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SESSION XII
SOCIAL INSECTS AND APIDOLOGY

Effects of seasonality and landscape composition on pesticide residues in pollen collected by honeybees

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In recent decades, pollinator abundance and diversity faced a strong decline due to multiple anthropogenic pressures, including the use of pesticides in agricultural areas and the loss and fragmentation of semi-natural areas. The honeybee (Apis mellifera Linnaeus) is the most widespread pollinator species, and its presence is crucial not only for ensuring the reproduction of plant species in natural habitats but also for crop production. Like most bees, the honeybee diet is based on nectar and pollen. The presence of pesticides in the pollen collected by honeybees has potential negative effects on bee health and it can be strongly affected by landscape composition and, in particular, the amount of agricultural areas.
This work aimed to explore how the pesticide residues in pollen collected by honeybees were modulated by seasonality and landscape composition heterogeneity in a mountainous cultivated area. We selected 13 locations in Northern Italy, and at each location, we placed two honeybee colonies from which we collected pollen samples every month during the whole flowering season from 2017 to 2020. For pesticide residue analysis, we searched for more than 400 compounds in pollen samples, including fungicides, acaricides, herbicides, and insecticides. We then calculated for each pollen sample the Pollen Hazard Quotient (PHQ), an index that provides a measure of the potential toxicity of contaminated pollen. Finally, to assess landscape heterogeneity, we determined the cover of the main habitat types in a 3 km radius buffer around the sampling locations and analysed landscape composition using Principal Component Analysis (PCA).
Only 6 pollen samples out of 200 (4%) were pesticide-free, while in the remaining 194 samples, we detected more than 100 compounds, mainly fungicides. PHQ values were high (PHQ > 1000) in 32 samples (16%), medium-high (500 < PHQ < 1000) in 14 samples (7%), medium (50 < PHQ < 500) in 47 samples (24%), and low (PHQ < 50) in 101 samples (50%). The sampling season had a strong effect on pesticide residues in pollen. PHQ was higher between April and July, when pesticide applications in agricultural areas were also higher, and strongly decreased in August and September. On the other hand, the highest number of compounds detected in pollen was recorded in June. Landscape composition differently affected pollen diversity and pesticide residues. Pesticide residues in pollen were also affected by the landscape, as pesticide residues increased with increasing proportion of certain categories of agricultural areas and decreased with increasing proportion of semi-natural areas in the landscape.
Our work highlighted that both seasonality and landscape composition strongly affected the presence of pesticide residues in pollen collected by honeybees, which can strongly negatively impact honeybee health. Also, since it has been shown that pollen quality can influence the response of bees to pesticides, it is therefore advisable for beekeepers to evaluate landscape composition before placing beehives, in order to maximise floral resources around the hives and thus the diversity of pollen collected by bees while minimising the likelihood of high pollen contamination by pesticides

KEY WORDS: Floral resources, Landscape heterogeneity, PCA, PHQ, Pollinators.

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