

Thrips (Thysanoptera: Thripidae) on the flowers of a dioecious plant, *Dioscorea japonica* (Dioscoreaceae)

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The genus *Dioscorea* L. (Dioscoreaceae) is widely distributed throughout Africa and Asia and includes 500 to 650 species (Burkill 1960; Miège and Lyonga 1982), almost all of which are dioecious (Terauchi 1990). Pollination of species in this genus has received little attention because many of the cultivated species are propagated vegetatively from tubers. Insect visitors to flowers have been reported for two species, *D. alata* L. from India (Abraham and Nair 1990) and *D. rotundata* Poir. from Nigeria (Pitkin 1973; Segnou *et al.* 1992; Bournier 1994). *Dioscorea japonica* Thunb. is found throughout Japan, Korea, and China (Ohwi and Kitagawa 1983), but insect visitors to the flowers have not previously been reported. We investigated the insect visitors to flowers of *D. japonica* because the insect fauna associated with one species of a genus often differs from that associated with other species of the genus and may vary within a single species between different geographic regions (Kobayashi *et al.* 1999).

In the summer of 2003, we collected all insects that visited the inside and outside of flowers of 10 individuals of each sex of *D. japonica* ($n = 20$ in total), sweeping all the flowers using an insect net and a slender brush. We chose individual plants of *D. japonica* that were adjacent to plants of the other sex. Our observations totaled 19 h (seven sessions of 2–3 h) between

1400 and 2000 on 13 August 2003 and from 2000 on 21 August until 0700 on 22 August 2003. The study site was located in Kamigamo Experimental Forest, Kyoto University, Kyoto Prefecture, central Japan (35°04'N, 135°46'E). The mean temperature in August 2003 was 26.4 °C and the humidity ranged from 62% to 92% (Kyoto University Forests 2006). We chose male and female plants of *D. japonica* that had more than 30 inflorescences in bloom at the time of our observations. Male and female plants of *D. japonica* have about 30 and 5 flowers in an inflorescence, respectively (Mizuki *et al.* 2005). The flowers open gradually from the base of the inflorescence to the tip in both sexes, and have a sweet fragrance (I. Mizuki, personal observation). The flowers are white and consist of six fleshy petals. Sex ratios among the Thysanoptera collected were analyzed with a χ^2 test using the SPSS statistical package for Windows (version 10.1) (SPSS Inc., Chicago).

A total of 427 insects were collected (Table 1), of which 97.0% were Thysanoptera (Table 1). Thysanoptera comprised the following species: *Ernothrips lobatus* Bhatti, 1967 (78.0%), *Thrips coloratus* Schmutz, 1913 (6.5%), *Thrips hawaiiensis* (Morgan, 1913) (1.2%), *Scirtothrips dorsalis* Hood, 1919 (0.24%) (Thripidae), and *Haplothrips gowdeyi* Franklin, 1908 (14.0%) (Phlaeothripidae). The sex ratio varied among species, but *E. lobatus* and *T. coloratus* were significantly female-biased (Table 2). We did not find any larvae or eggs of Thysanoptera, only adults. Of the Thysanoptera collected, 94.9% were on inflorescences

Received 6 January 2005. Accepted 1 September 2005.

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Table 1. Arthropod taxa and number of specimens of each taxon collected from *Dioscorea japonica*.

Order	Number
Thysanoptera	414
Hymenoptera (family Formicoidea)	6
Hymenoptera (superfamily Chalcidoidea)	4
Araneae (suborder Opisthothelae)	2
Diptera (suborder Nematocera)	1

Table 2. Numbers and sex ratios of species of Thysanoptera found on *Dioscorea japonica*.

Species	Number	Sex ratio (male:female)	<i>P</i>
<i>Ernothrips lobatus</i>	323	0.19	<0.001
<i>Haplothrips gowdeyi</i>	58	0.81	ns
<i>Thrips coloratus</i>	27	0.35	<0.05
<i>Thrips hawaiiensis</i>	5	0	—
<i>Scirtothrips dorsalis</i>	1	0	—

Note: *P* indicates the probability of a type I error for deviation of the sex ratio from 1:1 determined from a binominal distribution; ns, nonsignificant at *P* < 0.05.

Table 3. Total numbers of Thysanoptera found in male and female inflorescences of *Dioscorea japonica*.

Species	Number of insects	
	Male inflorescences	Female inflorescences
<i>Ernothrips lobatus</i>	308	15
<i>Haplothrips gowdeyi</i>	54	4
<i>Thrips hawaiiensis</i>	4	1
<i>Thrips coloratus</i>	26	1
<i>Scirtothrips dorsalis</i>	1	0
Total	393 (94.9%)	21 (5.1%)

of male *D. japonica* and 5.1% were on those of female plants (Table 3). Most Thysanoptera were inside the flowers, although some were on the flowers or the inflorescence axis; most preferred opened flowers to buds (I. Mizuki, personal observation). A few ants (Formicidae, head width about 500 µm) were collected on the flowers, but they were too large to enter the flowers (male *D. japonica* flowers 2.1–2.3 mm in diameter, with the opening a 100- to 200-µm three-way slit; female flowers 2.1–2.4 mm in diameter, with the opening 250–300 µm wide). By contrast, the head width of *E. lobatus* is about 95 µm (Masumoto and Okajima 2002).

Our observations suggest that the insects visiting flowers of *D. japonica* are very different

from those visiting *D. rotundata* (male *D. rotundata* flowers 1–3 mm in diameter, female flowers 4–8 mm in diameter, with the opening a 100- to 200-µm three-way slit (Segnou *et al.* 1992)). For *D. rotundata* the visiting pollinator families are Coleoptera (48.0%), Diptera (20.4%), Hymenoptera (20.0%), Hemiptera (5.8%), and Thysanoptera (5.8%). The thysanopteran visiting *D. rotundata* was *Larothrips dentipes* Pitkin, 1973 (Thripidae) (Segnou *et al.* 1992). Segnou *et al.* 1992 seem to have underestimated the percentage of visitors represented by Thysanoptera because they caught insects on and around flowers using a mouth aspirator but did not collect insects inside the flowers. Pitkin (1973)

indicated that *L. dentipes* breeds in the male flowers of *D. rotundata*, with adults moving in and out of the female flowers, suggesting that they may be one of the pollinators. Abraham and Nair (1990) reported that only thrips were caught on *D. alata* (female flowers 18–22 mm long and 7–10 mm wide); however, the thrips were not identified or counted. We found that Thysanoptera, especially *E. lobatus*, were the most abundant visitors to both male and female *D. japonica* flowers. Moreover, *E. lobatus*, *T. coloratus*, *T. hawaiiensis*, and *H. gowdeyi* were collected on male and female inflorescences of *D. japonica*, suggesting that these four species of Thysanoptera may be pollinators of *D. japonica* (Table 3). Also, *D. japonica* may be a preferred host plant for *E. lobatus*, whereas the other three species utilize many host plants (Miyazaki and Kudo 1988).

Thysanoptera are often found on flowers of many species of plants but are generally not thought to be pollinators (Kirk 1984). However, several recent reports have indicated that some species of Thysanoptera are pollinators of particular plants (Momose *et al.* 1998; Mound and Terry 2001; Sakai 2001; Williams *et al.* 2001; Zerega *et al.* 2004). Whether species of Thysanoptera, and especially *E. lobatus*, act as pollinators for *D. japonica* requires further investigation. *Ernothrips lobatus* is one of only three species belonging to the genus *Ernothrips* Bhatti. Although *E. lobatus* is recorded from India, Indonesia, Taiwan, Thailand, and Malaysia, it was first recorded from Japan only in 2002, where it was collected in small numbers from a wide range of plants (Masumoto and Okajima 2002). The report given here may be the first indication of the host plant of *E. lobatus*. *Dioscorea japonica* occurs only in eastern Asia, whereas *E. lobatus* occurs in eastern, southeastern, and southern Asia (Masumoto and Okajima 2002), implying that *E. lobatus* lives on other plants, especially in southeastern and southern Asia.

We thank R. Harada, A. Iwatake, A. Bosco, M. Ikeuchi, and H. Fukumasu for their assistance with the field research. Thanks are also due to the staff of the Kamigamo Experimental Forest, Kyoto University, for their support of this study. This study was supported by JSPS Fellows (No. 16000940) from the Japanese Society for the Promotion of Science. This study was also partly supported by a Grant-in-Aid for the 21st century COE program “Innovative

Food and Environmental Studies pioneered by Entomomimetic Sciences” from the Ministry of Education, Culture, Sports, Science and Technology of Japan.

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