

Within- and across-year legacy effects of herbivores on plant-associated arthropods and reproductive success in a perennial herb

(植食者の年内と越年の遺産効果が植物利用者と多年生草本の繁殖成功に及ぼす影響)

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Summary:

Introduction

Herbivores can alter a wide variety of morphological and chemical traits of plants. Through such phenotypic changes in plant traits, indirect interactions among arthropods on the same plant can occur. Importantly, herbivore-induced changes in plant traits often persist after the herbivore left, indirect interactions can occur among temporally separated herbivores. Although such persistent effect of past herbivores may have significant consequences for arthropods community and plant performance, it has been often overlooked because the damaging herbivores are no longer present. In this thesis, I defined herbivory effects that persist for a long time (at least more than weeks) as legacy effects and verified the significance of legacy effects of herbivores on arthropods and plant performance within and across years. In particular, I test three hypotheses in this thesis: (1) legacy of herbivores within a year can be a determinant of community structure of flower visitors, (2) herbivory effects influence seed production in the same year through flower visitor community, depending on herbivore species identity, and (3) across-year combination and orders of herbivore species influence plant growth and seed production in the following year.

Materials and methods

Using tall goldenrod (*Solidago altissima* L.) and its dominant two herbivore species (aphid: *Uroleucon nigrotuberculatum*; lacebug: *Corythucha marmorata*), I conducted insect-inoculation experiments at a common garden of Center for Ecological Research. In Chapter 2, using lacebugs as a presentative of herbivore, I assessed whether the early-season lacebug herbivory influences the community structure of flower visitors by changing floral traits in the same year. In Chapter 3, using aphids and lacebugs, I examined whether herbivory by aphids and lacebugs influence seed production through changes in flower visitors in the same year. In chapter 4, I explored effects of two-year sequential herbivory on plant growth and production of flowers and seeds, by manipulating combinations and orders of herbivory events (lacebug, aphid, or no herbivory)

Results

In Chapter 2, early-season lacebugs reduced flower abundance, and subsequently decreased pollinators, florivores, and thieves, but not predators in late season. Community composition of flower visitors on lacebug-damaged plants significantly differed from undamaged plants. In Chapter 3, I showed that the herbivore-altered community structure of flower visitors in turn influences seed production within a year. Specifically, lacebugs decreased seed production by decreasing flower abundance and species richness of flower visitors. In contrast, aphids had no impacts on flower abundance, and thus no impacts on flower visitors, and seed production. In Chapter 4, it was clarified that combinations and feeding orders of herbivore species for two years influenced plant growth and production of flowers and seeds in the second year. When the same herbivore species attacked plants for two years, across-year herbivores on plant resistance, growth, and production of flowers and seeds were not detected. In contrast, when the different herbivore species attacked plants between the first and the second year, across-year herbivores increase/decrease plant growth and flower production.

Discussion

Results in my thesis showed the legacy effects of herbivores have significant effects on later herbivores and flower visitors within and across years, and which in turn, influences seed production of plants. To gain a better understanding of herbivory effects on plant-associated arthropod communities and host plants, I discussed factors affecting strength and sign of legacy effects of herbivores on community structure of arthropods and seed production.

Conclusion

Legacy effects of herbivores are one of the strong forces to determine community structure of plant-associated arthropods and reproduction of host plants within and across years. Future studies should examine under what conditions the legacy effects of herbivores on the community structure of plant-associated arthropods and plant performance become strong. Paying attention to long-term consequences for interactions between plant and arthropods is necessary to understand how species interactions shape plant-arthropod communities.