The life cycle and parasitism of the European grasshopper mite *Eutrombidium trigonum* (Hermann 1804) (Prostigmata: Parasitengonae: Microthrombidiidae), a potential agent for biological control of grasshoppers (Saltatoria)

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**ABSTRACT**

The European grasshopper mite *Eutrombidium trigonum* (Hermann) lives concealed in the soil in relatively warm and xeric biotopes. The eggs and spermatophores display a moderate drought resistance. The adults, during mating and larvae leave the soil and are to be found on the soil surface. The host range of the parasitic larva is restricted to Saltatoria. The larval growth is much greater than that of other instars of *E. trigonum*; however, no damage or other effects on the hosts were obvious and usually the hosts survived parasitism. The active post-larval instars of *E. trigonum* are predatory and feed exclusively on the eggs of Acrididae. The life cycle of *E. trigonum* is univoltine to semi-voltine and is synchronized by an obligatory diapause of the adult instar before reproduction.

**Key words:** Life history, parasitism, biological control, mites, grasshoppers.

**INTRODUCTION**

Parasitengone mites are characterized by a complex life cycle which includes heteromorphic parasitic larvae and predatory post-larval instars. Since a number of economically important insect pests are parasitized by parasitengone larvae, species of this group are regarded as potential agents of biological control (Welbourn, 1983; Gerson and Smiley, 1990). Of the various species combined in the monophyletic taxon Parasitengonae (Witte, 1991), the velvet mite genus *Eutrombidium* is the most frequent parasite of grasshoppers (Huggans and Blickenstaff, 1966; Southcott, 1993) and is therefore regarded as being a **†Deceased.**

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promising candidate for the biological control of acridid pests (Welbourn, 1983).

In this paper, the habitat demands of *Eutrombidium trigonum*, the mechanisms influencing its life cycle, its specificity for prey and hosts and the mode for detecting them will be described in order to determine the suitability of this and closely related species as an agent for the biological control of grasshoppers.

MATERIALS AND METHODS

Location
Samplings and field measurements were performed in 1994 in a stony field near the River Taugl (Vigaun, Austria, 47°39'N, 13°08'E, 450 m above sea level). The ground was only sparsely covered by vegetation (maximum 40%, the dominant vegetation is *Pinus sylvestris* (L.), *Salix elaeagnos* (Scop.) and *Calamagrostis varia* (Schrad.)). For most of the year a dry macroclimate prevailed (Fig. 1). Parasitizing larvae were also captured on dry meadows at other localities in Austria (e.g. National Park Hohe Tauern, 47°04'N, 12°49'E, 2050–2300 m above sea level).

Laboratory rearing experiments were performed using plaster-charcoal-filled polystyrene boxes (25 x 25 x 20 mm). Unless otherwise stated, individuals were kept in an environment at 25°C (±1°C) with a 16 h : 8 h light : dark cycle at saturated air humidities. In addition, breeding cases adjusted at 5°C (12 h : 12 h light : dark cycle), 10°C (12 h : 12 h), 15°C (12 h : 2 h), 20°C (16 h : 8 h) and 30°C (16 h : 8 h) were used. For parasitism experiments, 50–70 larvae of *E. trigonum* kept in a box (80 x 80 x 80 mm) were exposed to two to three potential hosts for 4 days or longer. All the boxes were checked daily.

The fresh body weights of ontogenetic instars were measured on a microbalance (Satorius M5P, accuracy 0.001 mg). Determination of the drought resistance of the eggs was carried out in polystyrene boxes (25 x 25 x 20 mm) at 55.5, 76, 93.5, 98 and 100% relative air humidity (RH) and 25°C. The experiments started 2 days after deposition. The defined air humidities were adjusted with different salt solutions (Winston and Bates, 1960). The water vapour uptake of the spermatophores was tested in linear gradients starting at 100% RH, changing successively to 33% RH, and then moving back to 100% RH. At each humidity (33, 55.5, 76, 93.5, and 100% RH), the volume of the spermatophore capsule was calculated from its diameter (when constancy was achieved). The test was repeated five times with different spermatophores. The phototactic responses of the larvae were tested in glass tubes (100 x 25 mm) illuminated with a light source from alternating positions.

Identification of the specimens was performed according to Robaux (1971) and Southcott (1993). The voucher specimens are kept at the University of Bremen.