

Indication of jumping ability in the mite family Scutacaridae (Acari, Tarsonemina)

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(With 1 figure)

Abstract

Adult females of *Imparipes (I.) dispar* (Rack, 1964) show pronounced jumping ability. Analysis of video recordings has so far shown three kinds of jumps: an aimed jump, a sideward jump and a high-and-long jump. The ability to jump could be meaningful with regard to phoresy and as a flight reaction. This is the first time that jumping has been demonstrated in scutacarids or representatives of Tarsonemina.

Introduction

Jumping ability was discovered in the course of life-history studies in *Imparipes (I.) dispar* (Rack, 1964)*. Jumping is an ability that has been seen in various mite groups (Krisper 1990) but it is new for the Scutacaridae. Observations to date will be given in the following; further work to clarify details is in progress.

Material and Methods

Source of mite material: Haselsdorf-Tobelbad SW of Graz, Austria, on an outdoor kitchen compost heap overgrown with *Aspergillus ustus*; September 1992. Mite material taken from this site has been kept in the laboratory since 1992 and bred continuously. Breeding technique: breeding vessels were Petri dishes (5-10 cm diameter) coated with potato-carrot agar. This culture medium is inoculated at 23-24°C with pure cultures of *Aspergillus ustus* as well as some other imperfect fungi. The fungus carpet is available for the mites to feed on. The findings presented here were recorded in the laboratory with a SONY EVO-9800P Hi8 camcorder.

* = *Imparipes (I.) hystricinus dispar* Rack, 1964. An explanation of the new name combination will be given in a separate taxonomic publication.

Results

Adult *Imparipes dispar* females show a pronounced ability to jump which is lacking in larvae and adult males. This is thus the first time that any jumping behavior has been demonstrated in scutacarids respectively Eleutheregonina (cohort designation in the sense of Krantz 1978).

Adult females also show phoretic behavior. Mounting a transport host is preceded by waiting or expectancy behavior. The most pronounced form of the latter is seen when, with the slightest change in air currents, the animals stand up on leg pair IV and extend leg pairs I - III from the upright body ("perching"). The natural phoresy host is unknown. Preliminary observations of an experimental situation in which *I. dispar* females mounted a small (a few mm) beetle of the family Anthicidae suggest that the phoresy host is to be sought among small flying arthropods.

The video recordings show three types of jumps: (A) aimed jump; (B) sideward jump; (C) high-and-long jump. In the experimental situation, these jumps could be provoked in every female mite in the expectancy phase.

(A) Aimed jump: *Imparipes dispar* possesses long dorsal setae which are held away from the body in a vertical position. If the setae are touched with the tip of a needle, the animal turns toward the source of the stimulus or reacts as described in (B). Sometimes the slight draft caused by rapid back-and-forth movement of the needle will suffice to make the animal turn. When the mite has located the tip of the needle, quickly moving the tip back and forth can provoke an aimed forward jump. In this case the mite jumps from the normal forward-motion position (= "normal position") onto the receding needle tip. The distance covered by the jump is slight, only 1-2 body lengths.

(B) Sideward jump: This type of jump is commonly seen as a reaction to tactile stimuli administered with the tip of the needle. The sideward jump is made from the normal position without preceding turning of the body in the direction of the jump, i.e. the animal does not jump headfirst, but rather sideways (Fig. 1, a-b). The sideward jump is usually in the direction opposite to the stimulus source. The animal lands on legs I-IV on the side of the leading edge of the body. In this landing position, the rump is tipped upward with the ventral aspect oriented toward to take-off site. The sideward jump is a short, single jump (1-2 body widths) but can be repeated in two or three immediately consecutive phases. All the following jumps are also sideward, without the normal position ever being resumed (Fig. 1, a-b-c). The animals can also continue to tip over from the sideward position until they end up lying with their dorsal aspect on the substrate and the ventral aspect facing upward. In this position, the extremities of one side of the body continue to contact the substrate (Fig. 1, d). This unusual position is sometimes maintained for as long as 10 sec. A single sideward jump can also cover the same distance as a series of consecutive sideward jumps (Fig. 1, a-c).

(C) High-and-long jump: A variety of stimuli can provoke this jump experimentally. The air currents occurring when the breeding vessel is opened can suffice to induce mites to perform this kind of jump. The tactile stimuli with a needle tip, as mentioned above, or placing the animal on an unfamiliar substrate (e.g. the smooth bottom of a plastic jar) can provoke an immediate jump. This jump can be made from the normal

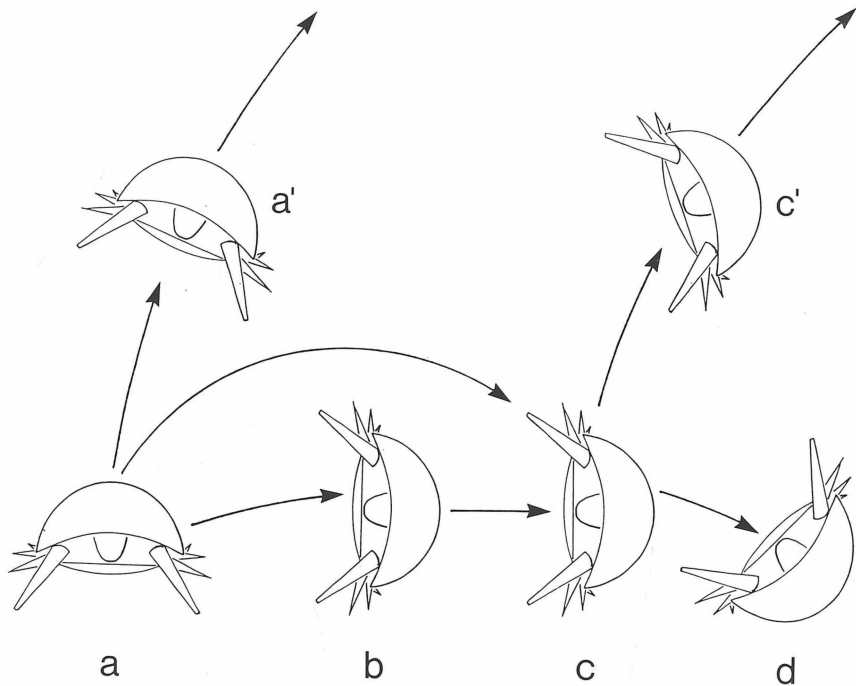


Fig.1. *Imparipes dispar* (female); schematic diagram (frontal view) of side jump and high-and-long jump. Explanation in the text.

position or the sideward position (Fig. 1, a-a', c-c'). The mites can make one or several consecutive sideward jumps and then end the jump series with a high-and-long jump. Takeoff is at a steep angle and is probably unaimed, i.e. the animal has not chosen a particular landing site. Preliminary experiments in a jumping arena, undertaken to determine the jump length, indicate that the animals can cover at least 75 times their own average body length of 0.20 mm. Jump distances that were observed but not measured suggest that considerably greater distances are also possible. The animal lands in the normal or sideward position.

Discussion

How the jumps performed by *Imparipes dispar* actually come about is still a matter of conjecture. Analysis of the jump mechanism and the course of the jump is limited by the high takeoff speed; a high-speed camera would probably be helpful here. Observations to date indicate that leg IV is probably the leg used in the jump but there is no clear concept as to how the rod-like, elongated tarsus and pretarsus and the long distal leg setae work together.

So far, only a few species of the subfamily Imparipedinae have been the subject of laboratory breeding and behavioral experiments; these include *Imparipes apicola* (Cross & Bohart 1992), *Imparipes brevitarsus* (Ebermann 1981), *Imparipes histricinus* (Ebermann 1982a), *Lophodispus irregularis* (Ebermann 1982b) and several species of the genus *Archidispus* (Ebermann 1991a, 1991b). Jumping was never observed in any of these animals. This is surprising insofar as there are no major differences in the morphology of the propulsive leg IV when *Imparipes dispar* and these species are compared.

The reason for this ability to jump can be interpreted in two ways. The aimed jump probably plays a role in phoretic behavior as it permits the mite to jump onto a fast-moving host and move up on it. The high-and-long jump permits large distances to be covered in a very short time. It seems reasonable to say that the latter jump and the sideward jump are both flight reactions. If the high-and-long jump and the sideward jump should actually be used to make a fast escape over a considerable distance, then this would be an alternative to the feigning death strategy (thanatosis). The latter has been shown for several Scutacarid species (Ebermann 1991c).

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Zusammenfassung

Adulte Weibchen von *Imparipes (I.) dispar* (Rack, 1964) zeigen ein ausgeprägtes Sprungvermögen. Bei der Analyse von aufgezeichneten Videosequenzen konnten bisher 3 Sprungtypen festgestellt werden: "Gezielter Sprung", "Seitwärts-Sprung" und "Hoch-Weit-Sprung". Das Sprungvermögen könnte für das Phoresieverhalten und als Fluchtreaktion von Bedeutung sein.

Es ist dies der erste Nachweis eines Sprungvermögens bei den Scutacariden bzw. den Tarsonemina.

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