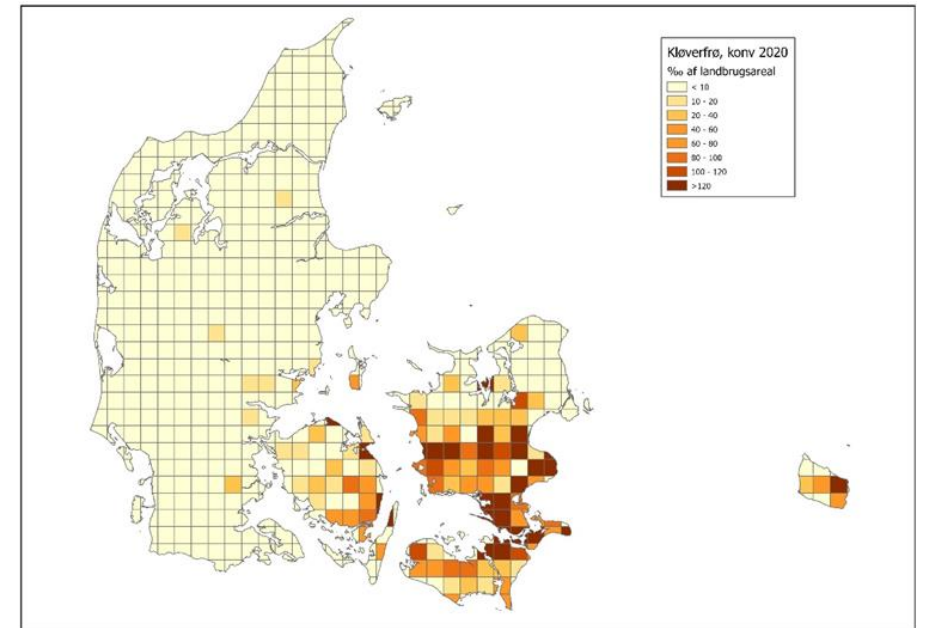


# Variation in $\lambda$ -cyhalothrin tolerance of the white clover seed weevil (*Protapion fulvipes*) and the clover head weevil (*Hypera meles*) in Danish white clover seed production.

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# WHITE CLOVER SEED CROP

- White clover (*Trifolium repens*) is an important component in grassland mixtures and as a green manure crop.
- Grass- and clover seed is grown on 60-80.000 ha by ca. 5,000 seed-farmers. Annual export is ca. 100.000 tons grass- and clover seed.
- Crop rotation with clover every 5th year is recommended to avoid nematodes and pathogens.
- Insects pests of clover are different weevil species, leaf beetles and aphids.



Conventional clover seed production in 2020.

# WHITE CLOVER PESTS

- In Denmark the White clover seed weevil (*Protapion fulvipes*) and the Clover head weevil (*Hypera meles*) are the main pests and seed yield losses of 40% have been reported.
- The damage caused by one larvae of clover head weevil is ten times greater than that caused by one larvae of clover seed weevil.
- It is recommended always to manage clover weevils in the spring. First spraying is done immediately before there are flowers in the field. By many weevils, the treatment can be repeated after 10-14 days. At least two treatments will often be needed against clover beetles.



# WHITE CLOVER SEED WEEVIL

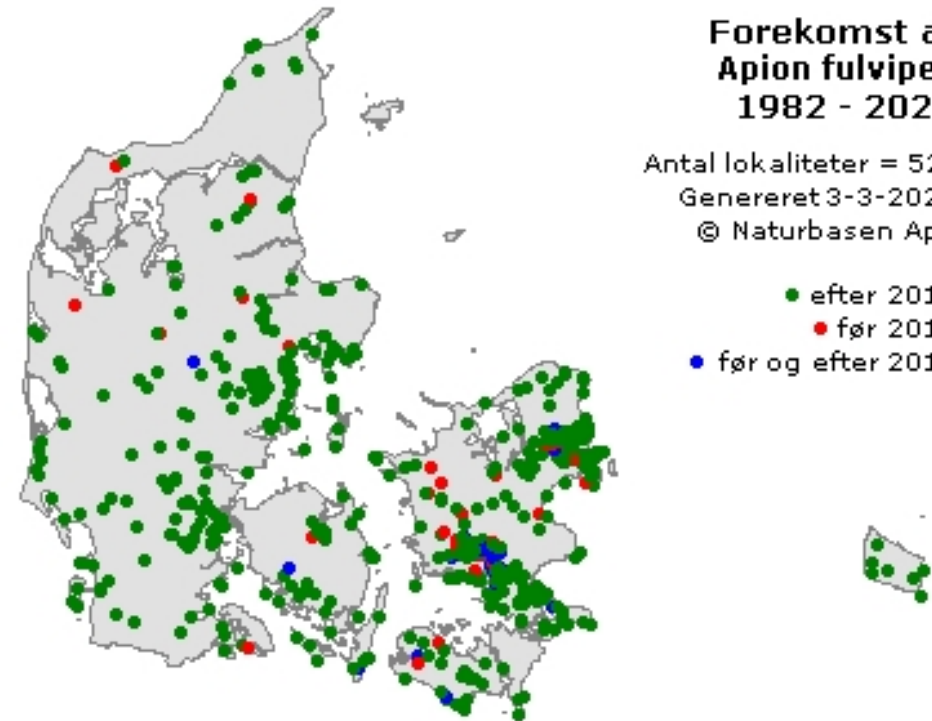
- A very small weevil; 1.9-2.2 mm.
- The species is found in all parts of the country and is one of Denmark's most common weevils.
- Associated with clover, but found in almost any well vegetated environment.
- Adults feed on leaves. Larvae feed in the flower heads of clover.



## Forekomst af *Apion fulvipes* 1982 - 2022

Antal lokaliteter = 523  
Genereret 3-3-2022  
© Naturbasen ApS

- efter 2012
- før 2012
- før og efter 2012



From "naturbase.dk"; a citizen science web-site.

# CLOVER HEAD WEEVIL

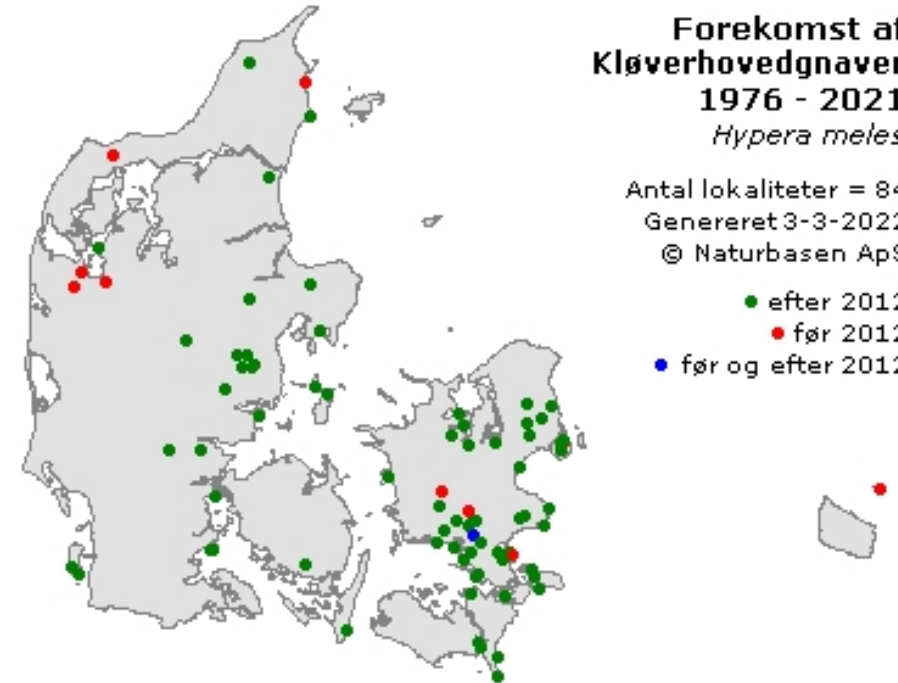
- A medium-sized weevil; 3.9-4.8mm.
- Its is common in Denmark, but more common in the eastern part.
- Its is likely to occur wherever clover is common; grassland, agricultural land, hedgerows and roadsides.
- Adults and larvae feed externally on the leaf , stem and pollen. Larvae also feed on seed and pods.
- 15% reduction in yield is seen.



**Forekomst af  
Kløverhovedgnaver  
1976 - 2021**  
*Hypera mele*

Antal lokaliteter = 84  
Genereret 3-3-2022  
© Naturbasen ApS

● efter 2012  
● før 2012  
● før og efter 2012



From "naturbase.dk"; a citizen science web-site.

# CONTROL OF CLOVER WEEVILS

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**Products approved (minor use or off label) for control of clover weevils.**

**2019 and 2020:**  $\alpha$ -cypermethrin (Fastac 50),  $\lambda$ -cyhalothrin (Karate 2,5WG), thiacloprid (Biscaya OD240).

**2021:**  $\alpha$ -cypermethrin (Fastac 50),  $\lambda$ -cyhalothrin (Lamdex), acetamiprid (Mospilan SG).

**2022:**  $\lambda$ -cyhalothrin (Lamdex), acetamiprid (Mospilan SG).

Mostly  $\lambda$ -cyhalothrin was used.

The recommended field dose for  $\lambda$ -cyhalothrin for clover weevils is the same as for pollen beetles  $75 \text{ ng cm}^{-2}$ .



# RESISTANCE TESTING OF CLOVER WEEVILS

- IRAC Susceptibility test Method 11; designed for pollen beetles (2-3mm).
- Glass vials coated with  $\lambda$ -cyhalothrin at 75 ng cm<sup>-2</sup> and 15 ng cm<sup>-2</sup> equal to 100% and 20% of recommended field rate.
- Making an assessment of severely affected beetles.
- Clover head weevil: 5 per vial
- White clover seed weevil: 10 per vial

Concentration (% of label rate)	Affected	Classification	Code
100%	100%	Highly Susceptible	1
20%	100%		
100%	100%	Susceptible	2
20%	< 100%		
100%	<100% to $\geq$ 90%	Moderately Resistant	3
100%	< 90% to $\geq$ 50%		
100%	< 50%	Highly Resistant	5

# CLOVER HEAD WEEVIL 2019

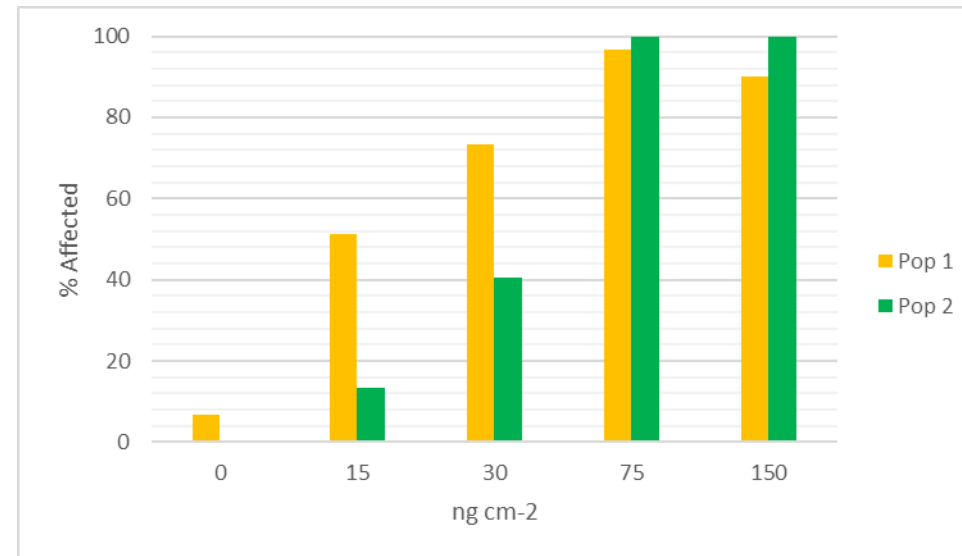
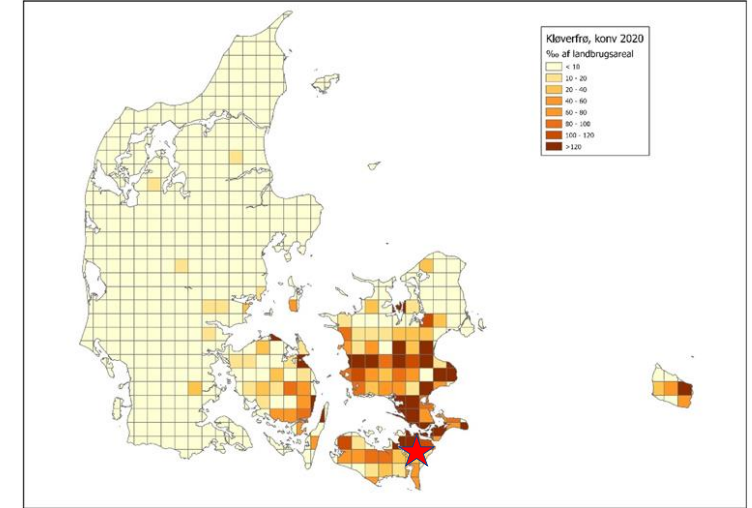
## IRAC 11:

- Two populations (tested by Agrolab).
- Four doses of  $\lambda$ -cyhalothrin + control.
- 12 vials with 5 weevils at each dose.

Pop 1 is moderate resistant (3)

Pop 2 is susceptible (2)

Note: Weevils are larger than pollen beetles, but recommended dose is the same!





# CLOVER HEAD WEEVIL 2020

## IRAC 11:

- Three populations from organic farms.
- Three doses of  $\lambda$ -cyhalothrin + control.
- 5 vials with 5 weevils at each dose.

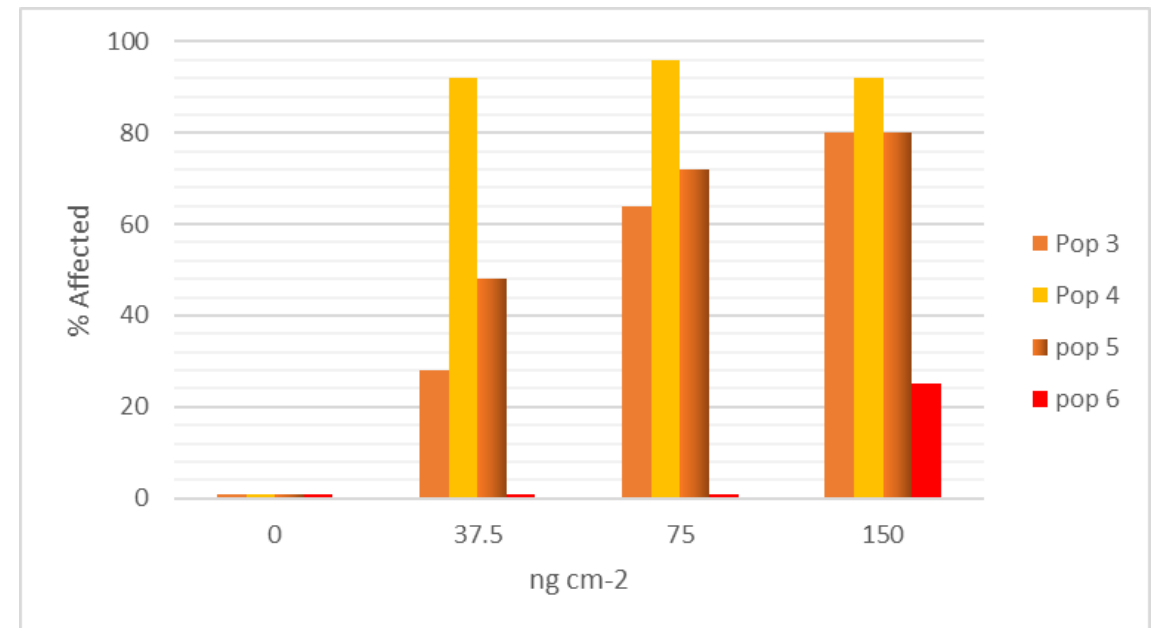
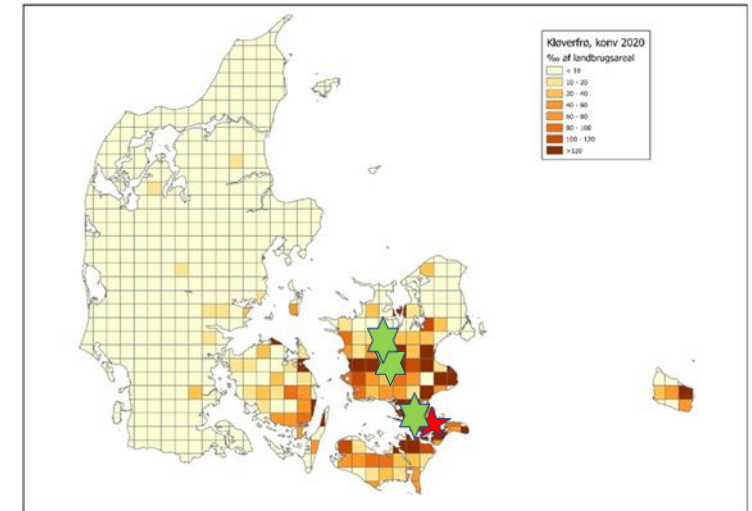
Pop 3 is resistant (4)

Pop 4 is moderate resistant (3)

Pop 5 is resistant (4)

[Pop 6 is very resistant (5)]

Note: Growers report they can't control clover head weevils and some fields are abandoned.



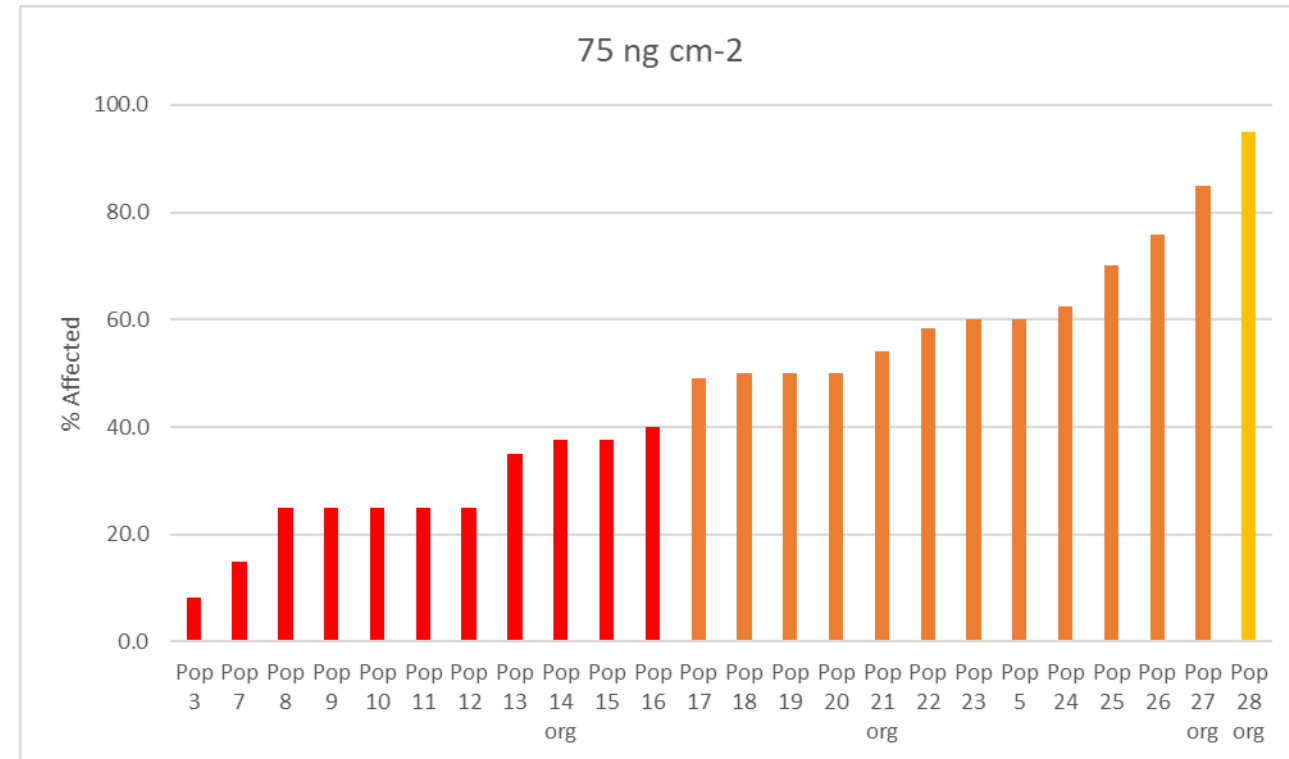
# CLOVER HEAD WEEVIL 2021

## IRAC 11:

- Twenty-four populations.
- Two doses of  $\lambda$ -cyhalothrin + control.
- 4 vials with 5 weevils at each dose.

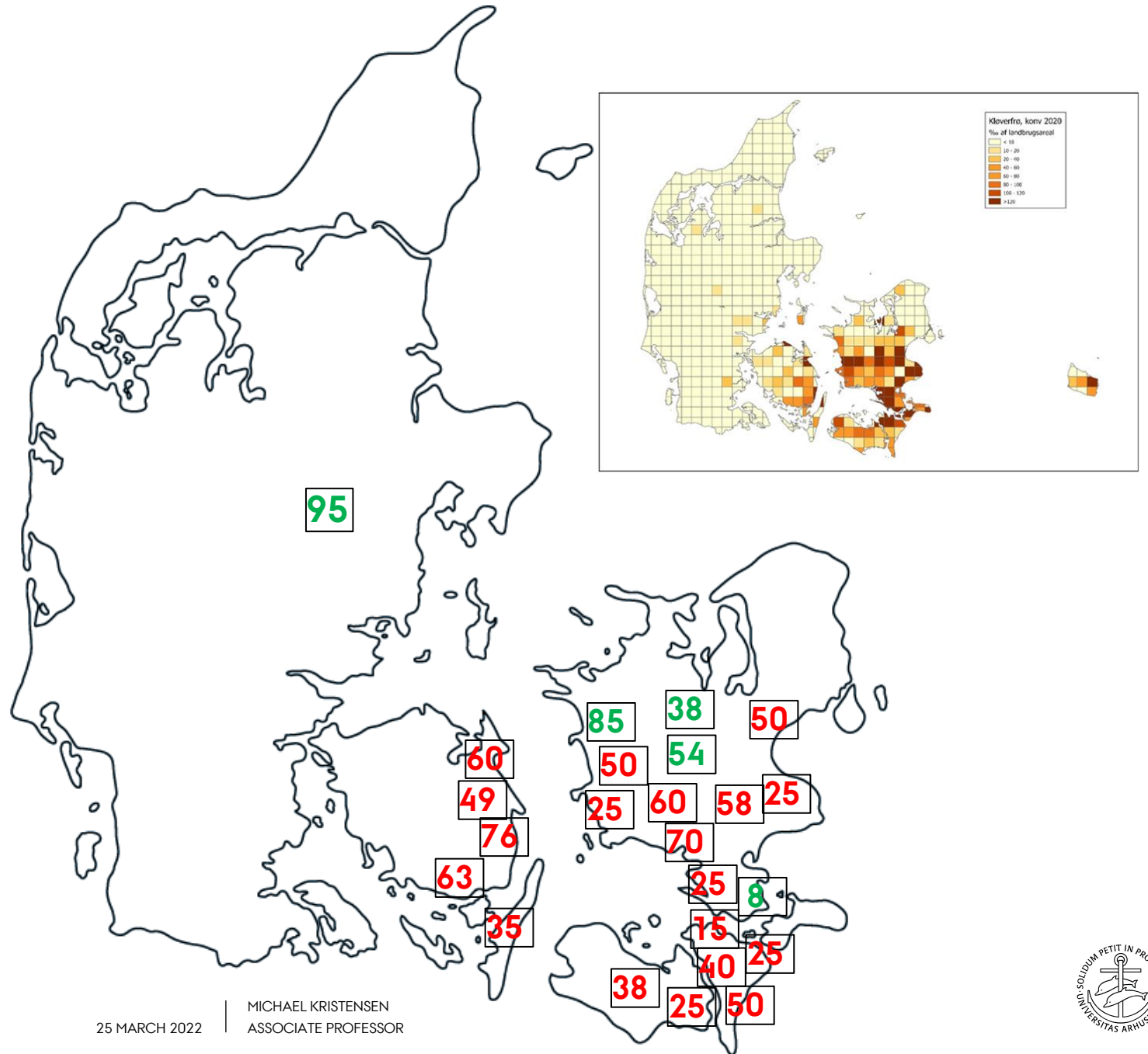
Four populations from organic farms were moderate resistant (3), resistant or highly resistant.

Ten populations from conventional farms were resistant (4) and ten were highly resistant (5).



The map shows the “% Affected”  
Green numbers indicate organic farms.

There is a clear geographical distribution of “% Affected” based on the initial observation of suspected pyrethroid resistance.



# CLOVER HEAD WEEVIL PYRETHROID RESISTANCE

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- There is some level of pyrethroid resistance.
- Calibration of vial-test is needed to be more exact in resistance level.
- Farmers repeatedly complain that Lamdex does not work.
- Presumably the wrong dose is used; ie for many years we have selected with sublethal dose.
- Does the adult weevil "Drop dead" behavior have an impact on selection?
- Larvae are only affected to a small degree; again sublethal selection.
- Knock-down weevils from vial-testing survive, when moved to non-toxic environment → metabolism?



# WHITE CLOVER SEED WEEVIL 2021

- Eight populations.
- Two doses of  $\lambda$ -cyhalothrin + control.
- 4 vials with 10 weevils at each dose.

IRAC 11:

Three populations from organic farms were susceptible (2).

Three population were moderate resistant (3) and two were resistant (4).

- Maybe emerging resistance.
- Note: There are no control problems.

