Norbarag 2017
Insecticide resistance in the Strawberry blossom weevil in Finland.

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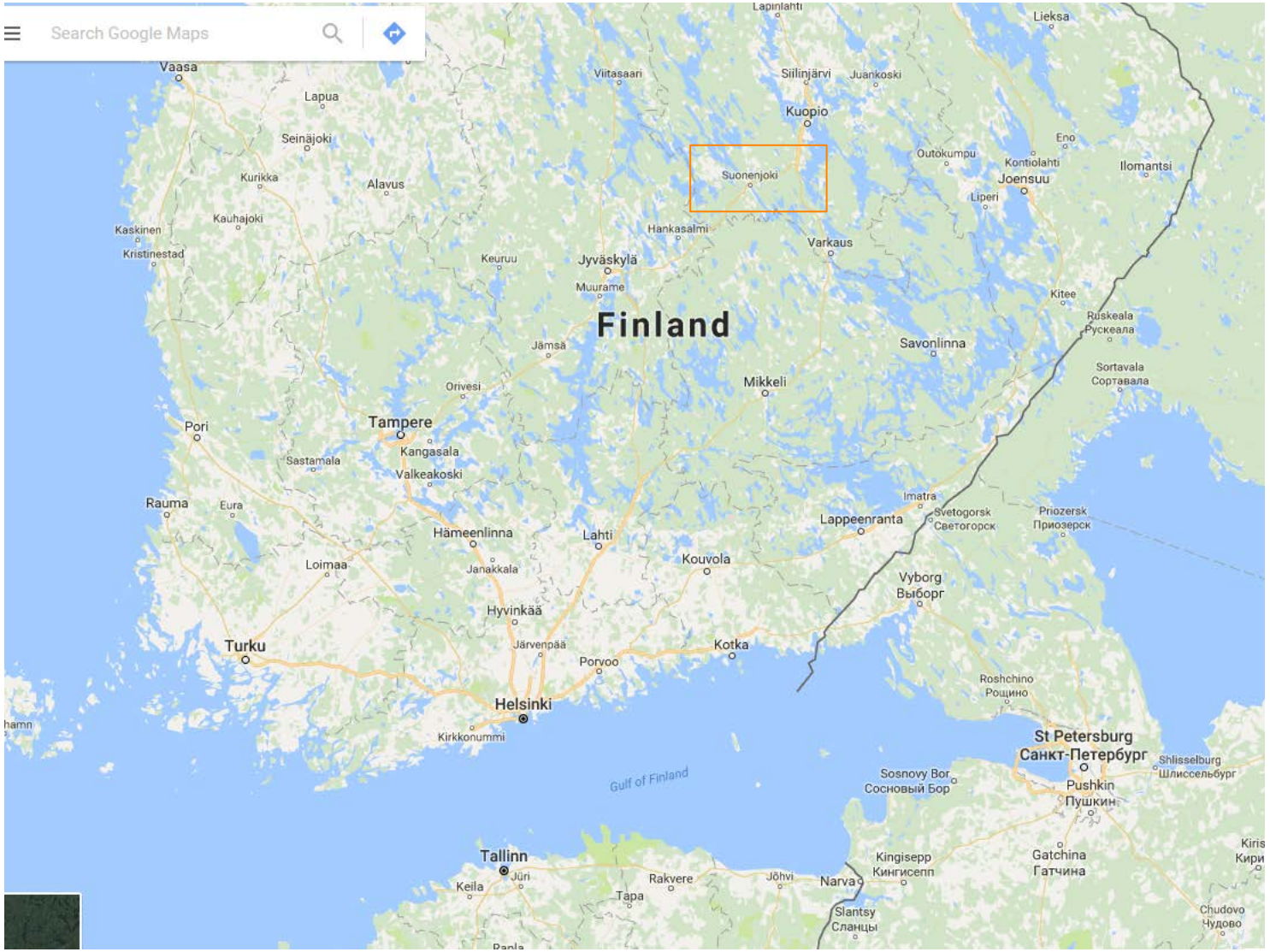
Insecticide resistance in the Strawberry blossom weevil in Finland.

- Strawberry blossom weevil (*Anthonomus rubi*) has been a severe problem almost every year during the last five years in the eastern part of country
- Spesialized strawberry farms have been concentrated in the same area in the frame of crop rotation
- In North Savo cultivated area of strawberry was 813 ha in 2014. In Suonenjoki for instance strawberry area of 56 farms was 290 ha (5.18 ha/farm)
- Pyrethroids were for many years the only insecticides allowed in Finland for control of strawberry weevil until Calypso was accepted for use against *A. rubi* in 2015



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About the life cycle of *A. rubi*

- Egglaying of A. rubi begins when the strawberry flower buds emerge (BBCH 57)
- Normally it is in the beginning of June, but may continue until end of July especially in cool weather
- Larvae of *A. rubi* live and pupate in the severed buds
- Emerging adults of *A. rubi* are feeding on strawberry leaves and petals wihout harming the plants.
- After some weeks adults of the new generation migrate to the hibernation sites in or near to the field
- Next spring the overwintering weevils feed on leaves before egglaying starts.

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- From the Suonenjoki area we received worried messages that strawberry fields suffered severe damages inspite of chemical control of *A. rubi*
- How to confirm or not suspicions of resistance against most pyrethroids in the growing area?
- The applied dose rate for e.g. Karate 2.5 WG (lambda-cyhalothrin 25g ai/kg) is 0.4-0.8 kg/ha
- In order to test the sensitivity of strawberry weevils the concentrations of 200 % (20 g ai/ha), 100 % (10 g ai/ha), 20 % (2 g ai/ha) and 0 % were planned to be checked in 2015
- Co-operator laboratory in making test vials was the Institute of Agriculture, LRCAF/ Dr. Smatas

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- In 2015 the spring was late and the weather was cool with rainshowers when the strawberry blossom weevils were collected for the vial tests
- After scouting the strawberry farms the number of collected weevils was less than planned
- 6 max 10 weevils were placed per each vial for 24 hours
- The vials with the highest concentration was left out from the test because of inadequate number of caught weevils
- It was concluded, that in some fields a decreased susceptibility was found
- Fields of susceptible strawberry weevils were assessed, as well.
- Additionally strawberry blossom weevil tests are planned to be carried out in 2016 related to the Project (BerryGrow)

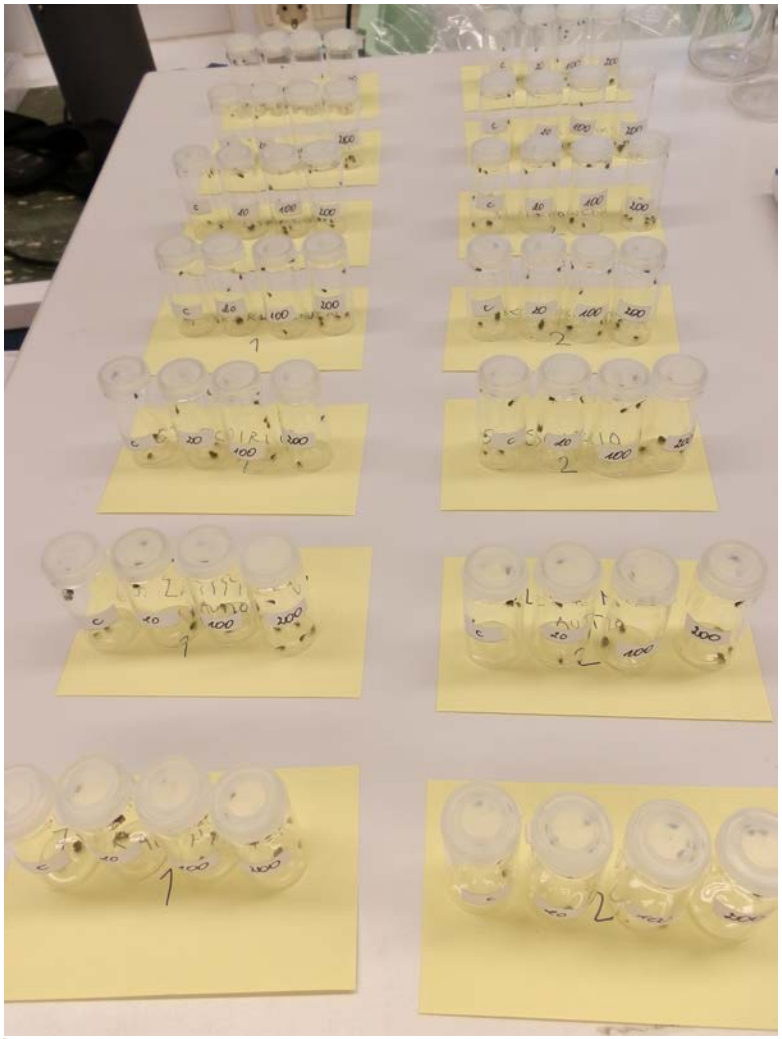
Sensitivity testing 2016

- The strawberry weevil samples were collected at two different occasions with a week in between in early June
- Samples from 7 respective 4 (due to spraying) conventional farms and one organic farm in the Suonenjoki region in Eastern Finland
- Weather changed from sunshine and 24 ^{o}C at the first sampling occasion to only 13 ^{o}C, cloudy and windy at the second one
- Tests were performed at Luke's laboratory in Suonenjoki and started the same day after sampling was finished
- 10 weevils/vial and checked after 24 h
- In order to test the sensitivity of strawberry blossom weevil the following concentrations of lambda-cyhalotrin were used: 0%, 20% (2 g ai/ha),100% (10 g ai/ha) and 200% (20 g ai/ha)

Results:

- Indications of decreased susceptibility against the pyrethroid was seen in most fields
- In spite of some adjustments due to experiences from the preliminary test in 2015 some problems occured

Sensitivity test in the laboratory

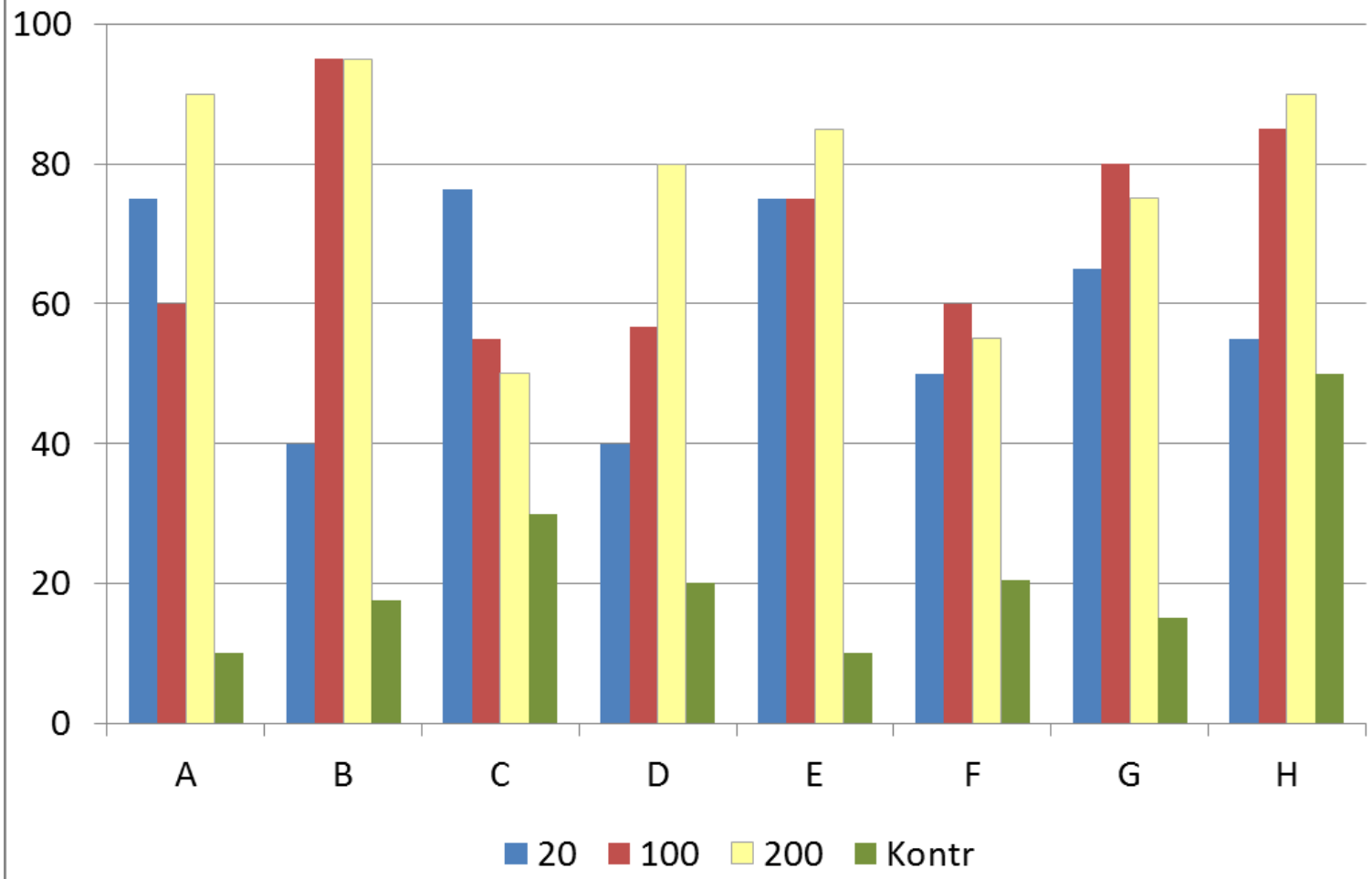


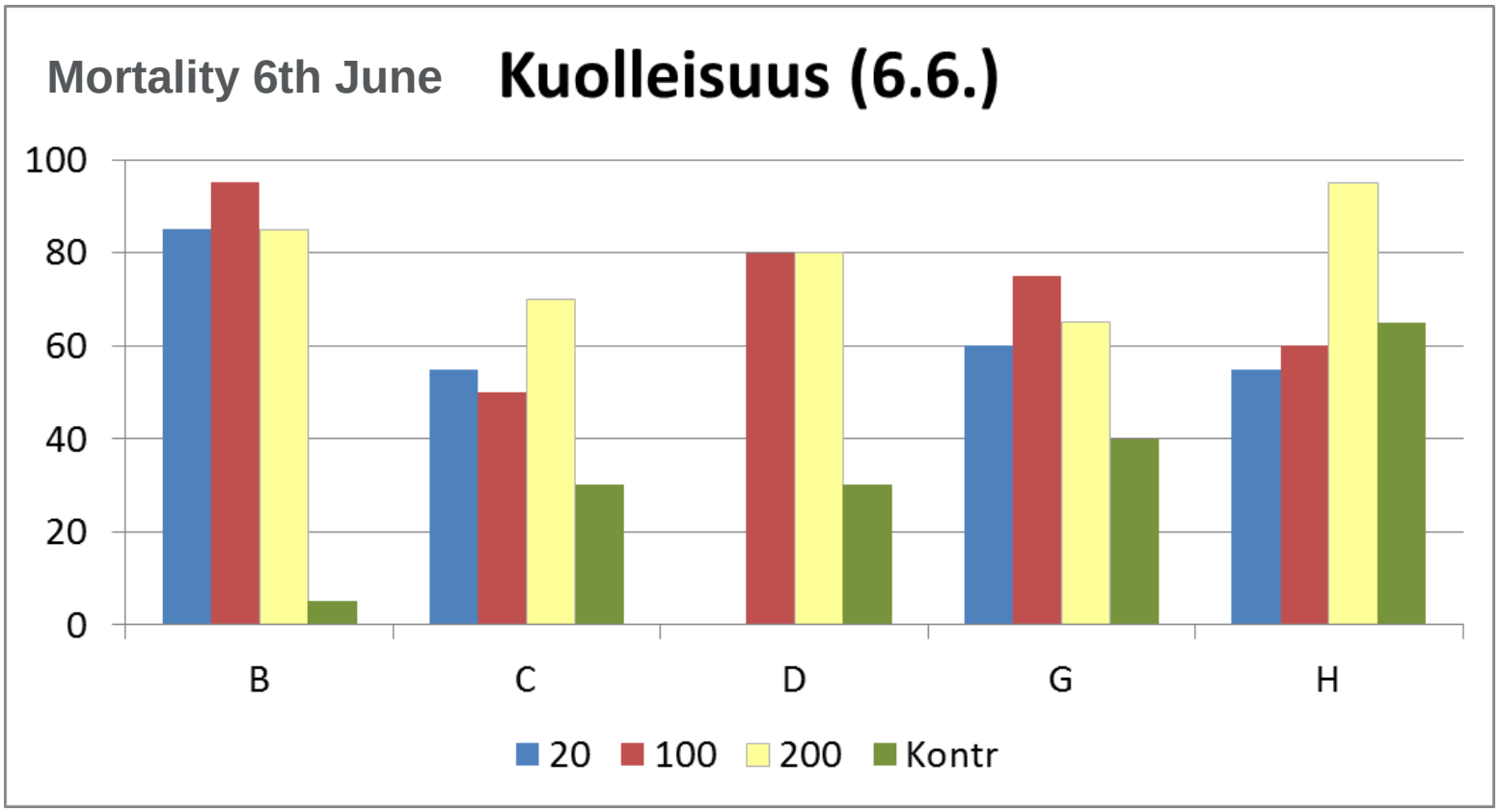
Insecticide resistance of the Strawberry blossom weevil in Finland. Preliminary results of 2015.

FIN	Suonen-joki 2015	Application rate	Affected	Alive	% Affected replic. 1	Affected	Alive	% Affected replic. 2	R1 and R2 % affected	code
					1.0			2.0		
1	Polka	100	4	2	66.7	6	0	100.0	83.3	
		20	6	0	100.0	6	0	100.0	100.0	
		utr	6	0	100.0	4	2	66.7	83.3	
1	Honey									
		100	5	0	100.0	4	1	80.0	90.0	
		20	3	2	60.0	6	0	100.0	80.0	
		utr	1	4	20.0	3	2	60.0	40.0	
2	Honey									
		100	5	0	100.0	6	0	100.0	100.0	
		20	6	0	100.0	6	0	100.0	100.0	
		utr	2	4	33.3	5	1	83.3	58.3	
3	Polka									
		100	5	0	100.0	5	0	100.0	100.0	
		20	5	0	100.0	4	1	80.0	90.0	
		utr	3	2	60.0	1	4	20.0	40.0	
4	Honey									
		100	4	0	100.0	4	0	100.0	100.0	
		20							0.0	
		utr	2	2	50.0	1	3	25.0	37.5	
4	Polka									
		100	8	2	80.0	10	0	100.0	90.0	
		20	10	0	100.0	7	3	70.0	85.0	
		utr	5	5	50.0	4	5	44.4	47.2	

1)Susceptible: Mortality at 20% rate =100%
2)Decreased susceptibility: Mortality at 20% rate between 90 and 100%
3)Resistance suscepted: Mortality at 20% rate <90%

Mortality 31st May Kuolleisuus % (31.5)





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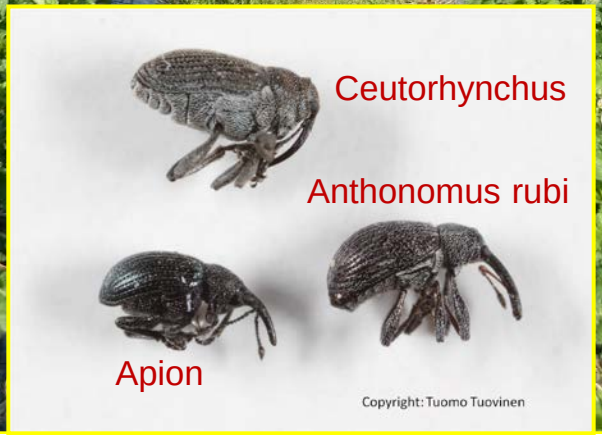
Monitoring



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Pesticides allowed in strawberry in Finland

Pyretroids:
Decis Mega EW 50), Maatilan deltametriini
Cyperkill 250 EC – withdrawing from market
Cooper Cyper – withdrawing from market
Fastac 50 EC , Maatilan sypermetriini
Kestac 50 EC
Karate Zeon-tekniikka, Maatilan syhalotriini 2
Mavrik 2 F (tau-fluvalinate)

Neonicotinoids:
Calypso SC 480 (thiacloprid)

Indoxacarbs:
Steward^{R} (indoxacarb), 2016

Resistance: decreased susceptibility of a pestpopulation to a pesticide

- Inheritable
- Some individuals of a pest population tolerate repeated use of eg a certain insecitcide better than others -> they survive and part of their offspring will inherit the ability to survive exposure to this insecticide. In the course of time most of the pest population has this trait.
- Metabolic resistance most common
  - Resistant organisms can destroy the toxin faster than susceptible organisms
  - Enzymes break down insecticides - higher levels or more efficient enzymes
  - Broad spectrum activity
- Pesticides are divided according to their mode of action eg pyrethroids
- An insect population can be resistant against two different active ingredients within the same class of insecticides → cross-resistance
- Target-site resistance – genetic modification at the site of action
- Behavioural resistance – avoidance of the toxin

INSEKTISIDIRESISTENSSI

Torjuntateho

Käytä valmisteita optimaalisesti
- Tehokas annostus
- Oikea ajoitus
- Hyvät edellytykset

Arvioi torjuntatarve
- Seuraa torjuntakynnyksiä
- Valitse tehokas valmiste
- Vaihtele tehoaineita

Estä! Harkitse vaikutuksia:
- Viljelykierto
- Kasvinvalinta
- Lajikevalinta
- Kylvöaika

Metabolinen resistenssi
Metabolinen resistenssi on yleisin resistenssimekanismi hyönteisillä ja suurin haaste. Kestävät eli resistentit hyönteiskannat hajoittavat insektisidejä nopeammin kuin ei-resistentit hyönteiset. Hyönteisten entsyymitoiminta hajoittaa insektisidejä. Resistenteillä hyönteisillä on tehokkaampi näiden entsyymien muodustumiskyky. Nämä entsyymit voivat hajoittaa monia erilaisia insektisidejä.

Target-site resistenssi
Hyönteisessä on tapahtunut geneettinen muuntautuminen, joka hidastaa insektisidin kiinnittymistä tai vaikutusta kohteessa. Siten insektisidin teho vähenee tai loppuu kokonaan.

Karbamaatit
Asetyylikoliini-esteraasin estäjä (AChE) inhibitors
1A

Pyretroidit
Natrium-kanavien toimintaan vaikuttaja
3A

Neonikotinoidit
Nikotiiniasetyyli-koliini reseptorien vastavaikuttaja (nAChR) antagonists
4A

Spinosyn
Nikotiiniasetyyli-koliini reseptorien aktivaattorit (nAChR)
5

Flonikamidi
(Pyridin-karboksimidi)
Valikoivat yhtälöissiipisten (kaskaat) syönninestäjät
9C

Indoksakarbi
Natrium-kanavien tukkijat
22A

Laji	Tehoaineryhmä	Resistenssityyppi	Käytettävissä vaihtoehtoja
Rapsikuoriainen, Rapsbagge (S) (*Meligethes aeneus*) (L)	Useimmat pyretroidit	Metabolinen	Kyllä. Ryhmissä 4A ja 22A

Muista! Sinä itse voit tehdä paljon: •Torju kun torjunta-kynnys ylittyy • Käytä ja vaihtele valmisteita joilla on erilainen vaikutustapa!

IRAC ryhmä	Ryhmä	Vaikutustapa	Esimerkkejä tehoaineista	Esimerkkejä valmisteista
1A	Karbamaatit	Asetyylikoliiniesteraasin estäjä	Pirimikarbi	Pirimor (ei Suomessa)
3A	Pyretroidit, pyretriini	Natriumkanavien toimintaan vaikuttaja	Luonnon pyretriini	Bioruiskute S
			Alpha-sypermetriini	Fastac 50, Fastac T
			Sypermetriini	Cyperkill 250 EC
			Deltametriini	Decis Mega EW 50
			Esfenvaleraatti	Sumi Alpha 5 FW
			Lambda-syhalotriini	Karate 2.5 WG, Karate Zeon-tekniikka
			Tau-fluvalinaatti	Mavrik 2 F
4A	Neonikotinoidit	Nikotiini – asetyleenikoliini – reseptorien vastavaikuttaja	Asetamipridi	Mospilan
			Kloatianidiini	Elado FS 480
			Imidaklopridi	Confidor WG 70, Gaucho WS 70
			Tiaklopridi	Biscaya OD 240, Calypso-valmisteet
			Tiametoksaami	Cruiser-valmisteet
9C	Flonikamidi	Valikoiva yhtälöissiipisten ravinnonoton estäjä	Flonikamidi	Teppeki
22A	Indoksakarbi	Natriumkanavien tukkija	Indoksakarbi	Avaunt, Steward

Taulukko on tehty kevään 2013 tietojen mukaan. Päivitetyt tiedot markkinoilla olevista kasvinsuojeluaine-valmisteista TUKESin kasvinsuojeluainerekis-teristä.
http://www.tukes.fi/kasvinsuojeluainerekisteri

Preventative measures:

- Avoid using the same type of products during the season
- Prefer short-term products
- If possible, do not spray the whole area - sensitive individuals remain

Further information:

- http://www.irac-online.org/
- www.mtt.fi/norbarag
- https://jukuri.luke.fi/handle/10024/532360

Thank you!

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