Recommendations for the establishment of trap tree plots for the monitoring of *Sirex noctilio* under South African pulpwood and sawtimber plantation conditions

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Summary

In South African pine growing areas, the plantations are managed under various silviculture treatments to produce numerous products. The diversity in stocking, rotation age, species, thinning regimes etc. creates a mosaic pattern. Within this mosaic pattern there is a need to establish trap trees to monitor the presence of *Sirex noctilio*.

Trap trees are created by applying herbicide to 13 to 20-year-old trees, six weeks before the *S. noctilio* peak emergence period. Older trees will die slower and younger trees will die quicker, which complicates the management of trap trees as some trees will be too wet and others too dry during the optimum time for inoculation of *Deladenus siricidicola*. Therefore, it has become necessary to standardise the establishment of trap trees in compartments of uniform age, species, risk rating and thinning status, to achieve effective results.

Key Findings

- Where the recommended approach has been implemented, effective trap trees have been established and inoculated with *D. siricidicola* in the optimum inoculation month.

Key Words

*Deladenus siricidicola*

*Emergence cages*

*Ibalia leucospoides*

*Parasitism*

*Trap trees*
Introduction

*Sirex noctilio* F. (hymenoptera: Symphyta: Siricidae) was introduced into the winter rainfall region of the Western Cape during 1994. This area was dominated by *Pinus radiata* grown in a sawtimber regime. Rapid introduction of the biological control agents *Deladenus siricidicola* (= *Beddingia siricidicola*) (nematode) and *Iballia leucospoides* Hochenerwarth (Hymenoptera: Ibilidae) (parasitoid wasp) successfully suppressed the *S. noctilio* population.

The spread of *S. noctilio* into the summer rainfall region, and in particular to, KwaZulu-Natal around 2003 brought different challenges. The area is dominated by *Pinus patula* mostly grown in a short rotation pulpwood regime of 14 to 18 years. Various adaptations were made to the traditional nematode inoculation methods; these included the development of trap tree plots suited to local pulpwood conditions.

As *S. noctilio* continued to move northwards through South Africa (2007 onwards), it started affecting summer rainfall sawtimber regimes in Mpumalanga and Limpopo. This northward movement of *S. noctilio* required the adaptation of trap tree preparation, developed in pulpwood, to sawtimber situations.

Croft et al. (2014) reported on standard operating procedures for monitoring and biological control operations in the management of *Sirex noctilio* in South Africa, and referred to trap tree preparation. This report highlights further developments and detail including a recommended methodology for establishing trap tree plots by the South African Sirex Control Programme (SASCP).

*Sirex noctilio* has now infested the entire pine plantation area in South Africa, some 619 311 ha from which sawlogs, pulpwood, poles and other products are produced (FSA 2014/2015). The area is managed by approximately 10 commercial companies and many medium and small growers applying various rotation lengths, stocking densities, species choice and numerous thinning regimes.

Monitoring the parasitism levels achieved by the biological control agents, *D. siricidicola* and *I. leucospoides* is imperative to determine the level of biological control that has been achieved. Areas where control still needs to be enhanced also need to be identified, to ensure that *S. noctilio* is prevented from creating further timber loss in either pulpwood or sawtimber compartments.

Trap trees provide a mechanism to achieve these objectives and this report describes a recommended methodology for using chemically stressed trees to create effective trap tree plots during the *S. noctilio* flight season in diverse plantation management regimes.

Trap trees (Hurley et al., 2012) are used for several purposes since stressed trees attract female *S. noctilio* wasps to oviposit their eggs.

- Trap trees are an efficient way of releasing *D. siricidicola* into *S. noctilio* infested trees since the wasps are drawn to the stressed trap trees to oviposit, particularly in areas of low *S. noctilio* infestation. It significantly reduces the need to “search” for *S. noctilio* infested trees during the search and inoculate operation. (Neumann and Minko 1981).
- Trap trees ensure a supply of *S. noctilio* infested logs at accessible locations (again removing the search aspect) when log samples are placed into emergence cages. These emergence cages enable accurate establishment of the levels of parasitism achieved by *D. siricidicola* and *I. leucospoides*.

Method

Criteria for site selection

The criteria to be considered in selecting sites should include the following plantation variables

- **Sites**
  - Sites where the pine is considered under stress due to poor site species matching or where species have been planted at altitudinal limits are usually more prone to *S. noctilio* infestations.
  - Large areas planted to pine may be vulnerable to *S. noctilio* if infestations are not timeously detected.

- **Species**
  - *Sirex noctilio* will oviposit in any pine specie. In the winter rainfall region, it infests mainly *P. radiata*. In the summer rainfall region, it infests mainly *P. patula*.

However, if there are stands of *P. taeda* these are also vulnerable. In mixed pine stands *S. noctilio* will be attracted to the most stressed specie resulting from inter tree competition.

- **Climatic Sirex Risk mapping**
  - Areas of medium to high risk should be prioritised.

- **Compartment age**
  - The desired age for trap trees should be from 13 to 20 years of age (Neumann and Minko 1981). Large or older trees (20+ years old) die at a slower rate and timing the trap tree preparation operation to ensure trees are at optimum stress levels during the *S. noctilio* flight period becomes more difficult to predict (Iede et al. 2012).
• Thinning status
  □ Pulpwood stands are normally not thinned and are particularly vulnerable between the ages of 10 to 16 years.
  □ Areas where the thinning regime has not been carried out timeously become vulnerable, especially where thinnings are delayed by about 2 years.
  □ Trees marked for thinning, can be utilised as trap trees (this removes the risk of losing production sawtimber trees) (Neumann and Minko 1981).

Determining the number of trap tree sites to be established
The number of sites to be monitored by trap trees is dependent on the objective of the trap tree plots
• For monitoring purposes 1 plot of 10 trees per 200 ha pine older than 12 years should be prepared.
• For inoculation purposes 1 plot of 10 trees per 100 ha pine older than 12 years should be prepared.

Establishment of trap tree plots
Trap trees are prepared four to six weeks before the annual S. noctilio adult peak emergence.
• In the summer rainfall region, adult peak emergence occurs mid-November. Trap tree plots should be prepared between the last two weeks in September and the first two weeks in October.

Figure 1: The position of the cuts made with a hatchet during the preparation of trap trees

• In the winter rainfall region, adult peak emergence takes place over a longer time, during January and February. Trap tree plots preparation should take place during the last two weeks of December.

The trap tree plot can comprise one row of trees perpendicular to the road (used in pulpwood compartments), or a selection of smaller trees in a localised area within the compartment (used in sawtimber compartments).

A tree on the roadside should be clearly marked with paint (STT and year) (i.e. STT 1 6).

Ten trap trees should be prepared, starting from the second tree from roadside.

Each tree must be clearly marked in paint with a number, to assist in locating the trees in subsequent visits.

Sawtimber compartments should be selected two to three years before the next thinning is due to take place. Smaller trees marked for removal in the next thinning, can be used as trap trees, and once identified should be left standing during any thinning operation.

Trap tree preparation
A hatchet is used to make cuts around the stem of the tree at intervals of 8 to 10 cm apart (+/-width of hand palm) as shown in Figure 1. The hatchet must be sharp to ensure that a single stroke penetrates through the bark and cambium into the stem of the tree. The cuts should be applied with a hatchet at a comfortable height (+/- 800 mm). The hatchet stroke should be applied with a slanted downward action to make a cut (of approximately 30 degrees off vertical) into the stem. Each cut should be horizontal to minimise herbicide run off to the side.
Chemical application

Dicamba causes the tree to die slowly and permits oviposition by *S. noctilio* females. Dicamba is applied at 20% weight to volume ratio and 2 ml of herbicide is applied into each cut with a calibrated spray bottle that dispenses 1 ml of liquid with each pull of the trigger (Carnegie and Bashford 2012). A cattle dosing gun calibrated at 2 ml per trigger pull can be used.

Dicamba 200 formulations are already at 20% w/v and need not be diluted. Other Dicamba formulations with various concentrations (g/l) must be diluted, e.g. the 480 g/l formulation requires 420 ml added to 580 ml of water while the 700 g/kg formulation requires 300 g made up to 1000 ml solution.

(Note: Pesticides mixed in water lose their effectiveness over time and only the amount needed per day should be mixed).

Currently the product brand used is Dominator (dimethylamine salt at 700 g/kg wg) distributed by Klub M5.

Smaller trees will each receive 4-6 ml of herbicide, whereas larger trees will receive proportionally more. The reaction by the tree should be a slow dehydration (Madden 1971) and consequently a slow tree mortality. The synchronisation of the tree under “stressed” conditions must coincide with the *S. noctilio* peak emergence.

Trap trees can be examined after the *S. noctilio* flight period, to determine if the trees were attacked by *S. noctilio* females. These trees can then be inoculated with *D. siricidicola* nematodes. However, as trap trees do not always show the typical resin exudation beads where *S. noctilio* females have inserted their ovipositors, and the trap tree crown browning may be due to the application of the herbicide, the impact of the phytotoxic mucus impact on the crown can be masked and therefore, in general practice, all trap trees are inoculated. Trap tree plots for inoculation purposes in the summer rainfall regions should be inoculated in February before the trees dry out too much. In the winter rainfall region, the trap trees are inoculated in June and July.

During August and September in the summer rainfall area, and November in the winter rainfall region, logs from inoculated trap trees are placed in emergence cages to determine the *D. siricidicola* and *I. leucospoides* parasitism that was achieved. Trees are inspected, (fell and cross-cut to determine if larvae and tunnels exist) when logs for the emergence cages are selected.

Results

Over the past few years, an increasing number of timber companies are using trap trees to monitor parasitism and enhance the level of biological control. Trap tree plots are established, and if required, inoculated annually. In most situations, the sample logs placed at emergence cage depots are the only reliable source of parasitism levels.

Results have been variable where large, older trees (over 20 years of age) were used as trap trees. Larger, older trees also require more nematodes (increasing costs), with no measurable advantage in increased parasitism. These larger, older trees are more valuable in the sawtimber market and should be avoided when creating trap trees.

Trap trees have enabled an improved parasitism verification process, due to a supply of *S. noctilio* infested timber being easily assessable to roadside, for transport to the emergence cage depots.

Conclusions

Monitoring of *Sirex* infestation levels as well as the effectiveness of biological control agents, through trap trees preparation and inoculation has become a norm in South African forestry and to date this practice has enabled management objectives to prevent further outbreaks of *S. noctilio* in South Africa.
References


