Arion linnaeus*, and effects led animals to refrain from feeding bringing death. (El-Deeb, *et al*., 2003; Soha and Randa, 2014).

Table 2. In-field effectiveness of a specific fungicide in eradicating *Leidyula floridana* infestations on ornamental plants in the Zagazig area.

	%Reduction after treatment (in days)						
Fungicide	**1st**	**3rd**	**Initial effect**	**7th**	**14th**	**Residual effect**	**General mean**
carbendazim	71.45±1.30	40.50 ±2.30	55.98±2.60	81.90±1.45	93.48±0.57	87.69±3.60	71.84±6.20

CONCLUSION

It should be noted that this particular slug is not thought of as a seasonal pest but rather as a pest that may proliferate all year long and pose harm to agriculture. Furthermore, that carbendazim substance can defend plants against slug attacks.

REFERENCES

Ali, R.F. (2017). Laboratory Observations of the Veronicellid Slug Biology *Laevicaulis stuhlmanni aegypti* Ali & Robinson, A new Subspecies and Record in Egyptian Agro-system. Egypt. Acad. J. Biolog. Sci., 9(2): 1- 11.

Awwad, M.H. (2021). First record of the slug *Leidyula floridana* (Leidy, 1851) in Egypt. J. of Plant Protection and Pathology, Mansoura Univ., Vol. 12 (12):861 – 863.

Brodie, G., Barker, G.M. (2012a). *Sarasinula plebeian* (Fischer, 1868). Family Veronicellidae. 'USP Introduced Land Snails of the Fiji Islands Fact Sheet Series', No. 4.

Brodie, G., Barker, G.M. (2012b). *Laevicaulis alte* (Férussac, 1822). Family Veronicellidae. USP Introduced Land Snails of the Fiji Islands Fact Sheet Series. No. 3.

Campbell, B.G., Little, M.D. (1988). The finding of *Angiostrongylus cantonesis* in ratsin New Orleans. American Journal of Tropical Medicine and Hygiene, 38(3):568-573.

Capinera, J.L., Rodrigues, C.G. (2015). Biology and control of the leatherleaf slug *Leidyula floridana* (Mollusca: Gastropoda: Veronicellidae). *Florida Entomologist, 9 8* (1) , 243-253.

Das, B., Parida, L. (2015). Morphometric studies of the tropical leatherleaf slug *Laevicaulis alte* from prachi belt of Odisha. Journal of Entomology and Zoology Studies, 3: 132-134.

Diaz, J.H. (2010). Recently reemerging helminthic infections causing eosinophilc meningoencephalitis: neuroangiostrongyliasis, baylisascariasis, and gnathostomiasis. Journal of Neuroparasitology, 1(1): 1-14.

El-Deeb, H.I., Eweis, E.A., Kandil, M.A., Gabr, W.M., Mobarak Soha, A. (2003). Toxicity and biochemical studies of methomyl and diazinon on different ages of the land gastropod species *Monacha obstructa*. J. Agric. Sci. Mansoura Univ., 28 (9): 7011-7023.

Garcia, E.N., Thome, W.J., Casteillejo, J.A. (2007). Review of Veronicellidae from Mexico (Gastropoda: Soleoliferea). Revisita Mexicana de Biodiversida 78: 41-50.

Henderson, G.F., Tillton, E.W. (1955). Test with acaricides against the brown wheat mite. J. Econ. Entomol., 48: 157 – 161.

Herbert, D., Kilburn, D. (2004). A field guide to the land snails and slugs of eastern South Africa," Pietermaritzburg: Natal. Museum, South Africa, pp. 1-336.

Ismail, Sh.A.A., Shetaia, S.Z.S. (2009). Preliminary studies on *Monacha cartusiana* snail infesting cotton seedlings at Sharkia Governorate. Zagazig J. Agric. Ros., 36 (4): 803-814.

Nagabhushanam, R., Kulkarni, A.B. (1971a). Histochemical observations on the egg capsules of the land slug, *Laevicaulis alte*. Marathwada University, J. Sci., Sect. B. Biol. Sci. 10: 121-122.

Nagabhushanam, R., Kulkarni, A.B. (1971b). Reproductive biology of the land slug, *Laevicaulis alte*. Riv. Biol. (Perugia) 64: 15-44.

Qvarnstrom Y., Sullivan J.J., Bishop, H.S., Hollingsworth R., Da Silva A.J. (2007). PCR based detection of *Angiostrongylus cantonensis* in tissue and mucus secretions from molluscan hosts. Applied and Environmental Microbiology, 73(5):1415-1419.

Rueda, A., Caballero, R., Kamnsky, R., Andrews, K.L. (2002). Vaginulidae in Central America, with emphasis on the bean slug *Sarasinula plebeia* (Fisher). In: G. M.Barker, ed., Molluscs as Crop pests. CABI Publishing, Wallingford, U.K., pp.115-144.

Soha Mobarak, A., Randa Kandil, A. (2014). The Teratogenic Effects of Carbendazim Compound on Radula of the Different Ages of Land Slug, *Arion Linnaeus* Nat. Sci., 12(7):138-141]. (ISSN: 1545-0740) (ISSN: 1545-0740). http://www.sciencepub.net/nature.

Teem, J.L., Qvarnstrom, Y., Bishop, H.S., Da Silva, A.J., Carter J., White-Mclean J., Smith, T. (2013). The occurrence of the rat lungworm, *Angiostrongylus cantonensis*, in nonindigenous snails in the Gulf of Mexico region of the United States. Hawai'i Journal of Medicine and Public Health, 72(6) supplement E: 11-14.

Wang, Q.P., Lai D.H., Zhu, X.Q., Chen, Z.G., Lunn Z.R. (2008). Human angiostrongyliasis. Lancet Infectious Diseases, 8(10): 621-630.

تقييم بعض الجوانب البيولوجية للبزاقة *Leidyula floridana* (Leidy,1851) في المختبر ومكافحتها فى الحقل

محمد حمزة عواد عبد البارى و أيمن سعيد محمد بشندى

قسم الحيوان الزراعى والنيماتودا-كلية الزراعة بالقاهرة -جامعة الازهر

الملخص

نظرًا للنمو السريع الذي حققته البزاقة (*Leidyula floridana*) مؤخرًا في الحقول المصرية وتطورها كآفة للنباتات البستانية والحقلية، سعت هذه الدراسة إلى التركيز على بعض خصائصها البيولوجية في البيئة المعملية على مدار أربعة مواسم مع المكافحة الحقلية. فيما يتعلق بالدراسة البيولوجية، أشارت النتائج إلى أن فصل الشتاء كان أعلى معدل في فترة ما قبل البويضة، وكمية البويضات، وفترة الحضانة، وفترات ما بعد البيض. بينما كان أعلى معدل فقس للبيض في فصل الربيع (95.1±0.47%). ومع ذلك، كانت فترة الحضانة في الصيف هي الأقصر عند (12.26±0.40) يومًا، بينما سجلت في الشتاء (35.2±0.98) يومًا. أظهرت نتائج مكافحة هذه البزاقة في الحقل بمبيد الفطريات (الكاربيندازيم ٥٠٪) إلى معدل وفيات مرتفع بلغ (71.84±6.20%) في نهاية التجربة. بالإضافة إلى ذلك، كان له تأثيرًا متبقيًا عاليًا على تعداد البزاقة بانخفاض سجل (87.69±3.60%) تحت ظروف الحقل. لذلك ينصح باستخدام كاربيندازيم كمبيد للرخويات.