The Bioscan
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
19(3): 103-105, 2024
www.thebioscan.com

MORPHOMETRIC STUDY OF SELECTED ACRIDIDAE EGG PODS UNDER LABORATORY CONDITION

VETHSELO DOULO[1] AND NEIKIELIE-Ü NOEMI SOTE[1*]

[1]Deparment of Zoology, Kohima Science College Jotsoma-797002 Nagaland, India

Email: neikienoemisote@gmail.com

DOI: https://doi.org/10.63001/tbs.2024.v19.i03.pp103-105

KEYWORDS
Acrididae,
egg pods,
laboratory,
morphometric

Received on:

08-08-2024

Accepted on:

10-12-2024

ABSTRACT

Under lab-based farming, three species namely *Oxya velox, Hygracris palutris* and *Choreodocus robustus* of Acrididae was reared to study their eggs and egg pods. The study comprehends about the species availability and its occurrence in both lab and natural condition. Results of morphometric analysis of eggs and egg pods showed that C. *robustus* has tremendous variation from the other two studied species. Furthermore, there is a distinction in shape and size in both eggs and egg pods among the three selected species. From the study, it reveals that adult body size can also corelates to size of egg pods and number of eggs within the pod. Although there are morphometric differences among the studied acridids species, *O. velox* shows suitability for farming due to its voltinism and high egg pods retrieval under laboratory condition

INTRODUCTION

Soil or substrate selection played the role for successful oviposition by the adult female. The egg pods studies are the major factors to determine the favorable abundance depending on different morphological and bio-ecology which varies from species to species (Katiyar, 1957; Shaikh and Sultana, 2018). Soil nutrients played a significant role in survivability and development for its population growth (Trisnawati et al., 2015). Study showed that soil moisture contributes to egg development whereas increase in the soil temperature reduce the hatching time duration (Wu et al., 2021). Soil moisture such as xerophilic, mesophilic and hydrophilic also contribute to determine the soil preferences among the Indian acridids (Katiyar, 1957).

The study of acridids egg pods and lab-based farming with different species was reported by various workers namely Katiyar, (1957); Pande et al., (1990); Haldar et al., (1998); Jat et al., (2007); Sultana and Wagan, (2007); Sultana and Wagan, (2009); Das et al., (2012a); Das et al., (2012b); Rathore et al., (2013); Ghosh et al., (2015); Tajamul and Ahmad, (2016); Shaikh and Sultana, (2018); Sultana et al., (2020); Wu et al., (2021). The present study was carried out to analyze the morphometric variation of both egg and egg pods among the selected species under laboratory condition. Hence, contribute to the reproductive biological behavior and add to the existing knowledge about the acridids egg pods.

METHODOLOGY:

The study was carried out in Kohima district, Nagaland at coordinates 25°31'44" N - 25°51'45" N latitude and 94°14'09" E - 93°54'30" E longitude. The random sampling method using insect aerial net and handpicking was employed for acridids collection from agricultural areas and surrounding vegetations. Three acridids species were selected for the study namely *O. velox*, *H. palutris* and *C. robustus* from May 2022 to May 2024. *O. velox* and *H. palutris* belongs to sub-families Oxyinae whereas *C. robustus* belong to the sub-families Catantopinae. The three acridids species were subjected to laboratory condition for rearing with modified technique proposed by Fry, (1927); Hinks and Erlandson, (1994) and Haldar et al., (1998). In laboratory condition, minimum and maximum temperature was recorded as 8.42°C and 28.2 °C respectively. Relative humidity ranges from 72.4% to 92.83%. The grasshoppers were fed *ad libitum* with fresh leaves. For oviposition, sterilized soil was provided in oviposition tray inside the cage with distilled water sprayed regularly to keep it moist. Egg pods laid by the adult females were checked on regular basis. The retrieved egg pods were sorted accordingly and the eggs were counted by removing the frothy materials. The comparative morphometric analysis of weight, width and length of eggs and egg pods were carried out using digital weighing balance and digital vernier calipers for all the three selected species. Also, morphometric analysis of the body length for both adult male and female was calculated to find any relation with the egg pod length and number of eggs per pod.

RESULT:

The number of egg pods retrieved during the study period from *O. velox*, *H. palutris* and *C. robustus* rearing cage were 72.5%, 23.5% and 4% respectively. The newly deposited egg pods of the three acridid species is soft and appeared ivory color and once exposed to environment condition turns to saddle brown color which revealed similar findings with Shaikh and Sultana, (2018); Sultana et al., (2020). The sculpturing display of *C. robustus* egg pods is long and cylindrical and straight and some slightly curved in between the two ends showed similarity to *C. insignis* (Katiyar, 1956). However, the sub family Oxyinae egg pods are comparable and showed distinctive subcylindrical shape with pointed form towards the anterior end and blunted on the posterior end. Eggs pods in the posterior end have greater number of eggs concentration as compared to anterior part of the egg pod which are common to all the three species. It was observed that within the egg pod, the eggs is systematic and tightly arranged with no space found between the two adjacent eggs. The eggs, except for *C. robustus*, *O. velox* and *H. palutris* have banana shape having similar findings to Sultana et al., (2020).

In the present study of egg pods weight, width and length (Table 1), *C. robustus* egg pods weight (3061.5 ± 53.03 mg) differ greatly from the other two species, *O. velox* (96.67 ± 26.57 mg) and *H. palutris* (114.08 ± 34.9 mg). Also, the egg pods width and length of *C. robustus* which measure about 13.135 ± 0.2 mm and 39.20 ± 0.45 mm shows wide difference than the other two species, *O. velox* (5.92 ± 0.64 mm and 10.38 ± 1.71 mm) and *H. palutris* (5.53 ± 0.83 mm, 12.07 ± 2.46 mm). In a single egg pod, *C. robustus,* contain the highest of number of eggs approximately about 74.25± 14.45 eggs, *H. palutris,* contain about 21±2.54 eggs per pod and least number was observed in *O. velox* containing 17.25±5.49 eggs per pod.

In case of egg weight, width and length (Table 2) *C. robustus* egg weight about 12.74 ±1.56 mg having higher egg weightage as compared to *O. velox* (4.79 ± 0.96 mg) and *H. palutris* (3.67 ± 0.78 mg). Also *C. robustus* egg width and length has 1.92 ± 0.14 mm and 7.12 ± 0.25 mm shows wide difference than the other two species, *O. velox* (1.54 ± 0.17 mm and 4.29 ± 0.39 mm) and *H. palutris* (1.80 ± 0.10 mm and 4.30 ± 0.31 mm).

The morphometric of both adult male and female body length of *C. robustus* (52.75 ± 0.62 mm and 74.25 ± 1.62 mm) are comparatively larger than *H. palutris* (26.05 ± +0.06 mm and 31.31 ± 0.29 mm) and *O. velox* (25.15 ± 1.20 mm and 30.51 ± 1.69 mm). The different in morphometric adult body length is positively correlated with the egg pods length and number of eggs per pod among the three species.

DISCUSSION:

The egg pods width and length of *C. robustus* in the present study when compared with the existing knowledge of the same genus *C. insignis* shows slight difference with Katiyar (1956) findings where the width and length egg pods was 11-13.5 mm and 48-74 mm respectively. In case of *O. velox* egg pods, width and length shows more or less similar to Sultana et al., (2020) finding on the same species where width and length were 5.40 ± 1.07 mm and 14.5 ± 1.35 mm. The variation of the egg pods within the same genus could be due to the soil type or ovipositional behavior (Sultana and Wagan, 2009). The present egg pods morphometric of the two sub families, Oxyinae and Catantopinae even shows wide difference to other sub families Acridinae and Hemiacridinae as reported by Shaikh and Sultana (2018). The number of eggs per pod in *C. robustus* (74.25± 14.45 eggs), is comparable to the finding of Katiyar (1956) on *C. insignis.* In respect to *O. velox* egg width and length which has about 1.54 ± 0.17 mm and 4.29 ± 0.39 mm shows slight similarity to Sultana et al., (2020) finding. The morphological shape and size of both eggs and egg pods result to a tremendous variation between the two sub families of the three selected species. Because *C. robustus* adult has larger body size as compared to *O. velox* and *H. palutris* which lead to the vast variation in weight, width and length having huge size egg pod, eggs and number of eggs present within a single egg pod.

In grassland region, different hatching period in summer was reported for *Hieroglyphus* species revealed the importance of monsoon rain for nymphal hatching (Riffat and Wagan, 2007). The morphology characteristics of *Poekilocerus pictus* egg pods revealed with favorable nymphal hatching in summer and least in autumn season (Sultana et al., 2017). The ecological studies such as moisture, soil and season are the important reason for nymphs hatching (Katiyar, 1957; Pradhan and Peswani, 1961; Pande et al., 1990; Wei et al., 2023). Researchers reported that around 10-11% egg deposition undergo diapause phase for almost 20 to 23 months (Roonwal, 1976; Shaikh and Sultana, 2018). Multivoltine species are preferred for farming because of rapid biotic biomass potential (Das et al., 2012a; Das, 2014; Ghosh et al., 2015).

The contribution of insect farming has a major role in food security (Das et al., 2012a; Das, 2014). The acridids are contemplate for protein rich food and alternative feed (DeFoliart et al., 1982; Romos-Elorduy et al., 1997; Das et al., 2012c; Ganguly et al., 2013; Das, 2014; Ghosh et al., 2017; Gosh and Mandal, 2019; Sumi and Ao, 2022). Presently, the biomass which are produced by the acridids are even formulated to animal feeds (Wang et al., 2007; Anand et al., 2008; Das and Mandal, 2014; Ganguly et al., 2014). In environment, availability of specific host plant does have positive correlation with the individual grasshopper species (Sanjayan and Murugan, 1987; Wei et al., 2023). Selecting the right host plant for specific acridids under laboratory condition had fundamental significant tools in biomass production. The *Oxya hyla hyla* and *Spathosternum prasiniferum prasiniferum* when fed with host plant *Brachiaria mutica* led to high biomass production (Das et al., 2012a). Accordingly, the optimum temperature and the light intensity is 35 ± 2ºC and 12:12 light and dark respectively for *Oxya hyla hyla* which is considered highly favorable for large scale production (Das et al., 2012b). The different soil types as a substrate for oviposition was also preferred basing on different species (Katiyar, 1957; Pande et al., 1990; Torto et al., 2024). The study has a role in understanding the reproductive biology, farming and its availability prediction both in natural and laboratory condition of grasshoppers. It reveals that although there are morphometric differences among the selected acridids, *O. velox* is more preferable for farming due to its voltinism and high egg pods retrieval under laboratory condition.

Table 1: Measurement (Mean ± SD) of egg pods for *O. velox, H. palutris* and *C. robustus*

Species	Measurement of the egg pods		
	Weight (mg)	Width (mm)	Length (mm)
O. velox	96.67 ± 26.57	5.92 ± 0.64	10.38 ± 1.71
H. palutris	114.08 ± 34.9	5.53 ± 0.83	12.07 ± 2.46
C. robustus	3061.5 ± 53.03	13.135 ± 0.2	39.20 ± 0.45

Table 2: Measurement (Mean ± SD) of egg for *O. velox, H. palutris* and *C. robustus*

Species	Measurement of the eggs		
	Weight (mg)	Width (mm)	Length (mm)
O. velox	4.79 ± 0.96	1.54 ± 0.17	4.29 ± 0.39
H. palutris	3.67 ± 0.78	1.80 ± 0.10	4.30 ± 0.31
C. robustus	12.74 ± 1.56	1.92 ± 0.14	7.12 ± 0.25

FINANCIAL SUPPORT

The financial support to NNS was received through National Fellowship for Higher Education of ST Students (NFST) to pursue PhD.

REFERENCES

- Anand, H., Das, S., Ganguly, A. and Haldar, P. 2008. Potential value of acridids as high protein supplement for poultry feed. Int. J. Poult. Sci. **7(7)**: 722-725.
- Feilding, D. J. 2011. Oviposition site selection by the grasshoppers *Melanoplus borealis* and *M. sanguinipes* (Orthoptera: Acrididae). J. Orthoptera Res. **20(1)**: 75-80.
- Das, A. 2014. Insects used as food with emphasis to acridid culture, biomass production and scope of application. Int. J. Zool. Res. **4(1)**: 82-87.
- Das, M. and Mandal, S. K. 2014. *Oxya hyla hyla* (Orthoptera: Acrididae) as an alternative protein source

for Japanese quail. International Scholarly Research Notices. 1-14.

- Das, M., Ganguly, A. and Haldar, P. 2012a. Annual biomass production of two acridids (Orthoptera: Acrididae) as alternative food for poultry. Span. J. Agric. Res. **10(3)**: 671-680.
- Das, M., Ganguly, A. and Haldar, P. 2012b. Determination of optimum temperature and photoperiod for mass production of *Oxya hyla hyla* (Serville). Turk. J. Zool. **36(3)**: 329-339.
- Das, M., Ganguly, A. and Haldar, P. 2012c. Effect of food plants on nutritional ecology of two acridids (Orthoptera: Acrididae) to provide alternative protein supplement for poultry. Turk. J. Zool. **36(5)**: 699-718.
- DeFoliart, G. R., Finke, M. D. and Sunde, M. L. 1982. Potential value of the Mormon cricket (Orthoptera: Tettigoniidae) harvested as a high-protein feed for poultry. J. Econ. Entomol. **75**: 848-852.
- Fry, H. Y. 1927. Grasshopper culture in the laboratory. J. N. Y. Entomol. Soc. **35(1)**: 41-51.
- Ganguly, A., Chakravorty, R., Das, M., Gupta, M., Mandal, D. K., Haldar, P., Ramos Elorduy, J. and Pino Moreno, J. M. 2013. A preliminary study on the estimation of nutrients and anti nutrients in *Oedaleus abruptus* (Thunberg) (Orthoptera: Acrididae). J. Nutr. Metab. **5(3)**: 50-65.
- Ganguly, A., Chakravorty, R., Das, M., Gupta, M., Mandal, D. K., Haldar, P., Ramos Elorduy, J. and Pino Moreno, J. M. 2013. A preliminary study on *Oxya fuscovittata* (Marschall) as an alternative nutrient supplement in the diets of *Poecilia sphenops* (Valenciennes). PLoS One **9(11)**: e111848.
- Ghosh, S. and Mandal, D. K. 2019. Nutritional evaluation of a short-horned grasshopper, *Oxya hyla hyla* (Serville) meal as a substitute of fishmeal in the compound diets of rohu, *Labeo rohita* (Hamilton). J. Basic Appl. Zool. **80:28**.
- Ghosh, S., Haldar, P. and Mandal, D. K. 2014. Suitable food plants for mass rearing of short-horn grasshopper, *Oxya hyla hyla* (Orthoptera: Acrididae). Eur. J. Entomol. **111(3)**: 448-452.
- Ghosh, S., Haldar, P. and Mandal, D. K. 2015. Biotic potential of a short-horned grasshopper, *Oxya hyla hyla* Serville (Orthoptera: Acrididae) to assess its biomass producing capacity. Proc. Zool. Soc. **70(1)**: 46-51.
- Ghosh, S. S., Bhagabati, B., Chatterjee, S. and Deka, P. 2017. Practice of entomophagy by the Bodo community residing in Rani area of Kamrup district, Assam. Int. J. Appl. Res. **3(6):** 387-389.
- Haldar, P., Das, A. and Gupta, R. K. 1998. A laboratory based study on farming of an Indian grasshopper *Oxya fuscovittata* (Marschall) (Orthoptera: Acrididae). J. Orthoptera Res. **8**: 93-97.
- Hinks, C. F. and Erlandson, M. A. 1994. Rearing grasshoppers and locusts: review, rationale and update. J. Orthoptera Res. **3**: 1-10.
- Jat, S. L., Swaminathan, R. and Rathore, P. S. 2007. Biological studies on the surface grasshopper, *Chrotogonus trachypterus* (Blanchard) at Udaipur. J. Trop. Agric. **25(3)**: 681-688.
- Kartiyar, K. N. 1957. Ecology of oviposition and the structure of egg pods and eggs in some Indian Acrididae. Records of the Indian Museum (ZSI). **55**: 29-68.
- Pande, Y. D., Ghosh, D., Dey, K. and Bhaitacharya, M. 1990. Preliminary observation on the ecology of some grasshoppers in Tripura with special reference to *Oxya hyla hyla* serv. (Orthoptera: Acrididae). Rec. Zool. Surv. India. **86(2)**: 355-360.
- Pradhan, S. and Peswani, K. M. 1961. Studies on the ecology and control of *Hieroglyphus nigrorepletus* Bolivar. Indian J. Entomol. **23**: 123-131.
- Ramos-Elorduy, J., Pino, J. M., Prado, E. E., Perez, M. A., Otero, J. L. and Guevara, O. L. 1997. Nutritional value of edible insects from the State of Oaxaca, Mexico. J. Food Compost. Anal. **10**: 142-157.
- Rathore, P. S., Haldhar, S. M. and Swaminathan, R. 2013. Biology and morphometric variation within local species of kharif grasshopper, *Hieroglyphus nigrorepletus* Bolivar in South-western Rajasthan. J. Entomol. Res. **37(2)**: 153-162.
- Roonwal, M. L. 1976. Ecology and biology of grasshoppers *Hieroglyphus nigrorepletus* Bolivar (Orthoptera: Acrididae) 1. Egg pods diapause, prolonged viability and annual hatching rhythm. Zool. Angew. Berlin. **63**: 171-185.
- Pradhan, S. and Peswani, K. M. 1961. Studies on the ecology and control of *Hieroglyphus nigrorepletus* Bolivar. Indian. J. Ent. **23**: 79-105.
- Sanjayan, K. P. and Murugan, K. 1987. Nutritional influence on the growth and reproduction in two species of acridids (Orthoptera: Insecta). Proceedings of the Indian Academy of Sciences (Animal Sciences). **96(3)**: 229-237.
- Shaikh, N. and Sultana, R. 2018. Comparative study on the morphometric characteristics of egg-pods in various subfamilies of Acrididae. J. Entomol. Zool. Stud. **6(1)**: 1423-1426.
- Sultana, R. and Wagan, M. S. 2007. Comparative studies on the ovipositional behavior of *Hieroglyphus* species (Hemiacridinae: Acrididae: Orthoptera) from Pakistan. Pakistan J. Zool. **39(5)**: 321-325.
- Sultana, R. and Wagan, M. S. 2007. The effect of food plants on the growth rate, fecundity and survivability of grasshopper *Hieroglyphus nigrorepletus* I. Bolivar (Orthoptera: Acrididae) a major paddy pest in Pakistan. J. Biol. Sci. **7(7)**: 1282-1286.
- Sultana, R. and Wagan, M. S. 2009. A comparative study on the morphology of egg pods, egg development and hatching of three *Hieroglyphus* species (Acrididae: Orthoptera). Pakistan J. Zool. **41(2)**: 143-148.
- Sultana, R., Kumar, S. and Soomro, A. I. 2017. Study on morphology and development of egg-pod and eggs of *Poekilocerus pictus* (Orthoptera: Pyrgomorphidae). J. Entomol. Zool. Stud. **5(3)**: 537-540.
- Sultana, R., Soomro, N., Kumar, S., Samejo, A. A. and Soomro, S. 2020. Comparative study of egg-pod morphology in two genera of Oxyinae (Acrididae: Orthoptera). Pakistan J. Zool. **52(4)**: 1327-1332.
- Sumi, A. and Ao, A. 2022. Entomophagy and commercially available insects among the Sumi Nagas in Dimapur District of Nagaland, Northeast India. Int. J. Curr. Microbiol. Appl. Sci. **11(4)**: 295-301.
- Tajamul, M. and Ahmad, S. T. 2016. Life history statistics and comparative morphometric assessment of rice grasshopper, *Oxya japonica* (Orthoptera: Acrididae). Int. J. Pure Appl. Zool. **4(1)**: 92-98.
- Torto, S. J., Sundufu, A. J., Samura, A. E., Fomba, S. N., Musa, D. P., Kanu, S. A. and Norman, P. E. 2024. Oviposition site preference and its effects on subsequent development of variegated grasshopper (*Zonocerus variegatus* L.) under laboratory conditions. Adv. Entomol. **12**: 143-154.
- Trisnawati, D. W., Tsukamoto, T. and Yasuda, H. 2015. Indirect effects of nutrients in organic and conventional paddy field soils on the rice grasshopper, *Oxya japonica* (Orthoptera: Acrididae), mediated by rice plant nutrients. Appl. Entomol. Zool. **50**: 99-107.
- Wang, D., Zhai, S. W., Zhang, C. X., Zhang, Q. and Chen, H. 2007. Nutritional value of the Chinese grasshopper, *Acrida cinerea* (Thunberg) for broiler. J. Animal Feed Sci. Technol. **135(1-2)**: 66-74.
- Wei, S., Liu, X., McNeill, M. R., Wang, Y., Sun, W., Tu, X., Wang, G., Ban, L., Zhang, Z., and Zhang, R. 2023. Identification of spatial distribution and drivers for grasshopper populations based on geographic detectors. Ecological Indicators. **154**: 110500.
- Wu, T., Hao, S. and Kang, L. 2021. Effect of soil temperature and moisture on the development and survival of grasshopper eggs in Inner Mongolian grasslands. Front. Ecol. Evol. **9**: 727911.