



E-ISSN: 2320-7078

P-ISSN: 2349-6800

JEZS 2018; 6(2): 3153-3156

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Received: 11-01-2018

Accepted: 12-02-2018

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Mating strategies in various species of acrididae (Acridoidea: Orthoptera)

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Abstract

Mating behavior is a very fascinating aspect in acrididae it is very peculiar in Acrididae which usually not occur in other groups of orthoptera. During this study mating behaviour of 03 species i-e *Truxalis fitzgeraldi* Dirsh, 1950, *T. eximia eximia* Eichwald, 1830 and *Acrida exaltata* (Walker, 1859) was investigated under laboratory condition it was noted that non-mated female become active after 12 to 15 days. Maturation period in male was 6.5 ± 0.61 days and 9.8 ± 2.77 days in females. Duration of mating was noted 94 mints in *Truxalis fitzgeraldi* and 61 mints in *Acrida exaltata*. Maximum number of mating was observed sixth in these species. Mating not stopped after 1st mating it continued after oviposition. It was also observed that virgin females live longer than non-virgin. There was significant variation in size and weight of female before and after mating. Length of femur and abdomen of mated female was $(4.1 \pm 40.11 \text{ mm})$ and $(3.74 \pm 0.19 \text{ mm})$. Non-mated was $(3.68 \pm 0.14 \text{ mm})$ and $(3.34 \pm 0.08 \text{ mm})$. Whereas non-mated male and female having the same size. Weight of mated and non-mated female was $1532 \pm 166.11 \text{ (mg)}$ and $1275 \pm 6.09 \text{ (mg)}$. Weight of mated and non-mated male was $249.2 \pm 22.12 \text{ (mg)}$ and $246.4 \pm 22.63 \text{ (mg)}$. During copulation soliciting behavior, was also noticed.

Keywords: Acrididae, mating behavior, prolong copulation, soliciting, maturation

1. Introduction

The grasshoppers are one of the very familiar groups of insects, the grasshoppers attack not only the agricultural crops but also the rangeland fields and they cause severe loss to our crops. Pakistan is an agricultural country; it constitutes the largest sector of our economy. Varieties of crops are present here i-e wheat, rice, banana, cotton, maize and sugarcane. The yield of these crops is moderately low due to heavy damage of insect and other factors^[1].

Earlier, many workers such as^[2-8] mostly centered upon the incidence of this pest in various localities.

However, there is no such data available on the breeding habits of Acrididae species except^[9-17] and^[18, 19] who worked on different aspects of the systematic occurrence of many species including brief work on the mating behavior of some species carried by^[20, 21] but there was no any authentic account on the comparative study of this aspect therefore present study was designed.

2. Material and methods

2.1 Sampling

Specimens used in this study were collected from different habitats i-e banana, wheat, maize and mixed vegetation of herbs, grasses by hand picking and insect net (9.1cm diameter and 52.2cm length), collection was made during the year of 2016-2017 from various districts of Hyderabad Division.

2.2 Rearing and Samples

After this collected specimens were reared under laboratory condition on Zea mays the final nymphal moult following observation were taken out viz: maturation, duration of mating and No. of mating in each individual. Weight was measured before and after mating. Beside this, male and female of each species were collected from the field which was kept in a cage, given with the natural green house; cage was about (length $16\frac{1}{2}$, width $13\frac{1}{2}$ cm's). Sand was kept inside; three times water was given to make the sand and grass moist. Fresh cut grass was provided on daily bases. The cage was checked after every five hours. Dead grasshoppers were replaced from the cage. The cage was cleaned daily or after 7 days put in sun light for 6-8 hours for avoiding infection.

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The identification of specimens was carried out in laboratory under the Stereoscopic Dissecting Microscope, through different keys available in the literature.

3. Results and Discussion

Different areas of Hyderabad division were visited such as Hala, Jamshoro, Kotri, Rajar village and Matiari. About 200 specimens have been collected and sorted out into 03 species from Hyderabad division, very less number of species was found in winter season. Most of the species were collected from Jamshoro and Matiari. The dominant species in these areas was *Acrida exaltata* and their mating was observed in the last week of the April.

Mating behavior in grasshoppers species is different. During present study mating behavior in *Acrida exaltata*, *Truxalis fitzgeraldi* and *T. eximia eximia* were described and compared by acoustical and visual communication. Female mature earlier than male. Prolong copulation occur in pair their time period varies after each successive mating. Actively signaling male achieve more mating, having greater mating success. Female mostly chooses active males for mating and repeatedly mate not only same but with a different male. It was noted that during mating male replace the other mating male and same behavior in female also observed, try to displace the mating female. It was noted that there is some morphological variation also noted in the volume of the abdomen during mating process size increase and there is different in the weight of insect before and after mating (Table: 1).

During the field survey it was noted that insect hatching started in the month of March and its peak population was noted in the month of April and May.

3.1 Copulation process

Male matures earlier than female. Non-mated females become

active after 12 to 15 days. Whereas male started first mating after 6 to 8 days. Females reject the mating in the first week of maturation. This cause failure attempts of mating in male. Collected female was aged than male and larger in size. As male was too shorter therefore, it didn't mount on the back of female, it moved beside of female abdomen and holed itself by fore and mid legs and left forelimb holed the hind leg of female, male turned its abdomen and attached with female genitalia. Both were not moving body parts. While hind legs of female were folded upward. Few females were engaged in feeding during copulation. Males couldn't eat during copulation due to stressful environments. Further, grasshoppers cannot escape quickly by flight when attacked as they fly normally. Male grasshoppers always compete with each other only active males enjoy the mating.

During mating male genitalia remain in contact for about 45-155 mints [22]. However, in present observation male remain in contact of about 18 to 94 mints. Due to less genital contact female laid less number of eggs, so this resembled with the observation by [23] female can also lay eggs 5 up to 10 eggs. Previously Niedzlek [22] reported that male lose their weight after mating but within few hours or overnight they regain their weight. He also reported that mated male can only be identified by weight not any other character [24]. Male become sexually receptive and starts first mating 6.0 ± 1.0 days, present study is agreed on this research we also noted first mating 6 to 8 days. Further Reinhardt [23] observed that female become mature and starts first mating after 7 to 12 days. Previously, [25-27] reported that female grasshoppers not only copulate with same male but she repeatedly copulate with different male in her life. Present study agreed with this statement that female mate either with same or different partners. As during the copulation pairs are very sluggish so it is a more appropriate time to adopt control strategies.

Table 1: The weight of mated and non-mated individual

Name of Species	Weight of Mated Female	Weight of non-mated Female	Weight of mated male	Weight of non-mated male
	(n=5) (Mean±SD)	(n=5) (Mean±SD)	(n=5) (Mean±SD)	(n=5) (Mean±SD)
<i>Truxalis eximia eximia</i>	1532±166.11mg	1275±6.09mg	249.2±22.12mg	246.4±22.63mg
<i>T. fitzgeraldi</i>	1448.25±434.84mg	1172.25±354.34mg	-----	-----
<i>Acrida exaltata</i>	584.8±159.47mg	574±155.28mg	193.6±79.39mg	189.6±78.18mg

Table 2: The age of maturation of species

Name of species	Age of Maturation	
	Male (n=5) (Mean±SD)	Female (n=5) (Mean±SD)
<i>Locusta migratoria</i>	5.8±1.39 days	9.1±2.50 days
<i>Acrida exaltata</i>	5.6±1.51 days	9.8±2.77 days
<i>Truxalis eximia eximia</i>	6.5±0.61 days	9.3±1.92 days

Table 3: Length of copulation along with mating numbers

Names of species	Length of copulation in mints/hrs	No: of mating
<i>Truxalis fitzgeraldi</i>	94 mints	1 st
	18 mints	2 nd
	04 mints (failure attempt)	3 rd
	45mints	4 th
	15mints	5 th
	1:38s (failure attempt)	6 th
<i>Acrida exaltata</i>	61mints	1 st
	48mints	2 nd
	60 mints 11s	3 rd
<i>Truxalis eximia eximia with T. fitzgeraldi</i>	1mint 16s (failure)	1 st
	3mints (failure)	2 nd
	53mints	3 rd
	49mints	4 th

Table 4: Variation in the body parts of mated and non-mated female

Name of Species	Mated female		Non mated female		Mated mated male		Non mated male	
	Length of abdomen	Length of femur	Length of Abdomen	Length of femur	Length of abdomen	Length of Femur	Length of abdomen	Length of femur
	(n=5) (Mean±SD)	(n=5) (Mean±SD)	(n=5) (Mean±SD)	(n=5) (Mean±SD)	(n=5) (Mean±SD)	(n=5) (Mean±SD)	(n=5) (Mean±SD)	(n=5) (Mean±SD)
<i>Truxalis eximia eximia</i>	3.74±0.19	4.14±0.11	3.34±0.08	3.68±0.14	2.52±0.08	2.78±0.08	2.52±0.08	2.78±0.08
<i>T. fitzgeraldi</i>	4.76±0.24	5±0.2	4.56±0.27	4.76±0.11	±	±	±	±
<i>Acrida exaltata</i>	4.68±0.13	4.98±0.32	4.42±0.08	4.62±0.29	3.08±0.08	3.38±0.08	3.08±0.08	3.38±0.08



(a)

(b)



(c)

(d)



e)

Fig 1: a) & b) showing copulatory behavior of *T. fitzgeraldi* c) same in *A. exaltata* d) copulatory behavior and soliciting of *T. eximia eximia* e) maturation after final moult

4. Conclusion

Taking into consideration the economic importance of the agriculture important grasshopper, the present attempt is made in order to determine the mating behavior of grasshopper species under laboratory conditions. Such studies would be instructive in understanding the life parameters and finding weak spots to restrict the damage.

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