Novel biosafe IPM strategies to manage pesticide resistance in pollen beetles

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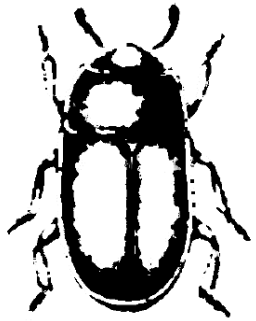


Project Partners:

- University of Helsinki, Finland (coordinator) – Prof. Heikki Hokkanen
- University of Ghent, Belgium (Flanders) - Prof. Guy Smagghe
- Aarhus University, Denmark - Prof. Gabor Lövei
- Estonian University of Life Sciences, Tartu, Estonia - Prof. Eve Veromann

Main question raised in this presentation:

Can one develop a system against the pollen beetle based on natural biological control by parasitic wasps?

In Finland it has been observed that parasitoid populations in the rapeseed system tend to build-up to high levels, but are systematically followed by crashes of the parasitoid populations. The reasons for these crashes have not been known. Our long-term monitoring data now explains for the Finnish conditions what is causing these crashes, and how we could rely on parasitoids for successful natural control of the pollen beetle.

Objectives of the IPM4Meligethes project

The **main objective** of this project is to:

develop novel, safe, sustainable , and economically feasible strategies for pollen beetle control,

where resorting to insecticide spraying is needed only rarely

This will **ease the selection pressure** on the pest, and prolong the efficacy of the insecticides, as resistance evolution will be slowed down, or even reversed.

Key components of our work include:

- Cropping system buffering against pest outbreaks
- Forecasting, monitoring, and dynamic thresholds
- Targeted precision biocontrol
- RNA interference methods for *Brassocogethes aeneus* control
- Biosafety and socio-economics of the proposed techniques

Forecasting, monitoring, and revised, dynamic thresholds

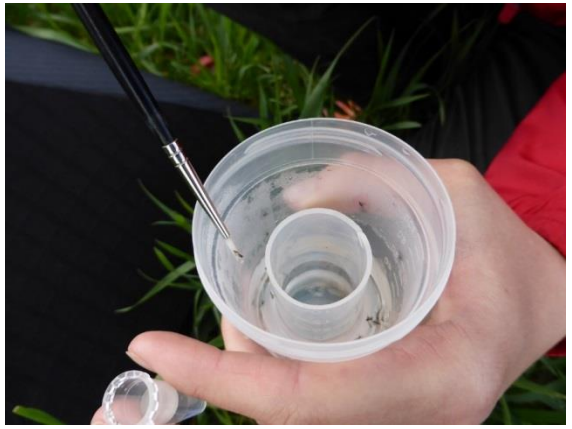
The main objective of this WP is to facilitate the development of a sustainable control procedure for the pollen beetle, using the principles of IPM. Specific objectives are to:

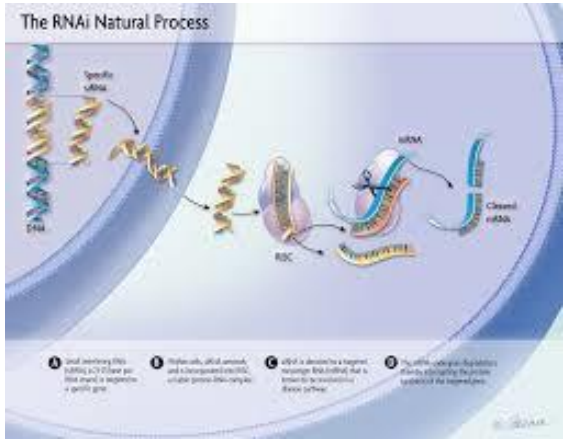
- improve the existing forecasting methods
- update the monitoring toolkit
- develop new, relevant action thresholds

Biosafety and socioeconomics

The objective is to determine:

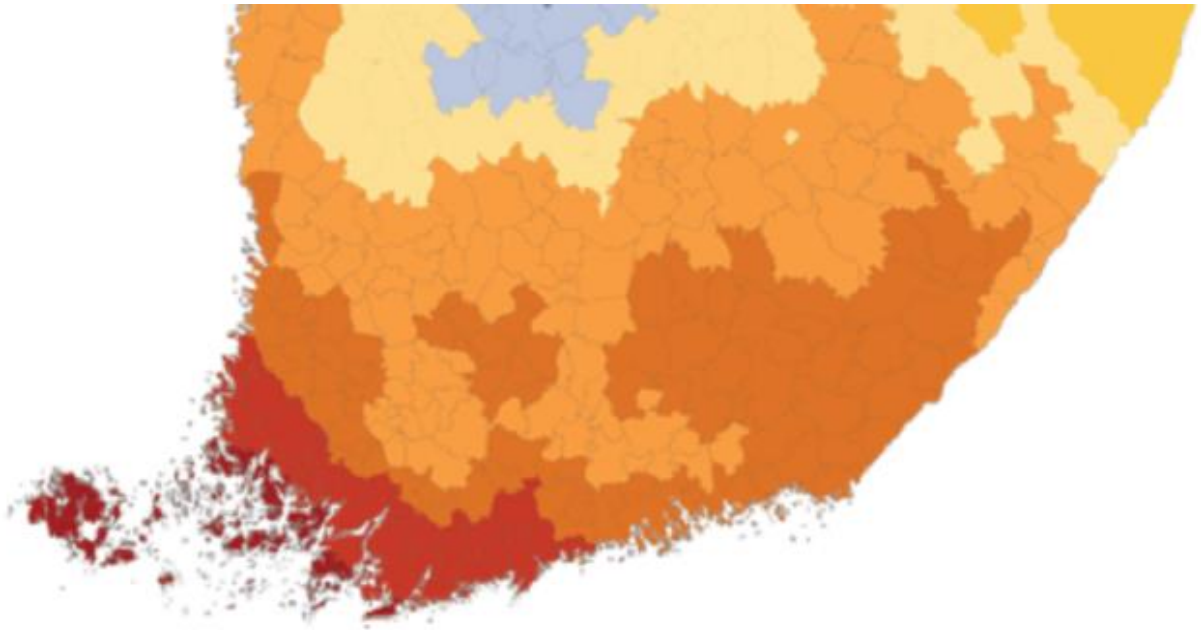
- the environmental safety of the developed RNAi-products or approaches
- the environmental safety of the entomovectoring products and approaches
- socioeconomic impacts of the proposed new IPM-strategies



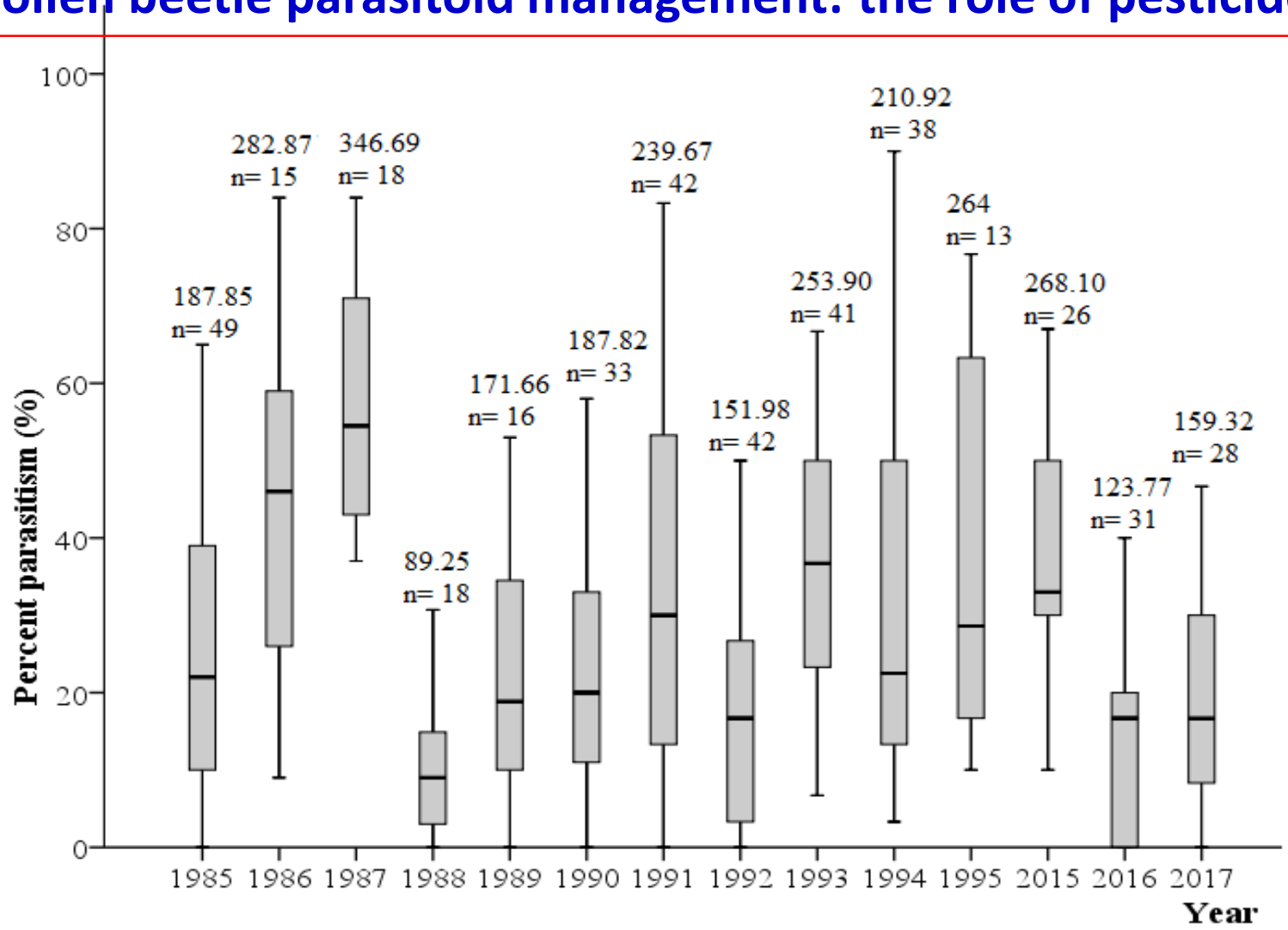


Large-scale, long-term monitoring of pollen beetle parasitism levels and factors affecting it in Finland

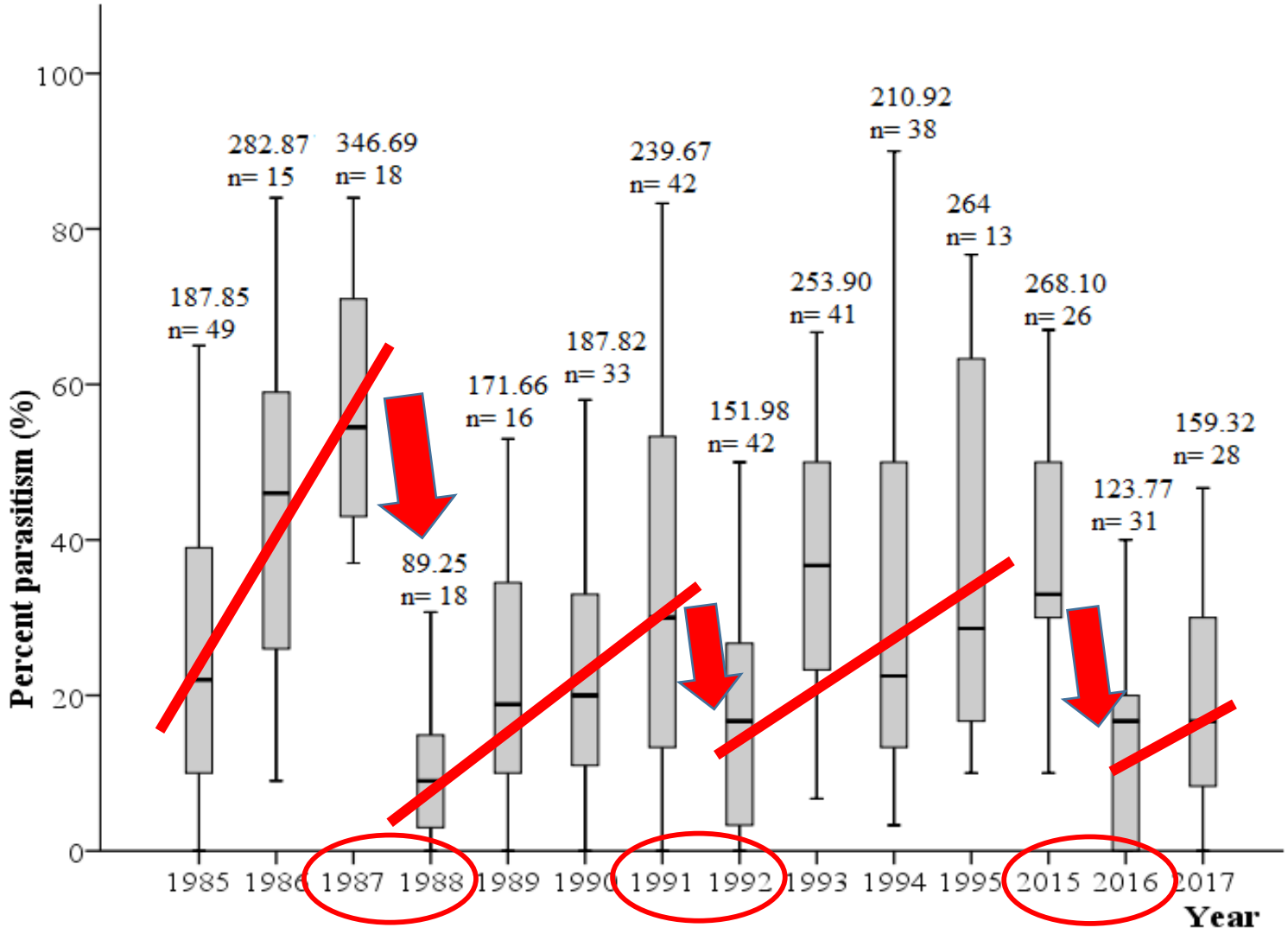
Larval samples collected annually between 1984-1995 and again in 2015-207 across the total cropping area of rapeseed in Finland (14 years of data). Initially over 70 locations (regions) were sampled, later optimised to about 30 locations (regions) per year.



Pollen beetle parasitoid management: the role of pesticide sprays



Boxplot examining percent parasitism of pollen beetle in Finland in different years. Mean ranks and sample sizes are expressed above each whisker



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Key to the pattern of crashes in the pollen beetle parasitism: cereal aphids!

What's happening?

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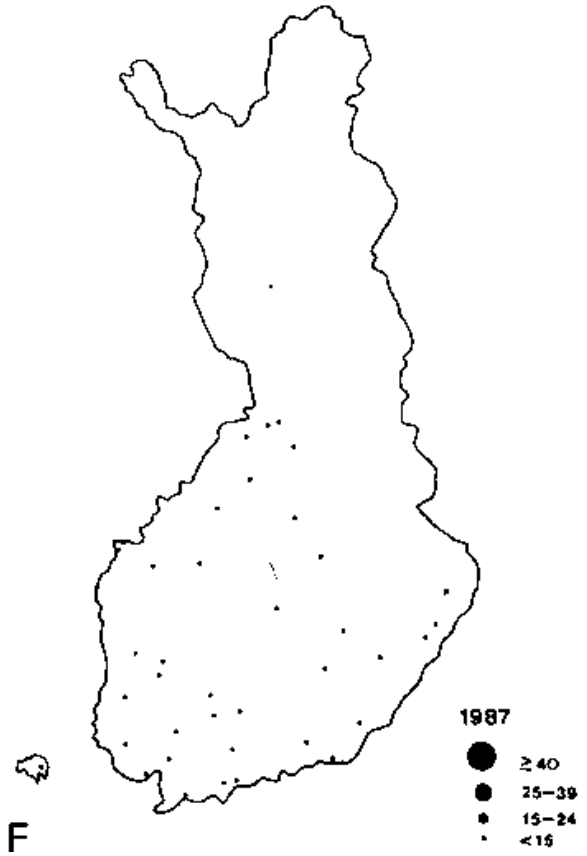
R. padi forecast (damage potential) for the summer 1987: overwintering population extremely small



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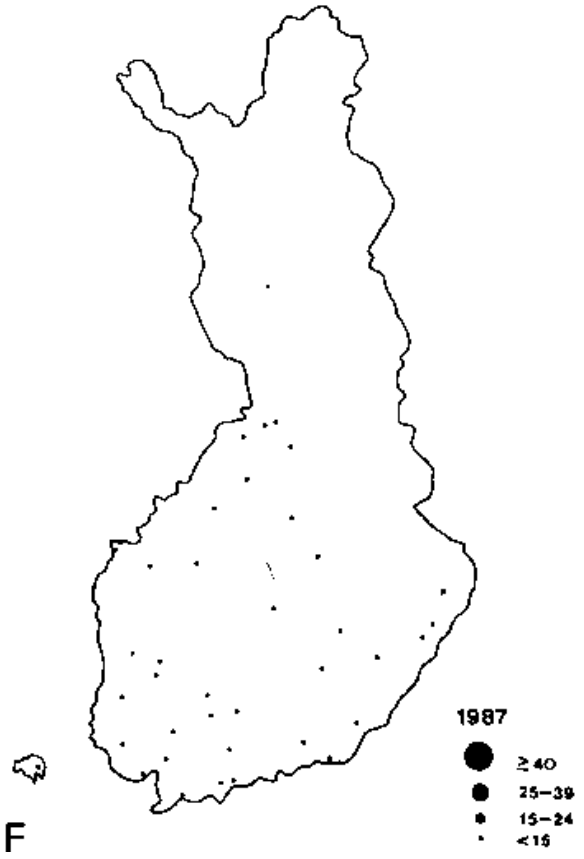


R. Padi forecast (damage potential) for the summer 1988: record number of aphids

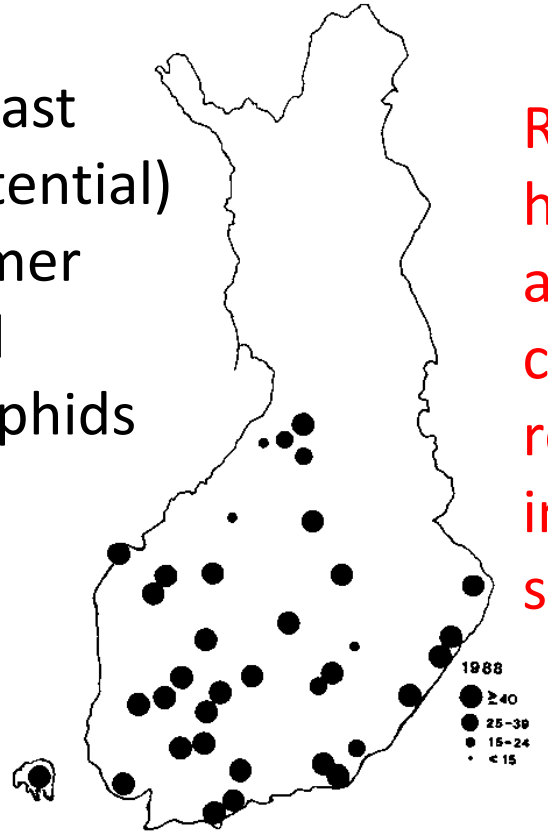
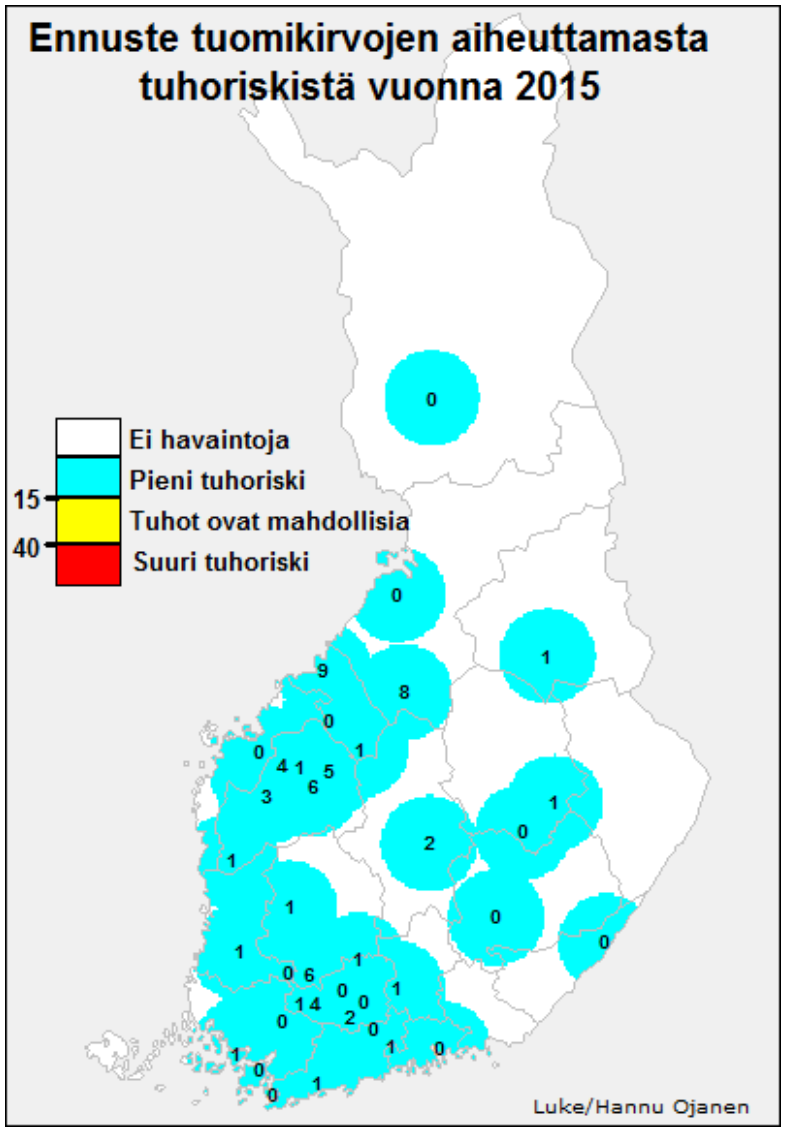
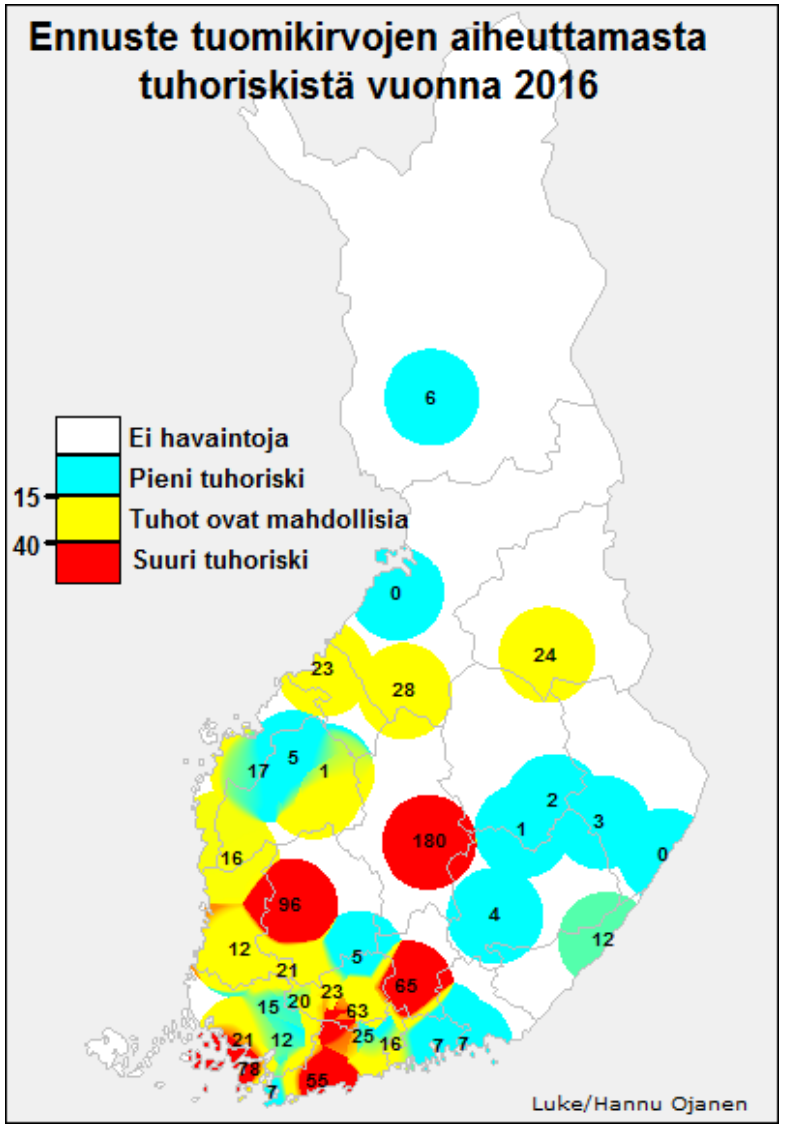


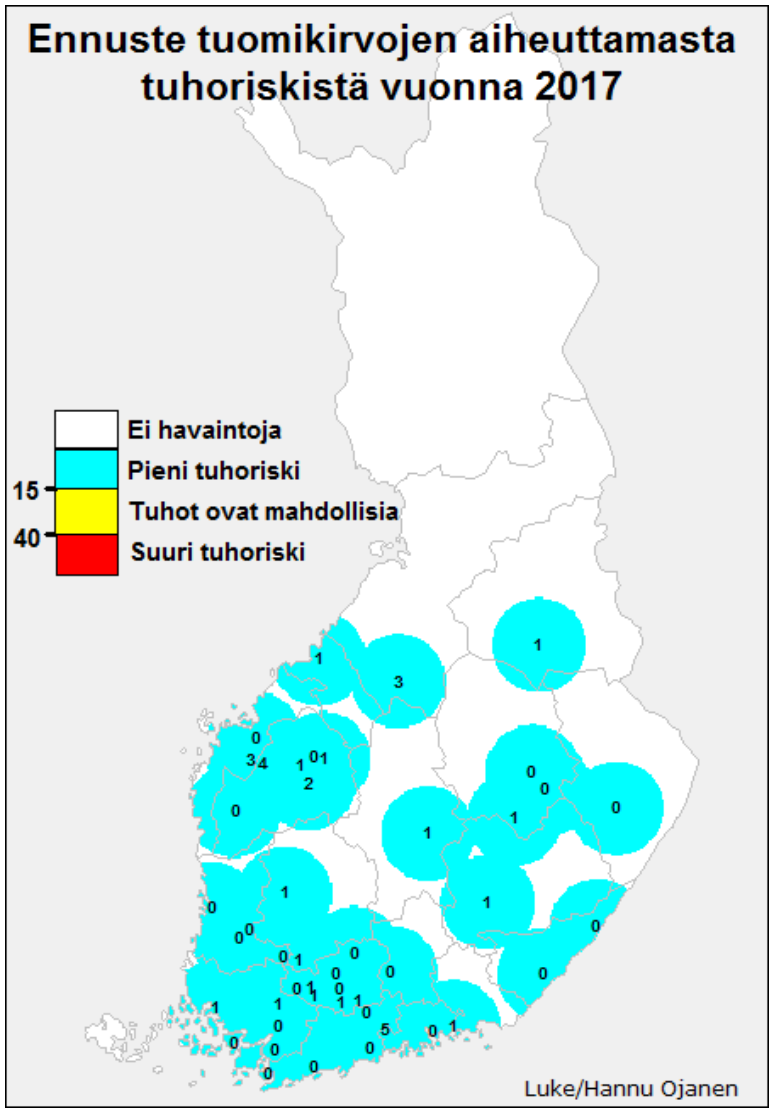
Fig. 1. *R. padi* winter eggs on bird cherry tree buds during 1981—1988. Scales show number of winter eggs per 100 buds of bird cherry tree, according to LEATHER (1983).

Resulted in highest aphid attack on cereals in recent ristory in early summer 1988

Same pattern in the new series: no aphid problems in 2015, huge damages in 2018, again no potential for damage in 2017







Pollen beetle parasitoids overwinter in the field soil of the rapeseed field, emerge in following spring

C-IPM

IPM Meligethes

C-IPM

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Key results from this study

Mean %-parasitism of pollen beetles is significantly, negatively correlated with the severity of aphid attack in the same year on spring sown cereals

Mean %-parasitism of pollen beetles is also significantly, negatively correlated with the annual sales of dimethoate (1986-1992)

The mean %-parasitism of pollen beetles, however, was not clearly associated with insecticide sprays to control the pollen beetle (spray window used? Or not enough data …)

Mean abundance of pollen beetle larvae in the current summer is significantly, negatively correlated with the %-parasitism of pollen beetles in the previous year

Conclusions

- Pollen beetle parasitoids are capable of completely controlling the pest and keeping it below economic threshold levels
- Parasitoid polulations are regularly, every few years, annihilated by chemical control of cereal aphids in the fields following rapeseed in the rotation. This happens region-wide in years of severe aphid attack, and prevents the effective natural control of pollen beetle by parasitoids.
- To more fully benefit from pollen beetle parasitoids, their populations should not be harmed by spraying insecticides on spring cereals in the fields where rapeseed was grown in the previous year

Conclusions

- Further techniques to ensure parasitoid preformance includes avoiding mechanical damage to hibernating parasitoids in the soil (ploughing, harrowing) of the rapeseed field after harvest (direct drilling of the next crop), and

- Physical proximity of rapeseed fields of consecutive years (parasitoids reach the new field in higher numbers)

Thank you for your attention

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