

# **Ovary Development Period of Tree Locust *Anacridium melanorhodon melanorhodon* (Walker) in Breeding Habitat of North Kordofan, Sudan**

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## **Abstract**

*Anacridium melanorhodon melanorhodon* (Walker, 1870) (Acrididae: Orthoptera) has been known as the tree locust, it's one of the pests that cause damage to trees. In Sudan, it has called night wanderer because of its nocturnal activity behavior. This study was conducted at North Kordofan. The aims of the study are to examine the factors that influence the tree locust population movements and distribution in the location. These factors include starting period of ovary development in female reproductive system. Females counting from field twice a week, from first appearance to the end of maturation period. Females were dissected in the laboratory to count the ovarioles development. The results showed that, adults of the tree locust appeared in the field in May and sexual maturation began during May /June with the first rains and lasted about 4 weeks. Oviposition period was during June and July. The female laid 1-3 egg pods and each pod containing 150-200 eggs. Adults were encountered during periods of low rainfall and relative humidity. Ovarioles development showed that the first oocyte gave 20169 developed eggs on May and failed to produce eggs on June, July and August. The second oocyte had 23985 and 7350 completed eggs on July and August, respectively. The third oocyte failed to produce sound eggs on June and July, but succeeded to produce 7343 completed eggs on August. That means females laid three egg pods separately according to rainfall.

## **Keywords**

Tree Locust, Ovarioles, Development Period, Sudan

## **1. Introduction**

There are major factors leading gum production are destructive to the tree and reduce gum production, especially insects. Insect-convicted defoliation causes losses in hashab tree [1, 2]. The consequential damage may have a substantial impression on wood supply and the telluric carbon balance. Gum arabic production in the Sudan declined due to many factors; including defoliation of the gum arabic trees by tree locust, especially in Kordofan State [3, 4]. The family Acrididae, including the familiar grasshoppers and the

destructive locusts are polyphagous plant feeders [5]. Insect infestation is among the most challenging environmental hazards that gum arabic producers face, predominantly tree locust *Anacridium melanorhodon melanorhodon*, which is significant defoliator affecting serious harmful on hashab tree [6, 7] and [8]. The tree locust *Anacridium melanorhodon melanorhodon* belong to the (Orthopter: family (Acrididae). *A. m. melanorhodon* is a mesophilous species which lives primarily in moderately humid habitats and it is also a xerophilous species which can live in dry habitat of open forest with thorny trees and shrubs [9]. *A. m. melanorhodon* occur in Cape Verde Island, Morocco, Mauritania, Mali,

Niger, Chad, Nigeria, Ethiopia and Sudan [10]. It appears to be most plentiful in the south- west (Darfur and Kordofan). From Khartoum it extends up the Blue Nile and Gezira district, between the Blue and White Niles [11]. *A. melanorhodon* overlap in eastern Sudan and western Eritrea [12]. The tree locust, *A. m. melanorhodon*, is univoltine with a dry season imaginal diapause. The females lay eggs in June-July, hoppers develop in August and September and imagoes emerge at the end of the rainy season and the onset of the dry season (November) has one generation per year. Generally sexual dimorphism is more visible in solitary forms than in gregarious forms [13, 14]. There are five to six instars for male of *A. m. melanorhodon* and six or seven for female [15], but other author verified six instars for both male and female [6], while only five nymphal instars under laboratory conditions [16, 17]. Copulation takes place after the first rains and copulating pairs stay on trees until eggs laying begins (June-July). Eggs are laid in damp soil during the rainy season 10-20 days after copulation. A female lays 1-3 egg pods containing 150-200 eggs. The eggs hatch to give hoppers, the shed skins of the earliest or intermediate molt are cast on emergence from the egg. The development of the hopper stages takes 48-69 days, the first fledglings appear in September-October [10, 16] and [15]. Imagoes remain in a resting maturity stage until the first rain of the following year in May- June [14, 16]. Very few studies have been done on tree locust in Sudan. It is not known what factors trigger the upsurge of locust population, or whether natural control agents will ultimately reduce the population back to recession levels. This is a potentially valuable area for research [18]. Thus more studies are needed on the biology, ecology and behavior of the tree locust for sound management strategies of this pest [19]. Such studies are necessary, particularly with regard to the key ecological factors leading to population upsurges.

## 2. Methodology

### 2.1. Field Studies

This study was carried out at Sheikan Locality, Northern Kordofan State, on *Acacia senegal* trees. Regular surveys of

Table 1. Mean number of ovarioles per single tree locust female ovary during May, June, July and August.

Months	May	June	July	August
*Mean of ovarioles	140.58b	186.18a	186.66a	187.40a
Std. error	±2.14	± 0.64	± 0.64	± 1.26
Std. deviation	±5.64	±2.87	±3.67	±3.19

\*Means within the same row followed by the same letter(s) are not significantly different at  $p < 0.05$ .

### 3.2. Ovarioles Development

Table 2: shows the mean number of the first oocytes were in the developing egg stage in May ( $23.87 \pm 2.52$ ), while in June there were ( $140 \pm 0.04$ ) developing egg and ( $146.79 \pm 0.68$ ) resorption eggs (red body), all females dissected in July and August showed ( $94.08 \pm 1.70$  and  $53.76 \pm 1.80$ ) completed egg and ( $291.75 \pm 0.70$  and  $188.19 \pm 1.64$ ) red body respectively.

the plantation were conducted twice a week to record tree locust populations during the period from May to October, as well as rainfall and % relative humidity.

### 2.2. Counting of Adults

The Counting of adults was carried out in the morning between 08:30 and 10:30 h., a period of minimum locust activity; the destructive sampling method was used [20]. Counting of adults started from corner of the target area (which is divided the field in four corners across (A, C), on 25 trees and the same was repeated on the distance from (B) to (D) thus fifty hashab trees were selected for adult and hopper counting twice a week.

### 2.3. Laboratory Studies

Dissection of female reproductive system was conducted at the laboratory of the Plant Protection Science Department, Faculty of Natural Resources and Environmental Studies, University of Kordofan. Fifteen females were killed in a killing jar then dissected using scalpels, scissors and clips. Dissection was done by cutting the wings, the legs and the head then cutting along the side of the abdomen, where a thin line joining the upper and lower parts of the body (pleura membrane) and dorsal tergum was removed and after that ovaries which were bound together above the alimentary canal were examined under a binocular. Fat bodies were removed using Ringer solution (which is made of: water ( $H_2O = 100g$ ); sodium chloride ( $NaCl = 6.5g$ ); potassium chloride ( $KCl = 0.15g$ ); calcium chloride ( $CaCl_2 = 0.12g$ ) and sodium bicarbonate ( $NaHCO_3 = 0.20g$ )). Numbers of red bodies (Resorption bodies), numbers of white bodies and ovarioles containing developing eggs were recorded; females were dissected twice a week.

## 3. Result

### 3.1. Number of Ovarioles

Table 1: shows the mean number of ovarioles per ovary of tree locust female during May, June, July and August. Ovarioles were observed in May and the number increased gradually during June, July and August.

Most of the oocytes failed to produce eggs. The second oocyte of ovariole with ( $152.13 \pm 1.06$ ) completed egg in July and ( $187.50 \pm 1.07$ ) in August (Table 2). The third oocyte developed with ( $139.08 \pm 1.65$ ) in July and with ( $12.79 \pm 1.81$ ) in August, while completed eggs showed ( $187.46 \pm 42$ ) in August (Table 3). The most of females of tree locust laid two pods in second and third oocyte.

*Table 2. Men egg development in the first oocyte.*

Condition	May		June		July		August	
	Mean	±S.E	Mean	±S.E	Mean	±S.E	Mean	±S.E
Developing egg	23.87c	2.52	140a	.04	47.05b	.04	0.0d	1.14
Completed egg	0.0c	1.93	0.0c	1.70	94.08a	1.70	53.76b	1.80
Red body	51.02d	1.60	146.79c	0.68	291.75a	.70	188.19b	1.64

\*Means within the same row followed by the same letter(s) are not significantly different at  $p < 0.05$ .

*Table 3. Men egg development in the second oocyte.*

Condition	May		June		July		August	
	Mean	±S.E	Mean	±S.E	Mean	±S.E	Mean	±S.E
Developing egg	49.62b	1.90	107.34a	1.70	58.03b	1.63	0.0c	1.75
Completed egg	0.0c	1.15	0.0c	1.06	152.13b	1.06	187.50a	1.07
Red body	0.0c	1.81	0.0c	1.57	44.01b	1.57	106.25a	1.68

\*Means within the same row followed by the same letter(s) are not significantly different at  $p < 0.05$ .

*Table 4. Men egg development in the third oocyte.*

Condition	May		June		July		August	
	*Mean	±S.E	*Mean	±S.E	*Mean	±S.E	*Mean	±S.E
Developing egg	0.0d	1.90	58.80b	1.65	139.08a	1.65	12.79c	1.81
Completed egg	0.0b	.45	0.0b	.39	0.0b	.39	187.46b	0.42
Red body	0.0c	1.53	0.0c	1.32	11.42b	1.32	79.95a	1.41

\*Means within the same row followed by the same letter(s) are not significantly different at  $p < 0.05$ .

## 4. Discussion

The prevailing wind at the beginning of the rainy season in the Sudan normally comes from the south western direction. This south western wind could give the chance to the tree locust adults to move towards North Kordofan State from the neighboring countries reported by [2, 22], especially from Mali, Nigeria, Niger and Chad. So, surveys through regional cooperation programs should be carried out in these countries beside North and South Darfur States to assess the damage of the tree locust and to have good data concerning its population in the solitary phase. The suggested surveys in the mentioned areas should be done in the dry habitat of open forests with thorny trees and shrubs as assumed by [9], especially on the main host plants reported by [17] such as *Acacia senegal*, *A. mellifera*, *A. nubica* (orfota), *Ziziphus* sp. and *Balanites aegyptiaca*. The early alarm concerning the tree locust population density will give sound prediction of the expected size of infestation. The ecological data, especially rainfall and relative humidity have good impact in such studies.

Ovary development of the tree locust female was observed in May and the number of ovarioles increased gradually during the beginning of the rainy season, and most of first oocyte in ovarioles developed, but more resorption eggs were observed. On July and August, the second and third oocytes of ovariole has developed well and produced eggs. This could be attributed to; unfavorable condition, such as delayed rainfall or reduced amount of food, most females of the tree locust produced only two egg pods (second and third oocytes). These results support by [16, 11, 10] and [23]. The oviposition period is in June- July. The female lays 1-3 egg

pods containing 150-200 eggs. In this study it was found that the number of adults decreased with the increase of rainfall and RH%, and at the same time the number of hoppers increased with the increase of rainfall and RH%. This may return to rainfall which has the best influence on the breeding and behavior of locusts, supplying the humidity desirable both for hoppers development and the growth of vegetation to maintain a population. This results agreed with [11] Who mentioned that during May- June sexual maturation begins with the first rains and lasts about 4 weeks. The oviposition period is in June- July and hoppers development lasts 1-2 months. Hoppers continue to develop during the rainy season and the first fledglings appear in September- October.

## 5. Conclusion

Sexual maturation begins during May – June with the first rains and lasts about 4 weeks. Oviposition period is in June – July and hoppers development lasts 1-2 months. The female lays 1-3 egg pods containing 150-200 eggs. Therefore, it is recommended that the study of different changes among population density of the tree locust concerning study of the life cycle will give a good background for designing a well management plans to influence the population mass of the tree locust to escape the outbreaks that could take place and prime to considerable damage to crops and the economical trees such as *A. senegal*. Regional agreements are suggested to be done between the Sudan and its neighboring countries to have a good data and substituting knowledge and information that help in a good prediction for regional management of the tree locust.

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