INSECTS ON URBAN PLANTS: CONTRASTING THE FLOWERHEAD FAUNA OF NATIVE AND EXOTIC ASTERACEAE

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INTRODUÇÃO

Urbanization causes marked changes in the composition of regional floras and faunas (3, 9, 12). However, till now there is no consensus about how urbanization affects species diversity (5). Some studies have shown that species richness is higher in urban areas than in natural ones, at least for some taxonomic groups (e.g., 4, 9). It is also known that plant richness in urban environments increases as a consequence of the colonization of innumerous exotic species, which are infrequent in natural and rural areas (4). In fact, it is widely reported and accepted that exotic plant species correspond to the largest proportion of urban flora.

Interactions involving plants and herbivore insects figure as a large component of most terrestrial trophic networks. Host plants and their associate herbivore insects also constitute informative systems to investigate the potential effects of urbanization on the structure and dynamic of species interacting networks. Given that both correlative and experimental studies have shown that plant diversity is a strong predictor of insect species richness at different spatial scales (e.g., 7, 10), we could predict that urban areas also have a larger number of insect species when compared to neighbouring natural habitats. However, Stefanescu *et al.,* . (11) found lower butterfly richness in urbanized areas of Catalonia (Spain), and McIntyre & Hostetler (6) showed that bee diversity was even lower in residential areas. A common explanation for such a decrease in herbivore - insect species richness in urban habitats is that most of the pristine insect fauna is comprised by oligophages and monophages, which do not feed on exotic plants-an extension of the enemy release hypothesis (13).

Here we analyzed the biodiversity of endophagous insects feeding on Asteraceae flowerheads (capitula) in urban areas. Since Asteraceae is well represented in urban environments, this particular set of plants and their associate herbivores comprise a good system to investigate the effects of urbanization on insect - plant interactions.

OBJETIVOS

Our objective with this study is twofold: first, we compare the incidence, species richness and composition of endophagous insect assemblages associated to different species of Asteraceae in an urban environment; secondly we test the predictions of the hypothesis stating that native plant species support a higher number of endophagous insect species than exotic ones. This is expected given that native plant and insect assemblages have evolved together and are, therefore, much more closely associated.

MATERIAL E MÉTODOS

This study was carried out in four green areas (lawns) of the Campus of the State University of Campinas, located in the city of Campinas, State of São Paulo, Brazil. We sampled each area in three different periods: June, September (both in 2005) and February (2006). These months include the flowering periods of the most representative tribes of Asteraceae according to previous phenological records. For each individual plant we collected randomly up to 80 ml of flowerheads. The abundance of each species in each area was estimated in eight classes based on a logarithmic scale of base 3: I) 1; II) 2; III) 3 to 10; IV) 11 to 30; V) 31 to 100; VI) 101 to 300; VII) 300 to 1000; VIII) $>$ 1000. In the laboratory, flowerhead samples were kept in plastic containers covered with a mesh lid, where emergence of adult insects was checked once or twice weekly for two months or until emergence rates became insignificant. All insects were reliably identified at least to genus level.

In order to evaluate whether native and exotic species differ in their incidences (number of occurring areas), abundances (mean value for the classes of local abundance) and flowering ranges (number flowering periods), we performed non - parametric randomization tests. The correlations of sampling size (weight of sampled flowerhead) and mean abundance of host - plant species with the number of insect individuals and species were examined through the Spearman's rank coefficient.

We tested for differences between the proportion of native and exotic Asteraceae species consumed by at least one flowerhead endophagous with Fisher's Exact Test through randomization. We also applied Fisher's Exact Test to evaluate differences in the following variables between native and exotic host species: abundance of insect individuals per weight of flowerhead per host species, the number of herbivore species per host plant, and the number of herbivore species per weight of sampled flowerhead per host species. The number of insect individuals per weight of flowerhead is a measure of insect density per host plant. However, the number of herbivore species per host plant is relatively small and does not increase linearly with sampling effort. Thus, our correction for sampling size cannot be interpreted as an adequate measure of herbivore species density per host species. We used this correction simply to provide a benchmark for the sampling size effect on the contrasts between the number of insects associated to native and exotic Asteraceae. Only plants with at least 1g of sampled flowerhead were considered. All randomizations were performed by using the software Resampling Stats (1).

RESULTADOS

We recorded 26 species of Asteraceae from 25 genus and 10 tribes. Among these species, four are native from Asia and/or Europe (*Crepis japonica*, *Emilia sonchifolia*, *Sonchus oleraceus*, and *Taraxacum officinale*), and three are from North and Central America (*Conyza canadensis*, *Parthenium hysterophorus*, and *Tridax procumbens*). Even though exotic species comprised 1/4 of the recorded Asteraceae, their local abundance and their incidence were significantly higher when compared to the native species (Non - parametric randomization tests: P = 0.0298 for abundance and P = 0.0198 for incidence). This finding is consistent with many other studies comparing the abundance and diversity of native and exotic plant species in urban areas (e.g., 4, 8). Furthermore, invasive plants usually show high tolerances to variations in soil and climatic conditions (5).

We recorded 419 endophagous individuals, comprising 26 insect species from 16 genera and five families (Agromyzidae, Cecidomyiidae, Pterophoridae, Pyralidae and Tephritidae). The number of flowerhead - endophagous species was not associated to mean plant abundance (rs = 0.291, P = 0.149), but the number of individual insects per host plant followed up an increase of host abundance (rs = 0.416, P = 0.0347). The number of insect individuals also raised following an increase in the weight of sampled flowerhead (a measure of sampling effort) and the number of insects individuals (rs = 0.517, P = 0.0068) and the number of insect species per host plant (rs = 0.490, P = 0.0109). It seems that urbanization leads to the reduction of the insect richness through the local extinction of the most specialist ones (2). This could be an explanation for the relatively low endophagous richness we found.

We found all insect species in at least one native host plant, whereas only four species were found in exotic ones. Tephritidae and Cecidomyiidae were the most species - rich families (with 11 and 8 species, respectively) and emerged only from native hosts. They are probably the most speciose families of flowerhead feeding insects and most of their species are specialists, feeding on few host - plants from the same subtribe. For instance, the abundance of the microlepidopteran *Rotruda* sp. (Pyralidae) was higher in exotic (n = 54) than in native host plants (n = 10). If the abundance of exotic plants is much greater than that of the native ones, the native insect discrimination becomes more difficult and, consequently, some of them tend to use exotic plants (9).

Although we found only four herbivore species in flowerheads of exotic species, the proportion of native and exotic host species consumed by at least one herbivore species was the same (Native plants: 15 herbivore species in 19 host species; Exotics plants: 3 herbivore insects in 7 host species; P = 0.0992). On the other hand, we found more herbivore species per host plant among native Asteraceae (P = 0.0310). This finding was consistent even after controlling for differences in sampling size (P = 0.0301). Finally, native and exotic Asteraceae had the same number of insects individuals per weight of sampled flowerhead (P = 0.0629).

CONCLUSÃO

The richness of flowerhead feeding insects was higher in native plants despite their lower abundance and incidence when compared to the exotic ones. In addition, the higher number of insect taxonomic groups found on the exotic host - plants constitute a small fraction of the genus and families found feeding on the native Asteraceae. This work contribute to the agreement of the processes and ecological standards associates to these effects, being plus a contribution aiming at to explain the effect of the urbanization on interactions involving phytophagous insects and their host - plants.

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