

THE LARGE WALNUT APHID (*Panaphis juglandis* Goeze) - A FEW OBSERVATIONS

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Walnut trees are known to stunt the growth of other plants and even to deter insect herbivores. This is because they have a highly toxic compound - juglone. According to Wikipedia, juglone is found in all the trees of the walnut family, juglandaceae, hence the name; it occurs not just in their roots, bark and fruit husks, but in the leaves as well. As it often happens with chemically defended plants, some invertebrates have found ways of detoxifying such compounds and, as a result, can develop nowhere else. For example, in the UK the European walnut tree (*Juglans regia*) hosts two specific aphids: the large walnut aphid (*Panaphis juglandis* Goeze) and the small walnut aphid (*Chromaphis juglandicola* Kaltenbach). The first feeds on the upper side of a leaf, along the vein, and leaves a characteristic dark scar, whereas the latter feeds on the underside.

In the past, I had the pleasure of watching quite a few large walnut aphids on the leaves of a walnut tree at the bottom of our garden, TL986244. I saw the smaller species only very occasionally, because it never established itself. This tree turned up by itself around 2006. Who knows who planted it; there are not many walnut trees around. A squirrel? Anyway, it grew very fast and soon I spotted these amazing aphids on the leaves. From then on, low branches were left un-pruned for observation purposes because, as usual, I became mystified by their life cycle of which I knew nothing. Meanwhile, as the squirrels ate all the walnuts, in January 2016 we decided to cut it down and plant a plum tree instead. Consequently, I have decided to write down my observations taken from 2010 till 2015, albeit very amateurish and rather incomplete. In the process of doing it I have learned about their lifecycle.

Large walnut aphid life cycle

As is common with aphids, the large walnut aphid has a rather complex life cycle spent entirely in the same host (Olson, 1975; Dransfield, 2016). It overwinters in the egg stage and the eggs hatch, presumably, when the new leaves sprout. Soon stem mothers, or fundatrices, start new colonies. Stem mothers are viviparous and parthenogenetic, that is, they give birth to live young without need to be fertilised. From then on their offspring feed on the top of the leaves and soon they reach maturity by undergoing four moults. At this stage, the adults are all winged parthenogenetic females, which reproduce very fast; many generations follow. However, when the days get shorter and the weather cools down, they start producing two new forms:

winged males and wingless oviparous females. These mate and the females lay eggs on the leaf buds, or cracks in the bark, and the cycle begins again.

Observations and discussion

In our area, walnut trees come into leaf rather late in the Spring and by June, when my first records of winged females started, the trees were in full leaf and had bloomed already. I have been told that, by then, those females were probably many generations past the egg stage (S. Halbert, pers. comm.). Anyway, throughout the season the winged females were busy giving birth to live young see photo 1.



*Photo 1 - 3 August 2010, black ant attending large walnut aphids on a leaf: four winged females together with three new born nymphs and an older nymph with transverse stripes. The central female is giving birth, arrowed.
Inset: another female giving birth.*

This was fascinating to watch, but fiendish to capture on camera. The nymphs are born feet first, very pale yellow, about 1mm. As they grow they acquire transverse stripes, which gives them a rather striking appearance.

After the last moult, adult females eclose with pale yellow wings but soon they have beautiful veins; in photo 2 there is one female with the wings still unfurled with the exuvia (the old nymph skin) still attached.



Photo 2 - 16 September 2012, large nymphs feeding along the vein, towards the stem, attended by black ants, and five newly-moulted pale yellow winged females, one with the wings still unfurled and the exuvia attached, arrowed.

You can see why this aphid is also known as the dusky-veined walnut aphid. These females disperse to other leaves and carry on giving birth parthenogenetically. I got the impression that they sometimes fell on a leaf below and started all over again. But this aphid in our garden never reached a population explosion in the lower branches, just a sprinkling on the leaves here and there. This is probably because ladybirds ‘prowled’ the leaves very often; the commonest species were the seven-spot (*Coccinella septempunctata*) and the harlequin ladybird (*Harmonia axyridis*); once I even saw a sixteen-spot ladybird (*Tytthaspis sedecimpunctata*).

I never saw any adults or their larvae actually eating an aphid, but often there were quite a few leaves with the tell-tale dark scar along the central vein, sometimes less than 5mm long; no aphids left.

Occasionally, when the sun was shining on the leaves, the nymphs did headstands - an interesting posture, perhaps to keep cool, see photo 3.



Photo 3 - 30 June 2013, large walnut aphid nymphs with their 'bums up' on a leaf in sunshine.

This type of posture is sometimes adopted by a number of species most commonly as a defence reaction to predators or any other source of disturbance. It is thought to facilitate the dispersion of kairomones produced by the siphunculi (a pair of pointed structures in the rear of their abdomen), one function of which is to make other aphids aware of danger (Hartbauer, 2010; R. Dransfield, pers. comm.). In such cases they often waggle in a coordinated way, but these nymphs were very still.

During the season the common garden ant (*Lasius nigra*) tended them, see Photos 1, 3 and 4. Ants stroke aphids gently in order to 'milk' them.



Photo 4 - 9 November 2012, black ants attending late season nymphs with darker stripes and swollen legs, scale 1mm.

Inset: 20 September 2012, wingless oviparous female on 2mm paper.

Aphids drink an enormous amount of sap which, being low in nitrogen and amino acids, is quickly excreted with most of its sugary nutrients. To compensate for the lack of protein in their diet aphids have formed an endosymbiotic association with bacteria that provides them with essential amino acids. This has been going on for the last 160 million years (Douglas, 1998).

Back to the ants, it is interesting to note that I never saw any red garden ants (*Lasius flavus*) tending them. Both species nest in our garden, but red ants were never seen tending any aphids species feeding above the ground.

Photos taken from mid-September onwards show that by then the fourth instar nymphs were getting somewhat darker stripes and in particular some had swollen legs (S. Albert, pers. comm.), see Photos 4-5.



*Photo 5 - 12 November 2012, late season nymphs feeding on a yellow leaf.
Note the black nymph, probably dead.*

They were already responding to the cool, shorter days and had started producing the sexual generation: wingless females (with swollen legs) and winged males. The females have pheromone glands in their legs to attract the males, another of their tricks (Dawson, 1990).

At that stage, I placed a leaf in a box in order to be able to take better observations, but the aphids soon abandoned it. No sap flowing, perhaps. Even so, I managed to take a picture of a newly-moulted wingless female, inset in Photo 4. She looks remarkably different from the dainty dusky-veined females.

In 2012, the aphids lasted well into November, by then the leaves were getting yellow and falling, but they were still reproducing. At this stage, I spotted some black nymphs, which were probably attacked by a fungus (R. Dransfield, pers. comm.). Aphids are often attacked by tiny parasitoid wasps; they swell up and often become dark. These aphid 'mummies' are very easy to spot, but I never saw any of those.

Conclusion

My observations fitted well with the expected life cycle. It was rather frustrating that I never saw the eggs. With hindsight I should have checked carefully the leaf buds of the branches that had been colonised till the end. Also, I didn't see the rather elusive stem mothers or the winged males. Perhaps one day I will find an aphid colony in another easily accessible walnut tree; or someone else will take an interest, there are quite a few gaps in our knowledge to be filled. The problem is that these aphids are rather rare locally and in the UK they seem to be under-recorded.

Acknowledgments

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Erratum:

Page 72, Photo 4 has been cropped, accidentally. Its original version is shown next page.



Photo 4 - 9 November 2012, black ants attending late season nymphs with darker stripes and swollen legs, scale 1mm.

Inset: 20 September 2012, wingless oviparous female on 2 mm paper.

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