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Influence of the egg laying period of *Pissodes strobi* on the new brood emergence: Evaluating the consequences of being late

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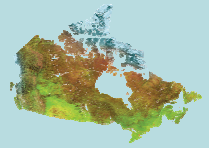
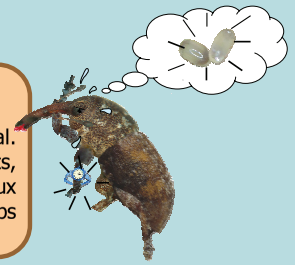




Introduction

A number of studies have demonstrated the importance for herbivorous insects to be synchronized with their host's phenology to ensure successful reproduction and survival. The seasonal variation of the quality and the quantity of food available determines their brood survival (Feeny 1976; Mattson and Scriber 1987). For the bark feeding insects, however, the evidence has not yet been demonstrated, as it has not been for the white pine weevil. Bark thickness, primary cortex thickness, resin canal morphology, resin flux and bark chemistry of the hosts of the white pine weevil show seasonal morphological and physiological variations. This study's objective is to determine the relationships between the oviposition period, associated with tree phenology, and the white pine weevil reproductive and development performance under natural field conditions.

Hypothesis

Oviposition during the natural early spring period enhances the oviposition performance and the number of adult emergences when compared with the emergences from the late oviposition period groups.

Methods

In 2005, in a 14-year-old Norway spruce (*Picea abies*) plantation, oviposition, the number of emerged adults, their weight and their sex were evaluated at three different weevil introduction periods (May 18, June 15 and July 13). For each introduction, three types of terminal leaders were used and repeated in 10 blocks:

- intact terminal (**I**) leaders
- winter-cut (**WC**) leaders
- seasonal-cut (**SC**) leaders

The **I** leaders were to reflect the natural larval development on a natural growing shoot. The **WC** leaders were harvested in March, and the **SC** leaders were cut from healthy trees at the caging period. The **WC** leaders were used as control leaders to evaluate the relative oviposition performance of each adult group having overwintered during different periods. The **SC** leaders are equivalent to the natural healthy leaders at this period without any active induced defence against the weevil.

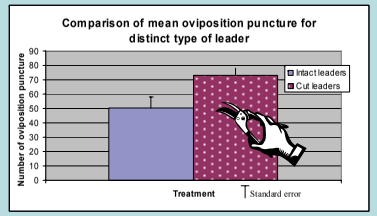
At each introduction period, cut leaders were set in water filled bottles at the same height as the tree terminal leaders. Overwintered weevils (2 females and 2 males) were caged on each leader during 14 days in all treatments. The temperature was also measured.

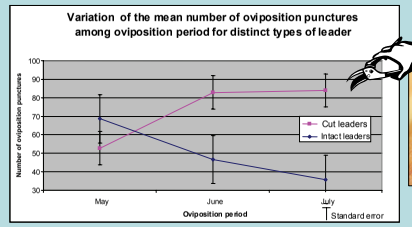
All the leaders were cut and collected at the end of the larval development (pupae stage) and put in a growth chamber at 25°C and 70% humidity in cardboard tubes.

The adult emergence was checked every other day. Every treatment was compared with a variance analysis and simple contrasts.

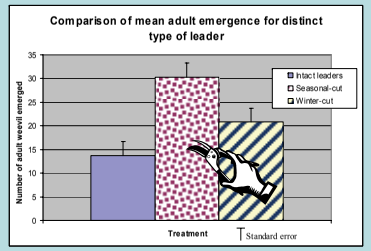
Introduction date

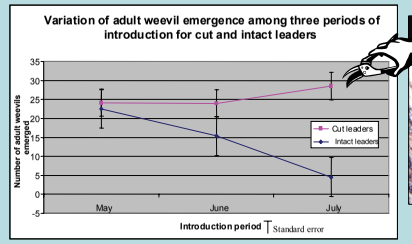
Leader type	May	June	July
Intact (I)			
Seasonal -cut (SC)			
Winter-cut (WC)			





Oviposition puncture





Weevil emergence

Results and discussion

Oviposition:

- The number of oviposition punctures was not significantly different between the three introductions for **WC** leaders. This indicates an equivalent reproductive performance of the females between the three introduction groups.
- The number of oviposition punctures did not differ between **WC** and **SC** leaders among the introduction periods.
- The number of oviposition punctures was significantly lower in **I** leaders, for all introduction periods. It is possible that the **I** leader is not as good as the **C** leader for oviposition. It can be caused by nutritive factors and/or inhibition by the tree.
- The oviposition performance on **C** leaders was not significantly different for all types of leaders in May. But we observed in June a positive variation for **C** leaders and a negative variation for **I** leaders. Thereafter for all types of leaders the oviposition performance remained stable.

Emergence:

- The number of emerged adults was significantly different between all types of leaders. **SC** leaders produced significantly more adults than the others, and **I** leaders significantly fewer. **SC** leaders have a higher diameter than **WC** leaders. This could explain the difference between the two types of cut leaders.
- The number of emerged adults did not differ between **WC** and **SC** leaders among the introduction periods.
- Cut leaders compared to the intact ones did not vary the same way among the introduction periods. There is a slight increase in the emergence in July for cut leaders and an important decrease from May to July for intact leaders. We could argue here that the quality of the leaders decreased from May to June and to July.

Sex ratio and weight did not vary significantly among treatments and oviposition periods.

Conclusion

The **I** leaders show a significant decrease in the number of weevil adults produced among the three introduction periods.
For the **SC** leaders there was no significant reduction in the number of emerged adults. Nutritive quality of **I** leaders as well as **SC** leaders was reduced during the growing season so it cannot explain the decrease in emergence. The main difference between **SC** and **I** leaders for larvae is their ability to respond to weevil attack. Intact leaders seem to resist weevil attack and this defence is initially weaker in mid-May to June and stronger in July.
This is why oviposition is limited to the late spring and early summer to ensure successful development. Leader selection appears to advantage female weevils that lay eggs in mid-May.

References

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- Mattson, W. J. and J. M. Scriber. 1987. Nutritional ecology of insects folivores of woody plants: nitrogen, water, fiber, and mineral considerations. *In* Nutritional ecology of insects, mites, and spiders. F. Slansky and J. G. Rodriguez (eds.). John Wiley and Sons, Inc.

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