Original scientific article / Izvirni znanstveni članek

OPPORTUNITIES TO REUSE FENCE POSTS USING METAL FOOTINGS
MOŽNOSTI PONOVNE UPORABE OGRAJNIH KOLOV Z UPORABO KOVINSKIH TALNIH NOSILCEV

Daniel WONG[1], Rod STIRLING[2*]

(1) FPInnovations, Canada, daniel.wong@fpinnovations.ca
(2) FPInnovations, Canada, rod.stirling@fpinnovations.ca

ABSTRACT
Residential wood fence posts may be dug directly into the ground, secured to a metal spike that goes into the ground, or secured to a concrete footing with a metal boot. It was hypothesized that, by keeping wood posts out of the ground, both spikes and boot attachments would increase protection against decay and termites and extend the service life of the posts. After 9 years of exposure in Kincardine, Ontario, Canada, at a site with decay and subterranean termites, we found that elevated fence post footings were associated with less biodegradation than posts dug directly into the soil. The spike and boot installations were particularly effective in reducing the incidence of termite attack under the conditions of this study. Spike and boot footings may offer a way to remediate posts by reusing the top portion of posts that were initially dug into the ground following a groundline failure.

Keywords: decay, fence posts, MCA, red pine, reuse, termites

IZVLEČEK
Leseni ograjni koli so lahko vkopani neposredno v tla, pritrjeni na kovinski čevelj, ki se zabije v tla, ali nameščeni na betonsko podlago s kovinskim čevljem. Domnevamo, da bi lahko tako kovinski čevlji, zabiti v zemljo, kot kovinski čevlji na betonski podlagi, ki preprečujejo stik lesa s tlemi, izboljšali zaščito pred razkrojem in termiti ter s tem podaljšali življenjsko dobo kolov. Po devetih letih izpostavitve v Kincardinu (Ontario, Kanada) na lokaciji, kjer vladajo razkroj in podzemni termiti, smo ugotovili, da so dvignjene podlage ograjnih kolov povezane z manjšim obsegom biološke razgradnje v primerjavi s koli, vkopanimi neposredno v tla. Kovinski čevlji, zabiti v zemlji, in kovinski čevlji na betonski podlagi so posebej učinkovito prispevali k zmanjšanju pogostosti napadov termitov. Kovinski čevlji, zabiti v zemlji, in čevlji na betonski podlagi lahko tudi omogočajo sanacijo obstoječih ograjnih kolov za ponovno uporabo zgornjega dela kolov, ki so bili prvotno vkopani v tla in so propadli v območju tal.

Ključne besede: razkroj, ograjni koli, MCA, rdeči bor, ponovna uporaba, termiti

GDK 814(045)=111
DOI 10.20315/ASetL.138.3

Prispelo / Received: 13. 08. 2025
Sprejeto / Accepted: 20. 10. 2025

1 INTRODUCTION
1 UVOD

Wood posts are widely used to support fencing. There are several reports on the durability of wood posts used in such applications (Miller, 1986; Cookson et al., 2002; Brischke and Rolf-Kiel, 2010; Lebow et al., 2015). Most of these studies consider exposures where the fence posts are dug into the ground and are in direct contact with surrounding soil. Soil contact creates a favourable environment for biodegradation. It may be home to subterranean termites, and it provides nutrients, moisture, and actively growing cultures of wood decay fungi (Wakeling and Morris, 2014).

Erlandsson (2013) reported a life cycle assessment (LCA) that compared treated Scots pine (*Pinus sylvestris* L.), Siberian larch (*Larix sibirica* Ledeb.), black locust (*Robinia pseudoacacia* L.), and plastic fence posts. This assumed a functional service life of 20 years for the treated Scots pine, 8–12 years for the larch and Robinia, and 20–30 years for the plastic. This estimate is similar to the service life expectations reported by Page and Singh (2014) of a 15-year minimum and 25–30-year average for 75–100 mm thick heartwood posts in New Zealand. Based on their service life assumptions, Erlandsson (2013) reported that the treated pine had lower impacts for each assessment category than the naturally durable wood products. This is in part a function of the longer service life and in part due to the greater transportation distances required for the other materials. It highlights the importance of functional service life on environmental impacts.

Technologies to increase fence post service life include preservative treatments and barriers or footings that reduce contact with the ground. Preservative treatments for residential fence posts vary by jurisdiction. Commonly used preservative systems include water-based copper plus cobiocide systems, such as alkaline copper quaternary, copper azole, or micronized copper azole. Preservative treatments have been extensively studied and are commercialized and standardized throughout the world (Miller, 1986; Cookson et al., 2002; Papadopoulos and Goroyias, 2008). Barrier wraps have been explored for their ability to increase the functional service life of wood posts by wrapping the groundline in an impermeable barrier (Howgrave-Graham et al., 2009; Baecker, 2010). Barriers may be applied with inert materials, though some technologies use a bituminous material to stick to the post, which may provide additional protection (Freeman et al., 2006). Freeman et al. (2006) reviewed the performance of barrier wraps and concluded that they can lower moisture content near the groundline and slow degradation by decay and insects.

Another way of installing fence posts is to attach a metal spike to the bottom of the post that will secure it in the ground, or to apply a boot that fits around the bottom of the post and sits on a concrete pad. Because of the structural limitations of the fastener connection between the post and base, these products are generally intended for residential fencing less than 1.2 m tall and are marketed for their ease of installation, as deep holes are not required (Make fence ..., 2024). It was hypothesized that, by keeping the posts out of the ground, both spikes and boots would increase protection against decay and termites and extend the service life of the posts.

2 METHODS

2 METODE

2.1 Test Materials

2.1 Materiali, uporabljeni v raziskavi

Twenty untreated red pine (*Pinus resinosa* Sol. ex Aiton) posts, 89 mm square and 2.4 m long, were obtained from a retailer in Ontario, Canada. Forty-five unincised red pine posts of the same dimensions and commercially treated with micronized copper azole (MCA) were obtained from a retailer in Ontario, Canada. The posts contained both sapwood and heartwood. The material was intended for ground contact use. Preservative penetration was measured from offcuts from each post. Retention was not measured. Ten untreated western redcedar (WRC, *Thuja plicata* Donn) posts of the same dimensions were purchased from a retailer in Ontario, Canada.

2.2 Installation and Inspection

2.2 Namestitev in pregled

Posts were installed in one of three ways: dug into the ground in direct soil contact, on a metal spike inserted into the ground, or in a metal boot on a concrete footing. For direct soil contact installations, the hole depth was approximately 0.75 m. Holes were dug by hand to minimize soil compaction and disturbance that might have impacted termite activity (Tucker et al., 2004). The spike installations used the Simpson Strong-Tie E-Z Spike™ and the boot installation used the Simpson Strong-Tie E-Z Base™ (Make fence ..., 2024), which sat atop a concrete footing. The top edge of the spikes and boots was approximately 10 cm from the soil level. All treated posts were cut to fence height after installation, and the cut ends were coated by brush with a field-cut preservative (copper naphthenate, 2% Cu) and protected with a metal post cap. Treated posts were used to construct the perimeter fence around the test site. Untreated posts, which were anticipated to fail rapidly, were installed just inside the fence perimeter but not attached to the fence itself.

All materials were installed at FPInnovations' field test site in Kincardine, Ontario, Canada (Fig. 1). The site is a residential lot within the Lorne Beach termite management area north of the town of Kincardine. It has a humid continental climate (Köppen Dfb) and hosts a population of the subterranean termite *Reticulitermes flavipes* (Kollar). It has sandy, well-drained soil and is home to several species of decaying basidiomycetes. The area receives an average of 998 mm of precipitation annually. Average annual temperature is 6.2°C, with mean daily maximum and minimum temperatures of −2°C and −10°C in January, and 24°C and 13°C in July (Stirling and Mankowski, 2022).

Untreated posts were inspected annually (except for 2020) between June and September, according to AWPA standard E8 (AWPA, 2023). Independent evaluations were made for degradation due to decay and termite attack. Treated posts were inspected using the same methods annually after 3 years of exposure (except for 2020). AWPA evaluations for decay and termite attack provide data on a scale from 10 to 0 based on the estimated percentage of cross-sectional area attacked, where 10 is sound and 0 is failure of the post. Average minimum ratings, indicative of the maximum extent of biodegradation, were calculated using the lowest rating (termite or decay) for each post.

3 RESULTS

3 REZULTATI

The rate of biodegradation of the untreated materials is shown in Fig. 2. Red pine posts in direct soil contact failed most rapidly, with all posts failing by 6 years. Red pine posts installed on spikes or boots failed at a slightly slower rate, but all failed by 7 years. The

Fig. 1: Test fence installation in Kincardine, Ontario, Canada

Slika 1: Namestitev preizkusne ograje v Kincardinu, Ontario, Kanada

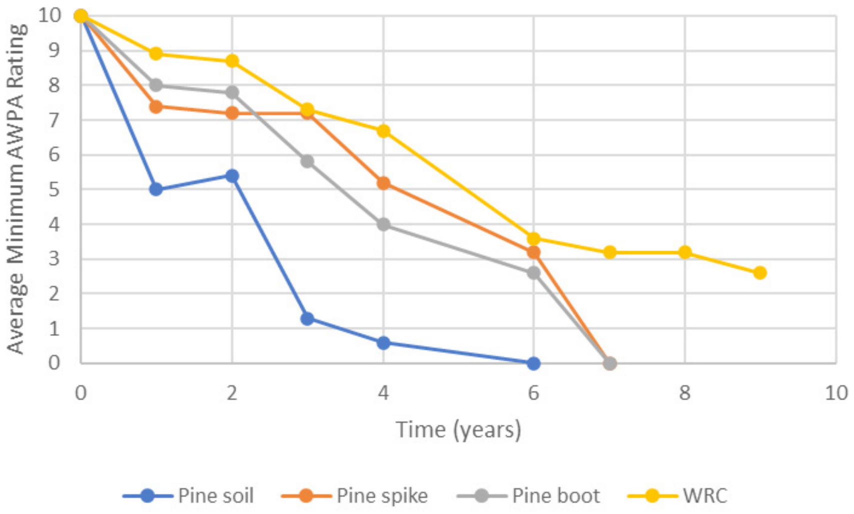

Fig. 2: Biodegradation of untreated fence posts exposed in Kincardine, Ontario, Canada for 9 years

Slika 2: Biološki razkroj neobdelanih ograjnih kolov po 9-letni izpostavitvi v Kincardinu, Ontario, Kanada

WRC reference was more durable, with some posts still in service after 9 years. This was expected as the WRC posts were entirely heartwood, which is known for its natural durability (Scheffer, 1957; Freitag and Morrell, 2001). Previous WRC post tests have shown service lives greater than 9 years (Morris et al., 2015).

The rate of biodegradation of the MCA-treated materials is shown in Fig. 3. MCA-treated posts in direct soil contact were most degraded after 9 years, with an average rating of 5.6. The boot and spike footings were less degraded after 9 years, with average ratings of 8.0 and 8.5, respectively. The rate of biodegradation in this study was greater than in a previous study where MCA-treated red pine posts were largely sound after 11 years of exposure at a test site in Petawawa, Ontario (Wilson et al., 2023). The test material had an average preservative penetration of 2.4 mm. This is substantially below standard requirements (CSA, 2021) and may explain the more rapid degradation of this material.

In this study, the greatest resistance to biodegradation was associated with the use of durable materials (MCA treatment or WRC) and with footings that reduce

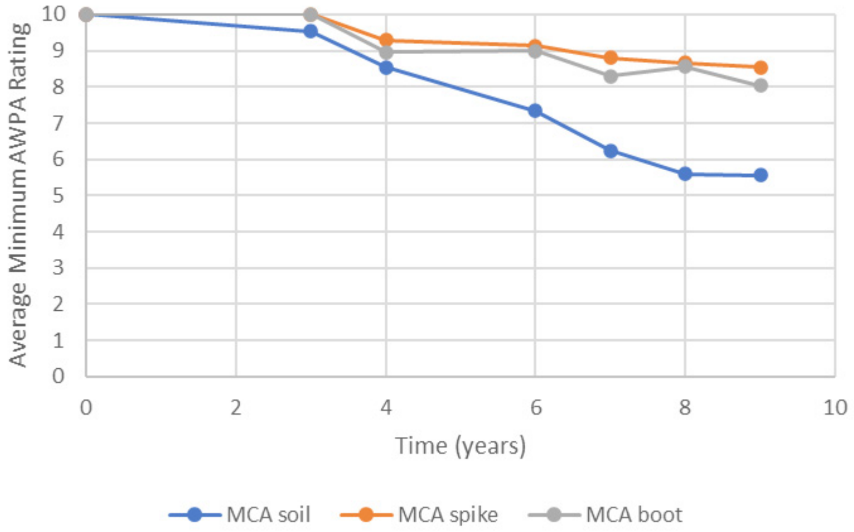

Fig. 3: Biodegradation of micronized copper azole (MCA)-treated fence posts exposed in Kincardine, Ontario, Canada for 9 years

Slika 3: Biološka razgradnja ograjnih kolov, zaščitenih z mikroniziranim baker-azolnim (MCA) zaščitnim pripravkom po 9-letni izpostavitvi v Kincardinu, Ontario, Kanada

contact between the soil and the post. Termite attack and post failure are visible in the images shown in Fig. 4.

Independent ratings for degradation due to decay and termites were made to evaluate the association between footing type and each form of biodegradation. However, failed posts were removed from the test. This means that the other measure could no longer be made on that specimen in subsequent years. To minimize the effect of shrinking sample sizes, ratings associated with post footing type and termite attack in untreated controls were compared at selected times when there were few failures. For untreated posts, this was year 1,

Fig. 4: Termite attack on an untreated red pine post installed in a boot (left) and failure of an untreated red pine post exposed in direct soil contact after 6 years (right)

Slika 4: Poškodbe termitov na neobdelanem kolu iz rdečega bora, nameščenim v kovinski čevelj (levo), in poškodba kontrolnega neimpregniranega kola bora v neposrednem stiku s tlemi po šestih letih izpostavitve (desno)

Table 1: Independent decay and termite ratings in untreated posts after 1 year of exposure

Preglednica 1: Neodvisne ocene glivnega razkroja in poškodb zaradi termitov pri neobdelanih kolih po enem letu izpostavitve

Post type	n	Average decay rating (SD)	Average termite rating (SD)	Decay rating range	Termite rating range
Red pine, soil	10	7.8 (0.4)	5.2 (3.2)	7–8	0–10
Red pine, spike	5	8.8 (0.8)	8.0 (1.9)	8–10	6–10
Red pine, boot	5	8.0 (0.7)	9.8 (0.4)	7–9	9–10
WRC, soil	10	9.3 (0.8)	9.0 (0.8)	8–10	8–10

Table 2: Independent decay and termite ratings in MCA-treated posts after 6 years of exposure

Preglednica 2: Neodvisne ocene glivnega razkroja in poškodb zaradi termitov pri kolih, zaščitenih z MCA, po šestih letih izpostavitve

Post type	n	Average decay rating (SD)	Average termite rating (SD)	Decay rating range	Termite rating range
MCA-treated red pine, soil	15	7.4 (3.3)	8.3 (2.6)	0–10	0–10
MCA-treated red pine, spike	15	9.2 (1.1)	10.0 (0.1)	6–10	9.5–10
MCA-treated red pine, boot	15	9.0 (0.7)	10.0 (0.1)	7–10	9.5–10

and for treated posts, this was year 6.

Direct soil contact exposure was associated with the lowest decay and termite ratings in untreated material (Table 1). The spike and boot were associated with less decay and termite activity. The boot with the concrete pad had much lower termite attack. Distance from soil was associated with less termite damage. The WRC reference had much less decay and termite attack than the red pine posts, indicating the impact of material durability. Failure of posts in ground contact was attributed to termites, though significant decay was also often present. Both decay and termite attack were responsible for failure of untreated posts in spike and boot configurations.

Direct soil contact exposure was associated with the lowest decay and termite ratings in treated material (Table 2). The spike and boot were associated with less decay and almost no termite attack.

The spike and boot footings used in this study are limited to residential applications with minimal strength requirements. While the primary intent is ease of installation, there are also potential durability benefits that could lead to longer service lives.

4 DISCUSSION AND CONCLUSIONS
4 RAZPRAVA IN ZAKLJUČKI

Elevated fence post footings were associated with less biodegradation than posts dug directly into the soil. The spike and boot installations were particularly effective in reducing the incidence of termite attack under the conditions of this study.

In this study, biodegradation of preservative-treated fence posts dug into the ground was limited to the groundline and below. Observed decay was primarily brown rot. *Coniophora olivacea* has been identified as an active soil-inhabiting, strand-forming brown-rot fungus at a nearby site (Morris et al., 2014). Both decay and termites resulted in post failures, though early failures were predominantly from termite attack. Technologies that protect against termites are important to prevent the earliest failures, while technologies that protect against both decay and termites are needed for longer-term protection. The moisture and oxygen conditions to support decay are often optimal at, or just below, the groundline, though optimal conditions at 30 cm below the groundline have been reported (Brischke and Rolf-Kiel, 2010). The top 1.6 m of the post remained sound. Failed, or severely biodegraded, posts could be reused by cutting off the bottom 0.8 m and installing the top portion on metal spikes or boots. Since only the belowground portion is removed, the height of the fence post would remain approximately the same. This approach could potentially double the functional service life of a fence post. However, this approach comes with some additional risks and uncertainties. Since the post is not through-treated, the freshly cut end would require protection with a field-cut preservative. Field-cut preservatives, including copper naphthenate, have been shown to protect exposed untreated wood from decay (Stirling and Wong, 2019). While the aboveground portion of the post would be visibly sound, it would still have been exposed for several years. This would likely have led to some leaching and depletion of the primary preservative, which could impact service life. Further study is needed to evaluate the performance of posts reused in this manner.

Data from this study show that the use of spike or boot installations may lead to incremental improvements in service life. With an initial installation in-ground and a secondary installation of the top portions of the in-ground posts in a spike or boot footing, a second service cycle may be obtained.

5 SUMMARY

5 POVZETEK

V raziskavi smo preučili vpliv različnih tipov talnih nosilcev na razkroj lesenih ograjnih kolov ter ocenili možnosti ponovne uporabe delov kolov, ki so propadli v območju tal. Leseni ograjni koli so v praksi običajno vkopani neposredno v zemljo, kar jih izpostavlja ugodnim razmeram za razkroj in napad termitov. Alternativni načini namestitve, kot sta kovinski čevelj, zabit v tla, in kovinski čevelj (boot) na betonski podlagi, zmanjšujejo stik lesa s tlemi, kar bi lahko vplivalo na življenjsko dobo konstrukcij. Namen raziskave je bil preveriti, v kolikšni meri dvignjene podlage znižajo stopnjo razkroja in ali omogočajo podaljšanje ali celo ponovno pridobitev funkcionalne življenjske dobe ograjnih kolov.

V Kincardinu (Ontario, Kanada), znanem po pojavljanju podzemnih termitov (*Reticulitermes flavipes*) in aktivnih gliv razkrojevalk, smo postavili poligon z neobdelanimi in mikroniziranim bakrovim azolom (MCA) zaščitenimi koli iz rdečega bora ter referenčnimi koli iz rdeče cedre (*Thuja plicata*). Koli so bili nameščeni na tri različne načine: (i) neposredno v zemljo, (ii) na kovinski čevelj, zabit v tla, in (iii) v kovinski čevelj na betonski podlagi. V obdobju devetih let smo spremljali glivni razkroj ter poškodbe zaradi termitov, skladno s standardom AWPA E8.

Rezultati kažejo, da so neobdelani koli najhitreje propadli v neposrednem stiku z zemljo – vsi so propadli v šestih letih. Razkroj na kolih na kovinskih čevljih ali čevljih na betonski podlagi je potekal nekoliko počasneje, vendar so vsi kljub temu propadli v sedmih letih. Referenčni koli iz redeče cedre so izkazali pričakovano visoko naravno odpornost; nekateri so ostali funkcionalni tudi po devetih letih. Pri obdelanih kolih je bila razlika med načini namestitve izrazita: po devetih letih so bili z MCAzaščiteni koli v zemlji najmočneje razgrajeni (povprečna ocena 5,6), medtem ko so koli v kovinskem čevlju ali na čevlju na betonski podlagi dosegli znatno višje ocene (8,0 oziroma 8,5). Nezadostna penetracija zaščitnega sredstva, izmerjena v povprečju le 2,4 mm, je verjetno prispevala k hitrejšemu razkroju obdelanih kolov.

Analiza ločenih ocen glivnega razkroja in poškodb termitov kaže, da je bil neposredni stik z zemljo dosledno povezan z najnižjimi ocenami trajnosti, medtem ko so kovinski čevlji, zabiti v zemljo, in kovinski čevlji na betonski podlagi bistveno zmanjšali pogostost termitskih napadov. Tudi pri neobdelanih materialih se je razkroj zmanjševal z oddaljenostjo od tal.

Pomemben praktični rezultat raziskave je ugotovitev, da delna sanacija kolov lahko omogoči ponovno uporabo zgornjega, praviloma nepoškodovanega dela kola. Ker sta razkroj in poškodba termitov omejena predvsem na območje tal in pod njimi, lahko vrhnji del kola ponovno uporabimo tako, da ga po odstranitvi poškodovanega dela namestimo na kovinski čevelj, zabit v tla, ali čevelj na betonski podlagi. Tak pristop lahko potencialno podvoji uporabno življenjsko dobo ograjnega kola, čeprav zahteva dodatno zaščito sveže odrezanega dela in vključuje določeno stopnjo negotovosti zaradi predhodnega izpiranja zaščitnega sredstva.

Rezultati potrjujejo, da dvignjeni talni nosilci pomembno prispevajo k zmanjšanju rakroja in napada termitov ter so obetavna možnost ponovne uporabe ograjnih kolov v namenskih, manj statično obremenjenih konstrukcijah.

DATA AVAILABILITY

DOSTOPNOST RAZISKOVALNIH PODATKOV

Research data are the property of FPInnovations. Contact the authors for more information. No research data created in any Slovenian public research organisation were used.

ACKNOWLEDGEMENTS

ZAHVALA

This project was financially supported by Natural Resources Canada. Field site support from Dave Minchin, Janet Ingram, Paul Morris, Stacey Kus, Stéphane Thibeault, Tommy Martel, and Mathieu Gosselin is gratefully acknowledged.

Results were originally presented at the International Research Group on Wood Protection Annual Meeting in Yokohama, Japan, 22–26 June 2025.

REFERENCES

VIRI

AWPA: standard field test for evaluation of wood preservatives to be used in ground contact (UC4A, UC4B, UC4C); post test. American Wood Protection Association, Birmingham, AL.

Baecker, A.A. 2010. Historical review of development of barrier protection systems for preserved wooden poles. International Wood Products Journal, 1, 1: 6-14. https://doi.org/10.1179/002032010X12761750912858

Brischke, C., Rolf-Kiel, H. 2010. Durability of European oak (*Quercus* spp.) in ground contact – a case study on fence posts in service. European Journal of Wood and Wood Products, 68, 129-137.

CSA: Standard CAN/CSA-O80 Wood Preservation. 2021. CSA Group, Toronto, Canada. 137p.

Cookson, L.J., Scown, D.K., Iskra, B. 2002. Performance trials of treated hardwood fences. (Document No. IRG/WP/02-30281). Stockholm, International Research Group on Wood Protection.

Erlandsson, M. 2013. LCA for NTR class A timber in ground contact and alternative materials – horse fences and fence posts. (IVL Rapport B2102E). IVL Swedish Environmental Research Institute.

Freeman, H.H., McIntyre, C.R., Makuvek, J. 2006. The use of Postsaver® barrier wraps to increase service life of wood in ground contact. Proceedings American Wood Protection Association, 102: 112–115.

Freitag, C.M., Morrell, J.J. 2001. Durability of a changing western redcedar resource. Wood and Fiber Science, 33, 1: 69-75.

Howgrave-Graham, A.R., Cookson, L.J., Percy, A. 2009. Using physical barriers to prevent in-ground wooden pole decay: protecting forest and economic resources as well as soil and groundwater. The International Journal of Environmental, Cultural, Economic & Social Sustainability, 5, 2: 305–316.

Lebow, S., Lebow, P., Woodward, B., Kirker, G., Arango, R. 2015. Fifty-year durability evaluation of posts treated with industrial wood preservatives. Forest Products Journal, 65, 7-8: 307–313.

Make fence post repair E-Z. 2024. Simpson Strong-tie. https://sst-toolbox.widen.net/view/pdf/b1i9my2lob/F-C-EZFPP24.pdf?t.download=true&u=cjmyin (4. 10. 2024).

Miller, D.J. 1986. Service life of treated and untreated fence posts: 1985 post-farm report. (Research Paper 48). Corvallis, Oregon State University.

Morris, P.I., Dale, A., Ingram, J.K. 2014. A serendipitous field test against the cellar fungus Coniophora olivacea. Forest Products Journal, 64, 3-4: 141–143.

Morris, P.I., Ingram, J.K., Stirling, R., 2015. Field performance of old-growth and second-growth western redcedar fence posts with and without barrier wraps. (Document No. IRG/WP/15-10838). Stockholm International Research Group on Wood Protection.

Page, D., Singh, T. 2014. Durability of New Zealand grown timbers. New Zealand Journal of Forestry, 58, 4: 7–11.

Papadopoulos, A.N., Goroyias, G.J. 2008. Performance of CCB (Copper-Chromium-Boron) and creosote treated fence posts after 18 years of exposure in Greece. Journal of the Institute of Wood Science, 18A, 1: 19–23.

Scheffer, T.C. 1957. Decay resistance of western red cedar. Journal of Forestry, 55: 434–442.

Stirling, R., Mankowski, M. 2022. Above-ground termite resistance of naturally durable species in Ontario and Mississippi. (Document No. IRG/WP/22-30767). Stockholm, International Research Group on Wood Protection, .

Stirling, R., Wong, D. 2019. Performance of field cut preservatives above-ground and in ground contact exposures. (Document No. IRG/WP/19-30742). Stockholm, International Research Group on Wood Protection.

Tucker, C.L., Koehler, P.G., Oi, F.M. 2004. Influence of soil compaction on tunnel network construction by the Eastern Subterranean Termite (Isoptera: Rhinotermitidae). Journal of Economic Entomology, 97, 1: 89–94.

Wakeling, R., Morris, P. 2014. Wood deterioration: ground contact hazards. IN: Deterioration and protection of sustainable biomaterials Schultz, T. P., Goodell, B., Nicholas, D. D. (ed.). Washington, American Chemical Society: 131–146.

Wilson, C., Zhang, J., Stirling, R. 2023. Field performance of MCA-treated wood in ground contact. (Document No. IRG/WP/23-30782). Stockholm, International Research Group on Wood Protection.