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EDITORIAL

Editorial of special issue "Plant-pollinator network: Processes and impacts"

Chuleui Jung[1,2*]

[1]Department of Plant Medicals, Andong National University, Andong 36729, Republic of Korea
[2]Agriculture Science and Technology Research Institute, Andong National University, Andong 36729, Republic of Korea

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***Corresponding author**
Chuleui Jung
E-mail cjung@andong.ac.kr

Pollination is the process of transferring pollen from an anther, male part of flower to the stigma, female part of flower which would enable the subsequent fertilization and the production of seeds. In angiosperm plants, if the pollen grains land on the head of stigma and chemical interaction begins, then pollen grains germinate and develops pollen tube down to the ovary through the style. Two male gametes reach the ovary, entering the ovum cell through micropyle, one male nucleus (n) fuses with polar body (2n) to produce endosperm tissue (3n) and the other (n) fuses with the ovule (n) to produce embryo (2n). This is an important ecosystem process which is conducted with many animals called pollinators such as insects, birds and bats among which bees are the primary importance.

As the pollination is crucial for plant reproduction, mutualistic co-evolution have been shaped the plant-pollinator network through morphological, physiological, chemical and ecological adaptations (Mayer et al. 2011). Mutualistic interaction between bees and angiosperm plant can be mediated by rewards; nectar (an energy source) and pollen (a source of protein) and services; fidelity (visiting same species) and consistency (visiting the same way). Thus the pollination service is the primary importance for success of plant reproduction and for increase of agricultural production as well. Most essential staple food crops such as wheat, corn, rice, sorghum are wind pollinated or self-pollinating. Thus insect pollination dependency for staple food production is relatively low. However most of greenhouse vegetables and fruit tree crops are highly pollinator dependent; 49.2% and 42.9% of productions are dependent on insect pollination in Korea (Jung and Shin 2022). It was obvious that pollination is the vital service for agricultural production, nutritional security, and biodiversity maintenance as well.

Pollination study in the Western roots back to Sprengel (1793) for his first publication of the interaction of insect and plant on transporting pollen grain to the stigma of the plant is the essential step for production of seeds and fruit. In Korea, we have plentiful records of the interaction of insect pollinators and plants such as Shin Saimdang (1504–1551) depicting painting of watermelon and butterflies, eggplant with butterflies, and daylily with bees. So that, human interplay with the mutualistic interaction with pollination system is not only for agricultural food production but also can be cultural.

In this special issue, we brought issues about the importance of pollination as an ecosystem service to human civilization and well-being as well as to agricultural production and wild life management.

For this, the possible contributions to this special issues on various subjects relative to "Plant-pollinator network: Process and impacts" were sought. I considered no restriction to the pure ecological perspectives of pollination but tried to include diversified topics such as pollinator diversity and protection, utilization of pollinators for other purpose of human intervention, plant-pollinator networks and related factors determination, even pollination syndrome and mechanisms. Beyond the typical scopes on pollination, we also invite new technology for studying the plant-pollinator networks.

Pollinators are not only important for ecological processes but also for forming the societal relics and culture. Meyer-Rochow (2021) analyzed the attributes of honey bees and their products relative to the cultural and medicinal perspectives in Asia where diverse myths, stories and idioms can be found. He reported that although folkloristic references to honey bees were found to be mostly positive highlighting fearlessness, cleverness, and industriousness of the bees, some also touch upon their ability to cause pain.

Also, honey bees could be placed as edible insects. Ghosh et al. (2021) described different aspects of honey bee as not for pollinators which play in the middle of the process of crop production but as a food itself. They reported the value of honey bee brood as a potential food sources noticing the competent nutrient composition of, in particular, honey bee brood, pupae, and prepupae, suggesting that they could be a potential source of human nutrition as well as animal feed. In the other way, the human consuming agricultural products also can share with our mutualistic partner, honey bees. As the climate change excavates the honey bee environment, food shortage or nutritional shortage can be problematic when there are scarce nectar or pollen flow. Danmek et al. (2022) tested if the longan fruit extract (longan syrup) could be an alternative carbohydrate sources for honey bees. Even honey bees do not accept the fresh longan syrup but boiled or enzyme-enriched syrup was equally accepted and positively influenced honey bee population, implying that artificial syrup made from longan fruit could feed honey bees when natural food sources are limited.

As the plant-pollinator interaction has shaped different traits for each group as a co-evolutionary processes. Mukherjee and Hossain (2021) determined the morphological variation relative to the specialization as the butterflies are nectar feeder the mouthpart (proboscis) morphology would be most important. They reported that the proboscis length, body weight, and wing length are positively related, and lycanid butterflies had strong preference to *Tridax procumbens*, and *Ocimum americanum* flowers but less frequently in *Syndrella nodiflora* flower which could influence the conservation of t those butterfly species. While, Dekebo et al. (2022) analyzed volatile organic compounds (VOCs) from flowers which are known to attract honey bees and bumble bees. Results showed the monoterpene 1,3,6-octatriene, 3,7-dimethyl-, (*E*) (*E*-β-ocimene) was the dominating compound in most flowers analyzed in *Lonicera japonica*, *Diospyros lotus*, *Amorpha fruticose* and *Robinia pseudoacacia*. Nitrogen containing VOCs were occurring principally in *Corydalis speciosa*; and *Diospyros kaki*. *Ligustrum obtusifolium* flower scent contains isopropoxycarbamic acid and *Castanea crenata* the preeminent compound is 1-phenylethanone (acetophenone). They addressed that the olfactory cues are important for pollinators to locate the floral resources but there exist complicated interaction among species of pollinators and plants. Further, Bisrat and Jung (2022) reviewed the roles of flower scent in bee-flower interaction since bees rely on flower scents to locate blooming flowers as visual clue is limited and also their host plants from a distance. Even flowering plants produce diverse VOCs, only a few of them are important for eliciting behavioral responses in bees. Mainly terpenoids, benzenoids, and volatile fatty acid derivatives are responsible for eliciting bee foraging. Bees generally use honest floral signals to locate their host plants with nectar and pollen-rich flowers. Thus, honest signaling mechanism plays a key role in maintaining mutualistic plant-pollinator associations.

But, most important message of pollination come from the enhanced crop production from this ecosystem service process. As the pollinating insects are diverse, comparing the efficiency of each species as a pollinator to the specific crop is important for managed pollination. Chuttong et al. (2022) studied the foraging behavior of honey bee (Apis mellifera) and stingless bees (*Tetragonula laeviceps* species complex) on mango plants. In this study they reported that pollination dependency of mango is near 100% which means that in pollinator exclusion treatment, no fruit was produced. However the fruit production quantity and quality were not different between honey bee and stingless bee treatments, but higher than open pollination treatment, signifying that managed pollinator program would benefit the mango growers for better productivity regardless of species.

Lastly, for the network analysis and habit mapping, Mohamadzade Namin et al. (2022) reviewed various methodologies in constructing plant-pollinator networks from studying the visitation, palynology, biparties network modeling to DNA barcoding as well as high throughput analysis. And then they concluded that DNA metabarcoding is practical for plant-pollinator studies, however, lack of reference sequence in online databases, taxonomic resolution, universality of primers are the most crucial limitations. Rahimi et al. (2021) introduced new methodology for crop pollination mapping technology since the ecosystem service mapping is an important tool for decision-making in landscape planning and natural resource management. To cope with the limitation of Lonsdorf model (Integrated Valuation of Ecosystem Services and Tradeoffs [InVEST] software), they introduced PollMap which estimates the pollination service according to a modified version of the Lonsdorf model and assumes that only cells within the flight range of bees are important in the pollination mapping. This can be applied in agricultural landscape.

This special issue on "Plant-pollinator network: Process and impacts" could attract interesting, and needed topics for the pollination ecology as well as for societal human well-being. Further research and education efforts could be guided for conservation of this valuable ecosystem service from this issue.

Abbreviations

Not applicable.

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Not applicable.

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