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IRIDOTHRIPS IRIDIS (WATSON, 1924) (THYSANOPTERA: THRIPIDAE): AN UNUSUAL SPECIES OF THRIPS THAT LIVES IN A SUBAQUATIC HABITAT

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The leaf sheaths of *Iris pseudacorus* are filled with a mucous substance that provides a suitable microhabitat for populations of *Iridothrips iridis* to survive independently of changes of water level outside. Although the leaf sheaths remain in water all year, the population of *I. iridis* breeds continuously. The apterous females move into the sheaths of the young leaves at the beginning of November for overwintering. This process is a significant element in the survival strategy of *I. iridis*. *Iris pseudacorus* is an aquatic plant but it can also survive prolonged dry conditions. The populations of *I. iridis* are strictly associated with *I. pseudacorus*; they breed in the leaf sheaths and are able to survive under varying environmental conditions for many seasons.

Key words: *Iridothrips iridis, Iris pseudacorus,* subaquatic habitat, wetland.

INTRODUCTION

Thysanoptera species are known as terrestrial animals living in flowers, on leaves and dead branches or in litter (Priesner 1928, 1960, 1964, Schliephake & Klimt 1979, Stannard 1968, Mound and Marullo 1996). *Organothrips bianchii* (Hood) was the first species found in a subaquatic habitat, on partially submerged wet taro (*Colocasia esculenta* var. *antiquorum*) plants in Hawaii (Bianchi 1940 cit. Bhatti 1974). *O. indicus* Bhatti was observed living in completely submerged condition on *Typha elephantina* by Bhatti *et al.* (1998) and on *Cryptocoryne* sp. by Titschack (1969).

In a description of *Iridothrips mariae* Pelikán, 1961 mentioned that this species is strongly adapted to the leaf sheaths of *Typha* sp. where it lives deep in the lower parts of plants in a very moist environment near the water level, often submerged.

Owing to the fact that *I. iridis* populations are associated with *Iris pseudacorus* (Priesner 1964, zur Strassen 2003, Jenser 1999, 2002, 2008) we have assumed that they breed under both aquatic and dry environmental conditions.

Since the annual rainfall was unusually high and consequently the water level was high throughout the year in the Mts Balaton Upland there was an opportunity to study the population dynamics of *I. iridis* between the leaf sheaths when they were permanently under water.

MATERIAL AND METHODS

The site of the regular observations consisted of about 20 hectares of wetland located in Hungary at the Balaton Upland Mts, at Vászoly (N46°55,594; E17°45,475; 285 m). It has continental climatic conditions and is in the temperate zone. The soil is saturated permanently with water. Owing to the high annual rainfall, the low parts of this wetland are partially or completely under water. In some years in summer and autumn only a small part of the low parts, but in other years the entire area, is under water. Accordingly, *I. pseudacorus* grows under varied environmental conditions.

Owing to the unusually high annual rainfall in the period of the observation from November 2009 to May 2011, the water level fluctuated between 30–50 cm. The leaf sheaths of *I. pseudacorus* remained under the water level during this time. In the winter of 2010–2011 the water was frozen and the leaf sheaths were under a layer of ice.

Iris pseudacorus, the breeding plant of *I. iridis,* is a herbaceous perennial plant growing in very wet conditions, where it easily tolerates long-lasting high water level. Although it is primarily an aquatic plant, its rhizomes can survive prolonged dry conditions too. Its leaves develop continuously thorough the vegetation period and decay in autumn, except the young leaves that develop at the end of summer and overwinter. At least the upper third part of the leaves is always above the water level. The basal third of the erect and long broad leaves comprising a closed leaf sheath are filled with a mucous substance. This peculiar microhabitat provides a suitable environment for the survival of populations of *I. iridis* even under alternating wet and dry conditions (Jenser 2008). In the period of study, the leaf sheaths remained continuously under water. The bud developing in the leaf sheaths emerges from under the water, and the flower blooms above the water level.

Investigations were carried out in order to estimate the effect of alternating water level on the population density of *I. iridis* especially when the water level was permanently high. Four samples of ten leaf sheaths were taken on nine occasions; 23rd April, 5th June, 10th July, 1st and 7th August, 5th and 22nd September, 15th October and 13th November in 2010. Owing to the very high water level the sampling could not be performed on 26th June. Further samples were taken on 7th and 22nd May in 2011. The leaves were cut at the base of the leaf sheath under the water.

In addition, samples were taken at two different biotopes from *I. pseudacorus* growing in water, where the leaf sheaths were under the water level for the entire vegetation period, and about 100 m away from this site, also from *I. pseudacorus*, which was growing on a somewhat elevated, semi-wet place in the Bodrog dead-arm (at Sárospatak, Hungary). Thus, the samples comprised

Table 1. The number of *Iridothrips iridis* specimens between the leaf sheaths of *Iris pseudacorus* under the water level (Vászoly 2010, 2011) (samples: 4 x 10 leaf sheaths)

Date		females		males	larvae
		macropterous	apterous	apterous	
2010	April 23	0	13	0	0
	June 5	6	0	0	0
	July 10	0	14	4	0
	August 1	0	57	29	2
	August 7	0	73	34	5
	September 5	0	234	54	0
	September 22	0	91	8	0
	October 15	0	42	2	0
	November 13	0	80	0	0
2011	May 7	0	4	0	0
	May 22	9	0	4	0

the whole leaf sheath developing under the water level throughout the vegetation period. The leaf sheaths were taken to the laboratory where the leaves were separated individually and the number of females, males and larvae were counted under a binocular microscope.

RESULTS

Between the leaf sheaths of the overwintering young leaves only a few apterous females were present in spring (23rd April) of the year 2010 (Table 1). Some macropterous females were observed at the beginning (5th) of June. The sampling could not be performed at the end of June (26th) owing to the high water level. The appearance of apterous females and males was observed at the beginning of July (10th) and their number increased from the beginning of August (1st) and remained at that level until early September. The larvae were present in low numbers at the beginning of August (1st and 7th). Later, the number of apterous females and males decreased and in November all the males disappeared. Forty-seven per cent of the apterous females were found between the leaf sheaths of the young, newly developed leaves on 13th November. In the following spring on the 7th May (2011) again only a few apterous females were found in the leaf sheaths, while two weeks later on the 22nd May nine macropterous females and four apterous males were recovered from developing buds enclosed in the leaf sheaths.

The studied population of *Iridothrips iridis* passes its entire life cycle and breeds within the leaf sheaths of *Iris pseudacorus* in completely submerged conditions.

DISCUSSION

The occurrence of *Organothrips bianchii* Hood is known on wet taro (*Colocasia esculenta* var. *antiquorum*) in Hawaii (Bhatti 1974), of *O. indicus* Bhatti on *Typha elephantina* in North India, also on water hyacinth (*Eichhornia crassipes*) in greenhouses in Australia (Mound 2000), and on *Cryptocoryne* sp. in heated aquaria in Germany (Titschack 1969). Titschack (1969) published his observations of *O. indicus* under the name *O. bianchii* Bhatti, 1974 (Bhatti *et al*. 1998),

According to these records *O. indicus* and *O. bianchii* were found under tropical and subtropical climatic conditions, in greenhouses or in aquaria where the breeding plant as well as the Thysanoptera species are able to breed continuously throughout the year (Titschack 1969, Bhatti *et al*. 1998, Mound 2000).

In contrast, under the climatic conditions of the temperate zone the life cycle of *I. iridis* and its host plant *Iris pseudacorus* is strongly influenced by the conditions during the winter period. Leaves that have developed in autumn overwinter and the apterous females are able to overwinter within their leaf sheaths.

The specimens of the reported *Organothrips* and *Iridothrips* species breed in the leaf sheath filled with mucous substance which prevents the penetration of water, or when the water level is low, it prevents the drying out of this microhabitat (Pelikán 1961, Titchack 1969, Bhatti *et al*. 1998, Mound 2000, Jenser 2008). This way, a permanent microhabitat is provided for the population that is independent of changes in the water level (Jenser 2008).

The winter of 2009 and the year 2010 were extremely rainy throughout and this provided the opportunity to investigate the effect on the population of *I. iridis* of having the leaf sheaths submerged throughout the whole year.

Although the leaf sheaths remained under water all the year the population density of *I. iridis* increased continuously. The number of individuals reached the peak at the beginning of September. The specimens survived and bred between the leaf sheaths of the outer leaves throughout spring and summer. In autumn when the outer leaves began to wither, some of the apterous females moved into the sheaths of the new developed young leaves. In our observations 47% of the apterous females were found between the sheaths of the young leaves at the beginning of November. Only the apterous females overwinter in this microhabitat, probably in reproductive diapause. This process proves to be a significant element in the survival strategy of *I. iridis*.

The occurrence of macropterous females was observed only in spring, both in the leaf sheaths and in the buds and flowers. The gradual growth of the stalk of buds brings some of the macropterous females above the water level, and this generation provides the dispersal of the species.

The populations of *I. iridis* strongly associated with *I. pseudacorus* are able to survive under variable environmental conditions. In other words, *I. iridis* having adapted itself to the extraordinary environment provided by its breeding plant is able to breed and survive above or under the water level in the wetlands throughout several seasons even under temperate climatic conditions.

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