Is pollinator activity influenced by non-protein nectar amino acids?

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Introduction

This study is focused on the plant-pollinator relationship in an isolated population of Gentiana lutea subsp. symphyandra. G. lutea L. (Gentianaceae) is a long-lived species that mainly grows on calcareous (sub)-alpine pastures. Flowering occurs between June and July. The study population is located on the eastern slope of Mount Grande (Northern Apennines; Bologna, Italy), between 1380 and 1460 m a.s.l. (Fig. 1). The main visitors of the plant in this population are bumble bees.

Previous observations, performed in 2011 and 2012 flowering season, pointed out an unusual sluggish behaviour in bumble bees feeding on plant nectar (Fig. 2). The abundant nectar of the plant was analysed and it resulted remarkably rich in proline and β-alanine amino acids (Rossi et al., 2014). The hypothesis is that this composition could influence insect dynamism, exerting a narcotic effect on pollinators (Nepi, 2014).

Materials and methods

This study was carried out in August 2013 considering two intervals per day (morning and afternoon), during two consecutive days. The following aspects were evaluated: nectar standing crop, nectar production, nectar amino acidic profile and visitors behaviour (genus Bombus).

Nectar standing crop:
estimated through samplings from 37 flowers open to insect visitation (Fig. 3) (12 flowering stems).

Nectar production:
estimated through samplings from 40 flowers protected by net (Fig. 4) (20 flowering stems).

Analysis of the amino acidic profile of nectar collected (Fig. 5):
• from closed or freshly opened flowers with indiscernible anthers;
• from flowers at older anthetic stage with discernible anthers.

Behavioural observations (Fig. 6):
• total of 9 observation hours;
• 155 individuals observed.
• Data recorded:
  • insect movements within and among plant and pseudo-whorls;
  • collected reward (nectar or pollen);
  • visitation time.
• Insects showing unusual behaviour were captured (Fig. 7) and subsequently identified (Fig. 8).

Results

• T-test between standing crop and nectar production shows an higher nectar quantity for flowers protected by net (p<0.000) (Fig. 9).
• The results of nectar analysis show that in 2013 amino acid concentration was 100-1000 times lower than in 2011 (Tab. 1).
• Analysis on visitation time between the two intervals shows a longer stay on pseudo-whorls in the afternoon (p=0.015). There aren’t significant differences for all the other variables.
• Taxonomic identification of the 29 captured bumble bees shows that 17 of them were nonparasitic bumblebees (species of Bombus Latreille excluding Psthyrus species) and 12 were social parasites belonging to the subgenus Psthyrus Lepeletier (Tab. 2).
• Observation on the captured individuals are analysed comparing all species by Kruskal-Wallis test. Psthyrus rupestris spends more time on each pseudo-whorl (Fig. 11), moving more between them and at the same time visits more flowers than the other species (Fig. 12).
• Comparing Bombus and Psthyrus, time spent on single pseudo-whorls (p<0.000) and time spent on all pseudo-whorls (p=0.003) are higher for subgenus Psthyrus.

Conclusions

Observations on visitors do not reveal a marked abnormal behaviour and nectar analysis does not show high amino acid concentration. This seems to confirm our hypothesis about a correlation between the amino acid presence and pollinator behaviour. On the other hand, the few collected bumble bee individuals showing the most sluggish activity, belonged mainly to the Psthyrus subgenus, whose adults, especially the males, were observed to perform slow movements on flowers (Sladen, 1989). This could be an alternative explanation to the behaviour observed in 2011 and 2012. Repeating this studies on G. lutea and on other plants nectar composition and bumble bee behaviour in coming years could validate one of these two hypotheses.

References