DOI: 10.5586/aa.1711

Publication history
Received: 2017-03-28
Accepted: 2017-03-28
Published: 2017-03-31

Handling editor
Bożena Denisow, Faculty of Horticulture and Landscape Architecture, University of Life Sciences in Lublin, Poland

Authors' contributions
Both authors equally contributed to writing the text.

Funding
This study did not involve any financial support.

Competing interests
MZ: member of the editorial council of the *Acta Agrobotanica*; MS: no competing interests

Citation
Stpiczyńska M, Zych M. Plant–animal interactions are a key to understand biodiversity. Acta Agrobot. 2017;70(1):1711. https://doi.org/10.5586/aa.1711

EDITORIAL

Plant–animal interactions are a key to understand biodiversity

Małgorzata Stpiczyńska, Marcin Zych*

Botanic Garden, Faculty of Biology, University of Warsaw, Aleje Ujazdowskie 4, 00-478 Warsaw, Poland

* Corresponding author. Email: mzych@biol.uw.edu.pl

For centuries, plant and animal studies progressed along mostly separate scientific pathways. However, ever since Darwin's famous quote "plants and animals, most remote in the scale of nature, are bound together by a web of complex relations" (*The Origin of Species*, 1859), naturalists have started to realize that plant–animal interactions are a powerful evolutionary force sustaining biological diversity in all terrestrial ecosystems. Recently, this cross-disciplinary subject has attracted researchers from different fields: plant biologists, behavioral zoologists, evolutionary ecologists, etc. In this issue of *Acta Agrobotanica*, we present a selection of papers extending our understanding of the various adaptations in plant–animal relationships. Among all, the contributions include the role of pollinators in shaping plant reproductive success, micromorphological adaptations of the flower and nectar characters to attract pollinators as well as the role of ecological stoichiometry in plant–animal interactions and the function of microorganisms in plant–animal interactions.

The observations carried out by Odintsova and Fishchuk [1] from Ukraine have revealed diversity of micromorphological adaptations to the pollination mode in closely related species from Convallariaceae (*Polygonatum multiflorum*, *Maianthemum bifolium*, and *Convallaria majalis*). They report the presence of a long septal nectary in the ovary and epidermal trichomes on the inner perigonium surface and on the filaments in the flower of *P. multiflorum* and suggest that the flower potentially functions as a xenogamous nectar and pollen flower. The disc-shaped flower of *M. bifolium* is morphologically adapted to generalist pollinators and self-pollination. In *M. bifolium*, a rudimentary external septal nectary was described for the first time. In contrast, the *C. majalis* flower is polleniferous with no nectaries or other morphologically distinct secretory structures.

The new perspectives in nectar evolution and ecology have been discussed by Nepi [2] from Italy in his fascinating review article. Nectar is considered as a main reward offered by plants to animals in exchange for benefits, mainly pollination and indirect defense against herbivores. Some nectar components (proteins and nectar secondary metabolites, e.g., nicotine and benzyl acetone or non-protein amino acids) have no primary nutritious function but are involved in plant–animal relationships in other ways. Proteins protect against proliferation of microorganisms and infection of plant tissues by pathogens. Nectar secondary compounds can be involved in modulating the behavior of nectar feeders, maximizing benefits for the plant. Nectar-dwelling microorganisms (mainly yeasts) have recently been revealed as a third partner in the scenario of plant–animal interactions mediated by nectar. There is evidence that yeast has a remarkable impact on the nectar feeder behavior, although the effects on plant fitness have not yet been clearly assessed.

The experiment conducted by Peters et al. [3] brings an important contribution to the interpretation of the role of bacteria in plant–animal interactions. The authors suggest a prominent role of bacteria in shaping the behavior of organisms at higher trophic levels, e.g., herbivory in natural, horticultural, and agricultural systems. In their survey, the authors reveal that the feeding behavior of the common slug *Arion vulgaris* is modified by bacteria associated with both plants and animals.

The last decades brought the emergence and spread of the pollination crisis, which greatly affects plant reproduction. Brzosko et al. [4] have evidenced that the deficiency of pollinators is the main factor limiting the reproductive success in populations of the rare orchid *Cypripedium calceolus* inhabiting environmental islands in the Biebrza National Park, NE Poland, and can affect the persistence of this threatened plant species.

Studying another red-listed plant species, *Polemonium caeruleum* L. (Polemoniaceae), Ostrowiecka et al. [5] found that the plant's pollination system may vary geographically and the composition of pollinator assemblages probably influences the plant mating, leading to the transition from self-incompatible to selfing populations.

Plant–pollinator interactions can also be influenced by human activities, be it habitat fragmentation or management of semi-natural ecosystems. Daubaras et al. [6] investigated the impact of forest management (clear cuts) on pollinator visitation in three ericaceous plant species, *Vaccinium myrtillus*, *V. vitis-idaea*, and *Calluna vulgaris*, important economic plants and common elements of pine forest understory.

In their review article, Filipiak and Weiner [7] focused on the importance of stoichiometric balance and inconsistency between the chemical composition of consumer's tissues and that of its food sources. This inconsistency affects the major life history traits of the consumer and may influence consumer's fitness and shape plant–herbivore interactions. The authors suggest that the trophic stoichiometric ratio (TSR) index is a useful tool for indicating the chemical elements that are scarce in food and have the potential to limit the growth and development of herbivores, thereby influencing plant–herbivorous insect interactions. The scarcity of the pollen element may differently contribute to the life history of mason bee (*Osmia bicornis*). The growth and development of this pollen consumer may be colimited by the scarcity of K, Na, and N in pollen, whereas the development of the cocoon might be colimited by the scarcity of P, Mg, K, Na, Zn, Ca, and N.

Finally, Nowakowski et al. [8] have shown the interaction between beef cattle and meadow ecosystems in the "The Warta Estuary" National Park, Poland. Animal welfare is one of especially important issues in such areas, and therefore minimally invasive methods are the most desirable in the case of any procedures related to the animals inhabiting the sites. Using *n*-alkanes markers, the authors estimated the pasture herbage intake by beef cows. The best prediction of DM intake estimation from a creeping bentgrass (*Agrostis stolonifera*) pasture, in agreement with the accepted energy and protein standards, was based on the proportions between alkanes C_{31}/C_{32}.

In conclusion, we believe that these papers substantially contribute to our better understanding of the complexity of plant interactions with other organisms. We take the opportunity to thank all the authors who have contributed to this issue of *Acta Agrobotanica*. Our sincere thanks go to all the reviewers for their valuable comments and suggestions, which greatly improved the final version of the presented papers.

The guest editors of the issue are:

- Małgorzata Stpiczyńska, University of Warsaw, Poland
- Marcin Zych, University of Warsaw, Poland.

References

1. Odintsova A, Fishchuk O. The flower morphology in three Convallariaceae species with various attractive traits. Acta Agrobot. 2017;70(1):1705. https://doi.org/10.5586/aa.1705
2. Nepi M. New perspectives in nectar evolution and ecology: simple alimentary reward or a complex multiorganism interaction? Acta Agrobot. 2017;70(1):1704. https://doi.org/10.5586/aa.1704
3. Peters B, Türke M, Junker RR. Epiphytic bacteria on lettuce affect the feeding behavior of an invasive pest slug. Acta Agrobot. 2017;70(1):1708. https://doi.org/10.5586/aa.1708

4. Brzosko E, Ostrowiecka B, Mirski P, Jermakowicz E, Tałałaj I, Wróblewska A. Pollinator limitation affects low reproductive success in populations of nectarless orchid in the Biebrza National Park. Acta Agrobot. 2017;70(1):1706. https://doi.org/10.5586/aa.1706
5. Ostrowiecka B, Brzosko E, Jermakowicz E, Wróblewska A, Mirski P, Roguz K, et al. Breeding system variability, pollination biology, and reproductive success of rare *Polemonium caeruleum* L. in NE Poland. Acta Agrobot. 2017;70(1):1709. https://doi.org/10.5586/aa.1709
6. Daubaras R, Cesoniene L, Zych M, Tamutis V, Stakėnas V. Effect of forest clear cuts on plant–pollinator interactions: the case of three ericaceous subshrubs in Lithuanian pine forests. Acta Agrobot. 2017;70(1):1707. https://doi.org/10.5586/aa.1707
7. Filipiak M, Weiner J. Plant–insect interactions: the role of ecological stoichiometry. Acta Agrobot. 2017;70(1):1710. https://doi.org/10.5586/aa.1710
8. Nowakowski P, Czyz K, Iwaszkiewicz M. Estimation of pasture herbage intake by beef cattle based on *n*-alkanes as markers. Acta Agrobot. 2017;70(1):1702. https://doi.org/10.5586/aa.1702