

STUDY ON THE DIETARY PREFERENCES OF ACRIDID GRASSHOPPERS (ORTHOPTERA: ACRIDIDAE)

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ABSTRACT

Three acridid grasshopper species—*Chrotogonus trachypterus*, *Acrida exaltata*, and *Oxya velox*—were used in this study for investigating their preferences for food plants in a tightly controlled laboratory environment. The grasshoppers were given specific plant species by the researchers, who then observed their feeding habits over a duration of 30 minutes. Some plants were rejected, while others were highly favoured among the 20 plant species that were evaluated. In the plant groups Poaceae, Fabaceae, Solanaceae, Brassicaceae, and Leguminosae, the grasshoppers have shown a high predilection for grasses, wheat, gram, maize, bajra, oats, cauliflower, and cowpea. On the other hand, pyaji, coriander, and chaulai were less common.

According to the study, the physical and chemical characteristics of the plants, such as their freshness, nutrient composition, and water content, have a major impact on the acridid grasshoppers' choice of food plant.

Keywords: *Chrotogonus trachypterus*, *Acrida exaltata*, *Oxya velox*, acridid grasshoppers, feeding preference

INTRODUCTION

Grasshoppers are herbivorous insects belonging to the order Orthoptera and the suborder Caelifera. They are widely distributed across the world, inhabiting grasslands, forests, and agricultural fields. These insects play a crucial role in ecosystems as both primary consumers and prey for various predators.

Surface grasshoppers (*Chrotogonus trachypterus* and *C. oxypterus*) are widely distributed across the Orient and Africa. In India, *C. trachypterus* is more prevalent in the northern regions, while *C. oxypterus* is commonly found in the south.

These grasshoppers are persistent pests of pastures throughout the year. The desert representative of the genus, identified by Kevan (1959) and collected from western Rajasthan, was classified as *C. trachypterus trachypterus*. This species is widely distributed across the ground, thriving on soil surfaces, and is frequently found in nurseries, gardens, and wheat fields. Its distribution spans the plains of India, including areas such as Orissa, South Arcot, Madurai, Coimbatore, Bellary, Madhya Pradesh, and Rajasthan.

Akhtar (1971) Grasshoppers are primarily phytophagous, feeding on grasses, leaves, and crop plants. Some species can cause significant agricultural damage, especially when present in large numbers, leading to outbreaks and locust swarms. However, they also contribute to nutrient cycling and serve as a food source for birds, reptiles, and other insects.

Grasshoppers are known as serious pests of young plants, particularly seedlings of wheat (*Triticum aestivum*), berseem (*Trifolium alexandrinum*), millet (*Pennisetum typhoideum*) and cotton (*Gossypium hirsutum*). While polyphagous herbivores feed on a wide range of plant families, many prefer dicotyledonous plants over monocotyledonous ones, though most species range from oligophagous to polyphagous feeding behavior. The nutritional needs of grasshoppers vary with growth stage, reproductive status, and behavioral patterns.

Some plant species use specific phytochemicals, such as tannins and alkaloids, as eating deterrents. Grasshoppers' selective feeding behaviour is influenced by food plants, which have been shown to have a substantial impact on their development, fecundity, hatchability, and longevity. By examining how much of commonly chosen plant species are consumed by three acridid grasshopper species—*Chrotogonus trachypterus*, *Acrida exaltata*, and *Oxya velox*—this study seeks to understand their dietary preferences.

MATERIAL AND METHODS

The three acridid grasshopper species—*Chrotogonus trachypterus*, *Acrida exaltata*, and *Oxya velox*—were gathered as adults and nymphs from Jodhpur's grasslands and agricultural regions. Under carefully monitored laboratory circumstances, these species were subsequently raised at $32 \pm 2^\circ\text{C}$ and $60 \pm 5\%$ relative humidity (R.H.). To watch their activity and offer food plant leaves, the grasshoppers were kept in wooden cages measuring 60 cm by 40 cm by 60 cm, with one glass side.

Newly hatched nymphs were housed in 15 cm x 20 cm glass jars with muslin cloth covering them and a rubber band holding it in place. Two times a day, they were fed cauliflower leaves.

The food plant resources came from neighbouring fields and the local market. To get rid of impurities, the leaves were cleaned under running water and allowed to dry completely before being used. As indicated in Table 1, twenty distinct food plants were used in the food choice experiment, with *Cynodon dactylon* (doob/grass) acting as the control plant species. The food choice study used, with minor adjustments, the methodology outlined by Haldar *et al.* (1995).

Feeding Test

For the acceptability and food preference tests, fifty mature grasshoppers were used for each trial. Prior to each experiment, all grasshoppers were starved for 18 hours in cages to standardize hunger levels.

Experimental Procedure:

1. Presentation of Food Plants:

- Leaves from twenty different host plants were placed inside the cage.
- The fifty grasshoppers were then released simultaneously for feeding.

2. Feeding Behavior Observation:

- Grasshoppers began feeding within 5–15 minutes after release, exhibiting a random feeding pattern.

- The number of grasshoppers feeding on each plant species was recorded at three consecutive time intervals: 30, 60, and 90 minutes.

3. Experimental Replication and Position Change:

- In the next trial, the positions of the plant samples were altered to reduce positional bias.
- Additional trials were conducted by replacing the tested plant samples with the remaining food plant species.
- Each experiment was replicated at least three times, allowing each grasshopper three opportunities to select food plants.

Data Analysis:

By comparing the number of grasshoppers consuming a certain plant species to those consuming the control diet (*Cynodon dactylon*, doob grass), the food preference value was determined.

To identify significant variations in food preference, one-way ANOVA was used to statistically analyse data on feeding frequency on each plant species and feeding marks seen on plant leaves.

RESULTS

Three acridid grasshopper species—*Chrotogonus trachypterus*, *Acrida exaltata*, and *Oxya velox*—were used in choice tests with specific food plants to determine their dietary preferences. Twenty plant species were provided for selection, and these grasshoppers showed differing levels of preference for each (Table-1).

By observing how fifty test grasshoppers fed, the primary host and preferred food plants were determined. All of the plant leaves that were supplied were somewhat accepted by the insects, however some species were more favoured than others. Among the 20 plant species, the Poaceae, Fabaceae, Solanaceae, Brassicaceae, and Leguminosae families were the most popular.

Grasshoppers engaged in grooming behaviours while feeding, patting and polishing the leaf surface with their mouthparts and mandibles. Their adventurous behaviour included hopping onto the cage wall and then going back to feeding in certain instances.

There was less acceptance of other plant species, such as coriander, pyaji, and chaulai. Cowpea, cauliflower, oats, bajra, wheat, gramme, maize, and grass, on the other hand, were among the most commonly selected food plants, suggesting a significant affinity for these species.

As a result, the grasshoppers' feeding habits were influenced by the leaf structures of various plants. The duration of the fasting was carefully regulated because an extended period of food and water deprivation may alter the insects' ability to choose

between different meal samples (Bernays, 1991).

Species-Specific Food Preferences: - *Chrotogonus* sp. showed a high preference for oat, grass, wheat, cauliflower, cabbage, gram, and bajra.

- Moderate preference was observed for cowpea, maize, moong, tomato, sugarcane, groundnut, alfalfa, and bathua.
- Lower preference was recorded for spinach, brinjal, coriander, pyaji.
- *Oxya* sp. most frequently preferred gram, cauliflower, grass, oat, wheat, and maize.
- Moderately preferred plants included sugarcane, tomato, moong, bajra,
- Least preferred plants were brinjal, spinach, coriander and chaulai

Both grasshopper species favoured cereal crops and legumes, but other green vegetables and herbs were less liked, highlighting species-specific differences in diet selection.

Oats, wheat, tomatoes, brinjal, and grass were the foods that *Acrida exaltata* preferred the most.

Coriander, bajra, spinach, pyaji, and bathua were the least favoured plants, whereas chaulai showed no signs of feeding. Interestingly, out of all the grasshopper species, coriander and chaulai were among the least popular feeding plants.

There was no discernible difference in food preferences, according to statistical analysis using a one-way ANOVA test ($p\text{-value}=0.378\geq 0.05$).

Table-1 Food plant preference by acridid grasshoppers

S. No	Botanical Name	Common Name	Family	<i>Chrotogonus trachypterus</i>			<i>Acrida exaltata</i>			<i>Oxya velox</i>		
				30 min	60 min	90 min	30 min	60 min	90 min	30 min	60 min	90 min
1.	<i>Vigna radiata</i>	Mungbean	Leguminosae	1	2.3	2.3	1	2.3	2	1	2.6	2.3
2.	<i>Vigna unguiculata</i> W.	Cowpea	Leguminosae	1.3	2	3.3	2	2.6	3.6	1	1.3	2
3.	<i>Triticum aestivum</i>	Wheat	Poaceae	2.3	3	4.3	3	4	5.3	3.3	2	4
4.	<i>Cynodon dactylon</i>	Doob/grass	Poaceae	2.3	4.6	4.6	3.3	2	4.6	4	3.3	4.6
5.	<i>Pennisetum typhoides</i>	Bajara	Poaceae	1.3	2	3.3	2	1.6	1	1.6		2
6.	<i>Saccharum officinarum</i>	Sugarcane	Poaceae	1	2.3	2	1	1.3	1.6	2.3	2	3.3
7.	<i>Avenasativa</i>	common oat	Poaceae	3	3.3	5	4.3	4	5.3	3	3.6	4.3
8.	<i>Cicerarietinum</i>	Gram	Fabaceae	2.2	3	3.3	2	3.6	3.6	4	4.3	5.3
9.	<i>Medicagosativa</i>	Alfaalfa	Fabaceae	2	1.3	1.6	3	3.3	3	2.3	2.3	1
10.	<i>Arachishypogea</i>	Groundnut	Fabaceae	2	3.3	3	2	3.3	3	2.6	-	1.3
11.	<i>Spinacia</i>	Spinach	Amaranthaceae	1	2	1.3	-	3	1.3	1	1.6	-

	<i>oleracea</i>											
12.	<i>Amaranthus caudatus</i>	chaulai	Amaranthaceae	-	-	1	-	-	-	1.3	-	-
13	<i>Chenopodium album</i>	Bathua	Amaranthaceae	2	2	1.6	2.3	1	2.3	1	1.6	1.6
14.	<i>Lycopersicon esculentum</i>	Tomato	Solanaceae	3.3	2.6	2.6	3.3	4.3	4.6	-	-	2.3
15.	<i>Solanum melongena</i>	Brinjal	Solanaceae	1.3	1.6	1.6	3.3	4.3	5.3	1.3	2.3	-
16.	<i>Brassica oleracea</i> var. <i>capitata</i>	Cabbage	Brassicaceae	3.3	3.6	4.3	2.3	1.3	1.3	2.6	2.6	1.6
17.	<i>Zeamays</i> L.	Maize		2	2.3	3.3	2	2.3	1	1	2.6	3.6
18.	<i>Brassica oleracea</i> var. <i>botrytis</i>	Cauliflower	Brassicaceae	3.3	4.3	4.3	1.3	1.3	1.6	2.3	4.3	4.6
19.	<i>Coriandrum sativum</i>	Coriander	Apiaceae	1	-	-	1.3	-	-	1	1	-
20.	<i>Asphodelus tenuifolius</i>	Pyazi	Asphodelaceae	-	1.3	1	-	-	1.3	-	-	1
One way ANOVA Fvalue-1.081407347, Non-significant (Pvalue-0.378422756865169 ≥ 0.05)												

DISCUSSION AND CONCLUSION

In polyphagous insects, a mix of physical, chemical, and sensory elements determine the choice of food plants (Ananthakrishnan *et al.* 1985). All species of acridid grasshoppers showed a very consistent preference for widely accessible plant species in their choice tests.

The most common food plants were wheat and grass, with gram, maize, bajra, oats, cauliflower, and cowpeas following.

According to a previous study by Ananthakrishnan *et al.* (1985), *Atractomorpha crenulata* favoured host plants belonging to the Euphorbiaceae, Fabaceae, Solanaceae, Poaceae, Asclepiadaceae, and Amaranthaceae families. It was also shown that nymphs were more likely to be found on dicot plants.

Early *Gastrimargus transversus* instars demonstrated a low preference for agricultural plants and a strong affinity for a range of grasses. Gramineae (grass) plants were preferred as food plants. Similarly, according to Das *et al.* (2002), *Hieroglyphus banian* mainly favoured plants of the Poaceae and Cyperaceae families.

Similarly, Nzekwu and Akingbohunge (2002) discovered that when *Oedaleus nigeriensis* nymphs were fed a combination of *Axonopus compressus*, *Eleusine indica*, *Cynodon dactylon*, and *Seteria gracilipes* (all grasses) as opposed to a single host plant, their development was accelerated.

(2003) Idowu and Sonde. found that a mixed diet and cassava (*Manihot esculenta*) were preferred by *Zonocerus variegatus* over *Acalypha wilkesiana* and pawpaw (*Carica papaya*).

In particular, *Acrida exaltata* preferred plants belonging to the Poaceae family (Haldar, P., 1995; Nath, S., 2009). The Walker (*Acrida exaltata*) is a significant pest of wheat, sal, rice, and grass. Along with vegetables like tomato and brinjal, it also harms crops including paddy, maize, oats, and wheat. *Oryza sativa* (rice) was its favourite plant, whereas *Triticum aestivum* (wheat) and *Cynodon dactylon* (grass) showed moderate growth. Conversely, *Brassica oleracea* var. *botrytis* (cauliflower) was the least favoured, while *Zea mays* (maize) was less preferred (Wani, P. A. S., and Tariq, A. G. 2014).

A common pest of crops like maize, jowar, bajra, rice, millet, groundnuts, and sugarcane, *Chrotogonus trachypterus* Blanchard is a surface-dwelling grasshopper that is especially harmful to seedlings. Its potential as a pest for established crops is shown by the species' clear preference for specific Solanaceae, legumes, and cucurbits that are economically significant. *Chrotogonus trachypterus* has been shown to consume large amounts of jute (*Corchorus capsularis*) and berseem (*Trifolium alexandrinum*) leaves, with consumption rates of 68.67% and 67.00%, respectively, in previous investigations. Between meals, a grasshopper usually waits two to three hours and consumes a single diet for one to three minutes (Asad R *et al.*, 2001, Singh A 1961).

Rahman (2001) found that *Chrotogonus lugubris* Blanchard preferred beans and clover to cotton leaves or wheat seedlings.

Chrotogonus trachypterus had the highest growth index when fed lucerne and then wheat, according to laboratory tests, while pigweed and nutgrass produced noticeably lower growth indices (2012).

According to research by Haldar *et al.* (1995) and Nath *et al.* (2009), *Acrida exaltata* favoured Poaceae plants. In contrast, *Atractomorpha crenulata* preferred 13 plant species, including *Daucus carota*, *Adiantum caudatum*, and *Hemarthria compressa*. Additionally, it was discovered that *Saccharum officinarum* and *Brassica oleracea* var. *botrytis* affected *Acrida exaltata* Walker's growth and development (1990).

While *Oxya fuscovittata* grew most on *Oryza sativa* (rice), followed by *Cyperus rotundus* (2014), *Oxya hylahyla*'s favourite feeding plants were *Sorghum halepense* and *Cynodon dactylon*.

Even though grasshoppers are naturally polyphagous, they show a predilection for specific host plants that are necessary for their development and growth. Because of this, acridid grasshoppers do not harm every plant species equally. They exhibit distinct preferences instead, which are impacted by the interplay between the food's nutritional value and the insect's needs.

The preferred food plants that are frequently found in the environments that acridid

grasshoppers occupy are thoroughly understood thanks to the current study. This information can provide insights into how they interact with their surroundings by predicting their preferred habitats and behavioural tendencies.

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