

Biological Control of Dutch Elm Disease

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Introduction

Elms are important trees in urban environments and coastal areas due to their resistance to harsh conditions such as wind, salt, flood, and narrow root space, as well as to their attractive architecture. However, a devastating disease, the so-called Dutch elm disease (DED), appeared in Europe during the 1920s and in North America by 1930. Sudden wilting and dying of the leaves and branches was caused by *Ophiostoma ulmi* during the first pandemic from 1920s to 1940s, while an even more aggressive strain *O. novo-ulmi* is responsible for the current pandemic. Elm bark beetles, mainly *Scolytus scolytus* and *S. multistriatus*, transmit the disease by breeding in weakened and dead elms (Scheffer et al, 2008).

Approximately 100 years after its first introduction into Europe, biological control of Dutch elm disease is an effective component of an integrated control strategy for this disease. Conidiospores of *Verticillium albo-atrum* isolate WCS850 (active ingredient of Dutch Trig®) enhance the natural defence mechanism of elms after being injected in the xylem tissue of tree, where they germinate and induces resistance (Scheffer, 1990). The isolate was proven to be non-pathogenic for all the 19 tree species that had been tested (<http://www.dutchtrig.com/home>).

The biocontrol agent and its production

The isolate WCS850 (previously identified as *Verticillium dahlia*) is a natural hyaline form of *V. albo-atrum* which is not producing resting spores. The inoculum is produced under sterile conditions on solid media. The conidiospores are harvested in distilled water, obtaining a suspension with 10⁷ spores per ml. No impurities, additives, or contaminating organisms are allowed in the product.

Method and time of application

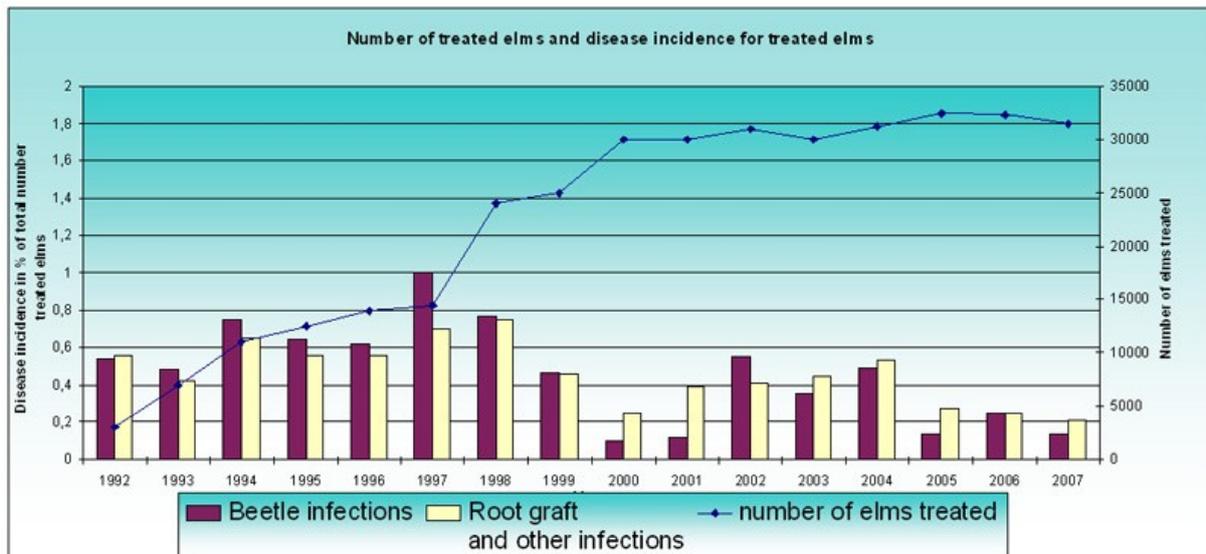
Trees are injected (vaccinated) with Dutch Trig® every year, once in early spring, as soon as the leaves have started to sprout after flowering of the elm, preferably before any beetle infection of Dutch elm disease occurs. The vaccine is injected into the tree trunk at breast height, every 10 cm of tree circumference, by pushing the chisel through the bark and releasing one drop with one pull of the trigger. The closed injection system prevents spills and any impact on plants, trees or animals in the environment. The method is fast, on average 2-3 minutes per treated tree, which enables treatment of large numbers of trees in the time frame available for Dutch Trig® injections.

Efficacy

The product is effective as a preventative treatment on healthy trees: 99% of the injected elms are successfully protected from Dutch elm disease. Dutch Trig®, however, does not protect already infected trees or trees connected with diseased trees via root grafts. In the Figure below the results of all 359.380 elms treated in the period 1992-2007 in the Netherlands are summarized. These figures concern commercial treatments, and show the same success rate of the treatment as was found in experiments in the USA. On average, approximately 1% of all treated trees dies of DED; half of them (0,5%) because of root graft or old infections, for which the preventative vaccination with Dutch Trig offers no protection.

Even though the disease rate amongst Dutch Trig treated trees has been fairly constant around the 1% average (which is low compared to the natural losses of Dutch elm disease ranging from 5-15% per

year), a significant decline in average disease incidence is shown during the last years. This improvement of treatment performance is not caused by a low natural disease pressure, because elm bark beetle-trap counts indicate a never subsiding high disease pressure over the entire country. The last years a lot of extra effort has been put into optimization of Dutch Trig cooled transport, production and better practices concerning hygiene and accurateness for the arborists doing the injections, which could very well be part of the cause of the decline in disease incidence in the Dutch Trig treated trees in the Netherlands.



Source: <http://www.dutchtrig.com/home>

Cost efficacy

The cost of the treatment with Dutch Trig® is depending on the size and number of trees to be treated. In the Netherlands, where approximately 32.000 trees are treated annually, the price per tree varies between 16 and 25 €. This is a relatively low price compared to the costs of removing and replanting a tree.

Registration and usage

The product is registered in the Netherlands since 1992. After extensive testing in the USA since 1995, full registration is achieved in 2005. Germany, Sweden, and Canada were the next countries where Dutch Trig was registered (in 2007, 2010, and 2010, respectively). A registration in the UK is currently in process. Since 2008, the active ingredient is approved on the Annex I list of the EU Directive 91/414/EEC (http://ec.europa.eu/sanco_pesticides/public/?event=homepage).

References

- Scheffer RJ, 1990. Mechanisms involved in biological control of Dutch elm disease. *Journal of Phytopathology* 130:265–76.
- Scheffer RJ, Voeten J, Guries RP, 2008. Biological control of Dutch elm disease. *Plant disease* 92:192-200.