In the summer of this year, I met up with two guys from West Yorkshire at the north end of Hyde Park close to Kensington Palace. They were about to treat some white-flowering horse chestnut trees with allicin, a powerful but natural chemical extracted from garlic bulbs, and possessing a well-established anti-microbial profile. The aim on this occasion was to ‘see off’ Pseudomonas syringae pv. aesculi, a plant pathogenic bacterium and the cause of bacterial bleeding canker which has been killing both red- and white-flowering horse chestnut trees for the last ten years at least.

These were no ordinary white-flowering horse chestnuts, not just because of a royal location connection. They were big ‘Baumannii’ horse chestnuts (Aesculus hippocastanum ‘Baumannii’), a fruitless variety of white-flowering horse chestnut favoured for landscape, amenity and urban plantings for its lack of autumn fruit and seed debris and the collateral damage inflicted to parked vehicles by conkers falling from a considerable height.

The trees still bear the beautiful candelabra-like blossoms but that’s as far as the reproductive process goes for the season.

Baumann’s horse chestnut was discovered in Switzerland in the early 19th century and propagated from a ‘sport’ (natural mutation) of the common white-flowering horse chestnut. It grows into a large tree with a broad crown but, whereas common white-flowering horse chestnut is a prolific seed producer, this variant is sterile.

The trees in Hyde Park had recently finished flowering and the inflorescences were still attached, but instead of being loaded with tiny, spiky horse chestnut fruits these were appropriately bare.

So much for Baumann’s horse chestnut trees but what about bacterial bleeding canker, and what were these two Yorkshiremen doing in a Royal Park in Central London armed with a water-soluble concentrate of ‘garlic juice’ for injection into these trees?

Andrew Bussey and Simeon Haigh are employees of a company called JCA Ltd, based at Halifax in West Yorkshire and owned by Jonathan Cocking. JCA Ltd has an experimental licence from CRD (Chemicals Regulation Directorate) to treat horse chestnut trees by trunk injection with allicin to control bacterial bleeding canker disease.

The biggest of the five ‘Baumannii’ horse chestnuts trees forming a grove in Hyde Park weighed in at 150 cm DBH (diameter at breast height), with a corresponding circumference of 470+ cm at breast height. Three of the five were clearly suffering (two with bleeding bark symptoms and one with a distinctly thinning canopy but no bark symptoms). These three were earmarked for treatment with allicin and the other two left as untreated controls.

The kit used is based on a Gloria 505T high performance pneumatic (pump up) sprayer, custom-modified to inject and introduce a diluted solution of allicin into the tree trunk. The Gloria 505T is fitted with a valve-controlled, pressure-regulated reservoir and dispenser from which issue 8 hoses with a nozzle attachment at the end of each.

The nozzles are inserted into the trunk, ideally as low as possible but in practice at various heights up the trunk. Compromise is required because invasive entry into the tree must avoid any diseased and damaged areas of bark as well as other weak areas and points. Otherwise the allicin solution injected into the tree under pressure may leak out thus aggravating any bark damage as well as losing expensive product. Furthermore bark on the ‘buttresses’ around the collar region of the tree is exceptionally hard and very difficult to penetrate.

Holes 9 mm in diameter and about 2.5 cm deep are drilled into the bark...
and the nozzles, equipped with a thread, are screwed into these holes to secure a tight and leak-proof fit. Nozzles are also equipped with side holes and it is through these lateral exits that the allicin solution is introduced under controlled pressure into the living vascular tissues (xylem and phloem) of the tree.

Andrew Bussey told essentialARB how they would expect to inject 750 ml of solution into large mature trees of this size although they can comfortably go down in size to trees with a trunk diameter at breast height of just 25 cm. “The concentrated product contains 5000 ppm (parts per million) allicin and we dilute this at 1:1 with water for injection into the tree,” said Andrew.

Simeon Haigh explained how for the size of tree being treated that day they would initially pump up the freestanding sprayer to 2 bar pressure and then to 3 bar, but thereafter maintain the pressure at 2.5 bar while monitoring the trees closely for any evidence of solution leaking from the bark at any point. “Under these pressure conditions we would expect a 2-hour time period for introducing the required 750 ml into the tree,” said Simeon.

Andrew Bussey added that for much smaller, and correspondingly much younger, trees, covered with thinner, softer and suppler bark, the pressure used would be proportionately less, although the time required would still be much shorter because of the much reduced bulk of the tree. This whole business of bark strength and weakness is a particularly important consideration when treating horse chestnut trees.

By the standards of most other British native trees the bark on horse chestnut trees is inherently thin and relatively weak. Indeed, this is almost certainly one of the key reasons, together with a moist maritime climate, why this bacterium (Pseudomonas syringae pv. aesculi) has evolved so quickly and successfully as a pathogen of Aesculus in the UK. And probably why the red-flowering horse chestnut (Aesculus x carnea), with its extremely thin and weak bark even by Aesculus standards, is proving to be much more susceptible to infection and terminal disease than the white-flowering horse chestnut.

Andrew and Simeon both emphasised how the prevailing weather and atmospheric conditions on the day of treatment have a very significant effect on the nature and efficiency of the process.

“Ideal conditions are sunny with a light breeze,” said Andrew, adding how this maximises transpiration (evaporation) of water from the leaves, thereby sustaining a strong ‘transpiration pull’ which is transmitted from the leaves and through the xylem vessels and into the roots which absorb water from the soil.

“We with these conditions fulfilled, the allicin will get pulled right up into the tops of the trees,” said Simeon, while adding how extreme weather and atmospheric conditions, whether hot sun, low temperature or high humidity, will slow the process right down because the stomata (leaf pores) are shut off by the guard cells which surround them. June 2nd 2015 in Central London was bright and sunny with a steady breeze and therefore ideal.

With the trio of trees still being ‘fed’ with allicin, I made for the park exit and an Italian bistro next door to Queensway Station. I pondered about what I had just seen over a cappuccino and, feeling peckish, ordered a spaghetti
bolognese although I gave the garlic bread a miss having had enough of the odour all morning.

The best time to see whether this allicin treatment has worked will be in late October after an autumn’s worth of rain has got the bacterial bleeding canker going again after the usual summer lull. I had planned my return for October 31st but decided that was perhaps not a sensible choice lest any beneficial effects of the garlic against bacterial bleeding canker are down to spiritual rather than chemical mechanisms!

At the core of garlic’s anti-microbial activity are a variety of natural sulphur-containing compounds and elemental sulphur which has been long regarded to possess magical properties (both black and white). Sulphur (brimstone) is closely associated with witchcraft. I was going to order another cappuccino but decided to have a stiff drink instead.

Dr Terry Mabbett

The allicin profile

Allicin is an organo-sulphur compound sourced from garlic (Allium sativum), a well-known and widely grown horticultural crop belonging to the Alliaceae (onion) family. Allicin was first isolated and studied in the laboratory by two American scientists, Chester J. Cavallito and John Hays Bailey, who published their work in Journal of the American Chemical Society in 1944. Intact garlic cells and tissue contain a compound called alliin. When the cells of fresh garlic are ruptured, by chopping or crushing the bulb, they release an enzyme called alliinase which converts alliin (the precursor) into allicin. The allicin thus generated is very unstable and changes rapidly into a series of other sulphur-containing chemicals such as diallyl disulphide. Allicin exhibits antibacterial, antifungal, antiviral and antiprotozoal activities as well as possessing nematicidal properties. Allicin, which is not present in garlic unless tissue damage occurs, is the garlic plant’s defence mechanism against pest attack. Allicin is the chemical which gives crushed garlic its characteristically pungent smell.

Simeon Haigh (left) and Andrew Bussey (right) of JCA Ltd, alongside a tree undergoing injection with allicin in Hyde Park.