TREES FOR BEES CORNER

STAR PERFORMERS PART 12: WONDERFUL WALNUT POLLEN IN SPRING

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Trees for Bees has produced a series of fact sheets showcasing the 'best of the best' bee plants that will maximise nutritional benefits for your bees. In this issue of the journal, the team explains why the spring-flowering walnuts are 'star performers'. For more information, see www.treesforbeesnz.org.

Walnut trees produce large quantities of pollen in spring—a great advantage for your bees during spring build-up.

Walnut trees *(Juglans spp.)* are star performers because they are wind-pollinated and consequently produce a huge quantity of pollen in springtime. Walnuts belong to the plant family Juglandaceae with 21 species (McGranahan & Leslie, 2009). All the species have edible nuts, all are deciduous and are characterised by their pinnately compound leaves (Figure 1).

Figure 1. Branch of walnut tree with pinnately compound leaves and cluster of female flowers.

At least nine of the 21 walnut species are present in New Zealand (see Table 1). Three of these, the English walnut (*Juglans regia*); black walnut (*J. nigra*); and butternut *(J. cinerea*) are naturalised to various degrees (Webb et al., 1988; Manaaki Whenua – Landcare Research Databases), but one of these, the Japanese walnut (*Juglans ailantifolia*), which has naturalised, is now prohibited for import in New Zealand (Ministry for Primary Industries, 2008). The Japanese walnut has been too invasive because it produces prolific seedlings under the trees (Webb et al., 1988). The remaining species are less widespread, but all are present in the Eastwoodhill National Arboretum and some are most likely used for plant breeding for the walnut industry; for example, *J. hindsii* is used for rootstock for grafted walnut trees used in commercial orchards (McGranahan & Leslie, 2009).

The English (or Persian) walnut (*J. regia*) was amongst the first of the nuts brought into New Zealand by the early European settlers and is one of the most successfully cultivated edible nuts in New Zealand (Webb et al., 1988). This is the best-known species in the world because the global commercial walnut trade is primarily based on the English walnut (Ministry for Primary Industries, 2008). Since the 1970s, the commercial walnut industry has been expanding in New Zealand and a recent surge of interest has resulted in the installation of many new orchards because it is such a lucrative tree crop (Hiser, 2003, as cited in Ministry for Primary Industries; Muller, n.d.; Lawrence, 2017). Much of the industry is based around Canterbury, with orchards also in Central Otago, Marlborough, Nelson, the Wairarapa and elsewhere in the North Island (Ministry for Primary Industries).

Figure 2. Catkins of male flowers producing pollen on walnut tree.

Table 1. List of walnut species present in New Zealand.

Botanical Name	Common Name	Global Range	NZ status
Major species			
Juglans regia	English or Persian walnut	South-eastern Europe, Iran to Himalayas, and China	In NZ Flora IV and LCR databases, naturalised
Juglans nigra	Eastern black walnut	Eastern United States	In NZ Flora IV and LCR databases, naturalised
Juglans ailantifolia	Japanese walnut	Japan (syn. *sieboldiana*)	In NZ Flora IV and LCR databases; INVASIVE: prohibited in NZ
Juglans cinerea	Butternut	Eastern United States	In LCR databases, but not in Flora IV
Minor species			
Juglans australis	Nogal criollo, tropical walnut	Argentina	Not in Flora IV or LCR databases
Juglans californica	Southern California black walnut	Southern California	Not in Flora IV or LCR databases
Juglans hindsii	Northern California black walnut	Northern California	Not in Flora IV or LCR databases
Juglans microcarpa	Texas black walnut	South-western United States and north-western Mexico	Not in Flora IV or LCR databases
Juglans neotropica	Andean walnut	North-western South America	Not in Flora IV or LCR databases

Sources: Webb et al. (1988) (NZ Flora IV), pp. 760–761; Manaaki Whenua – Landcare Research Databases (LCR); McGranahan, G., & Leslie, C. (2009); Ministry for Primary Industries (2008); Eastwoodhill National Arboretum Database (Weaver, M., personal communication) .

Flowers

Like many other wind-pollinated, temperate trees in the northern hemisphere, walnuts have floral structures that are specialised for two different functions: dispersing pollen on the wind and capturing airborne pollen coming in. The best way for a plant to engineer these two functions is to separate the sexes into two different specialised flowers on the same tree: one for broadcasting pollen and another for capturing pollen to fertilise the ovule and make a fruit.

Therefore, walnut trees have unisexual flowers with male flowers aggregated into male catkins (Figure 2) and female flowers arranged in less dense clusters at the tips of the branches (Figure 3). The numerous male flowers are borne on elongated drooping catkins exposed to the wind. They can sway back and forth, shaking the pollen out in all directions. In contrast, the sturdy upright female flowers stay fixed in place, nestled in at the end of branches where they will capture pollen and ultimately support fruit growth (Figures 1 and 3).

For English walnuts, particularly in commercial orchard plantations, it is critical to understand the timing of male and female flower maturation because walnut trees are self-fertile—meaning that pollen from a tree is able to fertilise its own female flowers on that same tree (McGranahan & Leslie, 2009). In general, outcrossed pollen results in superior fruit and better genetics for the species. So, walnut trees have a mechanism to prevent too much self-pollen from outcompeting cross-pollen from a different tree. To do this, they separate the time when male flowers disperse pollen on a tree from that of female flower receptivity on the same tree. This temporal separation within a tree promotes the success of outcrossed pollen, while the self-pollen is a backup system for the tree if there is a slight temporal overlap between male and female functions.

Figure 3. Cluster of female flowers receiving windblown pollen on walnut tree.

In some cultivars, the female flowers mature before the male flowers, but in others, the male flowers precede female flowers (McGranahan & Leslie, 2009). To the bees, it makes no difference either way because bees are just visiting the male flowers to harvest pollen for their brood and, in fact, they are robbing the pollen because they do not visit the female flower at all.

But a backyard or commercial orchardist will need to be concerned about the timing of pollen dispersal from polliniser trees, which must match the timing of female flower receptivity in their target trees. These considerations can get a bit complicated, but information is available from experts in the walnut trade; for example, New Zealand Walnut Industry Group Inc. (NZWIG) at https://walnuts.org.nz.

Pollen

We first discovered the usefulness of walnut pollen for bees in Canterbury when we were surprised to find walnut pollen dominating in some of our apiary hive pollen traps, so we know that bees do forage on walnut pollen when it is available.

The male catkins have ideal landing platforms for the bee to crawl along (Figure 4). The anthers are densely packed together and have no stalk (filament) so they are sturdy and sessile. Each male floret on the catkin has numerous anthers with no petals, which gives easy access to pollen for the bees.

The immature naked catkin buds first appear in the late summer and persist over winter to be ready to mature in the spring on the previous year's wood (McGranahan & Leslie, 2009). The anthers open gradually along the length of the catkin, while the catkin is further elongating. The quantity of pollen is copious, allowing bees to collect huge pollen loads very rapidly without much work (Figure 4).

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Figure 4. This bee has good access to pollen and a great landing platform in the male catkin.

Nectar

The female flowers are designed to capture pollen blown in by the wind (Figure 5). They are produced in the spring on the tips of the terminal shoots of the current year's growth. The flowers consist of a pistil with a swollen ovary and a very short style bearing a branched stigma with feathery lobes to trap windblown pollen (McGranahan & Leslie, 2009). Female flowers are in clusters of few to many and do not attract insects, as they have no petals and no nectar.

If walnut orchardists see many bees busily robbing pollen from male walnut catkins while ignoring female flowers, they might be concerned that their walnut yield will be reduced. However, that is highly unlikely because the quantity of pollen in wind-pollinated trees is enormous, and the action of the wind would be broadcasting the pollen faster than the bees could collect it all. It would take an extraordinary density of bees and continuously excellent flying conditions of warm weather for bees to outcompete the wind.

Multiple uses

The English and black walnuts are the species most used in the nut trade. In addition to providing an edible walnut, wood from black walnut trees is highly sought after for furniture and veneer (Molnar, Kahn, Ford, Funk & Funk, 2013), and English walnut produces high-quality decorative timber. Nevertheless, the specialty timber market for New Zealand-grown walnuts is limited, with most walnut trees established for nuts or amenity purposes. The cultivars specialised for timber are very different than the cultivars specialised for nut production (Reid, Coggeshall, Garrett and Van Sambeek, 2009).

Planting advice

Walnuts have occasionally been used on Trees for Bees demonstration farms, largely limited by the availability of suitable sites. Use has varied from single specimen trees through to groves for walnuts and amenity value.

Walnuts tend to grow best on deep, fertile, well-drained soils (e.g., Reid et al., 2009) and in sheltered sites. These sites are more typically found in valley bottoms, but upland sites that have deep, fertile soils with good water holding capacity are also suitable.

Walnuts do not do well on sites prone to drought, as spring/summer moisture deficit severely affects nut quality. Because walnuts require good soil moisture, they should not be established on sites that require irrigation. However, if the climate is too wet then the trees will be more susceptible to blight, which is one of the limitations of commercial production in New Zealand (Muller, n.d.). The other limitation on growing walnut trees is frost (Muller). Black walnut is especially sensitive to spring frost damage, particularly after the onset of bud break (Reid et al., 2009).

Walnuts can grow to 20–30m in height by 20m diameter at a medium to fast rate. Therefore, it is recommended that they be given enough space to grow into: suggested final spacing is 20–25m between trees, although you may wish to plant closer together initially and then select the best specimens later. As with all specimen trees, small-grade trees may only require a single stake and a tree guard if there are pests or stock around, whereas larger-grade trees may require larger stake(s).

You can establish walnuts from seed, or grafted cuttings if the focus is on nut production (Reid et al., 2009), although a wide variety of walnut cultivars are available for purchase from nurseries in New Zealand. It is best to consult the New Zealand Walnut Industry Group (NZWIG) for selection of cultivars and orchard layouts if you are planning a commercial orchard or wish to have a successful small grove or specimen trees for edible nuts (https://walnuts.org.nz).

Figure 5. A female walnut flower with bilobed feathery stigma and no petals around the ovary. All photos by Jean-Noël Galliot © Trees for Bees NZ.

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