

**Table A1: Nectar and pollen availability of important crop species:** The flowering period of each crop species is given by its start and end date of blooming (day of year). The amount of nectar and pollen per m<sup>2</sup> in average of each crop species is calculated by its mean number of open flower units per m<sup>2</sup> and its averaged amount of nectar and pollen produced per flower unit (i.e. single floret, flower head = composition of several single florets) in 24 hours (analogous to maximum nectar and pollen amount per m<sup>2</sup>). The averaged range of sugar concentration of each crop species is given in mol / l. The handling times (s) of nectar and pollen represent the time that a bee needs to fill up a full crop volume (50 µl) of nectar and the time a bee needs to collect a full pollen-load (0.015 g). Details of flowering period, # open flowers per m<sup>2</sup>, nectar and pollen amounts per flower unit, sugar concentration, visit time per flower and # visited flowers to collect a full crop volume and to collect a full pollen load are given in Table A2 and A3.

| Crop   | Flowering |     | nectar<br>[ml/m <sup>2</sup> ] |       | pollen<br>[g/m <sup>2</sup> ] |        | concentration<br>[mol / l] |      | Handling time [s] |        |         |         |
|--|-----------|-----|--------------------------------|-------|-------------------------------|--------|----------------------------|------|-------------------|--------|---------|---------|
|  | Start     | End | Mean                           | Max   | Mean                          | Max    | Min                        | Max  | Min               | Mean   | Min     | Mean    |
| <b>Oilseed rape</b><br>( <i>Brassica napus</i> )   | 114       | 136 | 0.3                            | 1     | 0.13                          | 0.349  | 1.3                        | 1.7  | 213.6             | 320    | 180.8   | 220.5   |
| <b>Maize</b><br>( <i>Zea mays</i> )                | 197       | 210 | 0                              | 0     | 0.752                         | 8.036  | -                          | -    | -                 | -      | no data | no data |
| <b>Sunflower</b><br>( <i>Helianthus annuus</i> )   | 237       | 264 | 0.003                          | 0.008 | 0.108                         | 0.18   | 0.7                        | 1.8  | 2949.5            | 9256.3 | 75.5    | 78.9    |
| <b>Field bean</b><br>( <i>Vicia faba</i> )         | 153       | 182 | 0.092                          | 0.6   | 0.0642                        | 0.0945 | 1.09                       | 1.46 | 118.2             | 691.9  | 225.0   | 297.5   |
| <b>White clover</b><br>( <i>Trifolium repens</i> ) | 140       | 242 | 0.049                          | 0.13  | 0.0094                        | 0.0141 | 1.08                       | 1.9  | 733.3             | 1630   | 2084.2  | 2573.7  |

**Table A2: Literature overview of flowering, nectar and pollen data of important crop species:** The duration of flowering is given in days. The daily amount of nectar ( $\mu\text{l}$  per flower unit per day) and pollen (mg per flower unit per day) refer to flower heads (composition of several single florets) for sunflower and maize. The nectar and pollen amounts of oilseed rape, white clover and field bean refer to single florets. Sugar concentrations (%) were converted into mol / l using the molar mass of sucrose ( $M = 342.3 \text{ g / mol}$ ).

| Crop  | Period         | Flowering<br>[days]          | nectar<br>[ $\mu\text{l}/\text{flower}/\text{day}$ ] |                     |                     | pollen<br>[mg/flower/day] |                     |                    | Concentration<br>[%] |                   | # Flowers per<br>m <sup>2</sup> per day |                   | Reference  |
|---|----------------|------------------------------|--|---------------------|---------------------|---------------------------|---------------------|--------------------|----------------------|-------------------|---|-------------------|--|
|   |                |                              | Min  | Mean                | Max                 | Min                       | Mean                | Max                | Min                  | Max               | Min.                                    | Max.              |  |
| <b>Oilseed rape</b> **<br>( <i>Brassica napus</i> ) | April -<br>May | 22<br>22 – 45 <sup>a</sup>   | 0.35 <sup>b</sup>                                    | 0.55 <sup>b</sup>   | 0.82 <sup>b</sup>   | 0.187 <sup>d</sup>        | 0.239 <sup>d</sup>  | 0.292 <sup>d</sup> | 44 <sup>e</sup>      | 59 <sup>e</sup>   | 543 <sup>c</sup>                        | 1194 <sup>c</sup> | <sup>a</sup> Radchenko 1964<br><sup>b</sup> Hedke 2000<br><sup>c</sup> Blazyte-Cereskiene et al. 2010<br><sup>d</sup> Von der Ohe et al. 1990<br><sup>e</sup> Maurizio and Schaper 1994                          |
| <b>Maize</b> ***<br>( <i>Zea mays</i> )             | June -<br>Sep  | 14 <sup>a</sup>              | -  | -                   | -                   | 16 <sup>b</sup>           | 35.3 <sup>c</sup>   | 125.7 <sup>c</sup> | -                    | -                 | 21 <sup>b,d</sup>                       | 64 <sup>b,d</sup> | <sup>a</sup> Emberlin 1999<br><sup>b</sup> Percival 1955<br><sup>c</sup> Miller 1985<br><sup>d</sup> Olson and Sanders 1988  |
| <b>Sunflower</b> &&<br>( <i>Helianthus annuus</i> ) | Aug -<br>Oct   | 28<br>(19 - 36) <sup>a</sup> | 0.22 <sup>b,c</sup>                                  | 0.81 <sup>b,c</sup> | 1.39 <sup>b,c</sup> | 26.6 <sup>d</sup>         | 28.7 <sup>a,d</sup> | 30 <sup>a</sup>    | 24 <sup>b</sup>      | 61.3 <sup>c</sup> | 1.5 <sup>e</sup>                        | 6 <sup>e</sup>    | <sup>a</sup> Minckley et al. 1994<br><sup>b</sup> Hedtke 1998<br><sup>c</sup> Zajácz et al. 2006<br><sup>d</sup> Percival 1955<br><sup>e</sup> AOF 2009  |
| <b>Field bean</b><br>( <i>Vicia faba</i> )          | June           | 30<br>30 – 39 <sup>a</sup>   | 0.19 <sup>b</sup>                                    | 0.86 <sup>a</sup>   | 4.44 <sup>c,d</sup> | 0.6 <sup>e</sup>          | -                   | 0.7 <sup>c</sup>   | 6 <sup>f</sup>       | 50 <sup>f</sup>   | 80 <sup>a</sup>                         | 135 <sup>a</sup>  | <sup>a</sup> Brown and Scott 1992<br><sup>b</sup> Pierre et al. 1996<br><sup>c</sup> Prabucki et al. 1987<br><sup>d</sup> Kubisova et al. 1984<br><sup>e</sup> Percival 1955<br><sup>f</sup> Osborne et al. 1997 |
| <b>White clover</b><br>( <i>Trifolium repens</i> )  | May -<br>Oct   | 102 <sup>a</sup>             | 0.02 <sup>b</sup>                                    | 0.1 <sup>b,c</sup>  | 0.18 <sup>c</sup>   | -                         | 0.019 <sup>c</sup>  | -                  | 37 <sup>c,d</sup>    | 65 <sup>b</sup>   | 247 <sup>e</sup>                        | 741 <sup>e</sup>  | <sup>a</sup> Percival 1950<br><sup>b</sup> Weaver 1965<br><sup>c</sup> Aleck 1997, unpubl.<br><sup>d</sup> Montgomery 1958<br><sup>e</sup> Free 1993   |

\*\* The number of open florets of oilseed rape was calculated by the daily number of flowers per plant and the number of plants per m<sup>2</sup>. For calculation we used # open flowers / plant per day: (mean = 18.1 and max = 19.9 (Blazyte-Cereskiene et al. 2010)) and # plants / m<sup>2</sup> (mean = 30 and max = 60).

\*\*\* Maize provides only large amounts of pollen (no nectar). The pollen amount of maize in average was given in amount of pollen per plant in total (3.5 g per plant in total according to Nowakowski and Morse 1982) and amount of pollen per flower in total (494 mg per flower in total according to Percival 1955). Data of pollen amount per flower per day were not available. Using amount of pollen per plant in total, amount of pollen per flower in total and flowering time per flower (14 days according to Emberlin 1999) we calculated the amount of pollen per flower per day. To calculate the maximum amount of pollen per plant in total we used the maximum number of pollen grains per plant (50 \* 10<sup>6</sup> pollen grains per plant in total according to Miller 1985) and the weight of one maize pollen grain (0.00025 mg according to Miller 1985). Using the maximum amount of pollen per plant in total, number of flowers per plant (7.1 flowers per plant) and flowering time per flower (14 days) the maximum daily amount of pollen per flower was calculated.

&& The daily nectar amount per head of sunflower was given in mg / head (mean = 0.29 mg / head and max = 0.5 mg / head). For calculation of nectar amount per head in µl we used the Dichte  $\rho_{\text{nectar}} = 360 \text{ mg / ml}$  and  $m_{\text{nectar}} = 0.29 \text{ mg / head}$  (or 0.5 mg head) to solve the equation  $V_{\text{nectar}} = m * \rho$ .

**Table A3: Flower visit data of crop species:** Using maximum and mean nectar and pollen amount per flower unit for each crop species we calculated the minimum and mean number of flowers that a bee needs to visit for collecting a full crop volume of nectar (50  $\mu$ l) and a full pollen load (0.015 g). Number of visited flowers and visit time per flower were used to calculate the handling time of a bee to collect a full crop volume or pollen load.

| Crop   | Visit time per flower [s] |                   | # visited flowers to collect a full crop load |       | # visited flowers to collect a full pollen load |        | References                                       |
|--|---------------------------|-------------------|---|-------|---|--------|--|
|  | Min                       | Mean              | Min   | Mean  | Min   | Mean   |  |
| <b>Oilseed rape</b><br>( <i>Brassica napus</i> )   | -                         | 3.52 <sup>a</sup> | 60.97   | 90.91 | 51.37   | 62.63  | <sup>a</sup> Picard-Nizou et al. 1995            |
| <b>Sunflower</b><br>( <i>Helianthus annuus</i> )   | 82 <sup>a</sup>           | 151 <sup>b</sup>  | 35.97   | 61.73 | 0.5   | 0.52   | <sup>a</sup> Free 1993<br><sup>b</sup> Fell 1986 |
| <b>Field bean</b><br>( <i>Vicia faba</i> )         | 10.5 <sup>a</sup>         | 11.9 <sup>a</sup> | 11.26   | 58.14 | 21.43   | 25     | <sup>a</sup> Free 1962                           |
| <b>White clover</b><br>( <i>Trifolium repens</i> ) | 2.64 <sup>a</sup>         | 3.26 <sup>a</sup> | 277.78  | 500   | -   | 789.47 | <sup>a</sup> Weaver 1965                         |

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