## Supporting Information

# Variation in nectar quality across 34 grassland plant species

**Running title:** Interspecific variation in floral nectar quality

**Authors:** Christine Venjakob1,2, Fabian A. Ruedenauer5, Alexandra-Maria Klein3, Sara Diana Leonhardt4,5\*

**Affiliations:**

1 Institute of Ecology, Ecosystem Functions, Leuphana University of Lüneburg, Lüneburg, Germany

2 Agroecology, DNPW, University of Göttingen, Göttingen, Germany

3 Faculty of Environment and Natural Resources, Nature Conservation and Landscape Ecology, University of Freiburg, Freiburg, Germany

4 Department of Animal Ecology and Tropical Biology, University of Würzburg, Würzburg, Germany

5 Plant-Insect Interactions, TUM School of Life Science Systems, Technical University of Munich, Freising, Germany

E-mail addresses of all authors: Christine.Venjakob@agr.uni-goettingen.de, alexandra.klein@nature.uni-freiburg.de, fabian.ruedenauer@tum.de

\* Corresponding author: leonhardt@wzw.tum.de

Plant-Insect Interactions, TUM School of Life Science Systems, Technical University of Munich, Hans-Carl-von-Carlowitz-Platz 2, Freising, Germany

Phone: +49 8161 714574

SDL <https://orcid.org/0000-0002-8154-9569>

AMK https://orcid.org/0000-0003-2139-8575

**Table S1** Nectar concentration and proportion of chemical components, such as amino acids and carbohydrates, were measured via HPLC. All values are mean and standard deviation (SD), either in mg/ml or dimensionless, N gives number of specimens sampled for nectar analysis, Volume gives sampled nectar volumes.

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±0.07 | ±0.09 | ±0.12 | ±0.13 | ±1.33 | ±2.96 | ±1.73 | | *Daucus* |  | 2.55 | 2.51 | 0.12 | 0.17 | 0.48 | 0.52 | 0.04 | 0.05 | 0.13 | 0.14 | 0.03 | 0 | 0.05 | 0.06 | 0.08 | 0.04 | 0.08 | 0.08 | 0.44 | 1.1 | 1.41 | | *carota* | 9 | ±1.23 | ±1.07 | ±0.06 | ±0.07 | ±0.26 | ±0.31 | ±0.01 | ±0.02 | ±0.10 | ±0.04 | ±0.01 | ±0.00 | ±0.02 | ±0.03 | ±0.04 | ±0.01 | ±0.03 | ±0.03 | ±0.46 | ±0.46 | ±0.65 | | *Heracleum* |  | 1.47 | 2.72 | 0.15 | 0.26 | 0.14 | 1.05 | 0.04 | 0.05 | 0.09 | 0.08 | 0.05 | 0 | 0.05 | 0.07 | 0.08 | 0.03 | 0.08 | 0.1 | 0.4 | 1.6 | 1.12 | | *sphondylium* | 9 | ±0.84 | ±1.93 | ±0.08 | ±0.23 | ±0.09 | ±0.89 | ±0.02 | ±0.03 | ±0.04 | ±0.05 | ±0.03 | ±0.00 | ±0.03 | ±0.08 | ±0.05 | ±0.02 | ±0.04 | ±0.06 | ±0.40 | ±1.21 | ±0.79 | | *Pastinaca* |  | 1.8 | 9.92 | 0.14 | 0.18 | 0.46 | 4.78 | 0.1 | 0.13 | 0.16 | 0.31 | 0.11 | 0 | 0.22 | 0.42 | 0.27 | 0.16 | 0.24 | 0.25 | 1.98 | 6.64 | 3.28 | | *sativa* | 8 | ±1.31 | ±3.33 | ±0.05 | ±0.08 | ±0.23 | ±2.04 | ±0.03 | ±0.04 | ±0.07 | ±0.17 | ±0.06 | ±0.00 | ±0.10 | ±0.23 | ±0.12 | ±0.07 | ±0.12 | ±0.12 | ±0.54 | ±2.70 | ±0.84 | | *Pimpinella* |  | 2.69 | 5.41 | 0.07 | 0.11 | 0.13 | 0.77 | 0.03 | 0.04 | 0.07 | 0.08 | 0.06 | 0 | 0.08 | 0.07 | 1.95 | 0.09 | 1.13 | 0.06 | 0.66 | 4.26 | 1.15 | | *major* | 10 | ±1.81 | ±3.89 | ±0.05 | ±0.07 | ±0.10 | ±0.56 | ±0.02 | ±0.03 | ±0.04 | ±0.05 | ±0.03 | ±0.00 | ±0.06 | ±0.05 | ±1.78 | ±0.07 | ±1.21 | ±0.03 | ±0.59 | ±3.27 | ±0.88 | | **Asteraceae** *Centaurea* |  | 1.43 | 10.42 | 0.3 | 0.24 | 0.43 | 5.5 | 0.15 | 0.21 | 0.23 | 0.72 | 0.15 | 0 | 0.3 | 0.33 | 0.22 | 0.23 | 0.34 | 0.32 | 0.74 | 7.68 | 2.74 | | *jacea* | 8 | ±1.07 | ±8.22 | ±0.21 | ±0.13 | ±0.33 | ±4.89 | ±0.09 | ±0.14 | ±0.12 | ±0.58 | ±0.11 | ±0.00 | ±0.21 | ±0.20 | ±0.16 | ±0.15 | ±0.19 | ±0.18 | ±0.79 | ±6.11 | ±2.16 | | *Cirsium* |  | 3.97 | 3.74 | 0.06 | 0.03 | 0.1 | 2.15 | 0.05 | 0.04 | 0.04 | 0.27 | 0.02 | 0 | 0.05 | 0.18 | 0.04 | 0.03 | 0.06 | 0.08 | 0.57 | 2.65 | 1.08 | | *oleraceum* | 9 | ±3.87 | ±3.37 | ±0.04 | ±0.02 | ±0.06 | ±2.06 | ±0.02 | ±0.02 | ±0.02 | ±0.24 | ±0.01 | ±0.00 | ±0.03 | ±0.14 | ±0.02 | ±0.02 | ±0.03 | ±0.06 | ±0.73 | ±2.39 | ±1.05 | | *Crepis* |  | 0.65 | 23.13 | 0.09 | 0.14 | 0.3 | 3.64 | 0.1 | 0.16 | 0.15 | 0.33 | 0.94 | 0 | 0.22 | 0.25 | 15.11 | 0.22 | 0.25 | 0.28 | 0.95 | 20.28 | 2.85 | | *biennis* | 10 | ±0.32 | ±9.57 | ±0.13 | ±0.10 | ±0.15 | ±1.97 | ±0.03 | ±0.07 | ±0.06 | ±0.19 | ±0.49 | ±0.00 | ±0.10 | ±0.12 | ±7.68 | ±0.17 | ±0.12 | ±0.10 | ±0.40 | ±8.84 | ±0.93 | | *Leontodon* |  | 0.68 | 10.86 | 0.18 | 0.18 | 0.18 | 6.45 | 0.07 | 0.07 | 0.1 | 0.33 | 0.07 | 0 | 0.1 | 0.26 | 0.13 | 0.09 | 0.12 | 0.14 | 2.4 | 7.45 | 3.41 | | *autumnalis* | 9 | ±0.33 | ±9.94 | ±0.14 | ±0.10 | ±0.13 | ±6.18 | ±0.04 | ±0.04 | ±0.06 | ±0.27 | ±0.04 | ±0.00 | ±0.07 | ±0.21 | ±0.09 | ±0.05 | ±0.09 | ±0.10 | ±2.48 | ±6.82 | ±3.15 | | *Leontodon* |  | 0.73 | 20.3 | 0.18 | 0.1 | 0.28 | 6.84 | 0.11 | 0.13 | 0.15 | 0.78 | 1.86 | 0 | 0.23 | 0.44 | 6.62 | 0.31 | 0.33 | 0.26 | 1.68 | 15.3 | 5 | | *hispidus* | 10 | ±0.36 | ±10.19 | ±0.07 | ±0.04 | ±0.11 | ±3.67 | ±0.04 | ±0.05 | ±0.05 | ±0.40 | ±1.19 | ±0.00 | ±0.10 | ±0.19 | ±3.85 | ±0.15 | ±0.15 | ±0.11 | ±0.92 | ±7.88 | ±2.36 | | *Taraxacum* |  | 0.85 | 7.21 | 0.1 | 0.12 | 0.11 | 4.67 | 0.05 | 0.06 | 0.08 | 0.19 | 0.06 | 0 | 0.07 | 0.13 | 0.17 | 0.05 | 0.07 | 0.09 | 1.19 | 5.39 | 1.82 | | *officinale* | 10 | ±0.26 | ±5.12 | ±0.04 | ±0.03 | ±0.03 | ±3.84 | ±0.01 | ±0.02 | ±0.02 | ±0.14 | ±0.02 | ±0.00 | ±0.02 | ±0.06 | ±0.04 | ±0.02 | ±0.03 | ±0.04 | ±0.97 | ±3.94 | ±1.19 | | *Tragopogon* |  | 0.25 | 20.89 | 0.49 | 0.29 | 0.6 | 8.56 | 0.28 | 0.2 | 0.27 | 0.55 | 0.18 | 0 | 0.24 | 0.51 | 0.15 | 0.16 | 0.22 | 0.28 | 7.9 | 10.59 | 10.3 | | *pratensis* | 8 | ±0.09 | ±14.20 | ±0.24 | ±0.08 | ±0.41 | ±5.89 | ±0.17 | ±0.11 | ±0.22 | ±0.39 | ±0.08 | ±0.00 | ±0.16 | ±0.38 | ±0.07 | ±0.10 | ±0.16 | ±0.15 | ±6.39 | ±6.95 | ±7.35 | | **Brassicaceae** *Cardamine* |  | 0.82 | 4.18 | 0.26 | 0.22 | 0.16 | 1.59 | 0.09 | 0.12 | 0.15 | 0.11 | 0.08 | 0 | 0.12 | 0.18 | 0.07 | 0.08 | 0.09 | 0.13 | 0.73 | 2.52 | 1.66 | | *pratensis* | 9 | ±0.36 | ±2.43 | ±0.11 | ±0.07 | ±0.05 | ±1.03 | ±0.05 | ±0.04 | ±0.09 | ±0.06 | ±0.04 | ±0.00 | ±0.04 | ±0.13 | ±0.04 | ±0.04 | ±0.04 | ±0.07 | ±0.67 | ±1.49 | ±0.95 | |

Table S1 (continued)

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0.25 | | | *sylvestris* | 7 | ±1.06 | ±0.01 | ±0.01 | ±0.01 | ±0.06 | ±0.00 | ±0.00 | ±0.00 | ±0.01 | ±0.00 | | ±0.00 | | ±0.01 | | ±0.00 | | ±0.00 | | ±0.01 | | ±0.01 | | ±0.00 | | ±0.05 | | ±0.05 | | ±0.05 | | | *Daucus* |  | 2.55 | 0.05 | 0.07 | 0.2 | 0.2 | 0.02 | 0.02 | 0.06 | 0.06 | 0.01 | | 0 | | 0.02 | | 0.03 | | 0.04 | | 0.02 | | 0.03 | | 0.04 | | 0.15 | | 0.44 | | 0.56 | | | *carota* | 9 | ±1.23 | ±0.02 | ±0.02 | ±0.10 | ±0.06 | ±0.01 | ±0.00 | ±0.04 | ±0.02 | ±0.00 | | ±0.00 | | ±0.01 | | ±0.00 | | ±0.02 | | ±0.00 | | ±0.00 | | ±0.01 | | ±0.10 | | ±0.06 | | ±0.06 | | | *Heracleum* |  | 1.47 | 0.06 | 0.09 | 0.06 | 0.37 | 0.02 | 0.02 | 0.04 | 0.03 | 0.02 | | 0 | | 0.02 | | 0.02 | | 0.03 | | 0.01 | | 0.03 | | 0.04 | | 0.13 | | 0.59 | | 0.41 | | | *sphondylium* | 9 | ±0.84 | ±0.01 | ±0.05 | ±0.02 | ±0.08 | ±0.01 | ±0.00 | ±0.01 | ±0.01 | ±0.01 | | ±0.00 | | ±0.01 | | ±0.02 | | ±0.01 | | ±0.00 | | ±0.01 | | ±0.01 | | ±0.04 | | ±0.08 | | ±0.08 | | | *Pastinaca* |  | 1.8 | 0.02 | 0.02 | 0.04 | 0.47 | 0.01 | 0.01 | 0.02 | 0.03 | 0.01 | | 0 | | 0.02 | | 0.04 | | 0.03 | | 0.02 | | 0.02 | | 0.03 | | 0.21 | | 0.65 | | 0.35 | | | *sativa* | 8 | ±1.31 | ±0.01 | ±0.01 | ±0.01 | ±0.08 | ±0.00 | ±0.00 | ±0.00 | ±0.01 | ±0.01 | | ±0.00 | | ±0.00 | | ±0.01 | | ±0.01 | | ±0.00 | | ±0.01 | | ±0.01 | | ±0.06 | | ±0.08 | | ±0.08 | | | *Pimpinella* |  | 2.69 | 0.02 | 0.02 | 0.03 | 0.15 | 0.01 | 0.01 | 0.02 | 0.02 | 0.01 | | 0 | | 0.02 | | 0.01 | | 0.36 | | 0.02 | | 0.18 | | 0.01 | | 0.12 | | 0.78 | | 0.22 | | | *major* | 10 | ±1.81 | ±0.01 | ±0.01 | ±0.01 | ±0.07 | ±0.00 | ±0.00 | ±0.01 | ±0.01 | ±0.01 | | ±0.00 | | ±0.01 | | ±0.01 | | ±0.22 | | ±0.01 | | ±0.11 | | ±0.00 | | ±0.07 | | ±0.10 | | ±0.10 | | | **Asteraceae** *Centaurea* |  | 1.43 | 0.03 | 0.03 | 0.04 | 0.52 | 0.02 | 0.02 | 0.02 | 0.07 | 0.01 | | 0 | | 0.03 | | 0.03 | | 0.02 | | 0.02 | | 0.03 | | 0.03 | | 0.07 | | 0.74 | | 0.26 | | | *jacea* | 8 | ±1.07 | ±0.01 | ±0.01 | ±0.00 | ±0.09 | ±0.00 | ±0.00 | ±0.01 | ±0.01 | ±0.00 | | ±0.00 | | ±0.01 | | ±0.01 | | ±0.00 | | ±0.01 | | ±0.01 | | ±0.01 | | ±0.05 | | ±0.06 | | ±0.06 | | | *Cirsium* |  | 3.97 | 0.02 | 0.01 | 0.03 | 0.57 | 0.02 | 0.01 | 0.01 | 0.07 | 0.01 | | 0 | | 0.02 | | 0.06 | | 0.01 | | 0.01 | | 0.02 | | 0.02 | | 0.11 | | 0.74 | | 0.26 | | | *oleraceum* | 9 | ±3.87 | ±0.00 | ±0.00 | ±0.01 | ±0.06 | ±0.01 | ±0.00 | ±0.01 | ±0.02 | ±0.00 | | ±0.00 | | ±0.01 | | ±0.02 | | ±0.00 | | ±0.00 | | ±0.01 | | ±0.01 | | ±0.09 | | ±0.08 | | ±0.08 | | | *Crepis* |  | 0.65 | 0.01 | 0.01 | 0.01 | 0.17 | 0 | 0.01 | 0.01 | 0.02 | 0.04 | | 0 | | 0.01 | | 0.01 | | 0.63 | | 0.01 | | 0.01 | | 0.01 | | 0.05 | | 0.86 | | 0.14 | | | *biennis* | 10 | ±0.32 | ±0.01 | ±0.00 | ±0.00 | ±0.07 | ±0.00 | ±0.00 | ±0.00 | ±0.01 | ±0.01 | | ±0.00 | | ±0.00 | | ±0.00 | | ±0.12 | | ±0.01 | | ±0.00 | | ±0.00 | | ±0.03 | | ±0.04 | | ±0.04 | | | *Leontodon* |  | 0.68 | 0.02 | 0.02 | 0.02 | 0.59 | 0.01 | 0.01 | 0.01 | 0.03 | 0.01 | | 0 | | 0.01 | | 0.03 | | 0.01 | | 0.01 | | 0.01 | | 0.01 | | 0.2 | | 0.69 | | 0.31 | | | *autumnalis* | 9 | ±0.33 | ±0.00 | ±0.01 | ±0.00 | ±0.05 | ±0.00 | ±0.00 | ±0.01 | ±0.01 | ±0.00 | | ±0.00 | | ±0.00 | | ±0.00 | | ±0.01 | | ±0.00 | | ±0.00 | | ±0.00 | | ±0.05 | | ±0.05 | | ±0.05 | | | *Leontodon* |  | 0.73 | 0.01 | 0.01 | 0.02 | 0.33 | 0.01 | 0.01 | 0.01 | 0.04 | 0.09 | | 0 | | 0.01 | | 0.02 | | 0.32 | | 0.02 | | 0.02 | | 0.01 | | 0.08 | | 0.75 | | 0.25 | | | *hispidus* | 10 | ±0.36 | ±0.00 | ±0.00 | ±0.01 | ±0.07 | ±0.00 | ±0.00 | ±0.00 | ±0.01 | ±0.03 | | ±0.00 | | ±0.01 | | ±0.01 | | ±0.05 | | ±0.01 | | ±0.01 | | ±0.00 | | ±0.02 | | ±0.03 | | ±0.03 | | | *Taraxacum* |  | 0.85 | 0.02 | 0.02 | 0.02 | 0.59 | 0.01 | 0.01 | 0.01 | 0.03 | 0.01 | | 0 | | 0.02 | | 0.02 | | 0.04 | | 0.01 | | 0.02 | | 0.02 | | 0.16 | | 0.73 | | 0.27 | | | *officinale* | 10 | ±0.26 | ±0.01 | ±0.01 | ±0.02 | ±0.14 | ±0.01 | ±0.01 | ±0.01 | ±0.01 | ±0.01 | | ±0.00 | | ±0.01 | | ±0.01 | | ±0.03 | | ±0.01 | | ±0.02 | | ±0.01 | | ±0.02 | | ±0.05 | | ±0.05 | | | *Tragopogon* |  | 0.25 | 0.03 | 0.02 | 0.03 | 0.41 | 0.02 | 0.01 | 0.02 | 0.02 | 0.01 | | 0 | | 0.01 | | 0.02 | | 0.01 | | 0.01 | | 0.01 | | 0.01 | | 0.36 | | 0.51 | | 0.49 | | | *pratensis* | 8 | ±0.09 | ±0.00 | ±0.01 | ±0.01 | ±0.06 | ±0.02 | ±0.00 | ±0.02 | ±0.01 | ±0.00 | | ±0.00 | | ±0.00 | | ±0.00 | | ±0.00 | | ±0.00 | | ±0.00 | | ±0.00 | | ±0.06 | | ±0.05 | | ±0.05 | | | **Brassicaceae** *Cardamine* |  | 0.82 | 0.07 | 0.06 | 0.04 | 0.37 | 0.02 | 0.03 | 0.03 | 0.03 | 0.02 | | 0 | | 0.03 | | 0.04 | | 0.02 | | 0.02 | | 0.02 | | 0.03 | | 0.15 | | 0.6 | | 0.4 | | | *pratensis* | 9 | ±0.36 | ±0.02 | ±0.03 | ±0.01 | ±0.03 | ±0.00 | ±0.01 | ±0.01 | ±0.01 | ±0.00 | | ±0.00 | | ±0.01 | | ±0.01 | | ±0.00 | | ±0.00 | | ±0.00 | | ±0.00 | | ±0.06 | | ±0.02 | | ±0.02 | | |

Table S1 (continued)

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |  |  |  |  | **Carbohydrates** | | | | |  | | **Plant family/** | **N C2** | **Volume  C mean ±SD3** | **Total  C4** | **Fructose** | **Glucose** | **Sucrose** | **Fructose** | **Glucose** | **Sucrose** | | ***species*1** |  |  | **Concentration mg/ml** | | | | **Proportion** | | | | **Apiaceae** *Anthriscus* |  | 2.2 | 11.48 | 7.2 | 2.13 | 2.15 | 0.66 | 0.21 | 0.13 | | *sylvestris* | 7 | ±1.06 | ±4.43 | ±2.10 | ±0.62 | ±3.92 | ±0.16 | ±0.07 | ±0.22 | | *Daucus* |  | 2.55 | 5.65 | 2.7 | 2.96 | 0 | 0.4 | 0.6 | 0 | | *carota* | 9 | ±1.23 | ±6.06 | ±2.88 | ±3.19 | ±0.00 | ±0.23 | ±0.23 | ±0.00 | | *Heracleum* |  | 1.47 | 23.06 | 11.02 | 10.04 | 2 | 0.48 | 0.47 | 0.05 | | *sphondylium* | 9 | ±0.84 | ±13.99 | ±6.61 | ±5.34 | ±5.50 | ±0.08 | ±0.08 | ±0.13 | | *Pastinaca* |  | 1.8 | 97.45 | 36.58 | 31.71 | 29.16 | 0.42 | 0.37 | 0.21 | | *sativa* | 8 | ±1.31 | ±65.10 | ±20.41 | ±18.08 | ±37.89 | ±0.12 | ±0.11 | ±0.23 | | *Pimpinella* |  | 2.69 | 8.7 | 4.18 | 3.42 | 1.1 | 0.48 | 0.38 | 0.14 | | *major* | 10 | ±1.81 | ±3.73 | ±2.27 | ±1.95 | ±1.65 | ±0.13 | ±0.10 | ±0.19 | | **Asteraceae** *Centaurea* |  | 1.43 | 32.4 | 15.49 | 15.54 | 1.37 | 0.48 | 0.47 | 0.05 | | *jacea* | 8 | ±1.07 | ±12.78 | ±6.87 | ±7.32 | ±3.86 | ±0.10 | ±0.06 | ±0.15 | | *Cirsium* |  | 3.97 | 59.31 | 16.72 | 14.6 | 27.99 | 0.31 | 0.26 | 0.43 | | *oleraceum* | 9 | ±3.87 | ±22.25 | ±6.62 | ±6.61 | ±21.25 | ±0.12 | ±0.10 | ±0.20 | | *Crepis* |  | 0.65 | 59.68 | 29.78 | 27.48 | 2.42 | 0.5 | 0.47 | 0.03 | | *biennis* | 10 | ±0.32 | ±25.02 | ±12.57 | ±11.16 | ±7.64 | ±0.05 | ±0.05 | ±0.09 | | *Leontodon* |  | 0.68 | 44.17 | 20.85 | 21.84 | 1.48 | 0.46 | 0.51 | 0.02 | | *autumnalis* | 9 | ±0.33 | ±17.37 | ±10.09 | ±7.21 | ±3.40 | ±0.10 | ±0.10 | ±0.06 | | *Leontodon* |  | 0.73 | 20.04 | 7.69 | 12.36 | 0 | 0.38 | 0.62 | 0 | | *hispidus* | 10 | ±0.36 | ±16.18 | ±6.83 | ±9.69 | ±0.00 | ±0.12 | ±0.12 | ±0.00 | | *Taraxacum* |  | 0.85 | 42.92 | 12.69 | 16.13 | 14.09 | 0.31 | 0.39 | 0.31 | | *officinale* | 10 | ±0.26 | ±9.08 | ±2.58 | ±2.41 | ±9.30 | ±0.09 | ±0.09 | ±0.18 | | *Tragopogon* |  | 0.25 | 136.68 | 60.96 | 61.82 | 13.9 | 0.47 | 0.47 | 0.05 | | *pratensis* | 8 | ±0.09 | ±59.89 | ±18.13 | ±18.87 | ±39.32 | ±0.09 | ±0.07 | ±0.15 | | **Brassicaceae** *Cardamine* |  | 0.82 | 59.15 | 30.34 | 28.81 | 0 | 0.51 | 0.49 | 0 | | *pratensis* | 9 | ±0.36 | ±13.92 | ±7.14 | ±6.83 | ±0.00 | ±0.01 | ±0.01 | ±0.00 | |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | Table S1 (continued) | | | | | | | | | | | | | | | | | | | | | | | | |  |  |  |  |  |  |  |  |  | **Amino acids** | | | | | |  |  |  |  |  |  |  |  | | **Plant family/** | **N AA2** | **Volume  AA mean ±SD3** | **Total AA4** | **Asp5** | **Glu** | **Ser** | **His** | **Gly** | **Thr** | **Arg** | **Ala** | **Tyr** | **Cystine** | **Val** | **Met** | **Phe** | **Ile** | **Leu** | **Lys** | **Pro** | **EAA6** | **Non-EAA7** | | ***species*1** |  |  |  |  |  |  |  |  | **Concentration mg/ml** | | | | | |  |  |  |  |  |  |  |  | | **Campanulaceae** *Campanula* |  | 1.25 | 8.88 | 0.24 | 0.3 | 0.35 | 1.11 | 0.07 | 0.12 | 0.22 | 0.31 | 0.1 | 0 | 0.16 | 0.58 | 4.03 | 0.14 | 0.2 | 0.16 | 0.8 | 6.71 | 2.16 | | *patula* | 11 | ±0.23 | ±5.54 | ±0.18 | ±0.17 | ±0.21 | ±0.69 | ±0.06 | ±0.07 | ±0.15 | ±0.20 | ±0.06 | ±0.00 | ±0.08 | ±0.45 | ±4.13 | ±0.09 | ±0.10 | ±0.10 | ±0.21 | ±5.00 | ±0.79 | | ***Dipsacaceae*** *Knautia* |  | 1.65 | 5.51 | 0.22 | 0.18 | 0.17 | 2.12 | 0.09 | 0.11 | 0.18 | 0.4 | 0.13 | 0 | 0.13 | 0.18 | 0.14 | 0.11 | 0.2 | 0.15 | 1 | 3.33 | 2.19 | | *arvensis* | 8 | ±0.98 | ±3.97 | ±0.17 | ±0.12 | ±0.10 | ±1.49 | ±0.06 | ±0.09 | ±0.14 | ±0.31 | ±0.11 | ±0.00 | ±0.11 | ±0.14 | ±0.12 | ±0.09 | ±0.18 | ±0.12 | ±0.84 | ±2.39 | ±1.62 | | **Fabaceae** *Lathyrus* |  | 3.9 | 1.87 | 0.12 | 0.14 | 0.29 | 0.36 | 0.06 | 0.1 | 0.05 | 0.22 | 0.05 | 0 | 0.06 | 0.08 | 0.05 | 0.06 | 0.08 | 0.08 | 0.08 | 0.92 | 0.95 | | *pratensis* | 10 | ±1.47 | ±1.50 | ±0.08 | ±0.09 | ±0.23 | ±0.32 | ±0.06 | ±0.07 | ±0.06 | ±0.17 | ±0.04 | ±0.00 | ±0.05 | ±0.08 | ±0.04 | ±0.06 | ±0.06 | ±0.07 | ±0.06 | ±0.80 | ±0.71 | | *Lotus* |  | 0.68 | 12.78 | 0.47 | 0.83 | 0.72 | 1.72 | 0.12 | 0.22 | 0.16 | 0.42 | 1.76 | 0 | 0.27 | 0.14 | 2.81 | 0.15 | 0.16 | 0.15 | 2.68 | 5.78 | 7 | | *corniculatus* | 7 | ±0.21 | ±4.31 | ±0.19 | ±0.37 | ±0.36 | ±0.57 | ±0.04 | ±0.08 | ±0.05 | ±0.25 | ±0.77 | ±0.00 | ±0.14 | ±0.07 | ±2.17 | ±0.08 | ±0.08 | ±0.06 | ±1.32 | ±2.97 | ±2.21 | | *Medicago* |  | 1.19 | 3.52 | 0.33 | 0.1 | 0.24 | 0.94 | 0.05 | 0.07 | 0.12 | 0.2 | 0.09 | 0.02 | 0.12 | 0.13 | 0.11 | 0.1 | 0.16 | 0.08 | 0.65 | 1.83 | 1.69 | | *varia* | 10 | ±0.56 | ±1.84 | ±0.30 | ±0.06 | ±0.16 | ±0.52 | ±0.03 | ±0.07 | ±0.07 | ±0.12 | ±0.05 | ±0.02 | ±0.07 | ±0.06 | ±0.06 | ±0.06 | ±0.09 | ±0.05 | ±0.39 | ±0.98 | ±0.90 | | *Onobrychis* |  | 1.47 | 5.97 | 0.46 | 0.81 | 0.6 | 1.14 | 0.07 | 0.28 | 0.17 | 0.53 | 0.08 | 0 | 0.19 | 0.22 | 0.16 | 0.13 | 0.16 | 0.13 | 0.85 | 2.58 | 3.39 | | *viciifolia* | 10 | ±1.06 | ±3.98 | ±0.39 | ±0.93 | ±0.40 | ±0.72 | ±0.03 | ±0.13 | ±0.11 | ±0.47 | ±0.04 | ±0.00 | ±0.10 | ±0.15 | ±0.11 | ±0.07 | ±0.10 | ±0.11 | ±0.71 | ±1.44 | ±2.59 | | *Trifolium* |  | 0.18 | 16.84 | 0.51 | 1.61 | 0.9 | 1.89 | 0.25 | 0.43 | 0.39 | 1.34 | 0.2 | 0 | 0.65 | 0.75 | 0.35 | 0.4 | 0.62 | 0.6 | 5.96 | 6.08 | 10.76 | | *campestre* | 8 | ±0.07 | ±8.88 | ±0.22 | ±1.19 | ±0.50 | ±1.56 | ±0.25 | ±0.25 | ±0.57 | ±0.66 | ±0.21 | ±0.00 | ±0.36 | ±0.48 | ±0.24 | ±0.23 | ±0.54 | ±0.63 | ±2.57 | ±4.80 | ±4.47 | | *Trifolium* |  | 0.97 | 6.65 | 0.47 | 0.19 | 0.23 | 2.52 | 0.11 | 0.15 | 0.16 | 0.23 | 0.14 | 0 | 0.19 | 0.24 | 0.13 | 0.17 | 0.23 | 0.23 | 1.25 | 4.03 | 2.62 | | *fragiferum* | 6 | ±0.38 | ±6.34 | ±0.43 | ±0.09 | ±0.23 | ±1.47 | ±0.14 | ±0.20 | ±0.20 | ±0.34 | ±0.14 | ±0.00 | ±0.21 | ±0.32 | ±0.15 | ±0.19 | ±0.29 | ±0.27 | ±1.89 | ±3.23 | ±3.13 | | *Trifolium* |  | 0.77 | 15.69 | 0.41 | 0.19 | 0.41 | 2.2 | 0.2 | 0.27 | 0.28 | 0.76 | 0.24 | 0 | 0.32 | 0.63 | 0.25 | 0.26 | 0.42 | 0.32 | 8.54 | 4.95 | 10.74 | | *hybridum* | 9 | ±0.28 | ±8.93 | ±0.23 | ±0.10 | ±0.22 | ±1.19 | ±0.17 | ±0.25 | ±0.17 | ±0.64 | ±0.22 | ±0.00 | ±0.33 | ±0.43 | ±0.24 | ±0.26 | ±0.44 | ±0.19 | ±4.97 | ±3.38 | ±6.00 | | *Trifolium* |  | 0.38 | 15.62 | 0.59 | 0.21 | 0.76 | 1.77 | 0.16 | 0.28 | 0.15 | 0.75 | 0.16 | 0 | 0.39 | 0.81 | 0.18 | 0.33 | 0.32 | 0.26 | 8.49 | 4.49 | 11.13 | | *pratense* | 3 | ±0.15 | ±13.68 | ±0.56 | ±0.10 | ±0.74 | ±0.94 | ±0.12 | ±0.29 | ±0.09 | ±0.83 | ±0.11 | ±0.00 | ±0.45 | ±0.68 | ±0.18 | ±0.36 | ±0.31 | ±0.19 | ±7.85 | ±3.45 | ±10.24 | | *Trifolium* |  | 0.87 | 9.14 | 0.24 | 0.15 | 0.38 | 1.86 | 0.09 | 0.13 | 0.14 | 0.43 | 0.1 | 0 | 0.17 | 0.43 | 0.11 | 0.12 | 0.21 | 0.22 | 4.36 | 3.39 | 5.75 | | *repens* | 8 | ±0.22 | ±2.86 | ±0.14 | ±0.05 | ±0.09 | ±0.57 | ±0.04 | ±0.05 | ±0.08 | ±0.13 | ±0.05 | ±0.00 | ±0.06 | ±0.15 | ±0.05 | ±0.06 | ±0.09 | ±0.11 | ±1.89 | ±1.11 | ±2.06 | | *Vicia* |  | 3.56 | 2.27 | 0.1 | 0.06 | 0.39 | 0.27 | 0.04 | 0.06 | 0.03 | 0.54 | 0.03 | 0 | 0.1 | 0.05 | 0.13 | 0.08 | 0.08 | 0.03 | 0.27 | 0.83 | 1.44 | | *cracca* | 9 | ±2.10 | ±1.27 | ±0.07 | ±0.04 | ±0.28 | ±0.09 | ±0.03 | ±0.04 | ±0.02 | ±0.47 | ±0.02 | ±0.00 | ±0.06 | ±0.02 | ±0.08 | ±0.04 | ±0.04 | ±0.02 | ±0.15 | ±0.36 | ±0.94 | |

Table S1 (continued)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |  |  |  |  |  |  |  |  |  |  |  | **Amino** | **acids** |  |  |  |  |  |  |  |  |  | | **Plant family/** | **N AA2** | **Volume  AA mean ±SD3** | **Asp5** | **Glu** | **Ser** | **His** | **Gly** | **Thr** | **Arg** | **Ala** | **Tyr** | **Cystine** | **Val** | **Met** | **Phe** | **Ile** | **Leu** | **Lys** | **Pro** | **EAA6** | **Non-EAA7** | | ***species*1** |  |  |  |  |  |  |  |  |  |  | **Proportion** | |  |  |  |  |  |  |  |  |  | | **Campanulaceae** *Campanula* |  | 1.25 | 0.03 | 0.04 | 0.05 | 0.14 | 0.01 | 0.01 | 0.03 | 0.04 | 0.01 | 0 | 0.02 | 0.07 | 0.36 | 0.02 | 0.03 | 0.02 | 0.12 | 0.7 | 0.3 | | *patula* | 11 | ±0.23 | ±0.02 | ±0.01 | ±0.03 | ±0.06 | ±0.01 | ±0.01 | ±0.01 | ±0.02 | ±0.00 | ±0.00 | ±0.01 | ±0.03 | ±0.24 | ±0.01 | ±0.01 | ±0.01 | ±0.06 | ±0.13 | ±0.13 | | ***Dipsacaceae*** *Knautia* |  | 1.65 | 0.04 | 0.04 | 0.03 | 0.39 | 0.02 | 0.02 | 0.03 | 0.07 | 0.02 | 0 | 0.02 | 0.03 | 0.03 | 0.02 | 0.04 | 0.03 | 0.16 | 0.61 | 0.39 | | *arvensis* | 8 | ±0.98 | ±0.01 | ±0.02 | ±0.01 | ±0.06 | ±0.00 | ±0.00 | ±0.01 | ±0.01 | ±0.01 | ±0.00 | ±0.00 | ±0.00 | ±0.01 | ±0.00 | ±0.01 | ±0.01 | ±0.05 | ±0.05 | ±0.05 | | **Fabaceae** *Lathyrus* |  | 3.9 | 0.07 | 0.08 | 0.15 | 0.2 | 0.03 | 0.05 | 0.02 | 0.12 | 0.02 | 0 | 0.03 | 0.04 | 0.03 | 0.03 | 0.04 | 0.04 | 0.05 | 0.48 | 0.52 | | *pratensis* | 10 | ±1.47 | ±0.03 | ±0.03 | ±0.04 | ±0.03 | ±0.01 | ±0.01 | ±0.01 | ±0.03 | ±0.00 | ±0.00 | ±0.01 | ±0.01 | ±0.00 | ±0.01 | ±0.01 | ±0.01 | ±0.02 | ±0.04 | ±0.04 | | *Lotus* |  | 0.68 | 0.04 | 0.07 | 0.06 | 0.14 | 0.01 | 0.02 | 0.01 | 0.03 | 0.14 | 0 | 0.02 | 0.01 | 0.21 | 0.01 | 0.01 | 0.01 | 0.21 | 0.44 | 0.56 | | *corniculatus* | 7 | ±0.21 | ±0.02 | ±0.03 | ±0.02 | ±0.02 | ±0.00 | ±0.01 | ±0.00 | ±0.01 | ±0.06 | ±0.00 | ±0.01 | ±0.00 | ±0.11 | ±0.00 | ±0.00 | ±0.00 | ±0.09 | ±0.10 | ±0.10 | | *Medicago* |  | 1.19 | 0.09 | 0.03 | 0.07 | 0.27 | 0.01 | 0.02 | 0.03 | 0.05 | 0.03 | 0.01 | 0.03 | 0.04 | 0.03 | 0.03 | 0.04 | 0.03 | 0.19 | 0.52 | 0.48 | | *varia* | 10 | ±0.56 | ±0.06 | ±0.01 | ±0.02 | ±0.06 | ±0.00 | ±0.01 | ±0.01 | ±0.02 | ±0.01 | ±0.00 | ±0.01 | ±0.01 | ±0.00 | ±0.00 | ±0.01 | ±0.01 | ±0.04 | ±0.06 | ±0.06 | | *Onobrychis* |  | 1.47 | 0.07 | 0.11 | 0.1 | 0.21 | 0.01 | 0.05 | 0.03 | 0.09 | 0.01 | 0 | 0.04 | 0.04 | 0.03 | 0.02 | 0.03 | 0.02 | 0.14 | 0.46 | 0.54 | | *viciifolia* | 10 | ±1.06 | ±0.02 | ±0.06 | ±0.02 | ±0.06 | ±0.00 | ±0.02 | ±0.01 | ±0.05 | ±0.00 | ±0.00 | ±0.01 | ±0.01 | ±0.01 | ±0.01 | ±0.01 | ±0.01 | ±0.06 | ±0.07 | ±0.07 | | *Trifolium* |  | 0.18 | 0.03 | 0.09 | 0.05 | 0.1 | 0.01 | 0.03 | 0.02 | 0.09 | 0.01 | 0 | 0.04 | 0.04 | 0.02 | 0.02 | 0.03 | 0.03 | 0.37 | 0.34 | 0.66 | | *campestre* | 8 | ±0.07 | ±0.01 | ±0.03 | ±0.01 | ±0.04 | ±0.00 | ±0.01 | ±0.01 | ±0.04 | ±0.01 | ±0.00 | ±0.01 | ±0.01 | ±0.00 | ±0.01 | ±0.01 | ±0.01 | ±0.09 | ±0.07 | ±0.07 | | *Trifolium* |  | 0.97 | 0.07 | 0.04 | 0.03 | 0.45 | 0.01 | 0.02 | 0.02 | 0.03 | 0.02 | 0 | 0.03 | 0.03 | 0.02 | 0.02 | 0.03 | 0.03 | 0.14 | 0.65 | 0.35 | | *fragiferum* | 6 | ±0.38 | ±0.03 | ±0.02 | ±0.01 | ±0.10 | ±0.00 | ±0.01 | ±0.01 | ±0.01 | ±0.00 | ±0.00 | ±0.00 | ±0.01 | ±0.00 | ±0.00 | ±0.01 | ±0.01 | ±0.06 | ±0.06 | ±0.06 | | *Trifolium* |  | 0.77 | 0.03 | 0.01 | 0.03 | 0.15 | 0.01 | 0.02 | 0.02 | 0.05 | 0.01 | 0 | 0.02 | 0.04 | 0.02 | 0.02 | 0.02 | 0.02 | 0.53 | 0.32 | 0.68 | | *hybridum* | 9 | ±0.28 | ±0.01 | ±0.01 | ±0.02 | ±0.05 | ±0.00 | ±0.01 | ±0.01 | ±0.01 | ±0.01 | ±0.00 | ±0.01 | ±0.01 | ±0.01 | ±0.01 | ±0.01 | ±0.01 | ±0.12 | ±0.09 | ±0.09 | | *Trifolium* |  | 0.38 | 0.04 | 0.02 | 0.05 | 0.14 | 0.01 | 0.02 | 0.01 | 0.04 | 0.01 | 0 | 0.02 | 0.05 | 0.01 | 0.02 | 0.02 | 0.02 | 0.53 | 0.31 | 0.69 | | *pratense* | 3 | ±0.15 | ±0.01 | ±0.01 | ±0.01 | ±0.04 | ±0.00 | ±0.00 | ±0.00 | ±0.01 | ±0.00 | ±0.00 | ±0.01 | ±0.00 | ±0.00 | ±0.01 | ±0.00 | ±0.01 | ±0.03 | ±0.04 | ±0.04 | | *Trifolium* |  | 0.87 | 0.03 | 0.02 | 0.04 | 0.21 | 0.01 | 0.01 | 0.01 | 0.05 | 0.01 | 0 | 0.02 | 0.05 | 0.01 | 0.01 | 0.02 | 0.02 | 0.47 | 0.38 | 0.62 | | *repens* | 8 | ±0.22 | ±0.01 | ±0.01 | ±0.00 | ±0.04 | ±0.00 | ±0.00 | ±0.01 | ±0.01 | ±0.00 | ±0.00 | ±0.00 | ±0.01 | ±0.00 | ±0.00 | ±0.01 | ±0.01 | ±0.09 | ±0.06 | ±0.06 | | *Vicia* |  | 3.56 | 0.04 | 0.03 | 0.16 | 0.14 | 0.02 | 0.02 | 0.02 | 0.21 | 0.01 | 0 | 0.05 | 0.03 | 0.06 | 0.04 | 0.04 | 0.02 | 0.13 | 0.39 | 0.61 | | *cracca* | 9 | ±2.10 | ±0.02 | ±0.01 | ±0.04 | ±0.04 | ±0.00 | ±0.00 | ±0.00 | ±0.08 | ±0.00 | ±0.00 | ±0.01 | ±0.01 | ±0.02 | ±0.01 | ±0.01 | ±0.00 | ±0.09 | ±0.07 | ±0.07 | |

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| |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | Table S1 (continued) | | | | | | | | | | |  |  |  |  |  | **Carbohydrates** | | |  |  | | **Plant family/** | **N C2** | **Volume  C mean ±SD3** | **Total  C4** | **Fructose** | **Glucose** | **Sucrose** | **Fructose** | **Glucose** | **Sucrose** | | ***species*1** |  |  | **Concentration mg/ml** | | | | **Proportion** | | | | **Campanulaceae** *Campanula* |  | 1.25 | 18.64 | 7.52 | 7.46 | 3.66 | 0.42 | 0.42 | 0.15 | | *patula* | 11 | ±0.23 | ±5.47 | ±1.51 | ±1.64 | ±4.66 | ±0.10 | ±0.10 | ±0.19 | | ***Dipsacaceae*** *Knautia* |  | 1.65 | 63.93 | 30.83 | 33.09 | 0 | 0.49 | 0.51 | 0 | | *arvensis* | 8 | ±0.98 | ±33.41 | ±15.66 | ±17.79 | ±0.00 | ±0.02 | ±0.02 | ±0.00 | | **Fabaceae** *Lathyrus* |  | 3.9 | 17.64 | 9.61 | 5.37 | 2.66 | 0.57 | 0.27 | 0.16 | | *pratensis* | 10 | ±1.47 | ±13.40 | ±8.06 | ±5.84 | ±3.50 | ±0.17 | ±0.09 | ±0.20 | | *Lotus* |  | 0.68 | 102.81 | 33.8 | 28.44 | 40.58 | 0.37 | 0.31 | 0.32 | | *corniculatus* | 7 | ±0.21 | ±38.03 | ±5.87 | ±13.98 | ±38.66 | ±0.14 | ±0.19 | ±0.30 | | *Medicago* |  | 1.19 | 25.69 | 6.28 | 5.08 | 14.33 | 0.28 | 0.24 | 0.49 | | *varia* | 10 | ±0.56 | ±8.64 | ±1.74 | ±2.29 | ±9.80 | ±0.14 | ±0.16 | ±0.28 | | *Onobrychis* |  | 1.47 | 52.5 | 5.55 | 4.97 | 41.97 | 0.11 | 0.1 | 0.79 | | *viciifolia* | 10 | ±1.06 | ±23.42 | ±2.15 | ±2.00 | ±20.61 | ±0.04 | ±0.04 | ±0.08 | | *Trifolium* |  | 0.18 | 190.5 | 64.9 | 61.26 | 64.34 | 0.43 | 0.32 | 0.25 | | *campestre* | 8 | ±0.07 | ±97.48 | ±27.33 | ±38.41 | ±70.31 | ±0.26 | ±0.18 | ±0.27 | | *Trifolium* |  | 0.97 | 53.31 | 13.82 | 9.66 | 29.82 | 0.29 | 0.19 | 0.52 | | *fragiferum* | 6 | ±0.38 | ±27.46 | ±5.61 | ±9.46 | ±18.33 | ±0.12 | ±0.19 | ±0.26 | | *Trifolium* |  | 0.77 | 98.73 | 24.05 | 23.74 | 50.95 | 0.25 | 0.25 | 0.5 | | *hybridum* | 9 | ±0.28 | ±26.32 | ±7.21 | ±8.64 | ±27.78 | ±0.09 | ±0.11 | ±0.20 | | *Trifolium* |  | 0.38 | 47.58 | 13.25 | 9.71 | 24.61 | 0.35 | 0.25 | 0.41 | | *pratense* | 3 | ±0.15 | ±26.39 | ±2.46 | ±1.92 | ±24.95 | ±0.22 | ±0.14 | ±0.36 | | *Trifolium* |  | 0.87 | 48.82 | 12.7 | 10.7 | 25.42 | 0.29 | 0.24 | 0.46 | | *repens* | 8 | ±0.22 | ±17.46 | ±4.48 | ±4.67 | ±11.78 | ±0.11 | ±0.10 | ±0.21 | | *Vicia* |  | 3.56 | 21.73 | 9.5 | 3.77 | 8.47 | 0.48 | 0.17 | 0.35 | | *cracca* | 9 | ±2.10 | ±9.70 | ±3.50 | ±1.82 | ±7.64 | ±0.16 | ±0.05 | ±0.19 | |

Table S1 (continued)

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| |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | Table S1 (continued) | | | | | | | | | | |  |  |  |  |  | **Carbohydrates** | | |  |  | | **Plant family/** | **N C2** | **Volume  C mean ±SD3** | **Total  C4** | **Fructose** | **Glucose** | **Sucrose** | **Fructose** | **Glucose** | **Sucrose** | | ***species*1** |  |  | **Concentration mg/ml** | | | | **Proportion** | | | | **Geraniaceae** *Geranium* |  | 3.38 | 64.7 | 14.24 | 12.73 | 37.73 | 0.21 | 0.19 | 0.6 | | *pratense* | 6 | ±2.17 | ±41.33 | ±10.18 | ±9.12 | ±22.07 | ±0.01 | ±0.02 | ±0.03 | | L**amiaceae** *Ajuga* |  | 0.92 | 150.9 | 17.11 | 14.92 | 118.87 | 0.12 | 0.1 | 0.78 | | *reptans* | 10 | ±0.28 | ±50.77 | ±6.21 | ±4.41 | ±44.57 | ±0.03 | ±0.02 | ±0.05 | | *Glechoma* |  | 1.39 | 48.29 | 9.5 | 8.5 | 30.29 | 0.21 | 0.19 | 0.6 | | *hederacea* | 10 | ±0.52 | ±14.69 | ±3.99 | ±3.52 | ±16.97 | ±0.13 | ±0.11 | ±0.24 | | *Prunella* |  | 2.43 | 52.64 | 12.4 | 8.4 | 31.84 | 0.24 | 0.16 | 0.6 | | *vulgaris* | 10 | ±1.71 | ±16.47 | ±3.29 | ±2.60 | ±11.97 | ±0.03 | ±0.04 | ±0.06 | | **Primulaceae** *Primula* |  | 1.27 | 68.33 | 18.64 | 18.6 | 31.1 | 0.27 | 0.27 | 0.46 | | *veris* | 10 | ±0.14 | ±11.17 | ±3.38 | ±3.21 | ±5.55 | ±0.02 | ±0.01 | ±0.03 | | **Ranunculaceae** *Ranunculus* |  | 0.82 | 49.26 | 0.86 | 0.48 | 47.92 | 0.03 | 0.02 | 0.95 | | *acris* | 10 | ±0.15 | ±23.79 | ±1.41 | ±1.52 | ±24.66 | ±0.05 | ±0.07 | ±0.12 | | *Ranunculus* |  | 1.15 | 34.22 | 2.82 | 4.01 | 27.4 | 0.14 | 0.2 | 0.66 | | *repens* | 13 | ±0.26 | ±19.69 | ±2.15 | ±3.08 | ±19.51 | ±0.15 | ±0.19 | ±0.34 | | **Rosaceae** *Sanguisorba* |  | 0.99 | 25.45 | 0 | 0 | 25.45 | 0 | 0 | 1 | | *officinalis* | 13 | ±0.28 | ±9.54 | ±0.00 | ±0.00 | ±9.54 | ±0.00 | ±0.00 | ±0.00 | | **Scrophulariaceae** *Veronica* |  | 1.01 | 19.45 | 7.19 | 12.26 | 0 | 0.35 | 0.65 | 0 | | *chamaedrys* | 7 | ±0.21 | ±6.13 | ±3.91 | ±2.92 | ±0.00 | ±0.15 | ±0.15 | ±0.00 | | 1. Plant families (bold) are in alphabetic order, also plant species within each family. 2. For each plant species minimum sampling number was aimed at 7 samples per plant species for both analyses (only exception were: *G. pratense, T. fragiferum,* and *T. pratense*), N is the number of samples analysed for AA (amino acids) and C (carbohydrates), respectively. 3. Volume is the mean value per plant species in µl ± SD (standard deviation). 4. Total amino acids are the mean sum of all single amino acids ± standard deviation in mg per ml, followed by individual amino acids. Order of displayed amino acids reflects the order of appearance in the chromatogram. Total carbohydrates are the mean sum of the three main carbohydrates (fructose, glucose, sucrose) in mg/ml ± SD (standard deviation). 5. Abbreviations: Ala - alanine, Arg - arginine, Asp - aspartic acid, Cystine,  Glu - glutamic acid, Gly - glycine, His - histidine, Ile – isoleucine,  Leu - leucine, Lys - lysine, Met - methionine,Phe - phenylalanine,  Pro - proline, Ser - serine, Thr - threonine, Tyr - tyrosine, Val - valine.  EAA: essential AA (His, Gly, Thr, Arg, Ala, Tyr, Cystine, Val, Met, Phe, Ile, Leu, Lys) 6. Non-EAA: non-essential AA (Asp, Glu, Ser, Gly, Ala, Tyr, cystine, Pro) | | | | | | | | | | |

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| **Fig. S1** Ratio of total amino acids (AA) in mg against total  sugar in mg.Different symbols indicate different plant species (in alphabetical order), with species of the same family depicted by the same colour. Lines added for the four most  abundant families (i.e. Apiaceae (grey), Asteraceae (red), Fabaceae (violet),  and Lamiaceae (black)). Depicted plant species: Ajurep =  *Ajuga reptans*, Antsyl = *Anthriscus sylvestris*, Campat = *Campanula patula*, Carpra = *Cardamine pratensis*, Cenjac = *Centaurea jacea*,  Cirole = *Cirsium oleraceum*, Crebie = *Crepis biennis*, Daucar = *Daucus carota*,  Gerpra = *Geranium pratense*, Glehed = *Glechoma hederacea*, Hersph = *Heracleum sphondylium*, Knaarv = *Knautia arvensis*, Latpra = *Lathyrus pratensis*, Leoaut = *Leontodon autumnalis*,  Leohis = *Leontodon hispidus*, Lotcor *= Lotus corniculatus*, Medvar = *Medicago varia*,  Onovic = *Onobrychis viciifolia*, Passat = *Pastinaca sativa*, Pimmaj = *Pimpinella major*,  Priver = *Primula veris*, Pruvul = *Prunella vulgaris*, Ranacr = *Ranunculus acris*,  Ranrep = *Ranunculus repens*, Sanoff = *Sanguisorba officinalis*, Taroff = *Taraxacum officinale*,  Trapra = *Tragopogon pratensis*, Tricam = *Trifolium campestre*, Trifra = *Trifolium fragiferum*,  Trihyb = *Trifolium hybridum*, Tripra = *Trifolium pratense*, Trirep = *Trifolium repens*,  Vercha = *Veronica chamaedrys*, Viccra = *Vicia cracca* |

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| **Fig. S2** Cluster dendrograms of the four most abundant plant families (Apiaceae, Asteraceae, Fabaceae, and Lamiaceae). Based on a) mean concentrations, b) mean proportions of the sum of all amino acids, and c) mean concentrations and d) mean proportions of the sum of essential amino acids in the nectar. |

**Table S2 is in a separate Excel file.**

**Table S2** Chemical distance matrix between 34 plant species based on Bray-Curtis distances between either the a,c) proportions (%) or b,d) concentrations (conc) of amino acids and carbohydrates.

**Table S3** Statistical results of generalized linear (mixed) models (GL(M)Ms) testing for effects of morphological factors (flower symmetry, nectar access, inflorescence area, flower height) and family on variation in individual and total amino acid concentrations and proportions. Given are the *F-* and *p*-values as well as the *R2-*values for each model. *P*-values below 0.05 are marked in italics. *P*-values below the significance level of 0.01 are additionally marked in bold. *R2*-values above 0.1 are marked in bold as well. If GLMMs were used, plot nested in plant species was used as random factor.

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| **Amino acid** | **Flower symmetry** | **Nectar access** | **Inflorescence area** | **Flower height** | **Family** |
| Aspartic acid concentration | *F =* 0.668  *p =* 0.420  *R2 =* 0.02 | *F =* 2.317  *p =* 0.138  *R2 =* 0.06 | *F =* 2.386  *p =* 0.133  *R2 =* 0.07 | *F =* 2.273  *p =* 0.144  *R2 =* 0.06 | *F =* 1.491  *p =* 0.212  ***R2 =* 0.34** |
| Aspartic acid proportion | *F =* 1.159  *p =* 0.290  *R2 =* 0.03 | *F =* 4.076  *p =* 0.052  ***R2 =* 0.10** | *F =* 0.049  *p =* 0.826  *R2 <* 0.01 | *F =* 0.347  *p =* 0.560  *R2 =* 0.01 | *F =* 2.266  *p =* 0.062  ***R2 =* 0.39** |
| Glutamic acid concentration | *F =* 3.842  *p =* 0.068  *R2 =* 0.05 | *F =* 0.848  *p =* 0.367  *R2 =* 0.02 | *F =* 0.471  *p =* 0.498  *R2 =* 0.01 | *F =* 0.199  *p =* 0.662  *R2 <* 0.01 | *F =* 10.943  ***p < 0.001***  ***R2* = 0.74** |
| Glutamic acid proportion | *F =* 1.638  *p =* 0.210  *R2 =* 0.05 | *F =* 1.139  *p =* 0.294  *R2 =* 0.03 | *F =* 0.199  *p =* 0.659  *R2 <* 0.01 | *F =* 0.152  *p =* 0.699  *R2 <* 0.01 | *F =* 3.325  *p = 0.011*  ***R2 =* 0.52** |
| Serine concentration | *F =* 2.231  *p =* 0.146  *R2 =* 0.06 | *F =* 4.929  *p =* 0.034  ***R2 =* 0.13** | *F =* 0.211  *p =* 0.649  *R2 =* 0.01 | *F =* 0.218  *p =* 0.643  *R2 =* 0.01 | *F =* 5.690  ***p < 0.001***  ***R2 =* 0.66** |
| Serine proportion | *F =* 0.093  *p =* 0.763  *R2* < 0.01 | *F =* 1.722  *p =* 0.199  *R2 =* 0.05 | *F =* 2.912  *p =* 0.098  *R2 =* 0.08 | *F =* 0.116  *p =* 0.736  *R2 <* 0.01 | *F =* 0.979  *p* = 0.501  ***R2 =* 0.22** |
| Histidine concentration | *F =* 0.144  *p =* 0.707  *R2* < 0.01 | *F =* 0.026  *p =* 0.874  *R2* < 0.01 | *F =* 0.186  *p =* 0.669  *R2 =* 0.01 | *F =* 2.833  *p =* 0.102  *R2 =* 0.09 | *F =* 2.444  *p = 0.037*  ***R2 =* 0.48** |
| Histidine proportion | *F =* 0.011  *p =* 0.916  *R2* < 0.01 | *F =* 0.503  *p =* 0.484  *R2* = 0.02 | *F =* 0.381  *p =* 0.542  *R2 =* 0.01 | *F =* 0.978  *p =* 0.330  *R2 =* 0.03 | *F =* 2.024  *p* = 0.079  ***R2 =* 0.43** |
| Glycine concentration | *F =* 2.732  *p =* 0.109  *R2* = 0.07 | *F =* 1.830  *p =* 0.186  *R2* = 0.05 | *F =* 2.283  *p =* 0.141  *R2 =* 0.07 | *F =* 0.185  *p =* 0.671  *R2 =* 0.01 | *F =* 3.780  ***p = 0.004***  ***R2 =* 0.57** |
| Glycine proportion | *F =* 6.326  *p = 0.024*  *R2* = 0.07 | *F =* 0.278  *p =* 0.605  *R2* < 0.01 | *F =* 0.369  *p =* 0.548  *R2 =* 0.01 | *F =* 0.456  *p =* 0.510  *R2 =* 0.01 | *F =* 1.555  *p* = 0.213  ***R2 =* 0.32** |
| Threonine concentration | *F =* 2.955  *p* = 0.107  *R2* = 0.03 | *F =* 0.923  *p =* 0.349  *R2* = 0.01 | *F =* 0.929  *p =* 0.342  *R2 =* 0.02 | *F =* 0.097  *p =* 0.760  *R2 <* 0.01 | *F =* 6.371  ***p < 0.001***  ***R2 =* 0.68** |
| Threonine proportion | *F =* 0.512  *p* = 0.479  *R2* = 0.02 | *F =* 0.034  *p =* 0.856  *R2* < 0.01 | *F =* 0.108  *p =* 0.745  *R2 <* 0.01 | *F =* 0.051  *p =* 0.823  *R2 <* 0.01 | *F =* 1.738  *p* = 0.133  ***R2 =* 0.39** |
| Arginine concentration | *F =* 4.661  *p* = 0.051  *R2* = 0.02 | *F =* 0.838  *p =* 0.378  *R2* < 0.01 | *F =* 0.288  *p =* 0.598  *R2 <* 0.01 | *F =* 0.160  *p =* 0.697  *R2 <* 0.01 | *F =* 15.983  ***p < 0.001***  ***R2 =* 0.85** |
| Arginine proportion | *F =* 4.673  *p* = 0.051  *R2* = 0.02 | *F =* 0.032  *p =* 0.893  *R2* < 0.01 | *F =* 0.288  *p =* 0.598  *R2 <* 0.01 | *F =* 0.132  *p =* 0.732  *R2 <* 0.01 | *F =* 14.392  ***p < 0.001***  ***R2 =* 0.39** |
| Alanine concentration | *F =* 0.776  *p* = 0.385  *R2* = 0.02 | *F =* 0.097  *p =* 0.758  *R2* < 0.01 | *F =* 1.122  *p =* 0.298  *R2 =* 0.03 | *F =* 0.344  *p =* 0.562  *R2 =* 0.01 | *F =* 7.200  ***p < 0.001***  ***R2 =* 0.69** |
| Alanine proportion | *F =* 0.041  *p* = 0.840  *R2* < 0.01 | *F =* 1.198  *p =* 0.282  *R2* = 0.03 | *F =* 0.345  *p =* 0.561  *R2 =* 0.01 | *F =* 0.374  *p =* 0.545  *R2 =* 0.01 | *F =* 1.073  *p* = 0.426  ***R2 =* 0.29** |
| Tyrosine concentration | *F =* 0.257  *p* = 0.617  *R2* = 0.01 | *F =* 0.256  *p =* 0.617  *R2* = 0.01 | *F =* 0.348  *p =* 0.560  *R2 =* 0.01 | *F =* 0.637  *p =* 0.435  *R2 =* 0.01 | *F =* 0.124  *p* = 0.999  *R2 =* 0.04 |
| Tyrosine proportion | *F =* 0.466  *p* = 0.503  *R2* = 0.01 | *F =* 0.546  *p =* 0.468  *R2* = 0.01 | *F =* 0.143  *p =* 0.708  *R2 <* 0.01 | *F =* 0.819  *p =* 0.562  *R2 =* 0.01 | *F =* 0.087  *p* = 1  *R2 =* 0.02 |
| Cystine concentration | NA | NA | NA | NA | NA |
| Cystine proportion | NA | NA | NA | NA | NA |

Table S3 (continued)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Valine concentration | *F =* 1.643  *p* = 0.209  *R2* = 0.05 | *F =* 1.087  *p =* 0.305  *R2* = 0.03 | *F =* 0.371  *p =* 0.547  *R2 =* 0.01 | *F =* 0.018  *p =* 0.893  *R2 <* 0.01 | *F =* 2.671  *p = 0.025*  ***R2 =* 0.50** |
| Valine proportion | *F =* 1.535  *p* = 0.213  *R2* = 0.05 | *F =* 1.974  *p =* 0.252  *R2* = 0.03 | *F =* 0.785  *p =* 0.501  *R2 =* 0.01 | *F =* 0.198  *p =* 0.818  *R2 <* 0.01 | *F =* 1.984  *p* = 0.121  ***R2 =* 0.50** |
| Methionine concentration | *F =* 2.018  *p* = 0.165  *R2* = 0.06 | *F =* 0.453  *p =* 0.506  *R2* = 0.01 | *F =* 0.634  *p =* 0.432  *R2 =* 0.02 | *F =* 0.527  *p =* 0.473  *R2 =* 0.02 | *F =* 3.838  ***p < 0.001***  ***R2 =* 0.58** |
| Methionine proportion | *F =* 4.339  *p = 0.045*  ***R2* = 0.12** | *F =* 0.289  *p =* 0.595  *R2* = 0.01 | *F =* 0.745  *p =* 0.395  *R2 =* 0.02 | *F =* 0.943  *p =* 0.339  *R2 =* 0.03 | *F =* 4.544  ***p = 0.002***  ***R2 =* 0.58** |
| Phenylalanine concentration | *F =* 0.033  *p* = 0.858  *R2* < 0.01 | *F =* 0.078  *p =* 0.782  *R2* < 0.01 | *F =* 0.203  *p =* 0.656  *R2 <* 0.01 | *F =* 0.003  *p =* 0.956  *R2 <* 0.01 | *F =* 0.490  *p* = 0.887  ***R2 =* 0.15** |
| Phenylalanine proportion | *F =* 0.035  *p* = 0.843  *R2* < 0.01 | *F =* 0.013  *p =* 0.921  *R2* < 0.01 | *F =* 0.222  *p =* 0.612  *R2 <* 0.01 | *F =* 0.019  *p =* 0.910  *R2 <* 0.01 | *F =* 0.864  *p* = 0.784  ***R2 =* 0.18** |
| Isoleucine concentration | *F =* 2.094  *p* = 0.163  *R2* = 0.04 | *F =* 2.450  *p =* 0.130  *R2* = 0.05 | *F =* 0.898  *p =* 0.351  *R2 =* 0.03 | *F =* 0.258  *p =* 0.617  *R2 =* 0.01 | *F =* 3.311  *p = 0.012*  ***R2 =* 0.53** |
| Isoleucine proportion | *F =* 0.319  *p* = 0.576  *R2* = 0.01 | *F =* 0.631  *p =* 0.433  *R2* = 0.02 | *F =* 0.948  *p =* 0.338  *R2 =* 0.03 | *F =* 0.261  *p =* 0.614  *R2 =* 0.01 | *F =* 1.718  *p =* 0.137  ***R2 =* 0.39** |
| Leucine concentration | *F =* 4.515  *p* = 0.051  *R2* = 0.05 | *F =* 3.324  *p =* 0.084  *R2* = 0.05 | *F =* 0.091  *p =* 0.764  *R2 <* 0.01 | *F =* 0.062  *p =* 0.807  *R2 <* 0.01 | *F =* 0.894  *p =* 0.569  *R2 =* 0.09 |
| Leucine proportion | *F =* 2.055  *p* = 0.178  *R2* = 0.01 | *F =* 2.410  *p =* 0.146  *R2* = 0.02 | *F =* 7.539  *p = 0.014*  *R2 =* 0.07 | *F =* 4.458  *p =* 0.060  *R2 =* 0.01 | *F =* 0.406  *p =* 0.927  *R2 =* 0.05 |
| Lysine concentration | *F =* 11.329  ***p = 0.007***  *R2* = 0.03 | *F =* 1.925  *p =* 0.191  *R2* = 0.01 | *F =* 0.526  *p =* 0.476  *R2 =* 0.01 | *F =* 0.138  *p =* 0.718  *R2 <* 0.01 | *F =* 39.530  ***p < 0.001***  ***R2 =* 0.92** |
| Lysine proportion | *F =* 38.488  ***p < 0.001***  *R2* = 0.04 | *F =* 1.876  *p =* 0.195  *R2* = 0.01 | *F =* 0.218  *p =* 0.645  *R2 <* 0.01 | *F =* 0.800  *p =* 0.391  *R2 <* 0.01 | *F =* 13.941  ***p < 0.001***  ***R2 =* 0.83** |
| Proline concentration | *F =* 0.579  *p* = 0.452  *R2* = 0.02 | *F =* 0.921  *p =* 0.344  *R2* = 0.03 | *F =* 0.827  *p =* 0.370  *R2 =* 0.03 | *F =* 1.474  *p =* 0.234  *R2 =* 0.05 | *F =* 0.779  *p* = 0.657  ***R2 =* 0.23** |
| Proline proportion | *F =* 0.655  *p* = 0.427  *R2* = 0.02 | *F =* 0.655  *p =* 0.424  *R2* = 0.02 | *F =* 0.364  *p =* 0.551  *R2 =* 0.01 | *F =* 2.399  *p =* 0.131  *R2 =* 0.07 | *F =* 1.091  *p* = 0.413  ***R2 =* 0.29** |
| Total AA concentration | *F =* 0.136  *p* = 0.715  *R2* < 0.01 | *F =* 0.193  *p =* 0.664  *R2* = 0.01 | *F =* 1.281  *p =* 0.267  *R2 =* 0.04 | *F =* 0.026  *p =* 0.873  *R2 <* 0.01 | *F =* 1.425  *p* = 0.241  ***R2 =* 0.34** |
| Total EAA concentration | *F =* 0.372  *p* = 0.547  *R2* = 0.01 | *F =* 1.653  *p =* 0.209  *R2* = 0.04 | *F =* 0.087  *p =* 0.770  *R2 <* 0.01 | *F =* 2.270  *p =* 0.146  *R2 =* 0.05 | *F =* 1.718  *p* = 0.158  ***R2 =* 0.30** |
| Total non-EAA concentration | *F =* 0.028  *p* = 0.869  *R2* < 0.01 | *F =* 0.126  *p =* 0.725  *R2* < 0.01 | *F =* 1.360  *p =* 0.252  *R2 =* 0.04 | *F =* 0.699  *p =* 0.410  *R2 =* 0.02 | *F =* 1.589  *p* = 0.174  ***R2 =* 0.37** |
| Total EAA proportion | *F =* 0.484  *p* = 0.492  *R2* = 0.02 | *F =* 0.350  *p =* 0.558  *R2* = 0.01 | *F =* 0.018  *p =* 0.893  *R2 <* 0.01 | *F =* 1.924  *p =* 0.175  *R2 =* 0.06 | *F =* 4.091  ***p = 0.003***  ***R2 =* 0.62** |

**Table S4** Statistical results of generalized linear (mixed) models (GL(M)Ms) testing for effects of morphological factors (flower symmetry, nectar access, inflorescence area, flower height) and family on variation in individual and total carbohydrate concentrations and proportions. Given are the *F-* and *p*-values as well as the *R2-*values for each model. *P*-values below 0.05 are marked in italics. *P*-values below the significance level of 0.01 are additionally marked in bold. *R2*-values above 0.1 are marked in bold as well. If GLMMs were used, plot nested in plant species was used as random factor.

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| **Carbohydrate** | **Flower symmetry** | **Nectar access** | **Inflorescence area** | **Flower height** | **Family** |
| Fructose concentration | *F =* 1.042  *p =* 0.315  *R2 =* 0.03 | *F =* 4.347  *p = 0.045*  ***R2 =* 0.12** | *F =* 0.077  *p =* 0.783  *R2 <* 0.01 | *F =* 0.033  *p =* 0.858  *R2 <* 0.01 | *F =* 0.661  *p =* 0.758  ***R2 =* 0.19** |
| Fructose proportion | *F =* 0.601  *p =* 0.444  *R2 =* 0.02 | *F =* 0.011  *p =* 0.919  *R2 <* 0.01 | *F =* 2.533  *p =* 0.121  *R2 =* 0.07 | *F =* 0.980  *p =* 0.330  *R2 =* 0.03 | *F =* 3.813  ***p = 0.004***  ***R2 =* 0.58** |
| Glucose concentration | *F =* 0.929  *p =* 0.343  *R2 =* 0.03 | *F =* 4.537  *p = 0.041*  ***R2 =* 0.13** | *F =* 0.074  *p =* 0.787  *R2 <* 0.01 | *F =* 0.014  *p =* 0.907  *R2 <* 0.01 | *F =* 0.738  *p* = 0.692  ***R2* = 0.21** |
| Glucose proportion | *F =* 0.204  *p =* 0.655  *R2 =* 0.01 | *F =* 0.108  *p =* 0.744  *R2 <* 0.01 | *F =* 4.325  *p = 0.046*  ***R2 =* 0.12** | *F =* 0.059  *p =* 0.809  *R2 <* 0.01 | *F =* 5.805  ***p < 0.001***  ***R2 =* 0.67** |
| Sucrose concentration | *F =* 0.365  *p =* 0.550  *R2 =* 0.01 | *F =* 1.179  *p =* 0.286  *R2 =* 0.04 | *F =* 2.626  *p =* 0.115  *R2 =* 0.08 | *F =* 1.710  *p =* 0.200  *R2 =* 0.05 | *F =* 2.006  *p* = 0.085  ***R2 =* 0.42** |
| Sucrose proportion | *F =* 0.454  *p =* 0.506  *R2* = 0.01 | *F =* 0.060  *p =* 0.808  *R2 <* 0.01 | *F =* 4.276  *p = 0.047*  ***R2 =* 0.12** | *F =* 0.059  *p =* 0.809  *R2 <* 0.01 | *F =* 5.805  ***p < 0.001***  ***R2 =* 0.67** |
| Total carboyhdrate concentration | *F =* 1.112  *p =* 0.300  *R2* = 0.03 | *F =* 4.629  *p = 0.039*  ***R2* = 0.13** | *F =* 1.224  *p =* 0.277  *R2 =* 0.04 | *F =* 0.391  *p =* 0.536  *R2 =* 0.01 | *F =* 0.585  *p* = 0.820  ***R2 =* 0.17** |

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| **Table S5** Plant species studied (Roscher *et al*. 2004) for their nectar amino acid and carbohydrate composition (plant species in italic and families in bold letters) with flower visitors recorded at different plots of the Jena Experiment in 2011 (for further details see Venjakob *et al*. 2016). Flower visitors were grouped as: B=beetles, BB=bumblebees, BF=butterflies, F=flies, HB=honeybees, HF=hoverflies, SB=solitary bees, W=wasps. Na (not available) indicates that a plant species was not flowering when visitor observations took place. | |
| **Plant family**  **Plant species** | **Observed flower visitor groups**  **HB BB SB W HF F BF B** |
| **Apiaceae**  *Anthriscus sylvestris*  *Daucus carota*  *Heracleum sphondylium*  *Pastinaca sativa*  *Pimpinella major*  **Asteraceae**  *Centaurea jacea*  *Cirsium oleraceum*  *Crepis biennis*  *Leontodon autumnalis*  *Leontodon hispidus*  *Taraxacum officinale*  *Tragopogon pratensis*  **Brassicaceae**  *Cardamine pratensis*  **Campanulaceae**  *Campanula patula*  **Dipsacaceae**  *Knautia arvensis*  **Fabaceae**  *Lathyrus pratensis*  *Lotus corniculatus*  *Medicago varia*  *Onobrychis viciifolia*  *Trifolium campestre*  *Trifolium fragiferum*  *Trifolium hybridum*  *Trifolium pratense*  *Trifolium repens*  *Vicia cracca*  **Geraniaceae**  *Geranium pratense*  **Lamiaceae**  *Ajuga reptans*  *Glechoma hederacea*  *Prunella vulgaris*  **Primulaceae**  *Primula veris*  **Ranunculaceae**  *Ranunculus acris*  *Ranunculus repens*  **Rosaceae**  *Sanguisorba officinalis*  **Scrophulariaceae**  *Veronica chamaedrys* | na  - - - - - F - -  HB - SB W HF F BF B  HB - SB W HF F - B  - SB W HF F - B  HB BB SB - - - - -  BB - - - - - -  HB BB SB - HF F - B  HB - - - HF F BF -  HB BB - - HF F - B  HB - - - - F - B  na  HB - - - - F - -  - BB SB - HF F - B  HB BB SB W HF F BF B  HB BB SB  HB BB SB - HF F BF -  HB BB SB W HF F BF -  HB BB SB - HF F - B  na  na  HB BB SB W HF F - -  HB BB SB W HF F BF B  HB BB SB - HF F - -  HB BB SB - HF F BF -  HB BB SB W HF F - B  - BB - - - - - B  HB BB SB - - F - -  - BB - - HF - - -  - BB SB - - F - -  HB - SB - HF F - B  - - SB - HF F - -  - - - - - F - -  - - SB - HF F - - |

**Table S6** Morphological traits of flowers and accessibility of pollen and/or nectar. Classified either by flower type (after Kugler 1970) or flower class (Mueller 1881); with typical pollinator guilds (Mueller 1881) listed following (Mueller 1881 supplemented with personal notes for Fabaceae, Lamiaceae, and Scrophulariaceae; Kugler 1970, data obtained from “BiolFlor - a new plant-trait database as a tool for plant invasion ecology” 2004).

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| |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Plant family** | **Plant species** | **Flower type after Kugler (1970)** | **Flower class after Mueller (1881)** | **Typical pollinators after Mueller (1881)** | | Apiaceae | *Anthriscus sylvestris* | disk flowers with nectar open | flowers with open nectar | beetles, flies, syrphids, wasps, medium tongued bees | | Apiaceae | *Daucus carota* | disk flowers with nectar open | flowers with open nectar | beetles, flies, syrphids, wasps, medium tongued bees | | Apiaceae | *Heracleum sphondylium* | disk flowers with nectar open | flowers with open nectar | beetles, flies, syrphids, wasps, medium tongued bees | | Apiaceae | *Pastinaca sativa* | disk flowers with nectar open | flowers with open nectar | beetles, flies, syrphids, wasps, medium tongued bees | | Apiaceae | *Pimpinella major* | disk flowers with nectar open | flowers with open nectar | beetles, flies, syrphids, wasps, medium tongued bees | | Asteraceae | *Centaurea jacea* | flower heads, Asteraceae, only disk flowers | flower associations with totally hidden nectar | bees, bumblebees, wasps, bombylides, syrphids | | Asteraceae | *Cirsium oleraceum* | flower heads, Asteraceae, only disk flowers | flower associations with totally hidden nectar | bees, bumblebees, wasps, bombylides, syrphids | | Asteraceae | *Crepis biennis* | flower heads, Asteraceae, only ray flowers | flower associations with totally hidden nectar | bees, bumblebees, wasps, bombylides, syrphids | | Asteraceae | *Leontodon autumnalis* | flower heads, Asteraceae, only ray flowers | flower associations with totally hidden nectar | bees, bumblebees, wasps, bombylides, syrphids | | Asteraceae | *Leontodon hispidus* | flower heads, Asteraceae, only ray flowers | flower associations with totally hidden nectar | bees, bumblebees, wasps, bombylides, syrphids | | Asteraceae | *Taraxacum officinale* | flower heads, Asteraceae, only ray flowers | flower associations with totally hidden nectar | bees, bumblebees, wasps, bombylides, syrphids | | Asteraceae | *Tragopogon pratensis* | flower heads, Asteraceae, only ray flowers | flower associations with totally hidden nectar | bees, bumblebees, wasps, bombylides, syrphids | | Brassicaceae | *Cardamine pratensis* | disk flowers with nectar ± hidden nectaries at base of stamens | flowers with totally hidden nectar | bees, bumblebees, wasps, bombylides, syrphids | | Campanulaceae | *Campanula patula* | bell shaped flowers with sticky pollen | bee flowers; hidden nectar (personal note) | bees | | Dipsacaceae | *Knautia arvensis* | flower heads, non-Asteraceae | flower associations with totally hidden nectar | bees, bumblebees, wasps, bombylides, syrphids | | Fabaceae | *Lathyrus pratensis* | flag blossom, Fabaceae type, explosive mechanism | hymenoptere flowers; hidden nectar (personal note) | hymenopteres | | Fabaceae | *Lotus corniculatus* | flag blossom, Fabaceae type, brush mechanism | bee flowers; hidden nectar (personal note) | bees | | Fabaceae | *Medicago varia* | flag blossom, Fabaceae type, explosive mechanism | hymenoptere flowers; hidden nectar (personal note) | hymenopteres | | Fabaceae | *Onobrychis viciifolia* | flag blossom, Fabaceae type, valvular mechanism | hymenoptere flowers; hidden nectar (personal note) | hymenopteres | | Fabaceae | *Trifolium campestre* | flag blossom, Fabaceae type, valvular mechanism | hymenoptere flowers; hidden nectar (personal note) | hymenopteres | | Fabaceae | *Trifolium fragiferum* | flag blossom, Fabaceae type, valvular mechanism | hymenoptere flowers; hidden nectar (personal note) | hymenopteres | | Fabaceae | *Trifolium hybridum* | flag blossom, Fabaceae type, valvular mechanism | hymenoptere flowers; hidden nectar (personal note) | hymenopteres | | Fabaceae | *Trifolium pratense* | flag blossom, Fabaceae type, valvular mechanism | bumble bee flowers; hidden nectar (personal note) | bumblebees | | Fabaceae | *Trifolium repens* | flag blossom, Fabaceae type, valvular mechanism | bee flowers; hidden nectar (personal note) | bees | | Fabaceae | *Vicia cracca* | flag blossom, Fabaceae type, explosive mechanism | hymenoptere flowers; hidden nectar (personal note) | hymenopteres | | Geraniaceae | *Geranium pratense* | disk flowers with nectar ± hidden nectaries at base of stamens | flowers with totally hidden nectar | bees, bumblebees, wasps, bombylides, syrphids | | Lamiaceae | *Ajuga reptans* | true lip flowers | bumble bee flowers; hidden nectar (personal note) | bumblebees | | Lamiaceae | *Glechoma hederacea* | true lip flowers | bumble bee flowers; hidden nectar (personal note) | bumblebees | | Lamiaceae | *Prunella vulgaris* | true lip flowers | hymenoptere flowers; hidden nectar (personal note) | hymenopteres | | Primulaceae | *Primula veris* | stalk disc flowers, stamina and pistil within tube | transition type bumble bee flowers - butterfly flowers | bumblebees, butterflies | | Ranunculaceae | *Ranunculus acris* | disk flowers with nectar ± hidden nectaries at base of petals | flowers with partly hidden nectar | syrphids, bees, butterflies | | Ranunculaceae | *Ranunculus repens* | disk flowers with nectar ± hidden nectaries at base of petals | flowers with partly hidden nectar | syrphids, bees, butterflies | | Rosaceae | *Sanguisorba officinalis* | disk flowers with nectar ± hidden in centre of flower | flowers with partly hidden nectar | syrphids, bees, butterflies | | Scrophulariaceae | *Veronica chamaedrys* | lip flowers, Verbascum type | syrphid flowers; open nectar (personal note) | syrphids | |

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