BUZZ POLLINATION OF ORPHEUM FRUTESCENS

Carpenter bees use wing vibrations to “buzz” pollen out of the anthers of Orphium frutescens

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Insects usually visit flowers to drink nectar, a sugary liquid produced as a reward for pollination. But some insects, such as bees and many beetles and flies, require pollen in their diet. Pollen contains far more protein than does nectar and is the primary food source for bee larvae. Some plants such as Orphium frutescens, a small shrub in the gentian family, offer pollen instead of nectar as a reward for pollination.

Orphium frutescens grows naturally in fynbos vegetation near the sea, but also does well in cultivation. The flowers of Orphium growing outside the Botany department at the University of Cape Town are regularly visited by females of the yellow banded carpenter bee, Xylocopa caffra, a member of the family Anthophoridae, as well as a smaller black carpenter bee. The behaviour of the bees towards the flowers is curious. They grasp the anthers and buzz loudly for a second or two, before flying off. Close examination of the flowers reveals that the anthers are twisted and have two apical pores through which most of the pollen is released.

Orphium is pollinated by a mechanism known as “buzz pollination” (Buchman 1983). The buzzing by carpenter bees is in fact a rapid vibration of the folded wings which serves to eject the pollen out of the pores of the anther and onto the bee’s body which is tightly curled around the anthers.

Pollination takes place when the bee visits another flower and some of the pollen is brushed from the bee’s body onto the stigma. In Orphium the stigma is placed away from the anthers and usually contacts with the bee’s abdomen. This position of the stigma is a feature of many buzz pollinated flowers and it may serve two purposes. Firstly, it avoids damage to the stigma when the anthers are grasped and vibrated by the bee. Secondly, it prevents pollen from being sprayed onto the stigma of the same flower, thus avoiding self pollination.

Only a fraction of the pollen collected by the female bee is involved in pollination, the rest being transferred to her hairy back legs and carried to the nest (a tunnel she has hollowed out of soft dry wood). The pollen is mixed with regurgitated nectar to produce a paste. A large egg is laid onto the paste and is sealed into the nest with a mixture of wood dust and saliva. This procedure is repeated along the tunnel. Because all the larvae are sealed into the nest, enough food (in the form of pollen paste) needs to be stockpiled to allow them to mature to the stage when they can fly.

Of the approximately 225 000 known species of flowering plants about 6-8% (15 000-20 000 species) are assumed to be buzz pollinated (Buchman 1983). Why is this complicated mechanism of pollination so successful in the plant world?

The main reason may be that the typically large yellow anthers always look invitingly full of pollen, thus bees continue to visit, and pollinate, flowers even if all the pollen has been buzzed out of the anthers. Another reason may be that most of the pollen is only available to “legitimate” pollinators capable of buzzing. Most plants have exposed pollen which can be collected by any Tom, Dick and Harry of the insect world, but the pollen of buzz pollinated plants is only available to insects likely to accomplish pollination. Some theft of pollen by honeybees (Apis mellifera capensis) does occur in Orphium because a fraction of the pollen escapes from a narrow spiral slit in the anthers, but most of the pollen is buzzed out of the apical pores by carpenter bees (the legitimate pollinators).

What other plants, apart from Orphium are likely to be buzz pollinated? Buzz pollination is strongly associated with pollen...
Above: The common yellow banded carpenter bee "buzz pollinating" a flower of *Orphium frutescens*.

Below: Close up of the flowers of *Orphium frutescens*. Note the bunch of twisted anthers and the displaced style.

release through pores, therefore plants such as *Cyanella* (family Tecophilaceae) and our indigenous *Solanum* species (family Solanaceae) would be a good place to start looking. Koos Roux at Kirstenbosch has told me that the flowers of cultivated tomatoes (*Lycopersicum esculentum*, also a member of the family Solanaceae) are buzzed by our local yellow banded carpenter bee. The parasitic genus *Harveya* (family Scrophulariaceae) has flowers with interesting spurred anthers which block the passage to the nectar. Rudolf Marloth was quick to realize that an insect entering the flower will contact these spurs and "produce vibration, thereby causing it to shed its pollen on the visitor" (Marloth 1919-1932). Another genus with pollen released through pores is *Roridula* (family Roridulaceae), an obscure fynbos plant with resinous glands on the leaves. The anthers are "irritable" and if touched eject a cloud of pollen through the pore, hence buzzing is almost unnecessary! Erica species have anther pores which vary from being apical (placed at the tip) to extending almost the entire length of the anther. Buzz pollination is therefore a possibility in some Erica species which have anthers protruding beyond the entrance to the flower.

References