

## The Pollination of European Orchids Part 4: *Goodyera* and *Spiranthes*

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In the third part of this series (Claessens & Kleynen, 2014) we discussed the development of the viscidium, a special organ for attachment of the pollinia to the pollinator. Now we will introduce two genera with a flower and column structure, specially adapted to their main pollinators.

### *Goodyera*

In Europe the genus only comprises two species, *G. repens*, the Creeping Lady's-tresses and *G. macrophylla*, a species only found in Madeira. Here we will only discuss the common species, *G. repens*. It has no tubers but instead creeping rhizomes, hence its name. The plants are about 10-20 cm high and have rosettes with oval shaped, net-shaped, veined leaves (Fig. 1). The rosettes can be found all through the year. The stem is hairy and the small, creamy white flowers are in a single spiral row. The perianth is covered with long, whitish hairs (Fig. 2). The flowers do not open wide, sepals and petals forming a narrow tube. The lip consists of two parts, a pointed, triangular, gutter-shaped epichile and a round, sack-shaped hypochile, where nectar is secreted (Fig. 3). The flowers emit a sweet scent. The column consists of an anther with two yellow pollinia and a large, rounded stigma on its underside. Part of the stigma is transformed into an oval viscidium, covered by a thin membrane. It lies between two fork-like, protruding parts of the rostellum, the modified part of the stigma that forms the viscidium. The anther opens at the front, and when the pollinia fall out of the anther, they can contact the viscidium.

Main pollinators of *G. repens* are bumblebees. When visiting a plant, they always follow the same visiting pattern: they start at the bottom of the inflorescence and creep upward, inspecting all open flowers. The flower structure is well adapted to this behaviour. The oldest flowers (the ones at the bottom) are open and allow the bumblebees to enter the flower. If they had any pollinia attached to their proboscis, they will push them against the sticky stigma while licking the nectar. But the newly open flowers, higher up the stem, open only slightly, leaving little space between lip and viscidium. When creeping up the stem, the bumblebee can no longer freely enter the flower, but while searching for nectar it will almost certainly touch the forward

Fig. 1: *G. repens*, habitat, Mechernich (Germany) 20-07-2013

Fig. 2: *G. repens*, flower spike. Brunssum (Netherlands) 17-07-2008

Fig. 3: *G. repens*, longitudinal section showing the sac-like hypochile and structure of the column



sticking viscidium, partly blocking the entrance to the flower (Fig. 4). This gradual opening of the flowers ensures cross-pollination: first the pollinia are deposited on the stigma and then new pollinia are attached to the insect. Unlike other pollinators, bumblebees rarely revisit a plant, so cross-pollination is highly promoted.

We mainly observed various species of bumblebees as pollinators like the buff-tailed bumblebee (*Bombus terrestris*), the common carder bee (*Bombus pascuorum*) or the red-tailed bumblebee (*Bombus lapidarius*) (Figs. 5 & 6). Bumblebees are very fast and efficient pollinators which can visit and inspect many flowers in a short time. Moreover, they can fly in much lower temperatures than honeybees, making them excellent pollinators. In a large site in Germany in one year the role of main pollinator was taken over by honeybees (*Apis mellifera*). The rigid proboscis of bumblebees is well suited to firm attachment of the viscidium with the adhering pollinia. This load does bother them, but it cannot be removed by grooming. The lip of *G. repens* is far too small to act as a landing platform for the comparatively large pollinators, so they use the inflorescence to gain a hold.

Although fruit set is high (we noted a mean of almost 70%) the plants mainly reproduce by means of long, slender runners and eventually form large cushions of rosettes. Because they only grow in the upper layer of humus or needles, the plants almost behave like an epiphytic orchid. They depend on a constant, moist environment. In the Eifel (Germany) and in the Dolomites (Italy) we saw plants growing under pines on rocks, covered with a thick layer of needles. The plants grow in shaded habitats which could be a disadvantage, because there are less potential pollinators available. But then there is less competition from other plants and once the bumblebees have found *G. repens* with its large supplies of nectar, they are regular visitors to the orchid.

### *Spiranthes*

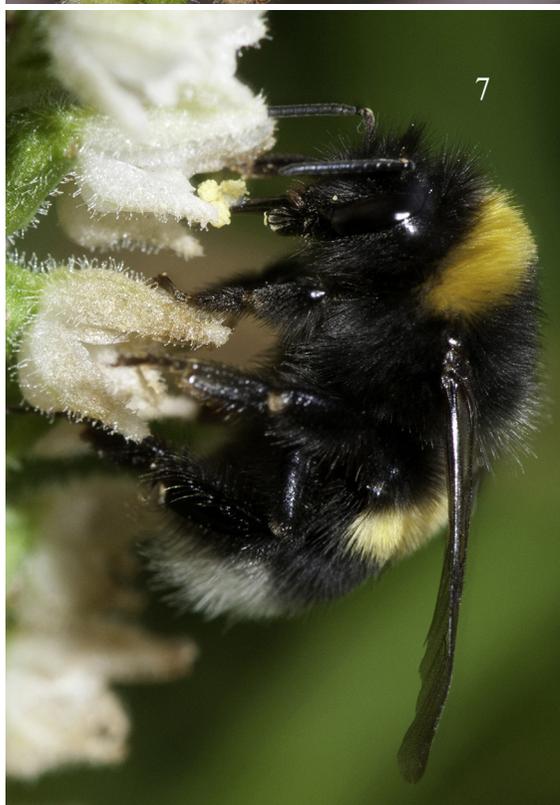
In Europe four *Spiranthes* species can be found. For illustration of the pollination process we will use the Autumn Lady's-tresses (*Spiranthes spiralis*) as an example (Fig. 8). In contrast to the genus *Goodyera*, the genus *Spiranthes* has tuberous roots, producing a rosette. The flower stem of *S. spiralis* is 10-25 cm high and covered with hairs and glandular hairs. The flowers are small, white and in a more or less

Fig. 4: *G. repens*, front view. The sepals and petals are removed. The protruding viscidium only leaves a small opening to the hypochile

Fig. 5: *Bombus lapidarius* pollinating *G. repens*, Mechernich (Germany), 11-07-2009

Fig. 6: *Bombus pascuorum* pollinating *G. repens*, Mechernich (Germany), 24-07-2010

Fig. 7: *Bombus terrestris* pollinating *G. repens*, Fontanazzo (Italy), 31-07-2011



spiral row (Fig. 9). Sepals, petals and lip form a narrow tube. The lip is oblong, gutter-shaped with upwards curving margins and a broad crystalline margin. In this way the column is completely wrapped up in the lip and perianth segments, forcing visiting insects to enter the flower from the front (Fig. 10). The column is elongated but shows principally the same structure as *G. repens*: anther with pollinia which are attached to a long, narrow viscidium. On both sides of the viscidium are also two fork-like elongations of the rostellum. The stigma is shield-shaped, glistening with stigmatic fluid. There is no spur, instead at the back of the lip are two globose nectaries. The nectar they secrete accumulates on the bottom of the lip.

Visiting insects are also Hymenoptera as in *Goodyera*, but it seems that *S. spiralis* attracts a larger pollinator spectrum. Pollination goes the same way as described for *G. repens*. Spiral placement of the flowers and their gradual opening promote cross-pollination. We observed various bumblebees (*Bombus terrestris*, *Bombus lapidarius*, *Bombus sylvarum*), honeybees and also small solitary bees (Fig. 11, *Halictus simplex*). The bumblebees and honeybees carry the pollinia on their proboscis (Figs. 12 & 13). We could confirm the preference for a certain flower when observing the visiting behaviour of honeybees. Some bees totally ignored the orchids, only visiting the surrounding Common bird's-foot-trefoil (*Lotus corniculatus*), whereas other bees intentionally visited and searched for *S. spiralis*, even if the plants were covered by grass or other herbs. Bumblebees also were very swift and efficient pollinators. They can fly at much lower temperatures than the honeybees and thus are excellent pollinators even in less favourable weather conditions. The *Halictus* bees have an ingenious, articulated proboscis which enables these small bees to reach the end of the flower tube of the flowers. A video showing pollination is on YouTube (Claessens, 2011)



Fig. 8 (above): *S. spiralis*, habitat, Garmisch-Partenkirchen (D), 30-08-2010

Fig. 9: *S. spiralis*, flower spikes, Garmisch-Partenkirchen (D), 30-08-2010

Fig. 10: *S. spiralis*, flower, view from above; sepals and petals removed. The column is shrouded in the lip margins.

Fig. 11: *Halictus simplex* has a hinged tongue which enables it to reach the nectar at the back of the lip. The pollinia are sticking to the tip of the tongue.

Garmisch-Partenkirchen (D), 29-08-2010

Fig. 12: *Bombus pascuorum* pollinating *S. spiralis*, Garmisch-Partenkirchen (D), 27-08-2010

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Fig. 13: Honebee (*Apis mellifera*) pollinating *S. spiralis*, Wijlre (NL), 23-08-2008

*S. spiralis* is an orchid that needs open grassland and short turf, for it is shade-intolerant. Experiments showed that the orchid disappears if there is too much shade from competing high grass. Site management should aim at mowing and removing biomass in July to create maximum light conditions and to reduce competition from other nectar plants. If there are few competing nectar plants, the rate of fruit set is augmented.

In the last few years various exotic *Spiranthes* species were found in the Netherlands, including *S. odorata* (back cover), *S. romanzoffiana*, *S. lucida* and *S. cernua*. It is not certain where they come from, but they could well have escaped from cultivation in gardens. Their occurrence raises questions about the need for protection or the threat they could mean to the local flora.

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For more info see our book “The flower of the European orchid – Form and function” or visit our website [www.europeanorchids.com](http://www.europeanorchids.com).”

### **Acknowledgements**

We would like to thank Mike Gasson for his great help in improving the manuscript.

### **Back Cover**

*Spiranthes odorata* at Enschede (Netherlands)  
Photo by Jean Claessens & Jacques Kleynen

