Tuberolachnus salignus the giant willow aphid

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Photo CM Collins

Tuberolachnus salignus has recently become noteworthy because it is increasingly found on commercially grown willows used in bioenergy production. Most information in the scientific literature is relatively recent (less than 20 years with several papers since 2012) and from Europe. Earliest reports from Australasia were in December, 2013 from Auckland, New Zealand. As of March 2014 this aphid can be found throughout the North Island and as far as Clyde in the South Island.

Identifying features

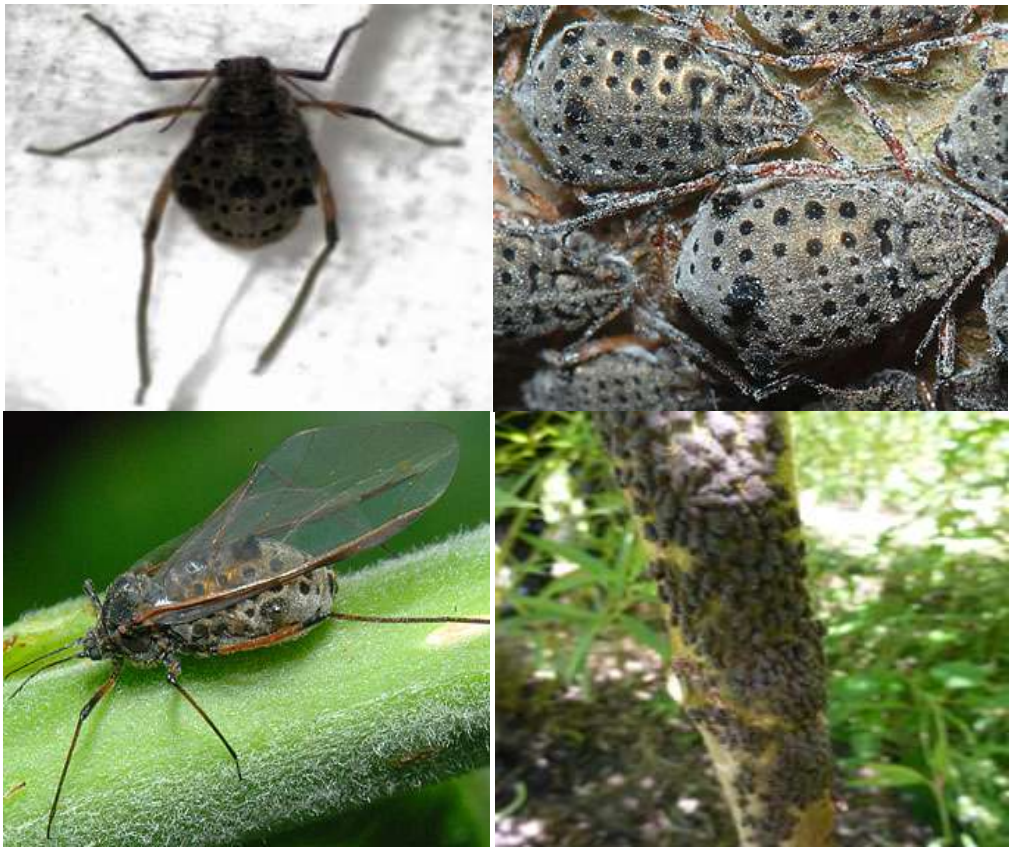
Tuberolachnus salignus is a very large aphid with a body length of 5.0-5.8 mm. Wingless individuals (Apterae) are mid-brown to dark brown with several rows of black sclerotic patches. The body is covered with numerous fine hairs, which give a greyish-golden sheen to the abdomen. There is a large dark brown tubercle in the centre of the back, just in front of the siphunculi which are on large dark cones. The antennae are less than half the body length. Winged individuals (Alates) have the forewing membrane unpigmented but the pterostigma (wing markings) and costal margin are dark brown. Rubbing against an aphid colony releases a red stain.

Life Cycle

Adults give birth to miniature adults called nymphs. Each adult alate (winged adult) weighs over 5 mg, and is reported to produce 34.3 nymphs on average, each surviving nymph capable of doing the same at maturity (see below for maturation times). Both adult forms continue to survive post-breeding.

The early season colonies appear in summer and are situated at the base of the willow trees, moving up the stems with increasing numbers. In summer, colonies formed by alatae dispersing from other

infestations start higher on the stem, some up to 3.5 m from the ground. By late summer colonies can contain tens of thousands of individuals.
Colonies persist through the autumn and, although they decline in late autumn, continue to feed on the stems after leaf fall and into late winter. Continuing growth and reproduction on leafless and dormant trees is unusual for aphids. Where they go from winter to early summer is not yet known.



photos Stephen Thorpe, Kevin Cash ,Wayne Teal

Development times

The development time, survivorship and reproduction of *T. salignus* were studied on *S. babylonica, S. matsudana* and *S. alba* at constant temperatures (17.5, 20, 22.5, 25 and 27.5°C). Development time of immature stages ranged from 14.6 days at 17.5°C to 12.5 days at 25°C on *S. babylonica*, 16.5 days at 20°C and 12.3 days at 25°C on *S. matsudana,* and from 17.00 days at 17.5°C to 12.21 days at 25°C on *S. alba*.. Total survivorship of immature stages of *T. salignus* varied from 28% to 85% at 22.5 °C and 17.5 °C, respectively, on *S. babylonica*, and from 13% to 63%, respectively, at 17.5°C and 25°C on *S. matsudana* and varied from 50 to 70% at 17.5 to 20°C on *S. alba*.

The optimal temperature for *S. babylonica* growth, development time, reproduction and percent survival was 25°C, and on S. alba was 20°C. The mean generation time of the aphid population ranged from 14.2 days at 25°C to 16.2 days at 17.5°C on *S. babylonica*, from 14.3 days at 25°C to 19.9 days at 20°C on *S. matsudana* and from 13.6 days at 22.5°C to 19.6 days at 17.5°C on *S. alba*.

At lower temperatures such as experienced in early winter generation times will be much longer.

It was estimated that 196 +/- 4 degree-days above a threshold temperature of 5.5 +/- 0.3 °C were required for apterae to complete development from birth to final ecdysis. The alate morph was significantly less fecund than the apterous morph and its fecundity did not vary with temperature.

Effects on the host willows

Tuberolachnus salignus has an adverse impact on the growth of the host trees and should be considered as a potential pest species in the context of willow as a production crop. Responses measured in the host plant are both quantitative and qualitative; 1 increase in photosynthetic rate, 2 increase in leaf N, 3 increase in tree water use, 4 reduction in shoot and root biomass, 5 reduction in growth in the following year.

Tree death has not been observed in Short Rotation Coppice (SRC) willows, but the implications for production willows are clear. Large scale tree willow mortality in Himachal Pradesh State, North India in 2001-2002 was attributed to high *T. salignus* populations, aphid infestation ranging from 40% to 100% of willow plantations. The age of the trees (150 years) was thought to have increased their vulnerability.

The increase in tree water use in response to aphid colonisation may exacerbate the effects of summer drought stress of the trees. The honeydew attracts wasps, though bees are reported to be infrequent feeders. Honeydew is sugar that is not reaching the roots which reduces the capacity of the tree to explore soil and absorb water and nutrients. Deposition of sugar on to the ground has been shown to induce tree branching in SRC willow. Wasps are likely indicators of aphid infestation.

Biological control agents

Colony reduction from predation is low, possibly because they taste strongly of salicin and tannins. Some colonies overseas have been decimated by a pathogenic fungus that attacks the aphid internally, but the identity and ecology of the pathogen is not yet known. No parasitoid of the species has been recorded in Europe. In Japan, *Tuberolachnus salignus* is parasitized by the braconid wasp *Aphidius salignae* and by a specific hyperparasitoid *Pauesia salignae*, which might indicate that this is where it is endemic.

Photo Wayne Teal

Chemical control

Systemic insecticides that are friendly to bees provide the best chemical control approach. It may be difficult to effectively use contact insecticides from a boom.

Population Genetics

Tuberolachnus salignus shows very low clonal diversity; only 16 genotypes were found in 660 specimens from 27 populations in five countries. There was limited geographical structuring in the samples, although the two most common genotypes, which comprised more than half of the specimens collected, had a very wide distribution. Furthermore, recent studies (published 2012) showed colonies of these aphids can consist of more than one genotype, suggesting aggregation of colonizing *T. salignus*.

This aphid reproduces parthenogenically all year round. No males are known. Though colonies of *T. salignus* can contain different genotypes, it is highly likely that a single genotype colonised New Zealand.

It colonises most willow species but colonies grow faster on some willows than on others. It has been reported overseas and in New Zealand on *Salix alba, S. fragilis, S. viminalis, S. schwerinii, S. miyabeana, S. matsudana* and their hybrids amongst others. It colonises both tree willows and non-tree willows (shrub and osier).

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