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Comparative study on the morphometric characteristics of egg-pods in various sub-families of Acrididae

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Abstract
During the present survey about 60 egg-pods were collected from different localities of Sanghar district. Collected material sorted out into 09 species. Overall, average length of egg-pod of Acridinae was noted 4.82 mm, width 0.63 mm, average length of egg pod of Hemiacridinae was noted that 5.6 mm, width 2.1 mm, and average length of egg pod of Oxyinae was noted that 5.4 mm, width 2.8 mm and laboratory observation showed that in Acrididae, the number of separate ovipositor, usually 3 and it was separated by the period of 10-20 days the number of egg in the first egg-pod reaches 120-160 in the second 80-100 and in the third 30-60. In addition to this, simplified taxonomic keys to the egg-pods of various sub-families was also presented. During the present survey from the field very small number of egg-pods were examined, it is suggested that some alternation in the key may be found necessary is due period of time. However, morphological description of egg-pods found very helpful to indicate the pest species in field.

Keywords: acrididae, egg-pods, observation, morphological, pest, species

Introduction
The family Acrididae comprise on 12 sub-families mostly they are pest of agricultural crops [1]. It occurs in wide varieties of habitats i.e. trees, herbs, shrubs, and grasses to wetland. The grasshopper belonging to Acrididae is generally phytophagous insects but mostly cause damage to rice field [2, 3]. The eggs were placed in an egg-pods; each one of them is always covered by a thin film of foamy material, soft at first and hardening up later. This material seem to preserve the egg from infection, since the eggs taken from eggs-pods may be kept alive for a much longer period than the fully developed eggs taken out of the ovaries. The eggs of grasshoppers are normally laid in pods in the ground. The abdomen of the female, during -oviposition is extended out gradually to almost double its normal length. After depositing the frothy material the female extrudes the eggs -one by one after a little pause between two successive eggs. Each egg passes out between the tips of the dorsal valvulae of the ovipositor [2, 3]. The micropylar end of the egg always comes out first and points downwards during oviposition and thus, that end always points downwards in the egg-pod. The female makes a fragile, frothy cap above the eggs. The female plugs the egg-pod with some secretion which forms a hard cap above the eggs. A little hardened secreted material is also deposited above the cap. When the female withdraws the abdomen from the oviposition hole [4, 5]. Comprehensive work on the distribution, taxonomy, ecology was carried out by many workers [6, 7, 8, 9, 10, 11, 12, 13, 14, 15]. But no information was available on the oviposition behaviour of Acrididae species. Therefore, the present investigation was carried out to note morphometric characteristics of egg-pods in various Sub-families of Acrididae.

Materials and methods
Sampling
During the present survey 60 egg-pods were collected from the different localities of Sanghar district mostly the herbs, shrubs and grasses. Corner of the field were inspected during the oviposition season. The samples were taken during the month of August to October in 2017.

Collection of egg-pods
From Laboratory
Eggs pods were obtained mainly from females reared in cages. At regular intervals throughout

the year collections of grasshoppers were made in different areas. They were sorted into species and placed in wooden cages, the bottoms of which were filled with a damp mixture of sand and earth. Fresh grass was supplied daily and the cages were kept in an outdoor insectary. The cages were examined for eggs once or twice each week, the soil being renewed.

From field

Pods were obtained from the field by square-yard sampling on an extensive scale. After examination the eggs were kept in cages and the resulting hoppers reared through to the adult stage for identification. An attempt was made to examine at least 10 pods of each species but this proved impossible in some cases.

In the course of the examination, the egg-mass and plug were measured, the presence or absence of plug and envelope noted, the arrangement of eggs as seen from a sides recorded diagrammatically and the number of eggs counted. Ten eggs were then measured from each pod and a preparation of the chorion made by splitting an egg into halves or quarters with a razor blade and mounting on a slide [16]. An attempt has been made to include all the species examined in the key. Consequently, where only small numbers of pods were examined. The numbers examined are indicated in parenthesis in the descriptions of the individual species.

Identification of Egg-pods was carried out on the basis of following

- Arrangements of egg in pods.
- Coating of earth around pods.
- Size and egg-mass.
- No. of eggs/pods.
- Ecological factors which relative to vegetative type of adult.
- No. of egg-pods laid earlier.
- Sculpturing on the chorion of the eggs.
- Presence/ absence of hexagon dots.

Results and Discussion

During the present survey about 60 egg-pods were collected from different localities of Sanghar district. Collected material was sorted out into 9 species. These nine species are: *Acrida exaltata* (Walker, 1859), *Truxalix fitzgeraldi* (Drish, 1950), *Hieroglyphous. nigrorepletus* Bolivar, 1912, *H. oryzivorous* Carl, 1916, *H. perpolita* (Uvarov, 1933), *Oxyina bidentata* (Willemse, 1925), *Oxya fuscovittata* (Marschall, 1836), *O. hyla hyla* Serville, 1831, and *O. velox* (Fabricius, 1787).

The above mentioned species belonging to 3 sub-families its identification key is given below:

Key to the egg-pods of various sub-families of Acrididae

1.	Egg-mass small not broad less than 5.5 mm long……..….....	2
_.	Egg-mass large broad more than 6.5 mm long.....	Hemiacridinae
2.	Usually has 28-30 egg per pod arranged in parallel rows Plug absent……....	Oxyinae.
_.	Usually has 45-65 egg/pod not arranged in parallel rows Plug present ……....	Acridinae

While earlier Kumar *et al.*, [17] reported 32 species as sever pest of crops from Sindh.

Table 1: Shows the different Localities of Sanghar District

S. No.	Location	No. of Trips	Sanghar	
			Duration	Finding
1.	Khipro	08	1 month	05
2.	Sanghar	05	1 month	06
3.	Tando Adam	04	15 days	04
4.	Jam Nawaz Ali	04	15 days	02
5.	Shadadpur	03	10 days	04
6.	Sinjhoro	05	14 days	03

Table 2: The measurement of egg-pod of sub-family Acridinae

S. No	Weight	Length	Width
1.	0.127gm	4.6mm	0.55mm
2.	0.132gm	4.5mm	0.62mm
3.	0.143gm	4.7mm	0.68mm
4.	0.152gm	4.5mm	0.70mm
5.	0.110gm	5.0mm	0.65mm
6.	0.134gm	5.2mm	0.75mm
7.	0.156gm	5.1mm	0.60mm
8.	0.124gm	4.9mm	0.58mm
9.	0.141gm	4.8mm	0.56mm
10.	0.130gm	4.9mm	0.61mm

Table 3: The measurement of fresh laid egg of Sub- Family Acridinae

S. No	Fresh weight(gm)	Width (mm)	Length (mm)
1.	0.0040gm	0.850mm	5.080mm
2.	0.0042gm	0.872mm	5.125mm
3.	0.0043gm	0.876mm	5.118mm
4.	0.0041gm	0.874mm	5.120mm
5.	0.0042gm	0.878mm	5.175mm
6.	0.0044gm	0.878mm	5.178mm
7.	0.0043gm	0.879mm	5.180mm
8.	0.0044gm	0.880mm	5.182mm
9.	0.0045gm	0.882mm	5.184mm
10.	0.0041gm	0.864mm	5.102mm

Table 4: The measurement of dry (single) egg of Sub- Family Acridinae

S. No	Dry Weight(gm)	Width (mm)	Length (mm)
1.	0.0029gm	0.875mm	5.075 mm
2.	0.0028gm	0.70mm	4.725 mm
3.	0.0027gm	0.875mm	4.55 mm
4.	0.0030gm	0.84mm	4.20 mm
5.	0.0028gm	0.77mm	4.34 mm
6.	0.0027gm	0.875mm	5.075 mm
7.	0.0029gm	0.875mm	5.25 mm
8.	0.0026gm	0.77mm	4.90 mm
9.	0.0031gm	0.77mm	4.90 mm
10.	0.0030gm	0.84mm	5.25 mm

Morphological characteristics of egg-pod

Egg-pod was generally elongated in shape with a slightly bend at the middle, the upper end is convex. The eggs were placed in an egg-pods; each one of them is always covered by a thin film of foamy material, soft at first and hardening up later. The egg-pod had earthen coating all round. Egg-pod was full of eggs without empty spaces. Freshly laid eggs were yellow in colour and they soon become brownish if they dried. The outer coat of the pod is so hard that it does not soften even if the egg-pod is placed in Sulphuric acid (H_2SO_4) and Nitric acid (HNO_3). Chorion of a freshly laid egg is cleaned, mosaic pattern of hexagonal, cell-wall with a thick, circular dot or tubercle at each of the angle. Chorion is composed of two layers, Exo-chorion, 6-8µm thick near the poles and about 3-5µ elsewhere. Endo-chorion thicker 9-10µ at the poles, 6-8µ elsewhere, stain with haematoxylin, semi-circular, felt like structure. Tubercles are divided into two hexagonal or pentagonal cells. Endo-chorion ridges meet with the Exo-chorion were hexagonal or pentagonal pattern. The ridges were thickened, pillar which is broad externally i.e. towards the Exo-chorion and narrow towards the chorion. The tubercles were wanting at the poles, ridges are present. Eggs are characterized by egg-shell or chorion, secreted by follicular epithelium which provides mechanical protection to the developing embryo. Section of chorion layer by follicle cell. Highest thickness was formed at the posterior pole. Lower thickness was formed in the anterior pole. Inside Preliminary stage, thickness of chorion is different from posterior to anterior pole. Posterior pole follicle secretion was higher. Four distinct layers, vitelline membrane, inter-chronic layer, air layers, fully formed chronic layer. Inside, the Exo-chorion is extremely thin structure, vitelline membrane in the egg adhere to surface of the egg-pod. Two principles types of egg-wall in the family Acrididae. Polysaccharide and protein were the key ingredient of chorion.

Diapause phenomenon

The majority of eggs show one year diapause, while only 10-11% eggs go to prolonged diapause i.e., 20-23 months after egg-laying even though watered regularly. Similar results were also reported by Roonwal [18] for Grasshoppers species in Pakistani grassland hatch in different periods of summer [19].

The difference between the emergences and duration of hoppers might be because of insect's habitat, seasonal fluctuation and egg diapause which vary from place to place depending on climatic and ecological conditions of the region. Furthermore, present study also revealed that rains in June and July are important, because if these two months were dry, a large percentage of the eggs would fail to hatch. On the whole, early and uniformly distributed summer rains create favourable conditions for this species. Hatching of the eggs of Grasshopper are governed by three main factors namely, moisture, soil and season. If any of these factors was missing, the eggs did not hatch [20].

Conclusion

Overall, average length of egg-pod of Acridinae was noted 4.82 mm, width 0.63 mm, average length of egg pod of Hemiacridinae was noted that 5.6 mm, width 2.1 mm, and average length of egg pod of Oxyinae was noted that 5.4 mm, width 2.8 mm, and laboratory observation showed that in Acrididae, the number of separate ovipositor, usually 3 and it was separated by the period of 10-20 days the number of egg in the first egg-pod reaches 120-160, in the second 80-100, and in the third 30-60. A freshly laid egg-pod is very delicate and it is impossible to take it out of the ground without breaking it, but after two or three days it become harder and may be dug out with comparative ease, it is cylindrical 9 to 9.5cm long is usually bow-shaped, the curve been directed backwards, in relation to the body of the female.

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