**Novel indices reveal that pollinator exposure to pesticides varies across biological compartments and crop surroundings**

**Laurent et al. 2023**

**Appendix A -** Supplementary information on the indices for pollen-nectar stores, bee bodies, nectar and pollen.

Figure A. 1 - The matrices collected in the 128 sites (64 related to apple orchards and 64 to oilseed rape) according to time of sampling: pollen collected from flowers (Pollen.Flower**)**, nectar regurgitated from *A. mellifera* foragers (Nectar.Apis), *A. mellifera* foragers (Apis), pollen loads collected from *Apis mellifera* colonies (Pollen.Apis), beebread collected from *A. mellifera* colonies (Beebread.Apis), regurgitated nectar from *B. terrestris* foragers (Nectar.Bombus), *B. terrestris* foragers (Bombus), pollen-nectar stores collected from *B. terrestris* colonies (Pollen-nectar stores.Bombus), pollen-nectar stores collected from *O. bicornis* nests (Pollen-nectar stores.Osmia).

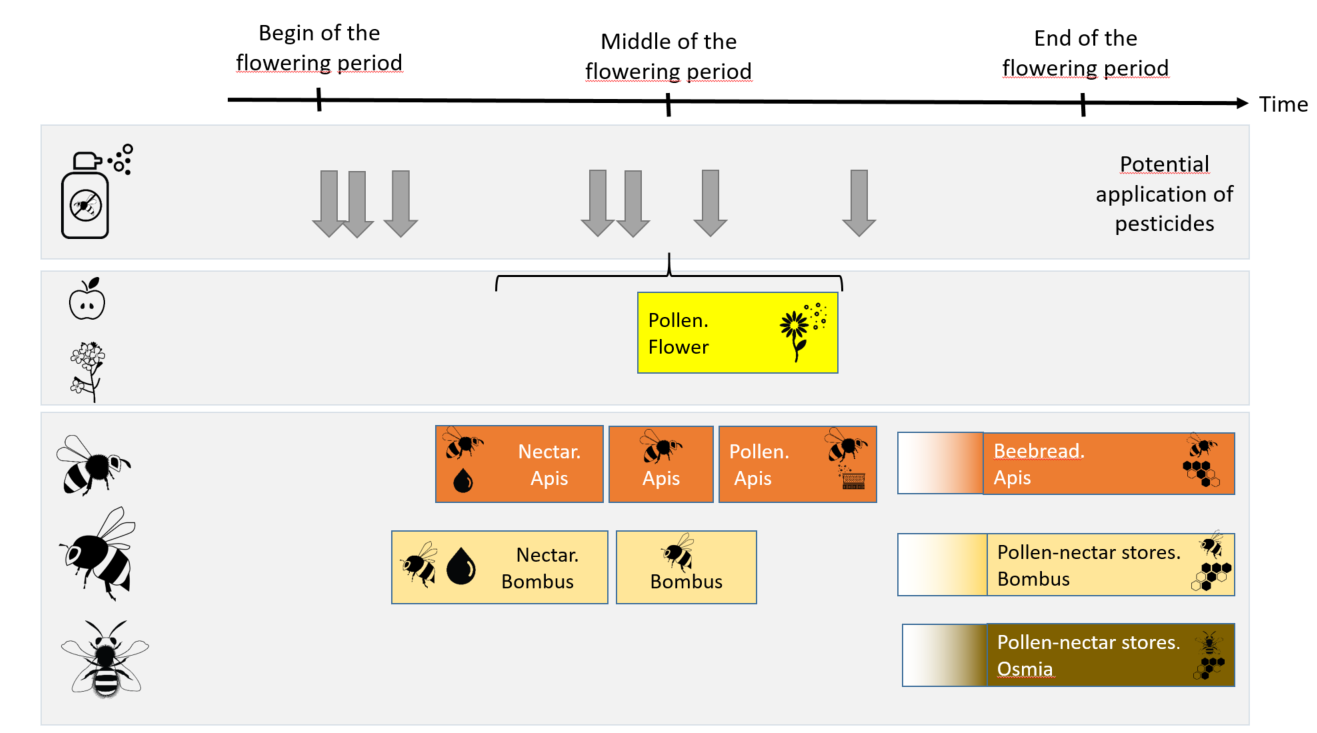


Figure A. 2 – Outline of bee and nectar collection in PoshBee. The matrices were all sampled in 2019.

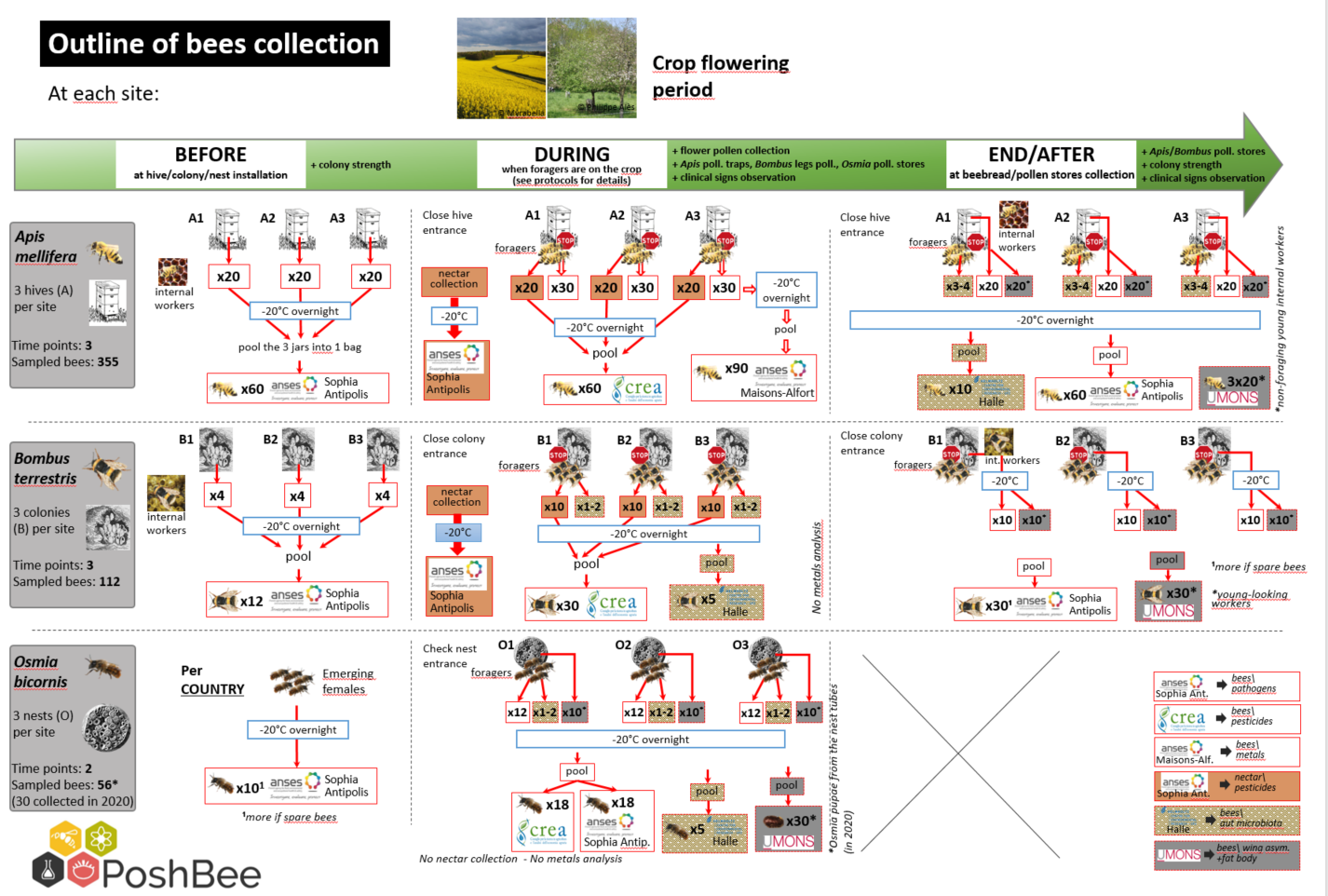


Table A.1. Values of the index for each of the 64 **apple orchard** sites and for each of the nine matrices. CHE: Swiss sites. ESP: Spanish sites. EST: Estonian sites. GER: German sites. IRL: Irish sites. ITA: Italian sites. SWE: Swedish sites. UK: the United Kingdom sites.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Sites** | **Pollen.Flower** | **Nectar.Apis** | **Apis** | **Pollen.Apis** | **Beebread.Apis** | **Nectar.Bombus** | **Bombus** | **Pollen-nectar**  **stores.Bombus** | **Pollen-nectar**  **stores.Osmia** |
| CHE\_APP\_09 | - | -0..001 | 0..274 | -0.544 | -0.693 | 0.017 | 0.438 | -0.282 | 0.537 |
| CHE\_APP\_10 | - | -0.372 | 0.274 | 0.079 | -0.971 | -0.353 | 0.438 | -0.282 | - |
| CHE\_APP\_11 | - | -0.001 | -0.481 | 0.079 | -0.971 | -0.779 | -0.608 | -0.643 | - |
| CHE\_APP\_12 | -0.038 | -0.001 | -0.481 | -0.544 | -0.445 | -0.353 | -0.608 | - | - |
| CHE\_APP\_13 | -0.858 | -0.001 | -0.085 | -0.544 | -1.287 | -0.779 | -0.608 | -0.643 | 0.327 |
| CHE\_APP\_14 | -0.038 | 0.327 | 0.895 | 1.252 | 0.276 | 0.342 | 0.854 | 0.401 | 0.998 |
| CHE\_APP\_15 | -0.49 | 0.327 | 1.166 | 0.926 | 0.088 | 0.342 | 1.219 | - | - |
| CHE\_APP\_16 | - | -0.798 | -0.481 | 0.744 | -0.33 | 0.017 | -0.608 | -0.068 | -0.312 |
| ESP\_APP\_09 | -0.858 | -0.798 | -0.481 | -0.955 | -0.113 | -0.779 | -0.608 | -1.641 | 0.327 |
| ESP\_APP\_10 | -0.665 | -0.798 | -0.085 | -0.955 | -0.566 | -0.779 | -0.608 | -0.396 | -0.834 |
| ESP\_APP\_11 | -0.858 | -0.798 | -0.481 | -0.955 | -0.219 | -0.779 | -0.608 | - | -0.032 |
| ESP\_APP\_12 | -1.313 | -0.001 | 0.599 | -0.544 | -0.693 | -0.353 | -0.608 | - | 0.094 |
| ESP\_APP\_13 | -1.072 | -0.372 | -0.085 | -0.955 | 0.088 | - | -0.608 | 0.65 | 0.636 |
| ESP\_APP\_14 | -0.858 | -0.798 | 0.274 | 0.079 | 0.538 | 0.017 | -0.044 | 0.882 | 0.998 |
| ESP\_APP\_15 | -0.665 | -0.798 | -0.085 | -1.472 | 0.276 | -0.353 | -0.608 | -0.068 | -0.47 |
| ESP\_APP\_16 | -0.858 | -0.372 | -0.085 | -1.472 | 0.276 | -0.353 | -0.608 | -0.779 | -1.049 |
| EST\_APP\_09 | - | -0.798 | -0.481 | -1.472 | -1.123 | -0.353 | -0.608 | -1.079 | -1.294 |
| EST\_APP\_10 | - | -0.001 | -0.481 | -0.544 | -1.66 | 0.342 | -0.608 | -0.923 | -1.294 |
| EST\_APP\_11 | - | -0.001 | -0.481 | -0.544 | -1.465 | 0.017 | -0.608 | - | -1.916 |
| EST\_APP\_12 | - | -0.001 | -0.481 | -0.544 | -1.66 | 0.017 | -0.608 | -2.137 | -1.049 |
| EST\_APP\_13 | - | -0.798 | -0.481 | -1.472 | -1.465 | -0.779 | -0.608 | -1.873 | -1.916 |
| EST\_APP\_14 | - | -0.372 | -0.481 | -0.955 | -0.445 | -0.353 | -0.044 | - | -0.032 |
| EST\_APP\_15 | - | -0.001 | -0.481 | -0.544 | - | -0.353 | -0.608 | -1.249 | -1.916 |
| EST\_APP\_16 | -1.072 | -0.372 | -0.481 | -0.544 | - | -0.779 | -0.608 | -1.435 | -1.578 |
| GER\_APP\_09 | - | 0.885 | 0.895 | 1.4 | 0.702 | 0.342 | 0.854 | 0.401 | 0.214 |
| GER\_APP\_10 | - | -0.798 | 0.274 | 0.546 | 0.453 | 0.017 | -0.044 | -0.173 | 0.094 |
| GER\_APP\_11 | - | -0.001 | -0.481 | 1.808 | 0.858 | -0.353 | -0.044 | 0.486 | -0.167 |
| GER\_APP\_12 | - | 0.327 | -0.085 | 1.934 | 0.858 | -0.353 | -0.044 | 0.729 | 0.434 |
| GER\_APP\_13 | - | -0.798 | -0.085 | 1.677 | 0.538 | 0.017 | 0.854 | 0.129 | 0.636 |
| GER\_APP\_14 | - | -0.798 | 0.274 | 1.808 | 0.781 | -0.353 | -0.608 | 0.65 | 0.911 |
| GER\_APP\_15 | - | -0.372 | -0.085 | 1.542 | 0.858 | -0.779 | -0.608 | 0.882 | 0.537 |
| GER\_APP\_16 | - | 0.619 | 0.599 | 0.079 | 1.224 | 0.342 | 0.438 | 0.807 | 1.082 |
| IRL\_APP\_09 | - | -0.001 | -0.085 | -0.544 | 0.088 | -0.779 | 0.854 | -0.173 | - |
| IRL\_APP\_10 | - | -0.372 | -0.085 | 0.744 | -0.445 | 0.63 | 1.219 | -0.173 | - |
| IRL\_APP\_11 | - | -0.001 | -0.085 | 0.079 | -0.113 | 0.017 | -0.044 | - | - |
| IRL\_APP\_12 | - | -0.798 | -0.085 | -0.544 | -0.445 | -0.779 | -0.044 | -1.435 | - |
| IRL\_APP\_13 | - | -0.798 | -0.481 | -1.472 | -1.287 | -0.779 | -0.608 | - | - |
| IRL\_APP\_14 | - | 0.327 | -0.481 | -0.544 | -0.113 | 0.342 | -0.044 | 0.032 | - |
| IRL\_APP\_15 | - | -0.798 | -0.085 | -0.207 | -0.011 | -0.353 | 0.438 | - | - |
| IRL\_APP\_16 | - | -0.798 | 0.274 | 0.079 | 0.276 | -0.353 | 0.854 | - | - |
| ITA\_APP\_09 | 0.875 | 0.327 | 0.274 | 0.744 | 0.934 | 0.63 | 0.438 | 1.171 | 1.472 |
| ITA\_APP\_10 | 0.973 | 1.13 | 0.895 | 0.926 | 1.082 | 1.553 | 1.219 | 0.957 | - |
| ITA\_APP\_11 | 0.775 | -0.001 | 0.274 | 1.4 | 0.088 | 0.017 | -0.044 | 0.486 | -0.312 |
| ITA\_APP\_12 | 1.069 | -0.001 | 0.274 | 0.744 | 0.276 | 0.342 | -0.044 | 0.401 | 0.731 |
| ITA\_APP\_13 | 1.608 | -0.372 | 0.274 | 1.094 | 1.082 | 0.63 | 0.438 | 1.441 | 1.397 |
| ITA\_APP\_14 | 1.345 | 0.619 | 0.274 | 1.542 | 0.621 | 0.89 | -0.608 | 0.882 | - |
| ITA\_APP\_15 | 1.069 | 0.327 | -0.481 | 0.926 | 1.428 | -0.353 | -0.044 | 0.807 | 1.082 |
| ITA\_APP\_16 | -0.038 | -0.372 | -0.085 | 0.326 | 0.453 | -0.779 | -0.608 | 0.569 | 0.823 |
| SWE\_APP\_09 | 0.672 | -0.001 | -0.481 | -0.955 | -0.011 | -0.353 | -0.044 | -0.173 | 0.636 |
| SWE\_APP\_10 | - | 0.327 | 0.274 | -1.472 | 0.183 | 0.017 | -0.044 | -0.173 | 0.434 |
| SWE\_APP\_11 | 0.094 | 0.327 | 0.599 | 0.079 | -0.011 | 0.342 | 0.438 | -0.396 | 0.214 |
| SWE\_APP\_12 | -0.329 | 0.885 | -0.481 | -0.544 | -0.693 | 0.017 | -0.044 | - | -0.47 |
| SWE\_APP\_13 | - | 0.327 | -0.085 | -0.207 | -0.566 | 0.342 | -0.044 | 0.032 | 0.094 |
| SWE\_APP\_14 | - | -0.001 | -0.481 | -1.472 | -1.287 | -0.779 | -0.608 | -0.643 | -0.834 |
| SWE\_APP\_15 | 0.455 | 0.619 | 0.274 | 0.546 | 0.088 | - | - | 0.807 | 0.537 |
| SWE\_APP\_16 | 1.069 | -0.372 | -0.481 | 0.326 | -0.33 | - | - | -0.068 | 0.214 |
| UK\_APP\_09 | - | 0.327 | -0.481 | - | 0.621 | 0.89 | -0.608 | 0.032 | - |
| UK\_APP\_10 | - | -0.001 | -0.085 | - | 0.453 | 1.553 | 0.854 | - | - |
| UK\_APP\_11 | - | 1.13 | 0.895 | - | 0.702 | 0.89 | 1.219 | 0.65 | - |
| UK\_APP\_12 | - | 1.358 | 0.599 | - | 0.366 | 1.127 | 1.544 | 0.569 | - |
| UK\_APP\_13 | - | 1.358 | 0.895 | - | 0.858 | 1.347 | 0.854 | 0.957 | - |
| UK\_APP\_14 | - | 1.13 | 0.895 | - | 0.538 | - | - | 0.313 | - |
| UK\_APP\_15 | - | 1.358 | -0.481 | - | 0.781 | 1.127 | -0.044 | 0.807 | - |
| UKUK\_APP\_16 | - | 1.358 | -0.085 | - | 0.702 | 0.89 | 0.438 | - | - |

Table A.2. Values of the index for each of the 64 **oilseed rape** sites and for each of the nine matrices. CHE: Swiss sites. ESP: Spanish sites. EST: Estonian sites. GER: German sites. IRL: Irish sites. ITA: Italian sites. SWE: Swedish sites. UK: the United Kingdom sites.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Sites** | **Pollen.Flower** | **Nectar.Apis** | **Apis** | **Pollen.Apis** | **Beebread.Apis** | **Nectar.Bombus** | **Bombus** | **Pollen-nectar**  **stores.Bombus** | **Pollen-nectar**  **stores.Osmia** |
| CHE\_OSR\_01 | -0.16 | -0.125 | -0.151 | -0.109 | -0.227 | -0.586 | -0.095 | -0.582 | -0.358 |
| CHE\_OSR\_02 | - | -0.731 | 0.447 | 0.108 | 0.287 | -0.067 | 0.132 | 0.118 | 0.384 |
| CHE\_OSR\_03 | -0.16 | -0.125 | -0.151 | -0.336 | 0.382 | -0.586 | 0.132 | 0.118 | 0.039 |
| CHE\_OSR\_04 | - | 1.574 | -0.151 | -0.109 | -0.012 | -0.067 | -0.095 | -0.097 | - |
| CHE\_OSR\_05 | - | -0.731 | -0.151 | -0.109 | -0.701 | -0.586 | -0.095 | -0.452 | -0.505 |
| CHE\_OSR\_06 | - | -0.731 | -0.151 | 0.108 | -0.456 | -0.586 | -0.095 | -1.007 | -0.358 |
| CHE\_OSR\_07 | -0.412 | -0.731 | -0.151 | -0.109 | -0.118 | -0.586 | -0.095 | -0.21 | 0.039 |
| CHE\_OSR\_08 | - | -0.125 | -0.151 | 0.314 | -0.118 | -0.586 | -0.095 | -0.717 | -0.358 |
| ESP\_OSR\_01 | -2.1 | -0.731 | 0.154 | 0.108 | 0.474 | -0.586 | -0.095 | -0.582 | -0.087 |
| ESP\_OSR\_02 | -0.706 | -0.731 | 0.154 | 0.108 | 0.737 | -0.067 | -0.095 | 0.013 | 0.159 |
| ESP\_OSR\_03 | -1.508 | -0.731 | 0.729 | 0.108 | 0.652 | -0.586 | -0.095 | 0.412 | 0.159 |
| ESP\_OSR\_04 | -0.16 | -0.125 | 0.154 | 0.108 | 0.822 | -0.067 | -0.095 | -0.097 | -0.219 |
| ESP\_OSR\_05 | -1.508 | -0.731 | 0.154 | -0.109 | -0.012 | -0.586 | -0.095 | 0.412 | -0.825 |
| ESP\_OSR\_06 | -1.061 | -0.125 | 0.154 | 0.314 | 0.474 | -0.586 | -0.095 | - | 0.039 |
| ESP\_OSR\_07 | -1.061 | 0.83 | -0.151 | 0.108 | -0.227 | -0.067 | -0.095 | 0.317 | 0.274 |
| ESP\_OSR\_08 | -0.706 | -0.125 | 0.447 | -0.109 | 0.091 | 0.39 | -0.095 | 0.013 | 0.274 |
| EST\_OSR\_01 | -1.061 | 0.388 | 0.154 | 0.108 | -0.456 | 0.39 | 0.355 | - | -0.66 |
| EST\_OSR\_02 | -1.508 | -0.731 | -0.151 | -0.336 | -0.576 | -0.067 | -0.095 | 0.013 | -0.219 |
| EST\_OSR\_03 | - | -0.125 | -0.151 | 0.108 | -0.456 | 0.797 | -0.095 | -0.582 | -0.66 |
| EST\_OSR\_04 | - | -0.125 | -0.151 | 0.108 | - | -0.067 | -0.095 | - | -0.219 |
| EST\_OSR\_05 | - | -0.731 | -0.151 | -0.109 | -0.576 | 0.39 | -0.095 | 0.118 | -0.66 |
| EST\_OSR\_06 | - | 0.83 | 0.447 | 0.511 | -0.456 | 0.797 | 0.355 | - | -0.505 |
| EST\_OSR\_07 | -0.412 | 0.388 | -0.151 | -0.109 | - | -0.067 | -0.095 | -0.329 | -0.358 |
| EST\_OSR\_08 | - | 0.83 | 0.154 | 0.108 | -0.701 | 0.797 | -0.095 | 0.219 | -0.825 |
| GER\_OSR\_01 | - | 0.388 | -0.151 | 0.108 | 0.287 | 0.39 | 0.132 | 0.317 | 0.274 |
| GER\_OSR\_02 | -2.1 | -0.125 | -0.151 | 0.108 | 0.19 | -0.067 | -0.095 | 0.118 | -0.358 |
| GER\_OSR\_03 | - | 2.204 | -0.151 | 0.699 | -0.227 | 0.797 | -0.095 | 0.924 | 0.49 |
| GER\_OSR\_04 | - | -0.125 | 0.154 | -0.109 | 0.474 | 0.39 | 0.132 | 0.679 | - |
| GER\_OSR\_05 | - | 0.388 | 0.154 | 0.314 | 0.474 | 0.39 | 0.132 | 0.013 | 0.274 |
| GER\_OSR\_06 | - | 0.83 | 0.154 | 0.699 | 0.822 | 0.797 | 0.355 | 0.219 | -0.087 |
| GER\_OSR\_07 | - | 0.388 | -0.151 | -0.109 | 0.474 | 0.797 | -0.095 | -0.452 | -0.358 |
| GER\_OSR\_08 | - | -0.125 | -0.151 | 0.314 | 0.652 | -0.586 | -0.095 | 0.118 | 0.274 |
| IRL\_OSR\_01 | 0.256 | -0.125 | -0.151 | -0.109 | -0.227 | 1.164 | -0.095 | - | - |
| IRL\_OSR\_02 | - | -0.125 | -0.151 | -0.336 | -0.227 | -0.067 | -0.095 | -0.097 | - |
| IRL\_OSR\_03 | - | -0.125 | -0.151 | -0.336 | 0.091 | -0.067 | -0.095 | -0.21 | - |
| IRL\_OSR\_04 | - | 0.388 | -0.151 | -0.109 | 0.19 | 1.164 | 0.132 | -0.097 | - |
| IRL\_OSR\_05 | - | -0.125 | -0.151 | 0.108 | -0.227 | -0.067 | -0.095 | -0.452 | - |
| IRL\_OSR\_06 | - | 0.388 | -0.151 | -0.109 | -0.339 | 0.39 | 0.132 | - | - |
| IRL\_OSR\_07 | 0.06 | - | -0.151 | 0.511 | 0.19 | 0.39 | 0.132 | - | - |
| IRL\_OSR\_08 | 0.256 | -0.731 | -0.151 | 0.108 | -0.339 | 0.39 | -0.095 | -0.329 | - |
| ITA\_OSR\_01 | 2.981 | -0.731 | -0.151 | -0.336 | 0.382 | -0.586 | 0.132 | -0.21 | 0.691 |
| ITA\_OSR\_02 | 1.601 | -0.731 | -0.151 | -0.336 | 0.19 | -0.586 | -0.095 | - | 0.49 |
| ITA\_OSR\_03 | 1.268 | -0.731 | -0.151 | -0.336 | -0.012 | -0.586 | -0.095 | 0.412 | 0.039 |
| ITA\_OSR\_04 | 2.894 | -0.125 | 0.154 | 0.314 | 0.564 | 0.39 | 0.355 | 1.002 | 0.879 |
| ITA\_OSR\_05 | 1.904 | -0.731 | -0.151 | -0.336 | -0.118 | -0.586 | -0.095 | 0.317 | -0.087 |
| ITA\_OSR\_06 | 1.383 | -0.731 | -0.151 | -0.336 | 0.287 | -0.586 | -0.095 | 0.412 | 0.274 |
| ITA\_OSR\_07 | 1.705 | -0.731 | -0.151 | -0.336 | 0.091 | -0.586 | -0.095 | -0.097 | -0.358 |
| ITA\_OSR\_08 | 0.889 | -0.731 | 0.154 | -0.336 | 0.19 | -0.586 | -0.095 | 1.078 | 0.691 |
| SWE\_OSR\_01 | 0.597 | 1.574 | 0.447 | 0.699 | 0.19 | 1.501 | 0.355 | 0.317 | 0.879 |
| SWE\_OSR\_02 | 0.256 | 1.899 | -0.151 | 0.108 | 0.287 | 1.164 | 0.132 | 0.118 | 1.056 |
| SWE\_OSR\_03 | -0.706 | 0.388 | -0.151 | -0.336 | -0.576 | 0.39 | -0.095 | -0.329 | -0.219 |
| SWE\_OSR\_04 | 0.06 | -0.731 | 0.154 | 0.108 | -0.012 | -0.586 | -0.095 | -0.097 | 0.039 |
| SWE\_OSR\_05 | -0.412 | -0.125 | 0.447 | 0.314 | -0.339 | -0.067 | 0.132 | 0.013 | 0.49 |
| SWE\_OSR\_06 | 0.434 | 0.388 | 0.154 | -0.336 | -0.339 | -0.586 | -0.095 | 0.013 | 0.274 |
| SWE\_OSR\_07 | -0.412 | -0.731 | -0.151 | -0.336 | -0.966 | -0.586 | -0.095 | -0.717 | -0.358 |
| SWE\_OSR\_08 | -0.412 | 0.83 | 0.154 | 0.511 | -0.012 | 0.39 | -0.095 | 0.118 | 0.159 |
| UK\_OSR\_01 | - | -0.125 | 0.154 | - | -0.227 | -0.067 | 0.132 | -0.452 | - |
| UK\_OSR\_02 | - | 0.388 | -0.151 | -0.109 | -0.118 | -0.067 | 0.132 | -0.097 | - |
| UK\_OSR\_03 | - | -0.125 | -0.151 | - | 0.091 | -0.586 | -0.095 | -0.097 | - |
| UK\_OSR\_04 | - | 0.388 | -0.151 | - | 0.19 | -0.586 | 0.132 | -0.21 | - |
| UK\_OSR\_05 | - | 0.83 | 0.447 | -0.336 | -0.227 | -0.586 | 0.355 | 0.317 | - |
| UK\_OSR\_06 | - | 0.388 | -0.151 | -0.336 | -0.012 | 0.39 | -0.095 | -0.097 | - |
| UK\_OSR\_07 | - | -0.731 | -0.151 | -0.109 | -0.576 | -0.586 | -0.095 | 0.317 | - |
| UK\_OSR\_08 | - | 0.83 | 0.154 | -0.336 | -0.012 | 0.797 | 0.132 | 0.118 | - |

Table A. 3 – Description and interpretation of the IRT indices related to the nine matrices under study for **apple orchard** sites. For a given matrix, the sites were clustered according to their index value. For each cluster, we give: the number of sites (N), the mean value of the index (Index), the mean number of pesticides (NbPest), the countries over-represented within clusters compared to the mean with p-value<0.05 (Sites) and the pesticides over-represented compared to the mean with p-value<0.003 (Pesticides, the mean concentration is given in brackets in µg/kg). ‘NULL’ was written when no modality was over-represented in the cluster according to the given p-value. ESP: Spanish sites. EST: Estonian sites. GER: German sites. ITA: Italian sites. SWE: Swedish sites. UK: the United Kingdom sites.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Matrix** | **Cluster 1** | **Cluster 2** | **Cluster 3** | **Cluster 4** |
| **Pollen.Flower** | **N=**11  **Index=** -0.87  **NbPest=**4.0  **Sites=**ESP  **Pesticides=**NULL | **N=**5  **Index=** -0.07  **NbPest=**8.8  **Sites=**NULL  **Pesticides=**NULL | N=8  **Index**=0.87  **NbPest**=17.0  **Sites**=ITA  **Pesticides**=  DIMETHOMORPH F (15.6)  FLUOPYRAM F (8.28)  DIFLUBENZURON I (17.7) | N=2  **Index**=1.48  **NbPest**=23.5  **Sites**=NULL  **Pesticides**=  FLUXAPYROXAD F (189)  FLONICAMID I (5057)  BUPIRIMATE F (1693)  FLUAZINAMF F (303)  ETHIRIMOL F (1808)  TRITICONAZOLE F (7.5)  TAU-FLUVALINATE I (83.5)  FLUDIOXONIL F (133)  ETOFENPROX I (90.8)  TEBUCONAZOLE F (2195) |
| **Nectar.Apis** | N=15  **Index**= -0.80  **NbPest**=0.0  **Sites**=ESP  **Pesticides=**NULL | N=40  **Index**=0.035  **NbPest**=2.15  **Sites**=NULL  **Pesticides=**NULL | N=9  **Index**=1.18  **NbPest**=6.22  **Sites**=UK  **Pesticides**=  TRIFLOXYSTROBIN H (13.1)  BOSCALID F (80.2)  PYRACLOSTROBIN H (43.3)  EPOXICONAZOLE F (2.43) |  |
| **Apis** | N=23  **Index**= -0.48  **NbPest**=0.0  **Sites**=EST  **Pesticides=**NULL | N=30  **Index**=0.07  **NbPest**=1.43  **Sites**=NULL  **Pesticides=**NULL | N=11  **Index**=0.81  **NbPest**=3.73  **Sites**=UK  **Pesticides**=  1,2,3,6-TETRAHYDROPHTHALIMIDE F (700.2)  BOSCALID F (176)  PYRACLOSTROBIN H (6.36) |  |
| **Pollen.Apis** | N=13  **Index**= -1.23  **NbPest**=0.46  **Sites**=ESP  **Pesticides=**NULL | N=24  **Index**= -0.26  **NbPest**=2.92  **Sites**=NULL  **Pesticides=**NULL | N=10  **Index**=0.79  **NbPest**=7.30  **Sites**=ITA  **Pesticides**=  CHLORPYRIFOS-METHYL I (16.3)  FLUAZINAM F (36.4)  CARBENDAZIM F (162) | N=9  **Index**=1.60  **NbPest**=12.4  **Sites**=GER  **Pesticides**=  MYCLOBUTANIL F (52.8)  TRIFLOXYSTROBIN H (349)  SPIROMESIFEN I (28.9)  TEBUFENOZIDE I (102)  METHIOCARB I (6.86) |
| **Beebread.Apis** | **N=**10  **Index=** -1.32  **NbPest=**3.90  **Sites=**EST  **Pesticides=**NULL | **N=**12  **Index=** -0.49  **NbPest=**9.67  **Sites**=NULL  **Pesticides=**NULL | N=21  **Index**=0.16  **NbPest**=15.8  **Sites**=NULL  **Pesticides=**NULL | N=19  **Index**=0.83  **NbPest**=23.7  **Sites**=GER, UK  **Pesticides**=  FLONICAMID I (78.2)  PYRIMETHANIL F (1090)  FLUXAPYROXAD F (452)  PENTHIOPYRAD F (62.8)  BOSCALID F (555)  DITHIANON F (9230) |
| **Nectar.Bombus** | N=13  **Index**= -0.78  **NbPest**=0.0  **Sites**=NULL  **Pesticides=**NULL | N=15  **Index**= -0.35  **NbPest**=1.0  **Sites**=NULL  **Pesticides=**NULL | N=20  **Index**=0.16  **NbPest**=2.45  **Sites**=NULL  **Pesticides=**NULL | N=12  **Index**=1.01  **NbPest**=5.58  **Sites**=UK, ITA  **Pesticides**=  PYRIMETHANIL F (48.6)  TETRACONAZOLE F (2.76)  EPOXICONAZOLE F (2.80) |
| **Bombus** | N=25  **Index**= -0.61  **NbPest**=0.0  **Sites**=EST, ESP  **Pesticides=**NULL | N=24  **Index**=0.12  **NbPest**=1.33  **Sites**=SWE  **Pesticides=**NULL | N=12  **Index**=1.03  **NbPest**=3.50  **Sites**=UK  **Pesticides**=  1,2,3,6-TETRAHYDROPHTHALIMIDE F (2170)  PYRIMETHANIL F (75.2) |  |
| **Pollen-nectar stores**  **.Bombus** | N=6  **Index**= -1.63  **NbPest**=2.17  **Sites=**EST  **Pesticides=**NULL | N=22  **Index**= -0.31  **NbPest**=10.9  **Sites**=SWE  **Pesticides**=NULL | N=23  **Index**=0.73  **NbPest**=22.1  **Sites**=ITA  **Pesticides=**NULL |  |
| **Pollen-nectar stores**  **.Osmia** | N=10  **Index**= -1.37  **NbPest**=1.9  **Sites**=EST  **Pesticides**=NULL | N=7  **Index**= -0.26  **NbPest**=7.43  **Sites**=NULL  **Pesticides**=NULL | N=16  **Index**=0.37  **NbPest**=12.5  **Sites**=SWE  **Pesticides**=NULL | N=9  **Index**=1.05  **NbPest**=19.8  **Sites**=ITA  **Pesticides**=  CHLORANTRANILIPROLE I (1.04)  DIMETHOMORPH F (1.72)  DIFENOCONAZOLE F (45.1) |

Table A.4 – Description and interpretation of the IRT indices related to the nine matrices under study for **oilseed rape** sites. For a given matrix, the sites were clustered according to their index value. For each cluster, we give: the number of sites (N), the mean value of the index (Index), the mean number of pesticides (NbPest), the countries over-represented within clusters compared to the mean with p-value<0.05 (Sites), and the pesticides over-represented compared to the mean with p-value<0.003 (Pesticides, the mean concentration is given in brackets in µg/kg). ‘NULL’ is written when no modality is over-represented in the cluster according to the given p-value. CHE: Swiss sites. ESP: Spanish sites. EST: Estonian sites. GER: German sites. IRL: Irish sites. ITA: Italian sites. SWE: Swedish sites. UK: the United Kingdom sites.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Matrix** | **Cluster 1** | **Cluster 2** | **Cluster 3** | **Cluster 4** |
| **Pollen.Flower** | N=8  **Index**= -1.49  **NbPest**=1.13  **Sites**=ESP  **Pesticides**=NULL | N=11  **Index**= -0.42  **NbPest**=4.0  **Sites**=CHE  **Pesticides**=NULL | N=8  **Index**=0.35  **NbPest**=7.62  **Sites**=IRL  **Pesticides**=  ETHOFUMESATE H (11.8) | N=7  **Index**=1.96  **NbPest**=21.0  **Sites**=ITA  **Pesticides**=  TETRACONAZOLE F 11.4)  CARBENDAZIM F (218)  DIMETHOMORPH F (58.3)  DIFLUBENZURON I (80)  HEXYTHIAZOX A (32.6)  LUFENURON I (24.8)  TRIFLOXYSTROBIN H (34.7)  METALAXYL (SUM OF ISOMERS) F (12.7)  FAMOXADONE F (15.6)  CARFENTRAZONE-ETHYL H (16.6)  PYRIDABEN I (28.2)  ACETAMIPRID I (9.6)  TRIFLUMURON I (8.2)  TRIADIMENOL F (9.5)  CYMOXANIL F (9.0) |
| **Nectar.Apis** | N=21  **Index**= -0.73  **NbPest**=0.0  **Sites**=ITA  **Pesticides**=NULL | N=19  **Index**= -0.12  **NbPest**=1.0  **Sites**=NULL  **Pesticides**=NULL | N=19  **Index**=0.55  **NbPest**=2.37  **Sites**=NULL  **Pesticides**=NULL | N=4  **Index**=1.81  **NbPest**=5.75  **Sites**=NULL  **Pesticides**=  SPIROXAMINE F (12.7)  ACETAMIPRID I (9.12)  THIAMETHOXAM I (2.52)  THIACLOPRID I (46.8) |
| **Apis** | N=40  **Index**= -0.15  **NbPest**=0.0  **Sites**=IRL  **Pesticides**=NULL | N=17  **Index**=0.15  **NbPest**=1.0  **Sites**=ESP  **Pesticides**=NULL | N=7  **Index**=0.49  **NbPest**=2.14  **Sites**=NULL  **Pesticides** =  BOSCALID F (275.2)  TAU-FLUVALINATE I (62.7) |  |
| **Pollen.Apis** | N=17  **Index**= -0.34  **NbPest**=0.0  **Sites**=ITA  **Pesticides**=NULL | N=15  **Index**= -0.11  **NbPest**=1.0  **Sites**=NULL  **Pesticides**=  CHLORPYRIFOS-ETHYL I (7.30) | N=23  **Index**=0.16  **NbPest**=2.26  **Sites**=ESP  **Pesticides**=NULL | N=6  **Index**=0.60  **NbPest**=4.50  **Sites**=NULL  **Pesticides**=  DIMOXYSTROBIN H (81.7)  INDOXACARB I (8.02)  FENHEXAMID F (2880)  FLUDIOXONIL F (6.3)  PYRIMETHANIL F (2334) |
| **Beebread.Apis** | N=11  **Index**=-0.59  **NbPest**=3.91  **Sites**=EST  **Pesticides**=NULL | N=16  **Index**=-0.23  **NbPest**=7.0  **Sites**=IRL  **Pesticides**=NULL | N=24  **Index**=0.15  **NbPest**=10.6  **Sites**=ITA  **Pesticides**=NULL | N=11  **Index**=0.60  **NbPest**=15.5  **Sites**=GER, ESP  **Pesticides**=  S-METOLACHLOR H (3.93)  DMF VET DRUG (3.49)  CHLORFENVINPHOS I (2.30)  METRAFENONE F (0.43)  DIFLUFENICAN H (5.94) |
| **Nectar.Bombus** | N=25  **Index**= -0.59  **NbPest**=0.0  **Sites**=ITA, CHE  **Pesticides**=NULL | N=28  **Index**=0.14  **NbPest**=1.46  **Sites**=NULL  **Pesticides**=NULL | N=11  **Index**=0.96  **NbPest**=3.45  **Sites**=NULL  **Pesticides**=  EPOXICONAZOLE F (2.70)  TEBUCONAZOLE F (9.33) |  |
| **Bombus** | N=43  **Index**= -0.09  **NbPest**=0.0  **Sites**=ESP  **Pesticides**=NULL | N=15  **Index**=0.13  **NbPest**=1.0  **Sites**=NULL  **Pesticides**=NULL | N=6  **Index**=0.35  **NbPest**=2.0  **Sites**=NULL  **Pesticides**=  THIACLOPRID I (19.7)  TAU-FLUVALINATE I (12.5)  DIMOXYSTROBIN H (6.5)  1,2,3,6-TETRAHYDROPHTHALIMIDE F (197) |  |
| **Pollen-nectar stores**  **.Bombus** | N=10  **Index**= -0.60  **NbPest**=2.9  **Sites**=CHE  **Pesticides**=NULL | N=30  **Index**= -0.06  **NbPest**=7.4  **Sites**=NULL  **Pesticides**=NULL | N=12  **Index**=0.33  **NbPest**=11.2  **Sites**=NULL  **Pesticides**=NULL | N=4  **Index**=0.92  **NbPest**=18.0  **Sites**=NULL  **Pesticides**=  ISOPYRAZAM F (0.75)  FLUXAPYROXAD F (3.97)  HEPTACHLOR EPOXIDE (ISOMER B) I (5.07)  PHENMEDIPHAM H (3.35)  DIMETHOMORPH F (10.9)  DMF VET DRUG (7.9)  MANDIPROPAMID F (2.55)  PENTHIOPYRAD F (3.72)  CHLORANTRANILIPROLE I (7.9)  LINDANE I (0.47)  TAU-FLUVALINATE I (3.85)  TETRACONAZOLE F (3.45) |
| **Pollen-nectar stores**  **.Osmia** | N=5  **Index**= -0.73  **NbPest**=1.60  **Sites**=EST  **Pesticides**=NULL | N=17  **Index**= -0.29  **NbPest**=4.47  **Sites**=NULL  **Pesticides**=NULL | N=16  **Index**=0.19  **NbPest**=8.25  **Sites**=NULL  **Pesticides**=NULL | N=8  **Index**=0.71  **NbPest**=13.3  **Sites**=ITA  **Pesticides**=  AZOXYSTROBIN F (29.5)  METAMITRON H (6.71)  BENTAZONE H (0.47)  S-METOLACHLOR H (122.1) |

Table A.5. Values of the (Pearson) correlation between index and number of pesticides for each of the nine matrices and each of the two crops (N=64 max).

|  |  |  |
| --- | --- | --- |
|  | Apple | 0ilseed rape |
| Pollen.Flower | 0.992 | 0.951 |
| Nectar.Apis | 0.992 | 0.990 |
| Apis | 0.998 | 1.000 |
| Pollen.Apis | 0.975 | 0.999 |
| Beebread.Apis | 0.989 | 0.998 |
| Nectar.Bombus | 0.991 | 0.997 |
| Bombus | 0.996 | 1.000 |
| Pollen-nectar stores.Bombus | 0.983 | 0.994 |
| Pollen-nectar stores.Osmia | 0.974 | 0.995 |

Tables A.6. Numbers and proportions (%) of the different families in the pesticides found significant to discriminate clusters (from Tables A.3. and A.4). The minimum and maximum quantities were given in µg/kg.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Fungicides | Insecticides | Herbicides | Acaricides | Vet Drug |
| Sites in apple orchards | | |  |  |  |
| Total (%) | 28 (70) | 8 (20) | 4 (10) | 0 | 0 |
| Min | 1.72 | 1.04 | 6.36 | 0 | 0 |
| Max | 9 230 | 5 057 | 349 | 0 | 0 |
| Sites in oilseed rape crops | | |  |  |  |
| Total (%) | 23 (43.4) | 18 (33.9) | 9 (16.9) | 1 (1.9) | 2 (3.8) |
| Min | 0.43 | 0.47 | 0.47 | 32.6 | 3.49 |
| Max | 2 880 | 62.7 | 122 | 32.6 | 7.9 |

Table A.7. Mean number of pesticides for the **apple orchard** sites per country and matrix. For each matrix the number of sites taken into account in the calculation (N) is given. CHE: Swiss sites. ESP: Spanish sites. EST: Estonian sites. GER: German sites. IRL: Irish sites. ITA: Italian sites. SWE: Swedish sites. UK: the United Kingdom sites.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | N | Mean | CHE | ESP | EST | GER | IRL | ITA | SWE | UK |
| Pollen.Flower | 51 | 10.4 | 7.0 | 3.9 | 3.0 | - | - | 18.1 | 12.8 | - |
| Nectar.Apis | 64 | 2.2 | 1.9 | 0.5 | 1.2 | 1.9 | 1.0 | 1.7 | 2.9 | 5.6 |
| Apis | 64 | 1.3 | 1.7 | 1.1 | 0.0 | 1.7 | 0.9 | 1.9 | 1.0 | 2.1 |
| Pollen.Apis | 56 | 4.7 | 4.9 | 1.2 | 1.4 | 11.1 | 3.0 | 8.4 | 2.6 | - |
| Beebread.Apis | 62 | 15.1 | 9.6 | 13.9 | 4.2 | 23.1 | 12.0 | 22.9 | 11.4 | 21.1 |
| Nectar.Bombus | 61 | 2.2 | 1.5 | 0.7 | 1.2 | 1.6 | 1.4 | 3.4 | 1.8 | 6.0 |
| Bombus | 61 | 1.2 | 1.4 | 0.1 | 0.1 | 1.4 | 1.9 | 1.4 | 1.0 | 2.6 |
| Pollen-nectar stores.Bombus | 56 | 14.9 | 11.5 | 12.8 | 3.2 | 19.2 | 10.2 | 23.6 | 13.1 | 20.0 |
| Pollen-nectar stores.Osmia | 42 | 10.7 | 13.0 | 9.7 | 2.1 | 13.6 | - | 18.2 | 10.5 | - |

Table A.8. Mean number of pesticides for the **oilseed rape** sitesper country and per matrix. For each matrix the number of sites taken into account in the calculation (N) is given. CHE: Swiss sites. ESP: Spanish sites. EST: Estonian sites. GER: German sites. IRL: Irish sites. ITA: Italian sites. SWE: Swedish sites. UK: the United Kingdom sites.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | N | Mean | CHE | ESP | EST | GER | IRL | ITA | SWE | UK |
| Pollen.Flower | 53 | 7.7 | 4.7 | 2.1 | 2.3 | 0.0 | 6.7 | 19.7 | 5.6 | - |
| Nectar.Apis | 63 | 1.4 | 1.0 | 0.75 | 1.5 | 2.4 | 1.1 | 0.12 | 2.4 | 1.75 |
| Apis | 64 | 0.5 | 0.2 | 1.2 | 0.5 | 0.4 | 0.0 | 0.2 | 0.9 | 0.5 |
| Pollen.Apis | 63 | 1.5 | 1.4 | 1.9 | 1.7 | 2.7 | 1.4 | 0.4 | 2.0 | 0.4 |
| Beebread.Apis | 62 | 9.3 | 8.1 | 13.1 | 4.3 | 13.2 | 8.1 | 11.1 | 7.2 | 8.1 |
| Nectar.Bombus | 64 | 1.2 | 0.25 | 0.6 | 2.0 | 2.0 | 2.1 | 0.25 | 1.75 | 0.9 |
| Bombus | 64 | 0.4 | 0.25 | 0.0 | 0.5 | 0.62 | 0.37 | 0.37 | 0.5 | 0.75 |
| Pollen-nectar stores.Bombus | 60 | 8.2 | 5.0 | 8.7 | 7.0 | 10.5 | 5.8 | 12.4 | 7.4 | 7.7 |
| Pollen-nectar stores.Osmia | 47 | 7.0 | 5.6 | 6.6 | 3.0 | 7.4 | - | 9.7 | 9.5 | - |