短 報

Solid food items foraged by Argentine ant during winter season

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Abstract Solid food items loaded by Argentine ant foragers returning to nests were surveyed in urban settings in Hiroshima City and its environs during winter 2000-2002. Arthropod corpses had the majority in such food items. Collembola corpses formed the greater or greatest part in the earlier period, but dwindled away in the later period. Homoptera corpses once decreased in mid-winter and then recovered. Seeds of henbit (Lamium amplexicaule Linn.), which is known as a myrmecochorous plant in Japan, were gathered by Argentine ant in early spring.

Key words: arthropod corpses, foraging, henbit seed, Linepithema humile, winter

Introduction

The introduced Argentine ant Linepithema humile (Mayr) invades into agricultural, natural and urban habitats worldwide, and causes severe damage to native biota and human society (e.g. Vega and Rust, 2001; Holway et al., 2002). Also in Japan, Argentine ant was confirmed to affect adversely native ants (Miyake et al., 2002; Touyama et al., 2003). Besides, recent researches have revealed that Argentine ant influenced on non-ant arthropods in Japan (Terayama et al., 2006; Touyama et al., 2008). Biological invasions of alien species, including Argentine ant, are well-known to threaten and demolish native ecosystem (e.g. Elton, 1958; Bright, 1998). In order to control the harmful pest ant and conserve


<table>
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<tr>
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<tbody>
<tr>
<td>Mean Temp. (°C)*</td>
<td>7.9</td>
<td>6.1</td>
</tr>
<tr>
<td>Zoic corpse</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collembola</td>
<td>10 (46)</td>
<td>13 (37)</td>
</tr>
<tr>
<td>Homoptera</td>
<td>4 (18)</td>
<td>1 (7)</td>
</tr>
<tr>
<td>Heteroptera</td>
<td>1 (10)</td>
<td></td>
</tr>
<tr>
<td>Formicidae</td>
<td>2 (9)</td>
<td>2 (6)</td>
</tr>
<tr>
<td>Diptera</td>
<td>1 (5)</td>
<td>3 (21)</td>
</tr>
<tr>
<td>others</td>
<td>3 (14)</td>
<td>1 (3)</td>
</tr>
<tr>
<td>Living arthropod**</td>
<td>1 (5)</td>
<td></td>
</tr>
<tr>
<td>Bird fece</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seed</td>
<td>5 (36)</td>
<td>9 (26)</td>
</tr>
<tr>
<td>Phytomaterial</td>
<td>1 (3)</td>
<td></td>
</tr>
<tr>
<td>Leftover</td>
<td>1 (5)</td>
<td>4 (29)</td>
</tr>
<tr>
<td>Unidentified</td>
<td>1 (7)</td>
<td>4 (11)</td>
</tr>
<tr>
<td>Total</td>
<td>22 (100)</td>
<td>14 (100)</td>
</tr>
</tbody>
</table>

*: Mean Temperature were measured at Hiroshima Local Meteorological Observatory: Japan Meteorological Agency [http://www.jma.go.jp/jma/index.html]

**: This item was visually confirmed being live at the sampling time.
native ecosystem, we should inquire into spatial and temporal fluctuation of foraging activity of Argentine ant.

Invasive Argentine ant can, unlike many native ant species, forage outdoors even during winter (Thompson, 1990; Touyama et al., 2004; Abril et al., 2007; Carpintero et al., 2007). However, little is known what Argentine ants forage outdoors then. In this paper, I report on the solid food items foraged by Argentine ants in urban settings in Hiroshima City during winter 2000-2002.

Materials and Method

I investigated the composition of solid food items foraged by Argentine ants in several urban lots in Hiroshima City and its environs, mainly in Ujina and Dejima in southern coastal area of Hiroshima City, from December 2000 to April 2001 (excluding January 2001) and from November 2001 to April 2002. I intercepted Argentine ant foragers and sampled their loads nearby their nest using aspirator. When solid food item was identifiable on the spot, I only observed and recorded it instead of taking-away. I only sampled food items from the worker returning to nest, not ones walking away from nest. In case that plural Argentine ants swarming about a leftover of human meal was observed, I dealt with it as a single food datum. Observations and samples from several sites were pooled and summed for each month. Because investigations were performed on occasion, total observation/sampling duration time were manifold for every month/site. So, I also showed percentage of number of each food item to summation in every month.

Results

Seasonal change of solid food composition

In this study, a total of 307 solid food items were taken. The majority of solid foods were arthropod corpses such as Collembola, Homoptera, Formicidae and Diptera (Table 1). Food item composition showed some seasonally-changing patterns, which were common to two winter periods. First, Collembola corpses formed the greater or greatest part of solid food items especially in the earlier sampling period, but dwindled away into less than 10% in April.

Secondly, Homoptera corpses, of which the majority were aphid, once decreased in January-March, and then reincreased and exceeded the level in previous November and December. Appreciable part of these aphid corpses appeared to be fresh; those seemed to be preyed, not be scavenged, by Argentine ants. I did not identify whether these aphids were myrmecophilous species or not.

Thirdly, Argentine ants began to forage many seeds of henbit L. amplexicaule since February in 2001/2002. These seeds had larger or largest part (20-30 %) of solid food items in late spring. Most of these seeds were fresh and equipped flawless elaiosome.

Native ants as food of Argentine ant

Argument ant foraged many Formicidae corpses during winter (Table 1). Majority of these were Tetramorium tsushimae Emery, and the rest were Argentine ant L. humile, Crematogaster osakensis Forel, Paratrechina sakurae (Ito), and unidentifiable fragments. I have repeatedly observed that Argentine ant carrying the conspecific corpses into, as well as out of, their nests. But I could not confirm whether such conspecific corpses were consumed as food or not.

I observed seven cases of Argentine ants' attacks on native ants during the survey. But Argentine ants frequently failed in preying on the native ants, as mentioned below in detail. In three cases, Argentine ants attacked weakened native ants (C. osakensis and T. tsushimae), but failed in preying those. In one case, Argentine ants attacked and killed a native Formica japonica Motschulsky, but the prey was abandoned there afterwards because it was too large to enter the Argentine ant nest entrance. In the rest three cases, I could not confirm the end of the struggles with T. tsushimae. Judging from these observations, Argentine ant in winter seemed not to be skillful hunter.

Discussion

Food item composition of Argentine ant seasonally changed (Table 1). First, percentage of Collembola corpses dwindled away from November to April. This pattern admits of some possible explanations. For example, Collembola corpses on the ground might be depleted by April. Or else, Collembola corpses might become valueless in early spring, by the occurring of more attractive foods (e.g., henbit seed: mentioned later). Since I have no information on the seasonal change of Collembola corpses' abundance to date, I do not discuss it here.

Secondly, there was a temporary decrease and subsequent recovery of Homoptera (almost aphid) corpses. Such decrease could be explained by depopulation of aphids in mid-winter (Setoguchi, 1983; Furuta, 1984; Nozato, 1987; Takada and Sugimoto, 1994; Okamura and Yamane, 1994). Besides, there is another possible explanation of such decrease: it reflects
the change of nutritional demand of Argentine ants. Aphid-
tending ants utilize aphid bodies (as resource of protein) as
well as exudates (as resource of carbohydrate), and probably
regulate the both usage in order to prevent extinction of
aphid colony (Sakata, 2000; Abril et al., 2007). If honeydew
resource other than aphid were exhausted in mid-winter,
Argentine ant might refrain from preying on aphids. Really,
horticultural flowers, which supplies nectar for Argentine ant,
decrease just in January and February (Touyama, unpublished
data, 2006-2007). The shortage of nectar resources might
induce Argentine ant to make much of honeydew-exudating
aphids. Markin (1970a) also pointed out that there was the
peak of aphid-tending by Argentine ants in February and
March. However, I regrettedly did not identify whether every
aphid corpse foraged was myrmecophilous species or not. So,
this explanation is only a possible hypothesis which should be
verified in the future.

Post-decrease recovery of foraged aphid corpuses was
also explained by the nutritional demand of Argentine ant, as
well as population growth of aphids. From the late in March
to the early in May, Argentine ants forage and consume more
protein-rich foods such as dead or alive insects between
spring and summer for the sexual larvae growth (Markin,
1970b; Krushelnicky and Reimer 1988; Rust, personal
communication, cited in Klots et al., 2000; Cooper et al.,
2008). The need of protein might facilitate the re-increases of
preying aphids in the early spring. In addition, the depletion of
Collembola corpuses might encourage Argentine ant to prey on
aphids.

Thirdly, L. amplexicaule seed harvesting began to be
observed since February. This pattern was caused by the
seedling phenology. In Japan, henbit L. amplexicaule is a
common myrmecochorous plant which seed has a small
elaisomous attracting ants (Nakanishi, 1988). Some species of
indigenous ants also forage henbit seeds: Messor aciculatus (F.
Smith), Ochetellus glaber (Mayr), Paratrechina amia (Forel)
and T. tsushimae (Touyama, pers. obs. 2004-2010). Argentine
ants may be a serious competitor with such indigenous ants
for seeds of myrmecochnorous plants.

Potogieter (1937) pointed out that winter season, when
the natural food supply diminished, might be favorable for the
control of Argentine ant. Present study, showing the temporal
shift of solid food composition of Argentine ant during winter,
should contribute to improve baiting method to control of
Argentine ant.

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