A NEW WAY OF TREATING CREOSOTED WOODEN POLES AGAINST DECAY USING BIOLOGICAL CONTROL AGENTS

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Introduction

Creosoted poles in service last until internal decay in the groundline zone, where both moisture and air are present in suitable concentrations for fungal growth, destroys much of their mechanical strength. They break down typically on a stormy day or under some other exceptional stress. The problem arises where poles (for various reasons such as insufficient seasoning, lack of a sufficient thickness of sapwood or poor treatment pressure) do not receive complete pentration of the creosote preservative in the susceptible sapwood region.

Properly treated creosoted wooden poles last from 30 to 50 years in service depending on climate, location size of pole, timber species etc. Poorly treated poles have failed in some cases within five years of installation. Since it is rather expensive to be certain that a pole has been thoroughly treated it is a common practise to replace, or re-treat, poles after a fixed period of from 15 to 25 years depending on previous site experience.

Re-treatments

All existing methods rely on more or less toxic substances including such ill famed compounds as pentachlorophenol, arsenic and more recently boron.

In Britain the only method currently in use is the "Cobra" treatment, involving the injection of a paste containing active ingredients 50% sodium fluoride, 20% dinitrophenol and 20% arsenic pentoxide into more than forty holes drilled into a region of the pole extending to 300mm below and 1m above the groundline. Not surprisingly the poles have to be subsequently sheathed with metal to prevent the poisoning of mammals that might lick the salts.

Although the salts diffuse throughout the pole, studies have shown (Henningson Nilsson, 1975) that as little as nine years after the treatment there is virtually no difference in the microbial population of treated and untreated poles.

Responsible organisms

The internal decay of creosoted wood poles is initiated by relatively few kinds of fungi belonging to the Basidiomycetes. In Britain the organism responsible for most of the damage is <u>Lentinus lepideus</u>. This has a high tolerance of creosote and, if able to gain entry to the pole via a crack, will spread into those untreated areas of the sapwood, in the North Pacific region of America, <u>Poria carbonica</u> (<u>P. monticola</u>) is the main decay agent.

Few kinds of fungi are involved because wood is relatively low in nitrogen and readily available energy. Cellulose and lignin are both energy rich but difficult, if not impossible to utilise for most micro organisms.

Biological control

Faced with the uncertainties attached to the existing chemical treatments and concern over the environmental consequences research has turned towards a biological solution. In particular the quest for a fungus, antagonistic to basidiomycetes, which is capable of growing throughout the untreated regions of creosoted poles.
To date the interest has focussed primarily on species of the group of soil fungi in the genus <u>Trichoderma</u>. Their effectiveness in the control of silver leaf disease (<u>Chondrostereum</u>) of fruit trees has been demonstrated by A.T. Corke (1974) and a product, BINAB T, was granted commercial clearance in the U.K. under the Pesticides Safety Precautions Scheme in 1982. Subsequently the same product has been used to good effect (Gear, 1984), in the prevention and treatment of Dutch Elm Disease (<u>Ceratocystis ulmi</u>).
In the U.K. practical laboratory and field studies on the antagonistic effect of <u>Trichoderma</u> against <u>Lentinus lepideus</u> have been performed by Oxley (1976), Bruce (1983), and Bruce and King (1983). Ricard and other workers in the U.S. have done work on the control of <u>Poria carbonica</u> in Douglas fir poles, using another biological control agent, <u>Scytalidium lignicola</u> FY strain.

Laboratory tests

All authors report that in standard agar plate tests both <u>Trichoderma</u> and <u>Scytalidium</u> FY strain overgrow and destroy a range of wood rotting fungi, including <u>L. lepideus</u>, <u>Heterobasidium annosum</u>, <u>Serpula lacrimans</u> and <u>Coniophora puteana</u>.

Extending the research to wood blocks showed that L. lepideus could be controlled by both organisms. In the case of Bruce and King (ibid) using lime and pine blocks pre-treated with <u>Trichoderma</u> and /or <u>Scytalidium</u> FY strain the results ...."show for the first time that control by residues of both organisms persists even when the control agents had been killed and the wood blocks thoroughly leached". This finding is of particular importance, indicating as it does that adverse environmental and nutritional factors should not affect the performance of <u>Trichoderma</u> introduced into creosoted poles.

It is not especially surprising, however, for it occurs in the case of wooden logs in Japan on which the edible Shiitake fungus, Lentinus edodes, is grown, and which is periodically ravaged by natural Trichoderma attacks.

Field Trials

The most extensive field trials to date have been carried out under the harsh conditions prevailing in the Scottish Highlands under the auspices of the Scottish Hydro Electric Board and under less extreme conditions in the area of the Midlands Electricity Board.This three year study is reported by Bruce (ibid). Two hundred poles were treated with BINAB FYT pellets (a formulation of Trichoderma and Scytalidium species). In each case, a single downward slanting hole was drilled to the centre of each pole at a point 100mm above the groundline. Two 5mm diameter pellets were placed in the hole which was then closed with a vented plastic plug.

The poles were subsequently sampled for the presence of Trichoderma. This was re-isolated from 90%-94% of the poles with the percentage actually increasing with time.. Quoting from Bruce (ibid), ..."No difference existed between the sites with regard to the frequency of Trichoderma establishment even though the sites differed with respect to mean average rainfall levels, temperatures, soil conditions and years in which the poles were installed. Pole age and presence of decay had no deleterious effect on the frequency of Trichoderma establishment from FYT inoculation." Even "Cobra" treated poles were thoroughly colonised by Trichoderma, though at a slower rate than untreated poles. The author goes on to conclude:
"Inoculation of poles with BINAB FYT pellets reduces the incidence of decay produced by either prior or subsequent inoculation with L. lepideus. The success of the treatment, however, appeared again to be linked to the levels of pole resident fungi.

The studies were biased in favour of the decay fungus as the inoculum of L. lepideus used to inoculate the poles was far greater than that of the control organisms present in the BINAB FYT pellets.

It was found that the pellets were easy to apply, the inoculation process was quick (approximately 5 minutes per pole) and required only one person; pellet viability remained high provided that the pellets were stored at 5 degrees C.; the cost of treatment was low compared with currently used remedial treatments, which cost is closely related to the ease of application and the small amount of manpower required..."

The proviso mentioned in the first quoted paragraph of Bruce's conclusion refers to the ability of non-decay fungi in the pole, such as Cladosporium resinae, to prevent the thorough spread of Trichoderma throughout the pole. This could be overcome if the pellets were inserted at more than one position around the circumference of the pole. One suggestion has been to use three BINAB T pellets inserted into each of four equi-spaced holes drilled into every pole.

The sucess of the Dundee experiment can be contrasted with that carried out at Imperial College and reported to the B.W.P.A. Convention in 1984 by Morris et al. A small number of poles were inoculated with pellets containing either Scytalidium species or T. harzianum. The results were disappointing with the former while in the case of the latter protection was only conferred for one year. The authors concluded that the balance should be tipped in favour of the control fungi by providing them with suitable nutrients. Work is now proceeding along these lines.

This explains the success of Bruce's work, for the BINAB pellet contains not only T. harzianum which is active at 15-25 degrees C. but more importantly, T. polysporum which grows below 10 degrees C., together with metabolites and nutriants.

The next phase of the experimental programme will be the treatment in the U.K. of at least 2000 poles a year, with 12 BINAB T pellets in each pole, in a much extended field trial.

Though more work is needed in order that all of the outstanding questions can be answered (whether or not poles are inoculated before being erected, for instance, as well as being treated in the field) there can be little doubt that in Trichoderma we have a cheap, effective and environmentally safe method of treating creosoted wooden poles against fungal decay.

Availability

BINAB T and BINAB FYT pellets have received experimental clearance for use on creosoted wooden poles from both the Pesticide Safety Precautions Scheme in the U.K. and the equivalent body in France. These products are covered by patents in Britain, France and Canada, though in the latter country, permission for experimental use and/or sale has yet to be applied for from Agriculture Canada. Further information, including quotations for BINAB T and FYT pellets, can be obtained from the author or through our Canadian agent Mr. Peter Taylor.

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