Cercospora Leaf Spot in sugar beet: spread, crop protection strategies and resistances to fungicides in Serbia

Dr Dragana Budakov
dbudakov@polj.uns.ac.rs

University of Novi Sad
Faculty of Agriculture
Department for Plant and Environmental Protection
Trg Dositeja Obradovica 8
21000 Novi Sad
Serbia

CLS resistance workshop, Sipcam-Oxon, October 20th, 2015, Milano

TOPICS:

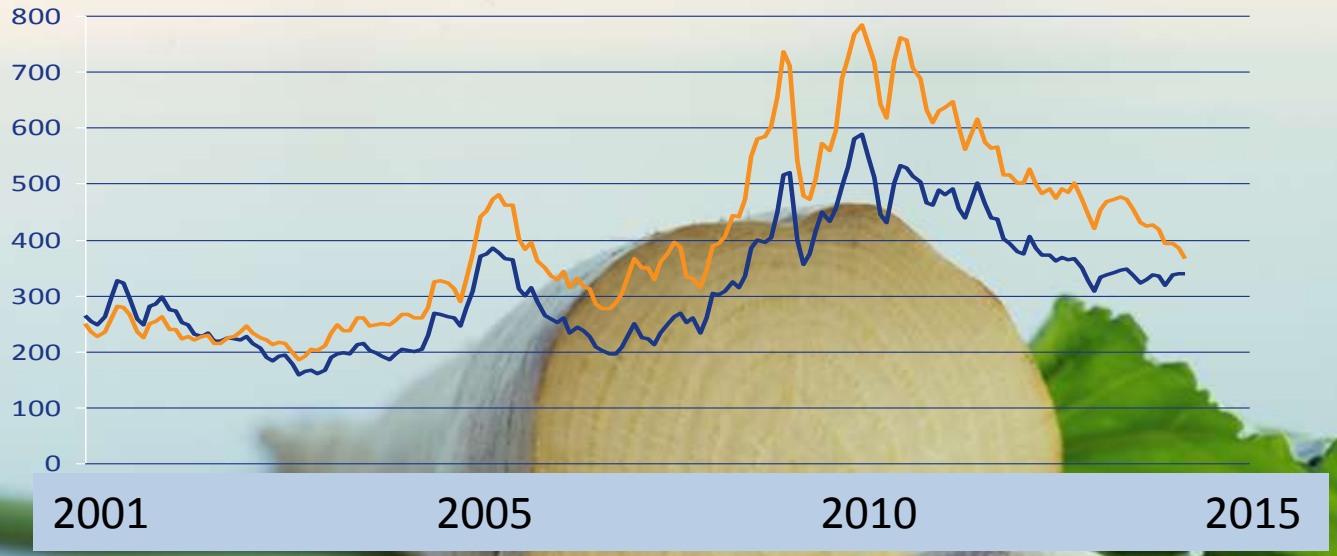
1.Introduction: SB production parameters, damages from CLS, epidemiology, available control measures.

2. Research of *C. beticola* resistance to fungicides in Serbia.

3. Presentation of results from trials in 2011 and 2015. Possible management strategies.

4. Conclusions.

Sugar beet areas and production in Serbia



2005-2013
- 70.000 ha
- 50 t/ha
-16%

PROFIT!

Economical losses

CLS MONITORING IN SERBIA

1. State extension service
2. Private extension services
3. Plant Protection officers in chemical, sugar production, seed and other companies

4. University-Faculty of Agriculture – science (companies like Sunoko, Hellenic sugar, KWS, STRUBE, Sesvandehave etc co-finance research)

1st spots and conidia – usually mid to end of June

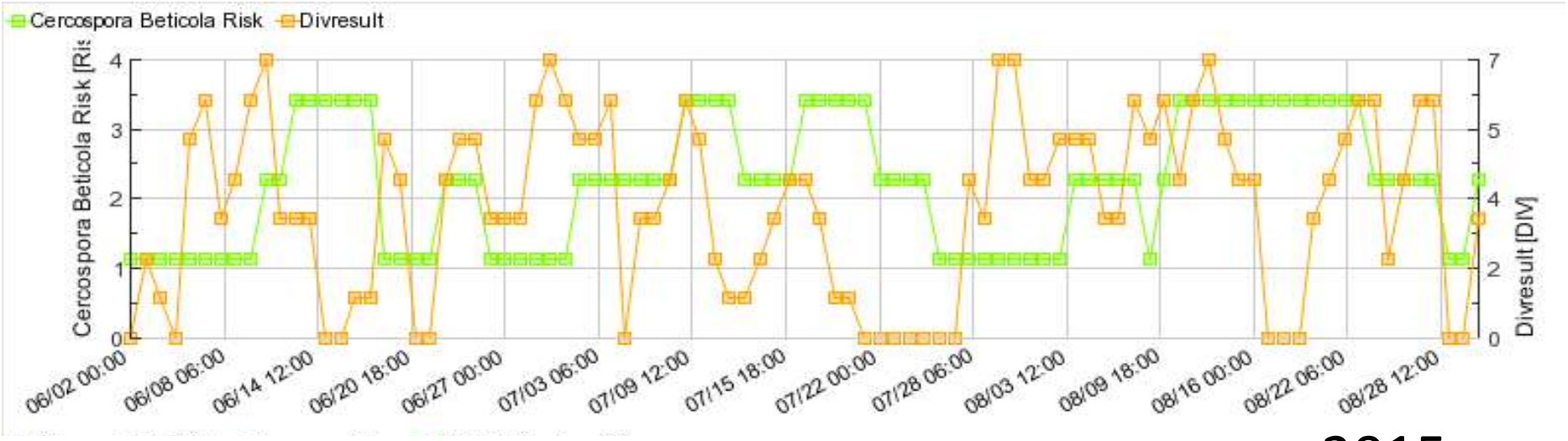
EPIDEMILOGY

First applications - first decade of July

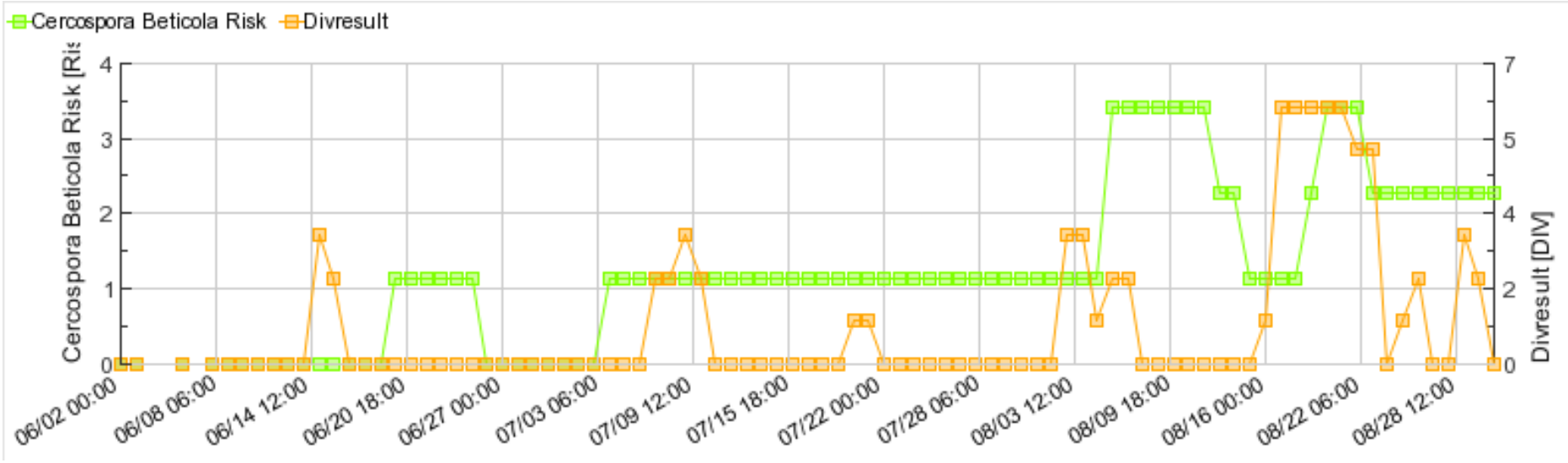
Based on characteristics of each individual field (cultivar, canopy density, temperatures, rainfall, inoculum – 5% infection is a treshold)

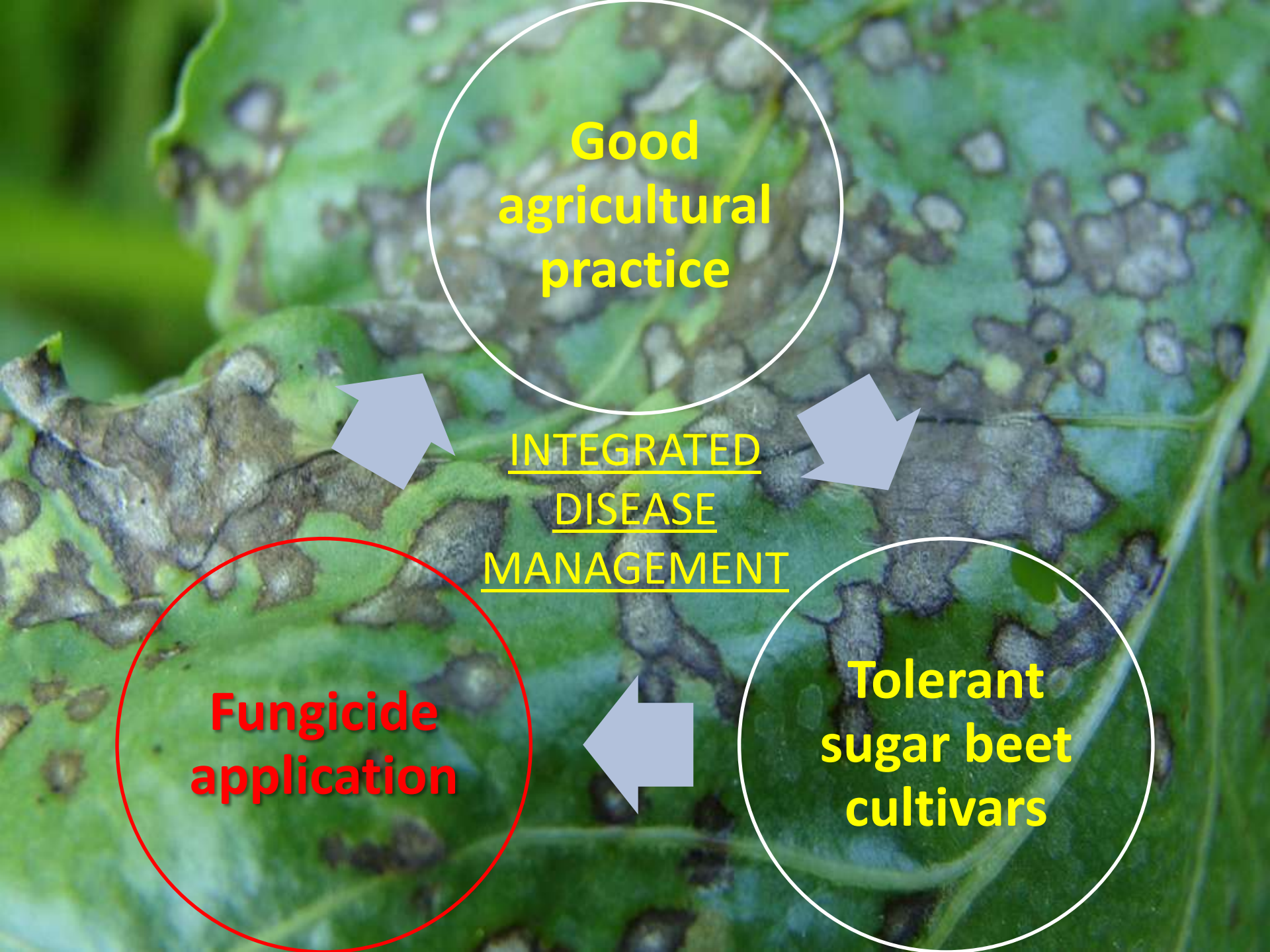
Periods favorable for CLS infection and spread vary from year to year (no irrigation)

2014

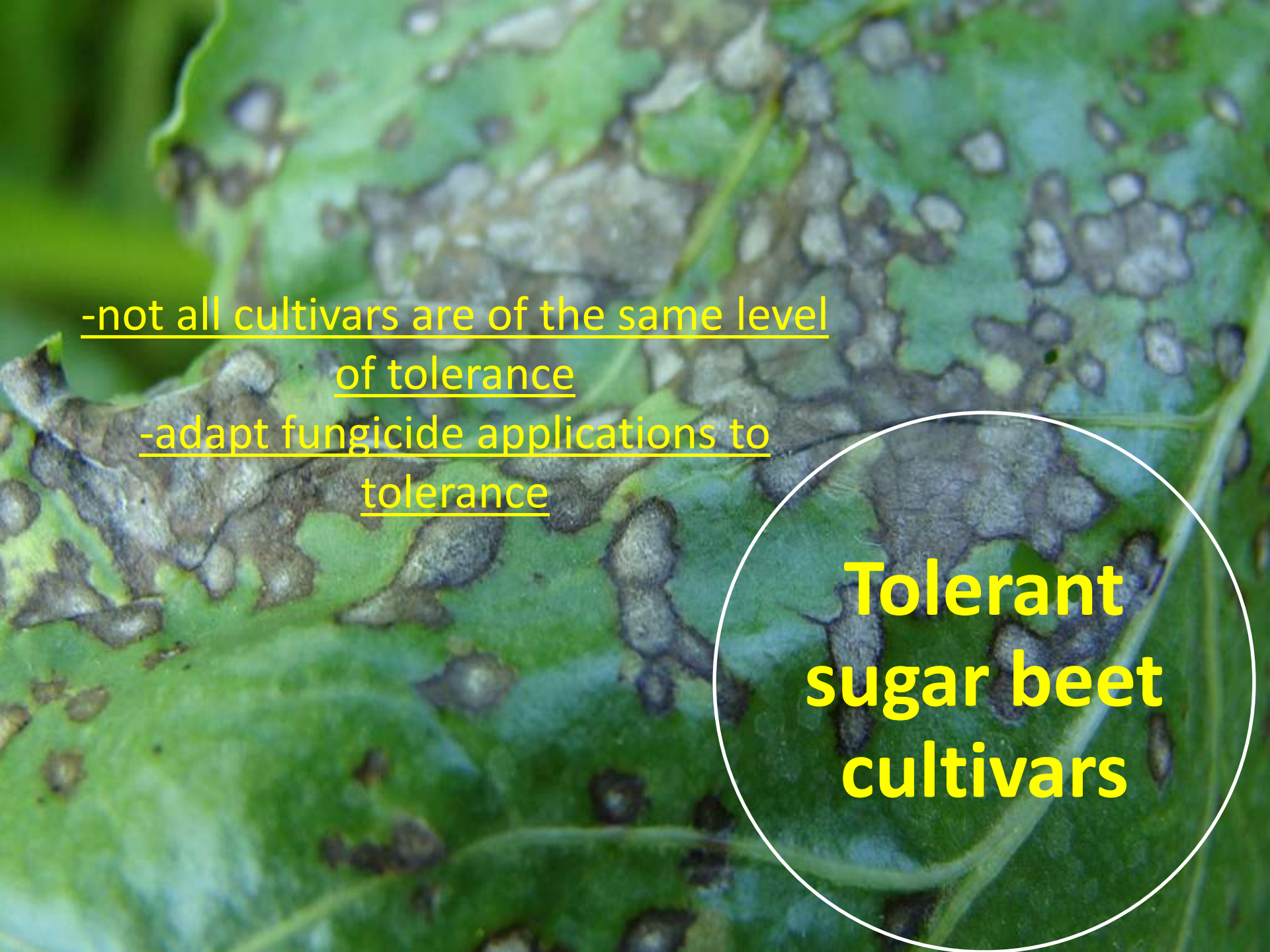


2015

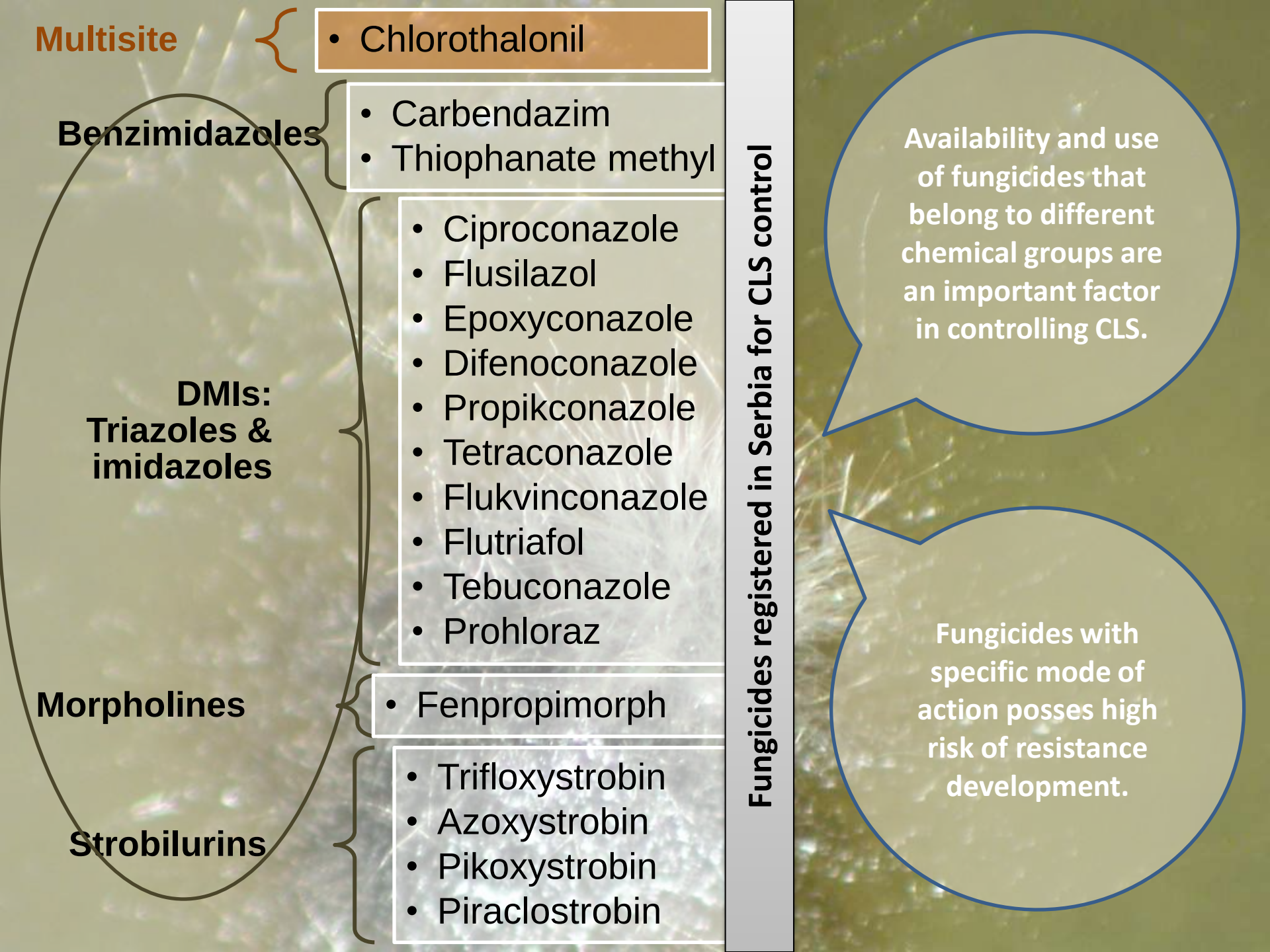



Good agricultural practice
INTEGRATED DISEASE MANAGEMENT
Tolerant sugar beet cultivars
Fungicide application


Good agricultural practice
-narrow crop rotation!!!
-excessive nitrogen fertilization
-reduced cultivation (diseased leaves not being properly handled)


-not all cultivars are of the same level of tolerance
-adapt fungicide applications to tolerance
Tolerant sugar beet cultivars


Fungicide
application


Multisite
• Chlorothalonil
Benzimidazoles
• Carbendazim
• Thiophanate methyl
DMIs: Triazoles & imidazoles
• Ciproconazole
• Flusilazol
• Epoxyconazole
• Difenoconazole
• Propikconazole
• Tetraconazole
• Flukvinconazole
• Flutriafol
• Tebuconazole
• Prohloraz
Morpholines
• Fenpropimorph
Strobilurins
• Trifloxystrobin
• Azoxystrobin
• Pikoxystrobin
• Piraclostrobin
Fungicides registered in Serbia for CLS control
Availability and use of fungicides that belong to different chemical groups are an important factor in controlling CLS.
Fungicides with specific mode of action posses high risk of resistance development.

2. Cercospora resistance to fungicides in Serbia

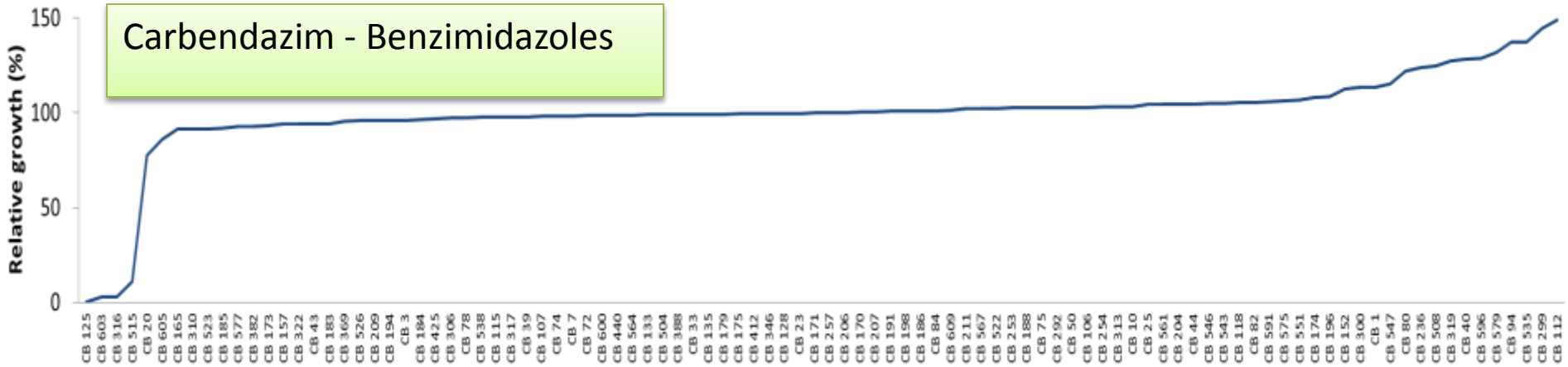
a stable, heritable pathogen adaptation that results in a reduced sensitivity to a fungicide (**Gallian et al., 2001**).

enables individuals within the population to survive the application of fungicides (**Brent & Holloomon, 2007**).

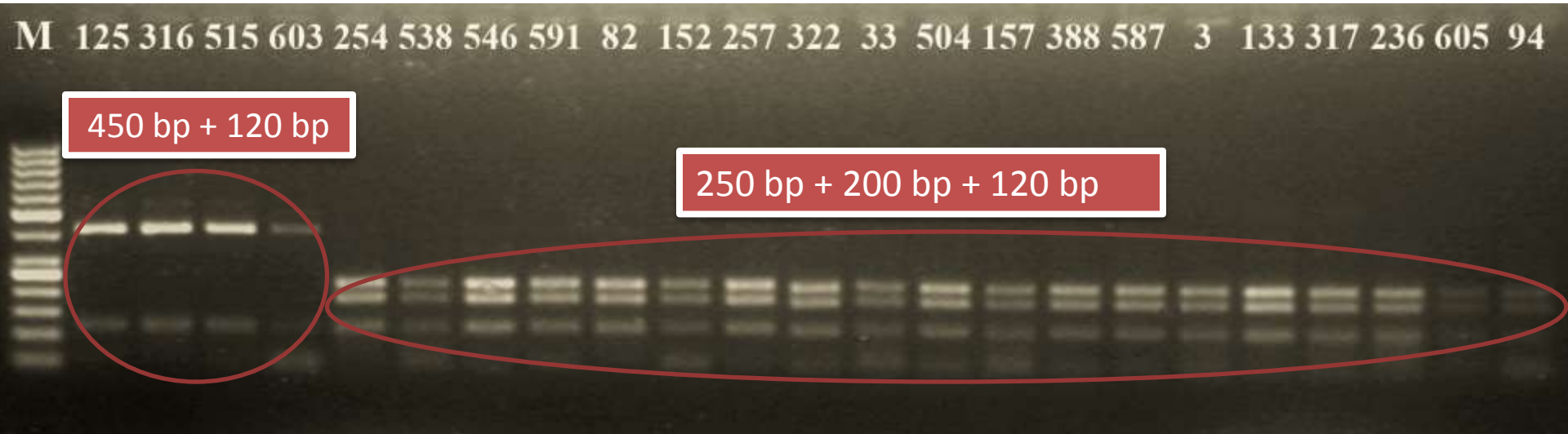
- Benzimidazoles (**Georgopoulos & Dovas, 1973; Marić et al., 1976**),
- Tin containing fungicides (**Giannopolitis, 1978; Bugbee, 1996; Campbell et al., 1998**),
- DMI fungicides (**Balaž et al., 1999; Karaoglanidis et al.; 2000, Budakov et al., 2014**)
- Strobilurins (**Kirk et al., 2012; Budakov-unpublished data**).

Benzimidazoles

- Partially discontinued after the rise during 1970s
- In combinations with DMIs
- Monitoring of resistance (2007-2011) showed that **frequency of resistant isolates was over 93%** (Budakov et al, 2014; Trkulja et al., 2015).
- Fitness of resistant isolates – very stable even without fungicide selection pressure (Karaoganidis & Ioannidis, 2010).
- On fields with low frequency of resistant isolates can be used in management of *C. beticola* resistance to DMIs or QoIs.



Restriction of β-tubulin gene with Bsh1236I



DMIs

- First changes of sensitivity noted in 1995 (flutriafol).

Polygenic nature of resistance

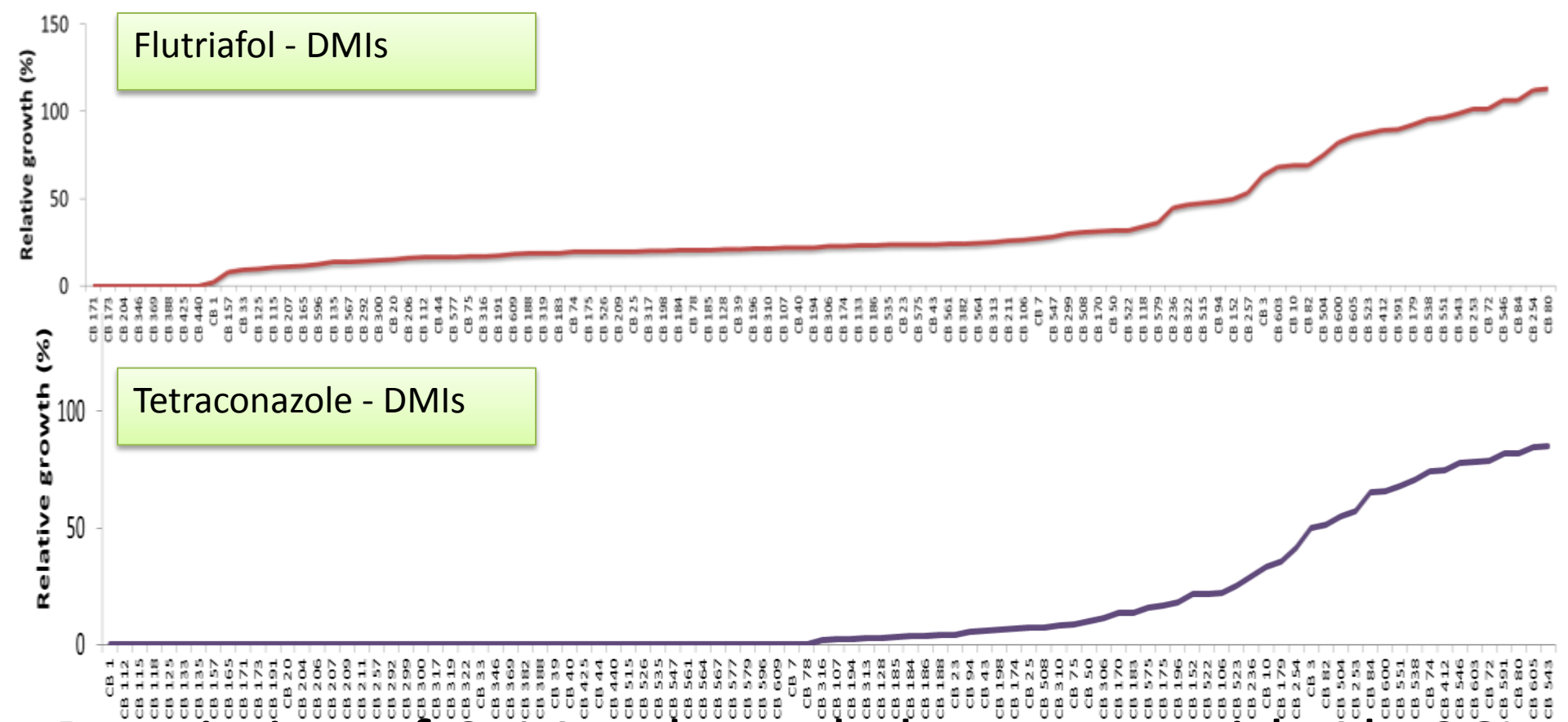
+

a large number of active substances available

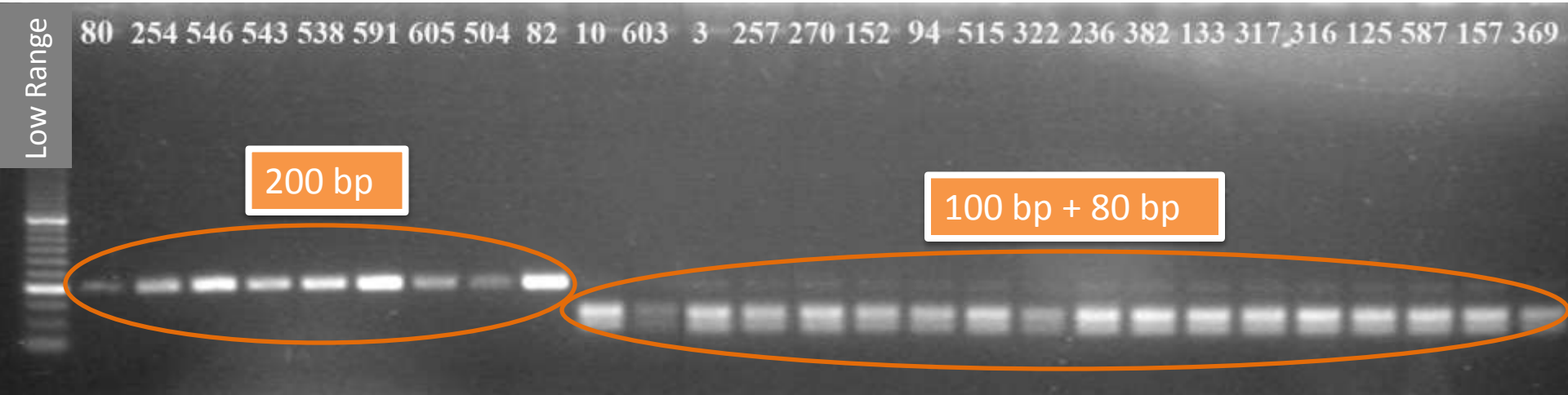
=

slowly development of resistance

- Monitoring from 2007-2011 showed that frequency of resistant varied **up to 42%** (Budakov et al, 2014; Trkulja et al., 2015), but level of sensitivity also varied.
- Continuous sensitivity distribution.



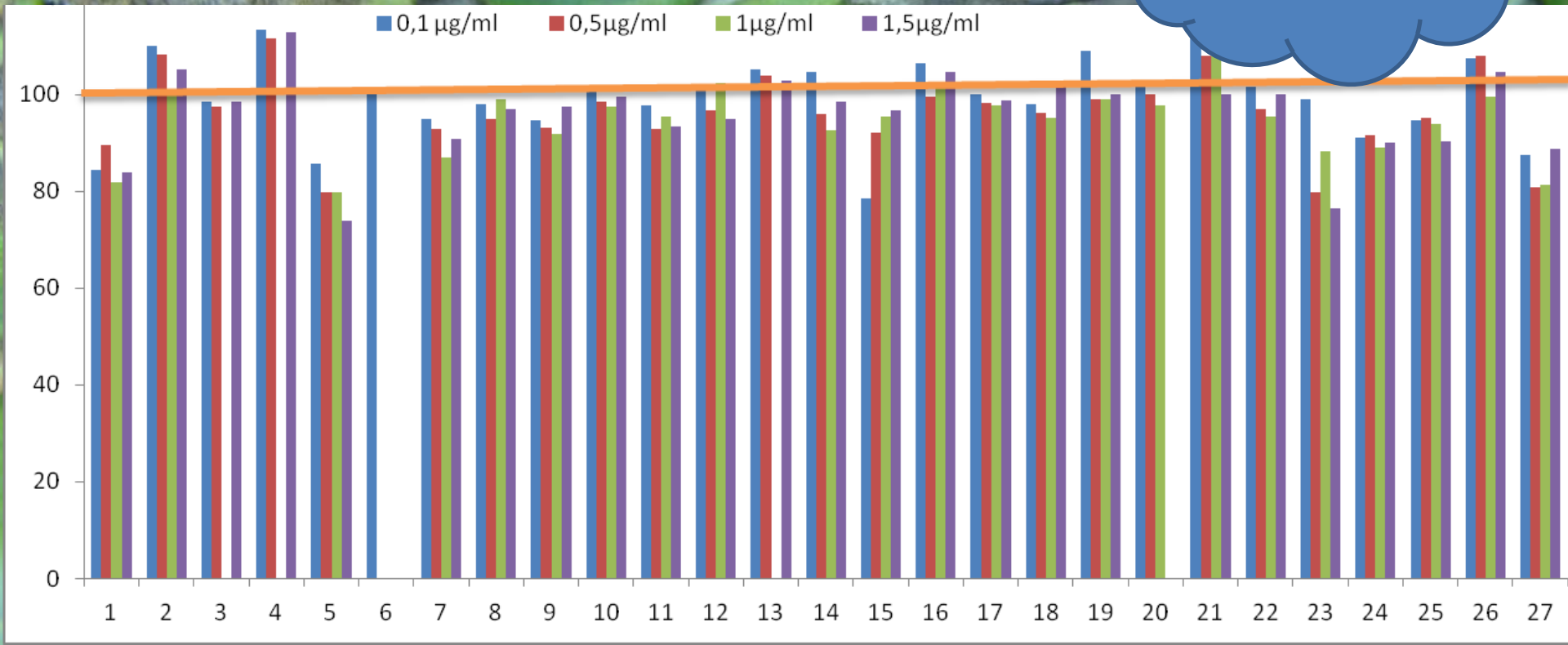
Restriction of C-14 α demethylase gene with Alw26I



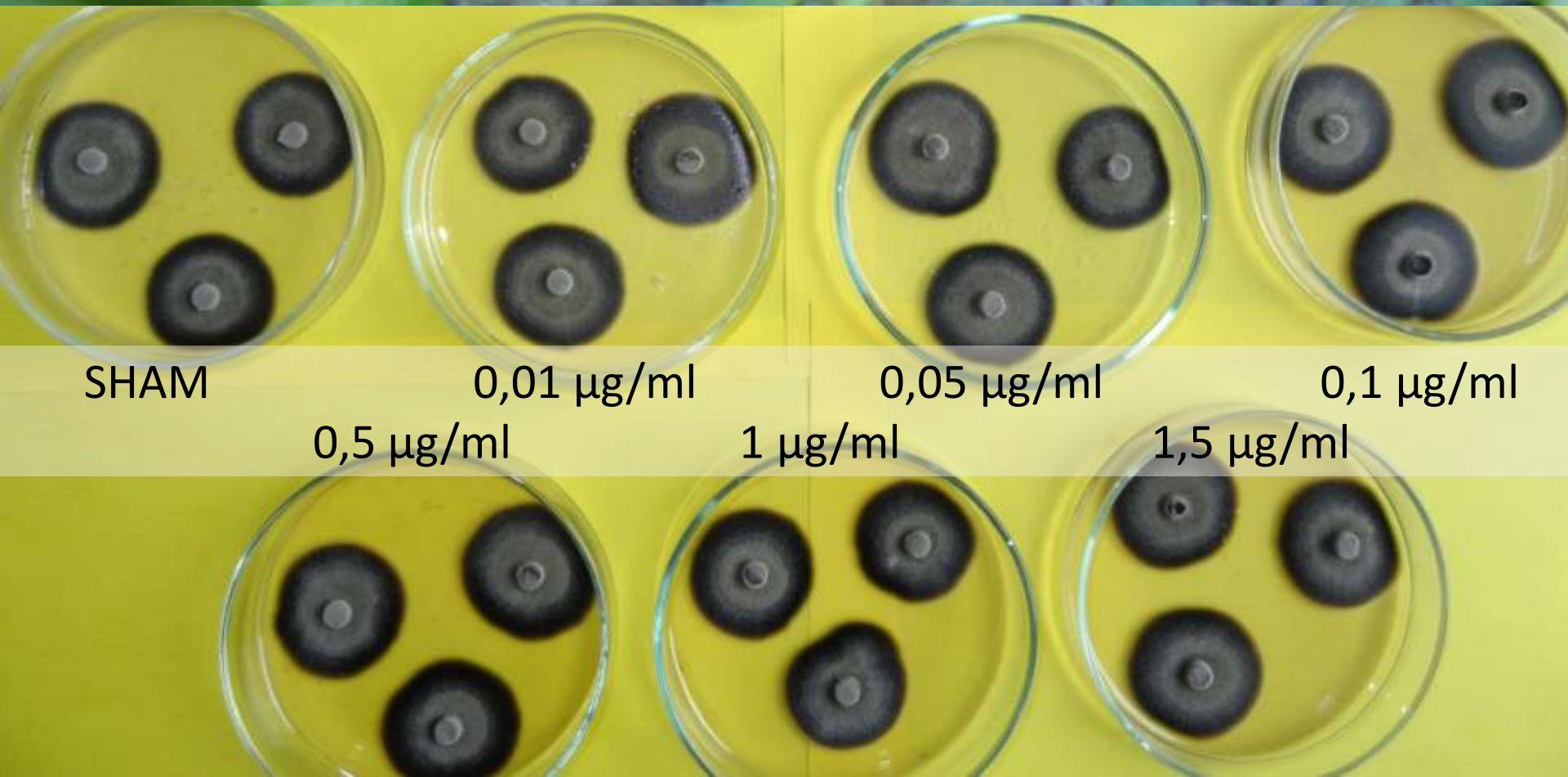
Qols

- Monitoring in 2007 – no changes in sensitivity
- Monitoring in 2014 and 2015 – a large frequency of resistant isolates.

Media amended with azoxy+SHAM



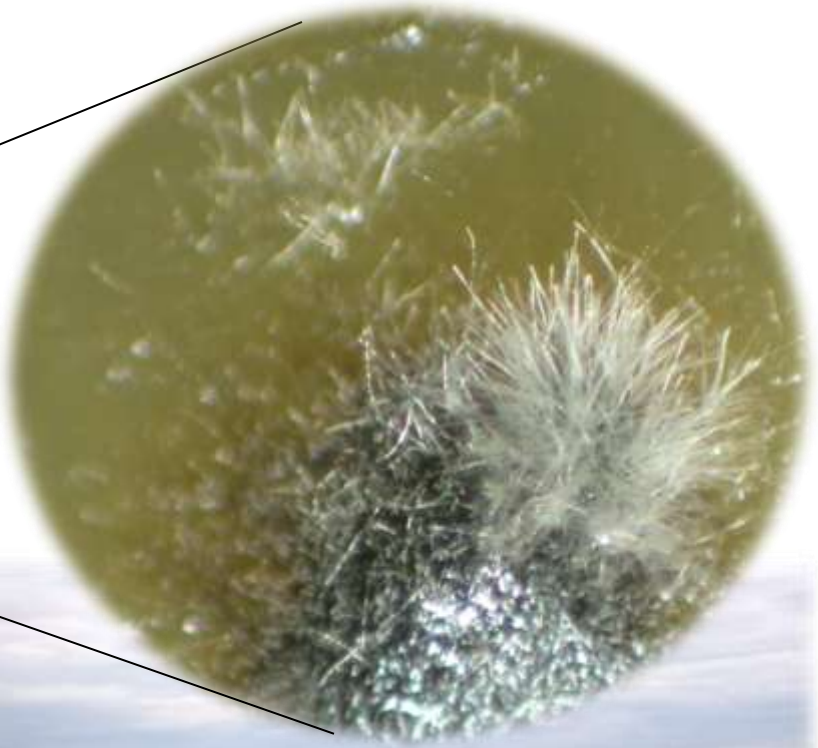
Cercospora beticola (PA-A) on nutrient media amended with azoxystrobin + 0,5mM SHAM.



3. Presentation of results from trials in 2011 and 2015. Possible management strategies.

Field trial in 2011

- Preparation of inoculum



- Inoculation

Conidia - Sugar Beet Leaf Extract Agar

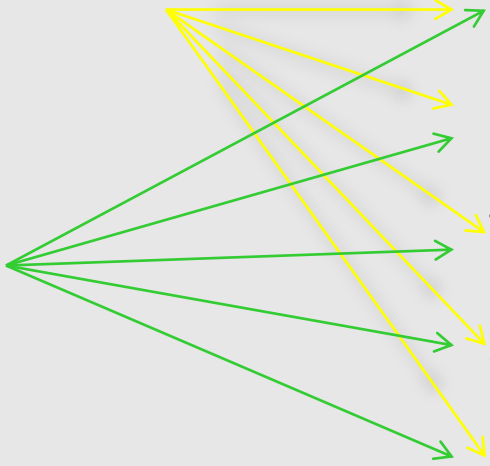
Spore suspension – 500 spores/ml

300 L H_2O/ha

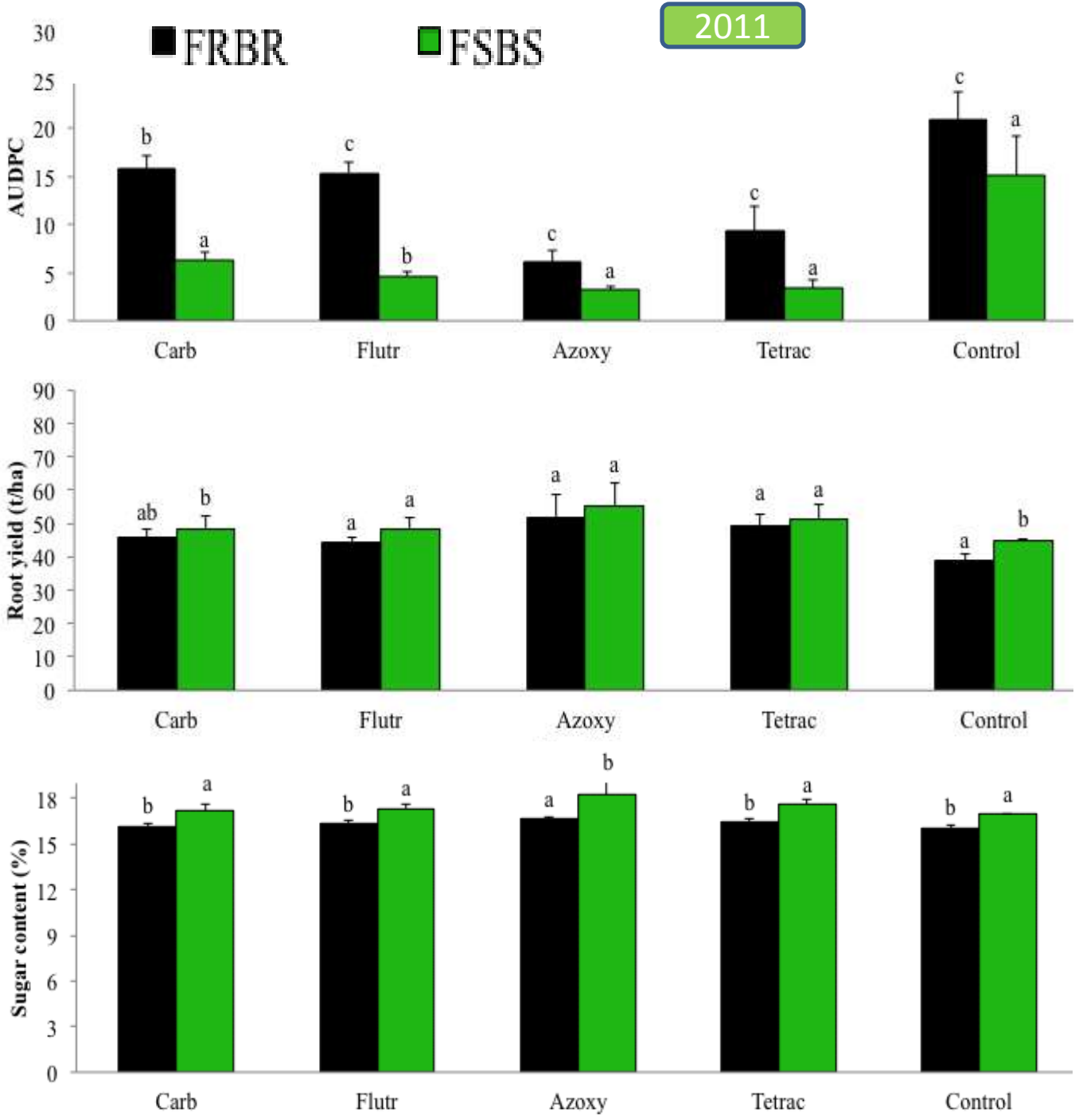
Backpack sprayer

Favorable conditions for disease development

Isolates	Active substance
Resistant to flutriafol & carbendazim	Carbendazim
	Flutriafol
	Tetraconazole
Sensitive to flutriafol & carbendazim	Azoxystrobin
	Untreated control



2011


2011
FRBR
FSBS
AUDPC
30
25
20
15
10
5
0
b
a
c
b
c
a
c
a
c
a
Carb
Flutr
Azoxy
Tetrac
Control
Root yield (t/ha)
90
80
70
60
50
40
30
20
10
0
ab
b
a
a
a
a
a
a
a
b
Carb
Flutr
Azoxy
Tetrac
Control
Sugar content (%)
18
15
12
9
6
3
0
b
a
b
a
a
b
b
a
b
a
Carb
Flutr
Azoxy
Tetrac
Control

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Sensitivity of *Cercospora beticola* isolates from Serbia to carbendazim and flutriafol

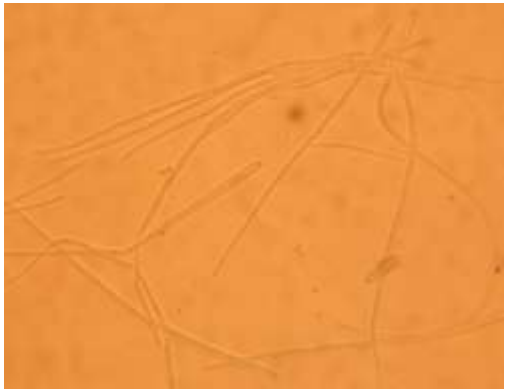
Dragana Budakov [a], Nevena Nagl [b, *], Vera Stojšin [a], Ferenc Bagi [a], Dario Danojević [b], Oliver T. Neher [c], Ksenija Taški-Ajduković [b]

[a] *Faculty of Agriculture, University of Novi Sad, Trg Dositeja Obradovica 8, 21000 Novi Sad, Serbia*
[b] *Institute of Field and Vegetable Crops, Maksima Gorkog 30, 21000 Novi Sad, Serbia*
[c] *The Amalgamated Sugar Company, 1951 S. Saturn Way, Suite 100, Boise, ID 83709, USA*

Material and methods

Fungicide trial in 2015:

To evaluate efficacy of different fungicides alone and in combination with multisite chlorothalonil in control of Cercospora population of known sensitivity to fungicides.
Effect on disease severity and sugar content.



Detection of sensitivity of *C.beticola* before fungicide applications

DISCRIMINATIVE CONCENTRATIONS

Carbendazim 5 µg/mL
Tetraconazole 0.6 µg/mL
Azoxystrobin 0.1 µg/mL

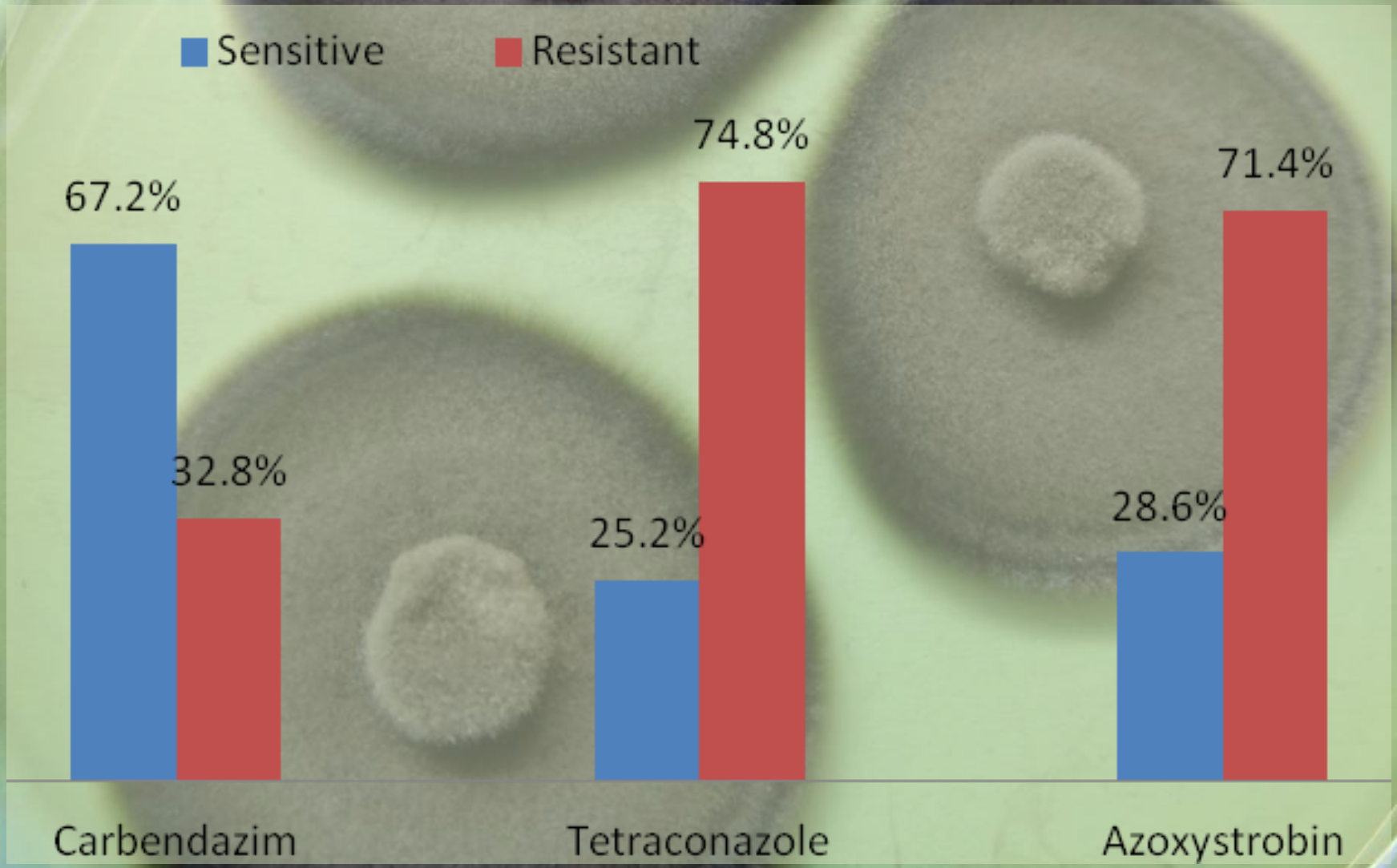
Cca. 900 isolates per fungicide

Field trial treatments

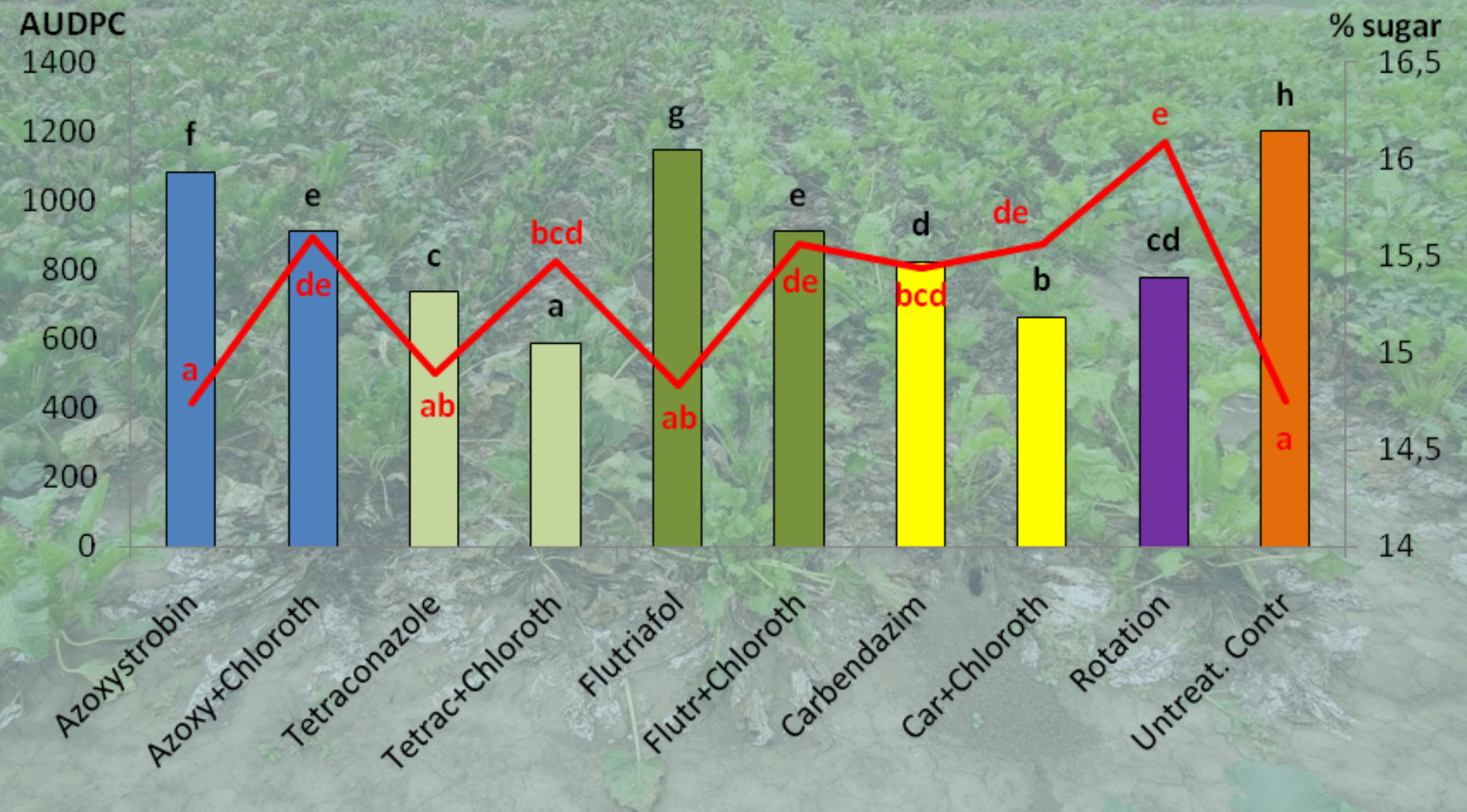
No	Active ingredient	Fungicide	Dose per ha
1	Azoxystrobin (250 g/L)	Azbany 250SC	1L
2	Carbendazim (500 g/L)	Galofungin	0.6L
3	Tetraconazole (125 g/L)	Eminent 125ME	0.8L
4	Flutriafol (125 g/L)	Takt	0.5L
5	Azoxystrobin (250 g/L) + Chlorothalonil (500 g/L)	Azbany 250SC+ Bevetikola	1L+ 0.75L
6	Carbendazim (500 g/L)+ Chlorothalonil (500 g/L)	Galofungin+ Bevetikola	0.6L+ 0.75L
7	Tetraconazole (125 g/L)+ Chlorothalonil (500 g/L)	Eminent 125ME+ Bevetikola	0.8L+ 0.75L
8	Flutriafol (125 g/L)+ Chlorothalonil (500 g/L)	Takt+ Bevetikola	0.5L+ 0.75L
9	FUNGICIDE ROTATION:		
	1. Difenoconazole (150 g/L) + Propiconazole (150 g/L) + Chlorothalonil (500 g/L)	Rias 300EC + Bevetikola	0.3L + 0.75L
	2. Azoxystrobin (200 g/L) + Ciproconazole (80 g/L) + Chlorothalonil (500 g/L)	Amistar Extra + Bevetikola	0.75L + 0.75L
	3. Tetraconazole (125 g/L) + Chlorothalonil (500 g/L)	Eminent 125ME + Bevetikola	0.8L + 0.75L
	4. Trifloxystrobin (375 g/L) + Ciproconazole (160 g/L) + Chlorothalonil (500 g/L)	Sphere + Bevetikola	0.35L + 0.75L
10	Untreated control	-	-

RESULTS

Frequency of sensitive and resistant isolates



Disease intensity (AUDPC) and sugar content (%)



Azoxystrobin alone

Fungicide rotation

Conclusions

Availability and use of fungicides with different mode of action.

Always use fungicides in combinations.

Use of multisite protective fungicides.

FRAC – Fungicide Resistance Action Committee

Conclusions

Isolates that showed resistance to flutriafol and carbendazim in in vitro experiments, were successfully controlled in field trials with azoxystrobin and tetraconazole, which provided a high yield and sugar content.

Carbendazim and flutriafol were not sufficiently effective in control of isolates with corresponding resistance. These two fungicides were as successful as others in disease control caused by sensitive isolates.

Conclusions

Importance of monitoring changes in the sensitivity *of Cercospora beticola* populations to the fungicides used in our sugar beet growing area.

Make a selection of fungicides according to the frequency of resistant isolates.

Prevalence of resistant individuals in the field population can lead to significant losses in sugar beet yield and sugar content, but also to major economic losses due to fungicide application in which lacks the necessary biological efficacy.


Thank you for your attention.
Questions?