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# EFFECTIVENESS OF COPPER CHROME ARSENATE AND USED ENGINE OIL IN PROTECTING FENCING POSTS OF UGANDAN GROWN EUCALYPT CLONE GC550 AND *Phoenix reclinata* AGAINST TERMITE ATTACK

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## ABSTRACT

Eucalypts and *Phoenix reclinata* posts are the most commonly used species for fencing posts in urban areas of Uganda. Although eucalypts are known to be susceptible to termites, fencing posts are still used untreated. In this study, the effectiveness of Copper Chrome Arsenate and used engine oil in protecting Ugandan grown *Eucalyptus grandis* × *Eucalyptus camaldulensis* clone and *Phoenix reclinata* fencing posts against termite attack were assessed. The objectives were to determine (i) the incidence and (ii) severity of termite attack on *Eucalyptus grandis* × *Eucalyptus camaldulensis* and *Phoenix reclinata* fencing posts treated with Copper Chrome Arsenate or used engine oil. Ninety 2ft long samples of *Eucalyptus grandis* × *Eucalyptus camaldulensis* and *P. reclinata* posts were treated with Copper Chrome Arsenate or used engine and others left to act as control then buried in 1ft deep pits in the ground at a spacing of 1m by 1 in Eastern Uganda. The samples were visually inspected monthly for termite damage for 9 months. More than 80% of untreated samples of both species had been attacked by termites within the first month. Copper Chrome Arsenate treated *Eucalyptus grandis* × *Eucalyptus camaldulensis* and *Phoenix reclinata* samples were first attacked in the 8<sup>th</sup> and 5<sup>th</sup> months respectively. While used engine oil treated *Eucalyptus grandis* × *Eucalyptus camaldulensis* and *Phoenix reclinata* samples were first attacked in the 7<sup>th</sup> and 5<sup>th</sup> months respectively. The modal severity for samples of both species treated with either Copper Chrome Arsenate or used engine oil was class 1 (less than 1% of the sample volume eaten) while for the untreated samples it was class 5 (above 60% volume eaten) for the 9 months of field exposure. It was concluded that untreated posts of *Eucalyptus grandis* × *Eucalyptus camaldulensis* and *Phoenix reclinata* were highly susceptible to termite attack and that the protection offered by used engine oil or Copper Chrome Arsenate managed to restrict damage by termites to only less than 1% of the sample volume, over the 9 months of exposure for most of the sample posts. It is recommended that the experiment be repeated for a much longer period in order to ascertain the exact service life of the posts under these circumstances. Penetration and retentions of the preservatives in the posts should also be studied in order to ascertain their effect on the efficacy.

**Keywords:** Incidence, severity, treated posts, wood preservation, wood protection.

## INTRODUCTION

The need to improve quality of timber as well as shorten the rotation of trees has led to the development of a number of fast growing forest plantation timber species (Petit and Montagnini, 2004). Fast growing clonal eucalypts were introduced in Uganda from South Africa in 2002 by the National Forestry Resources Research Institute (NaFORRI) (Epila-Otara 2004). GC550, a hybrid of *Eucalyptus grandis* × *camaldulensis* is one of the of 12 eucalypt clones introduced in Uganda (Epila-Otara 2004

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quoted by Turinawe *et al.* 2014) that has been widely adopted for transmission poles and fencing posts (Turinawe *et al.* 2014). However, because of the relatively high cost of the eucalypt clones, *Phoenix reclinata* has been used as an alternative to the eucalypts for fencing posts, especially in Central Uganda despite being a palm (Ssembajjwe *et al.* 2005). *P. reclinata* is a widely planted ornamental palm tree in tropical and subtropical regions. Although its wood is reported as durable and resistant to attacks by termites and fungi (Segu 2012), it has been observed to be easily attacked by termites in Uganda albeit this is not backed by scientific data since there is little information available. Yet untreated *P. reclinata* fencing posts continue to be used in central Uganda.

Euclyptus has been found to be highly susceptible to termite attack in different parts of Uganda (Ssemaganda *et al.* 2011, Nyeko and Olubayo 2005). According to Soderlund (2013), three sub families; *Apicotermittinae*, *Macrotermittinae* and *Termitinae* were found to be existent in Uganda. In Tororo district in Eastern Uganda, *Macrotermes bellicosus* and *M. subhyalinus* were considered the most abundant termite species attacking the widest range of trees and crops, and causing the most damage (Nyeko and Olubayo 2005). Whereas *Pseudacanthotermes militaris*, *Macrotermes subhyalinus*, *M. bellicosus*, *Nasutitermes arboreus* and *Eutermes arborum* were reported to cause severe damage to pasture grass, trees and/or crops in Nakasongola district (Orikiriza *et al.* 2012) in Uganda.

According to Ssemaganda *et al.* (2011), some of the strategies to protect wood from termite attack include using naturally resistant tree species and or applying biocides. A range of different chemical treatments has been developed to enhance the durability and service life of timber. In addition to conventional wood preservatives such as creosote and waterborne preservatives, several authors (Pereira *et al.* 2015, Mattos *et al.* 2013, Ssemaganda *et al.* 2011) have reported use of used engine oil as an effective alternative to improve the biological resistance of wood in Uganda and Brazil. McKee and Plutin (1989) indicated that although fresh gasoline engine oil and both the fresh and used diesel engine oil were noncarcinogenic, majority of the used gasoline engine oils were carcinogenic and can, therefore, kill wood degrading agents in contact. According to Mattos *et al.* (2012), easy access of used engine oil from motor vehicles, its low cost and ease of application since pressure is not required, makes it suitable for preserving wood in rural areas by soaking or brushing. Some plant extracts have also been proved to be toxic and important in protection against termite damage. (Kadir 2017, Fatima and Morell 2015). For this study, the effectiveness of used engine oil in protecting fencing posts was investigated. Copper Chrome Arsenate (CCA) representing the conventional preservatives chemicals was used for bench marking purposes. The objectives of the study were to determine (i) the incidence and (ii) severity of termite attack on GC550 and *P. reclinata* fencing posts treated with CCA and used engine oil.

## MATERIALS AND METHODS

### Timber

Thirteen debarked, defect free *P. reclinata* posts 2,1m long and 8-10cm in diameter, were randomly selected from Ndeeba, a Kampala suburb that harbors one of the largest market centers for this species and cross cut to 45 samples of 0,6m length. Two defect free, 3 years old GC550 individual trees of Diameter at Breast Height (DBH) 10cm were randomly selected and felled from a wood lot in Bukaleba, Mayuge District, 120km east of Kampala. The trees were debarked and crosscut into 45 pieces of 0,6m length. The 0,6m long samples of both GC550 and *P. reclinata* were then air dried in ambient conditions until moisture content, measured by a moisture meter was 20% and then treated with CCA and used engine oil.

### Treatment of samples with preservatives

Out of the 90 samples i.e. 45 for GC550 and 45 for *P. reclinata*, 15 samples of each species were treated with CCA by steeping for 2 days. The formulation of CCA used to treat the specimens comprised of copper oxide (25,61%), chromium trioxide (41,24%) and arsenic pentoxide (33,15%),

this was diluted to 4%. Fourty liters of used engine oil was mixed with 12 liters of kerosene in an open drum in order to reduce the viscosity of engine oil and increase its penetration into the samples, then another 15 samples of each species were then submerged separately in the preservative for 2 days as well. The remaining 30 samples i.e.15 for GC550 and 15 for *P. reclinata* were left untreated to act as control. The samples were then air dried and when the surfaces of the treated samples were dry enough for handling, they were transported to the field for exposure to termites.

Study area description

The field site was in Miroi village, Kolir Sub-County, Bukedea district in Eastern Uganda where a large infestation of termites had been detected earlier during the reconnaissance survey. It lies between the longitudes of 33° 00 E & 33° 45 E, and latitudes 33° 00 E & 33° 45 E, and an average altitude of 1800 meters above sea level. The District has a land Area of 2256,5 km² of which water and swamps cover 406 km². The main vegetation covering the district is wood land and grass savannah. *Pinus caribea* is the most common tree species planted in the district.

Setup of the experiment

The experiment was carried out in an enclosure to keep away grazing animals and people from tampering with the specimens. Ninety pits were dug at a spacing of 1m × 1m and the samples were then buried in the pits with one foot height in the ground and the other one foot exposed. The samples were placed systematically in the order: CCA treated followed by the control and then the Engine oil treated sample (Figure 1).

Data collection procedure

Inspection of the samples was done every after 30 days for a period of 9 months starting from 28<sup>th</sup> March, 2016 in order to monitor and evaluate the level of termite damage on the samples. At each time of inspection, specimens were removed from the ground and cleaned, and then the damage assessed. The incidence of termite attack was recorded as follows: A representing attacked and N represented not attacked. whereas the severity of the damage was recorded as follows: 1 representing less than 1% of total wood volume eaten; 2 for 1-20% of total wood volume eaten; 3 for 21-40%; 4 for 41-60%; and 5 representing above 60% of total wood volume eaten (Ssemaganda *et al.* 2011).

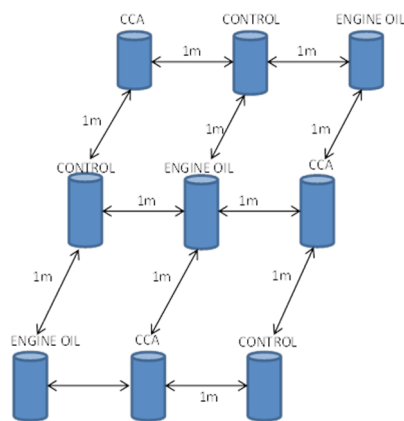


Figure 1: Arrangement of samples in the field.

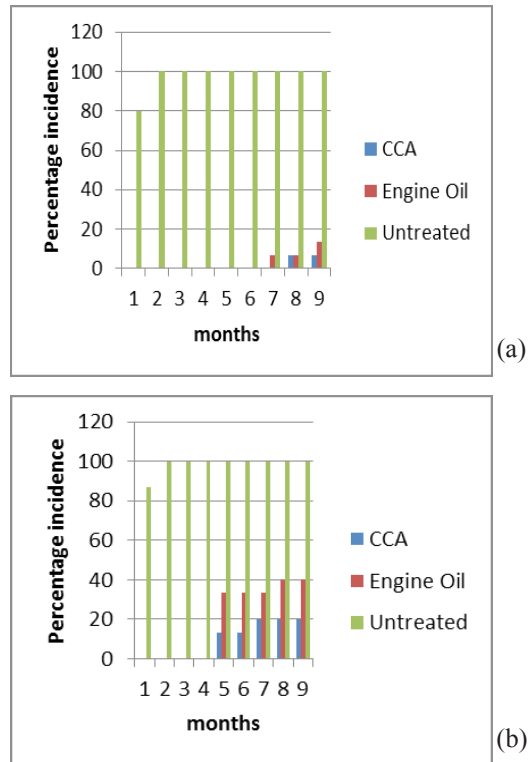
### Data analysis

Descriptive statistics such as the modal incidence of attack, modal severity and the variations of termite damage on samples with different treatments were used.

## RESULTS AND DISCUSSION

### Incidence of termite attack

After one month of the experiment, none (0%) of the treated samples of GC550 or *P. reclinata* were attacked while over 80% the untreated samples of both GC550 and *P. reclinata* had been attacked by termites (Figure 2). No CCA treated GC550 samples were attacked for 7 months and only 1(0,67%) sample had been attacked by end of the 9 months. However, attack on CCA treated *P. reclinata* samples commenced in the 5<sup>th</sup> month and by the end of the experiment 20% of the samples had been attacked (Figure 2). The first engine oil treated GC550 sample was attacked in the 7<sup>th</sup> month, with only 1 sample attacked by the end of the 9<sup>th</sup> month. Similar to CCA, engine oil treated *P. reclinata* samples were first attacked in the 5<sup>th</sup> month but 40% of these were attacked by the end of the experiment (Figure 2).



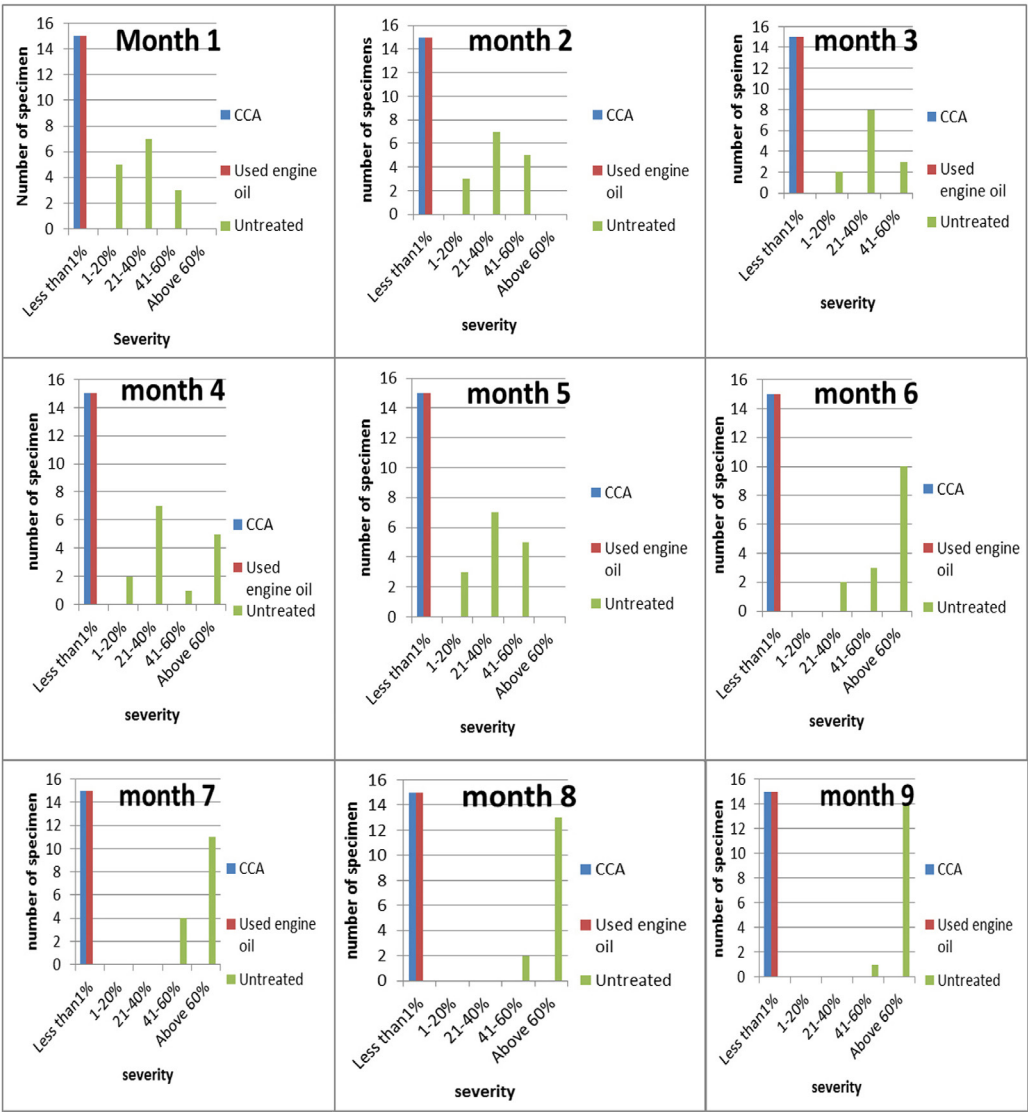
**Figure 2:** Percentage Incidence of termite attack on (a) GC550 and (b) *P. reclinata* for each month.

### Severity of termite attack

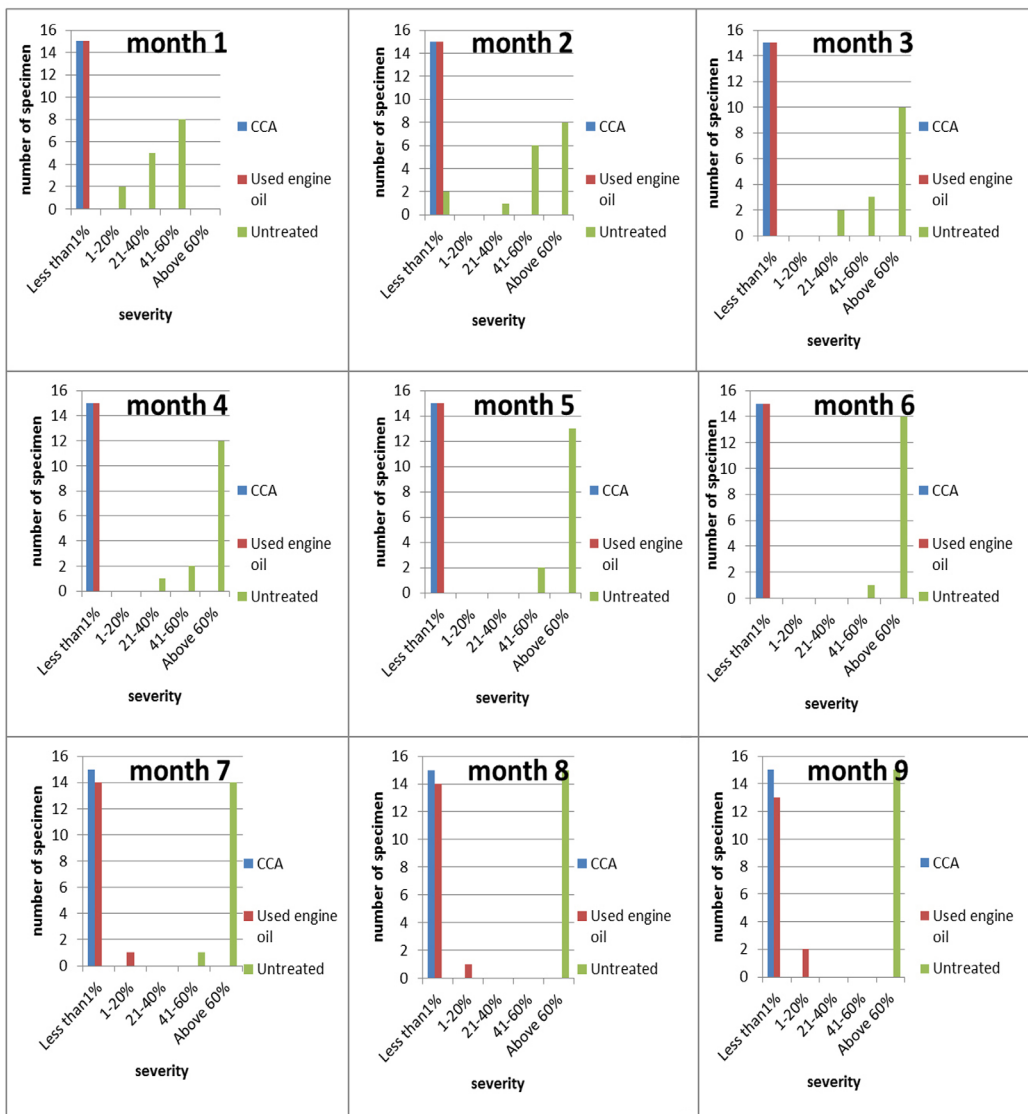
For the entire period of the experiment i.e. 9 months, all samples of both GC550 and *P. reclinata* treated with CCA were still in class 1. Whereas, GC550 samples treated with engine oil remained in class 1, *P. reclinata* samples were in severity class 2 by 7<sup>th</sup> month (Figure 3 and Figure 4).

However, for the untreated samples, just after 1 month of the experiment 46,7% of the GC550

samples were in already in severity class 3 (Figure 3). More than half (53,3%) of the untreated *P. reclinata* samples, were in severity class 4, just after one month. By the end of the experiment, 14 of the 15 (93,3%) of untreated GC550 samples were in severity class 5 (Figure 3) while it took only 8 months for all the untreated *P. reclinata* samples to fall in class 5 of termite damage (Figure 4).



**Figure 3:** Number of GC550 samples treated with CCA and used engine oil in different severity classes at different months after establishment of the experiment.



**Figure 4:** Number of *P. reclinata* samples treated with CCA and used engine oil in different severity classes at different months after establishment of the experiment.

### Modal severity of the samples

The modal severity for GC550 and *P. reclinata* samples treated with either CCA or used engine oil was class 1 for the entire 9 months of field exposure. For untreated GC550 samples, for the first four months the modal severity was class 3 and class 5 for the rest of the remaining months (Table 1). The modal severity was class 4 for the first month and class 5 for rest of months in untreated *P. reclinata* samples.

Table 1: Modal Severity of termite damage for all the samples.

Treatment	Samples	Months								
		1	2	3	4	5	6	7	8	9
CCA	GC550	1	1	1	1	1	1	1	1	1
	<i>Phoenix reclinata</i>	1	1	1	1	1	1	1	1	1
Used engine oil	GC550	1	1	1	1	1	1	1	1	1
	<i>Phoenix reclinata</i>	1	1	1	1	1	1	1	1	1
Untreated	GC550	3	3	3	3	5	5	5	5	5
	<i>Phoenix reclinata</i>	4	5	5	5	5	5	5	5	5

Key: 1,2,3,4 and 5 are severity classes representing less than 1 %, 1-20 %, 21-40 %, 41-60 % and above 60 % respectively.

The fact that all the untreated samples of GC550 and *P. reclinata* were attacked by termites in the first month of the experiment shows that both of these species are highly susceptible to termite attack. For use in fencing, posts of the two species require preservative treatment yet the practice in Uganda is normally use of untreated posts. Untreated *P. reclinata* samples were marginally more susceptible to termite attack despite being preferred to eucalypts for fencing newly acquired land in Kampala. Even when treated with CCA or used engine oil, *P. reclinata* posts were still more susceptible to termite damage than GC550 treated with the same chemicals. Perhaps *P. reclinata* samples are softer and easier to tear by mandibles of worker termites compared to GC550 samples.

In GC550 samples, used engine oil was as good as CCA in giving protection against termites. At the end of the 9 months, all the GC550 samples treated with either used engine oil or CCA, were in severity class 1 (less than 1% of the total volume attacked) which is in agreement with Ssemaganda *et al.* (2011) but in *P. reclinata*, CCA was marginally better than engine oil over the 9 months. This is probably because CCA was able to penetrate better in *P. reclinata* samples than used engine oil.

CONCLUSIONS

Untreated posts of both GC550 and *P. reclinata* were highly susceptible to termite attack although the severity of the damage was marginally greater in the *P. reclinata* samples at the end of the experiment.

Treatment of GC550 samples with used engine oil or CCA delayed termite attack up to the 7 months but in *P. reclinata* both preservatives could only delay termite attack up to the 5<sup>th</sup> month.

After 9 months, most of the treated posts of both species had only less than 1% of their total volume eaten by termites, for both preservatives.

And it is recommended that:

Posts of GC550 and *P. reclinata* should only be used when treated to extend their service life since they are highly susceptible to termite attack;

The mixture ratios, viscosity as well as retention and penetration in the two species be studied to establish the effect on the efficacy of the preservatives;

The experiment be repeated for a much longer period in order to ascertain the service life of the poles;

The same research be done on other *Eucalyptus* hybrid clones and other preservatives.

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