



# Changes in performance of SBR fungicides over the years and new management strategies adopted in Brazil

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Ministério da Agricultura,  
Pecuária e Abastecimento



# Brazilian Agricultural Research Network

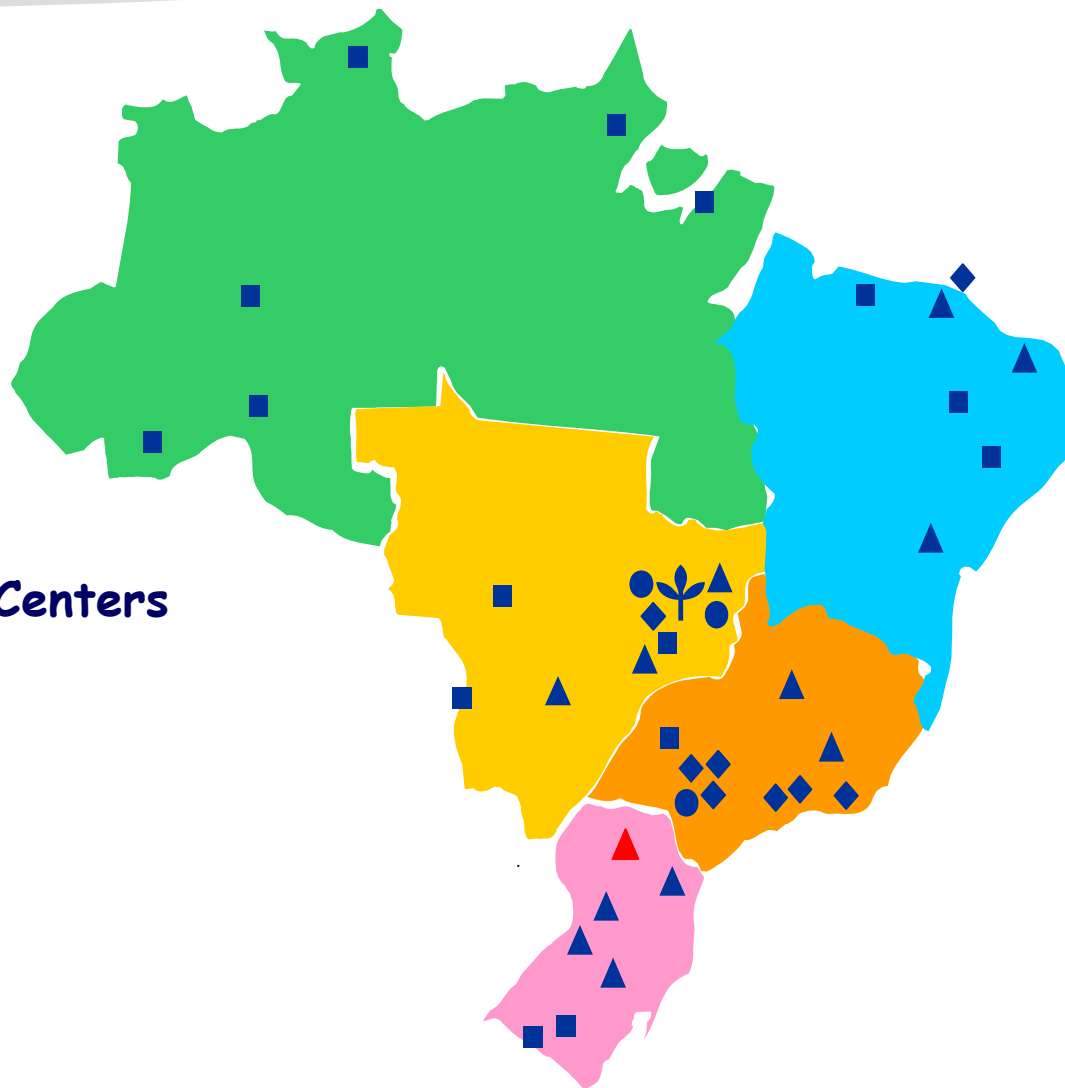
🌿 Embrapa Headquarters

◆ 9 Thematic Research Centers

■ 13 Ecorregional Research Centers

▲ 15 National Centers by Products

● 3 Services



# Embrapa Soybean



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1. Introduction

2. Network of fungicides from 2003 - 2009

3. Sensitivity monitoring tests

4. Resistant cultivars

5. Perspectives for 2009/10



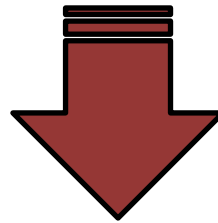
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# Anti Rust Consortium

First report of ASR in Brazil - May 2001

Anti Rust Consortium (ARC) was created in 2004



Annual meetings to discuss and define the recommendations  
Warning system - 100 labs in the main soybean producing regions  
Update the website's warning system in real time

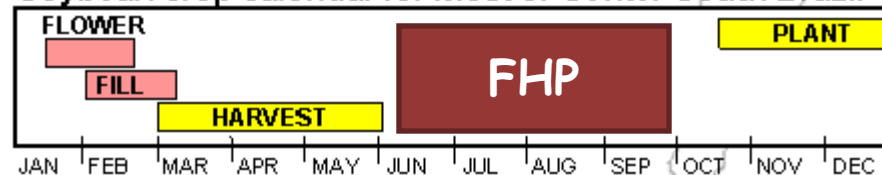


# Strategies adopted by ARC

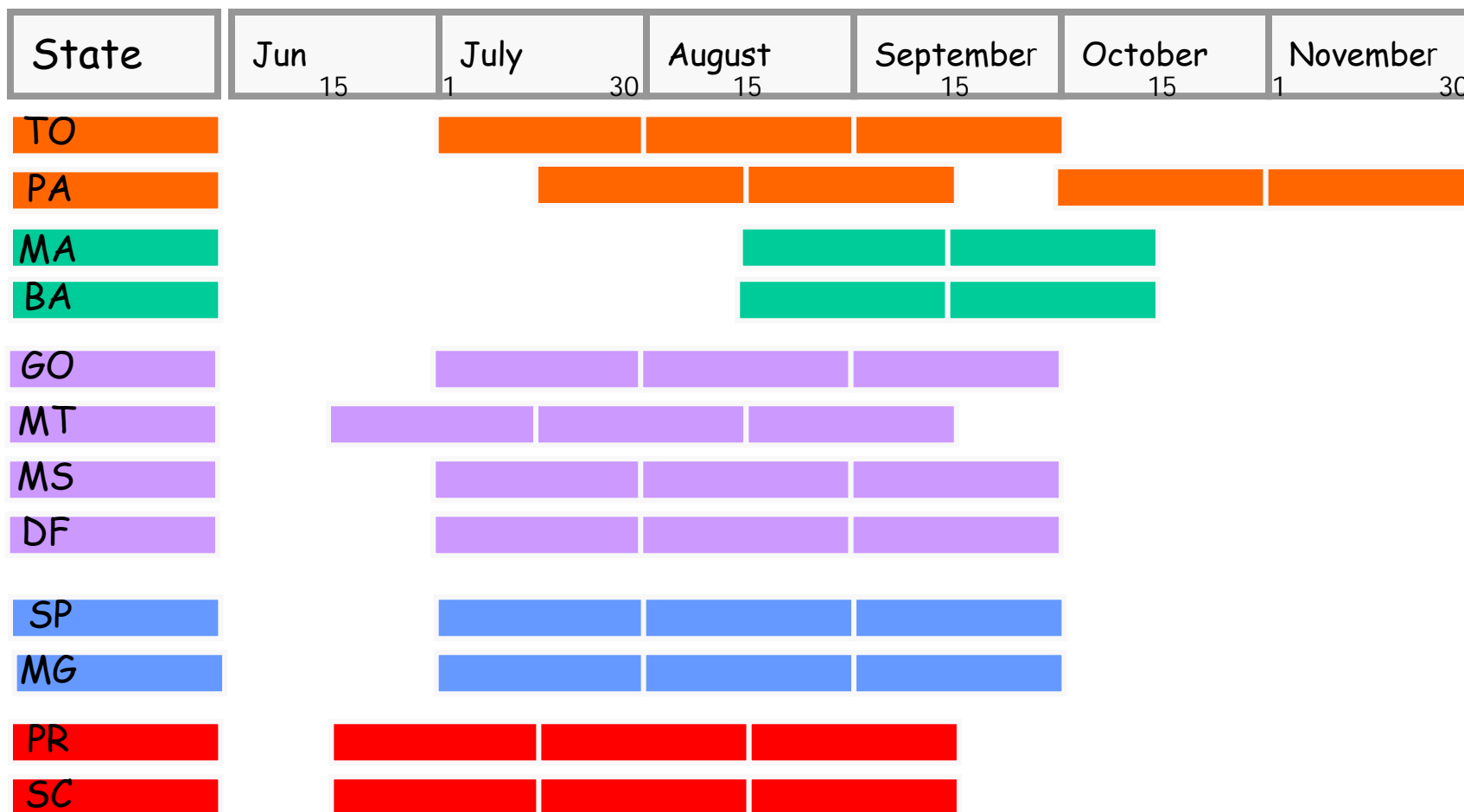
## ➤ Crop management in the winter season

- ✓ Eliminate volunteer plants;
- ✓ Avoid second summer crop;
- ✓ "Free host period" (FHP) - no soybeans in the winter season

Soybean crop calendar for most of Center-South Brazil



# Free host period

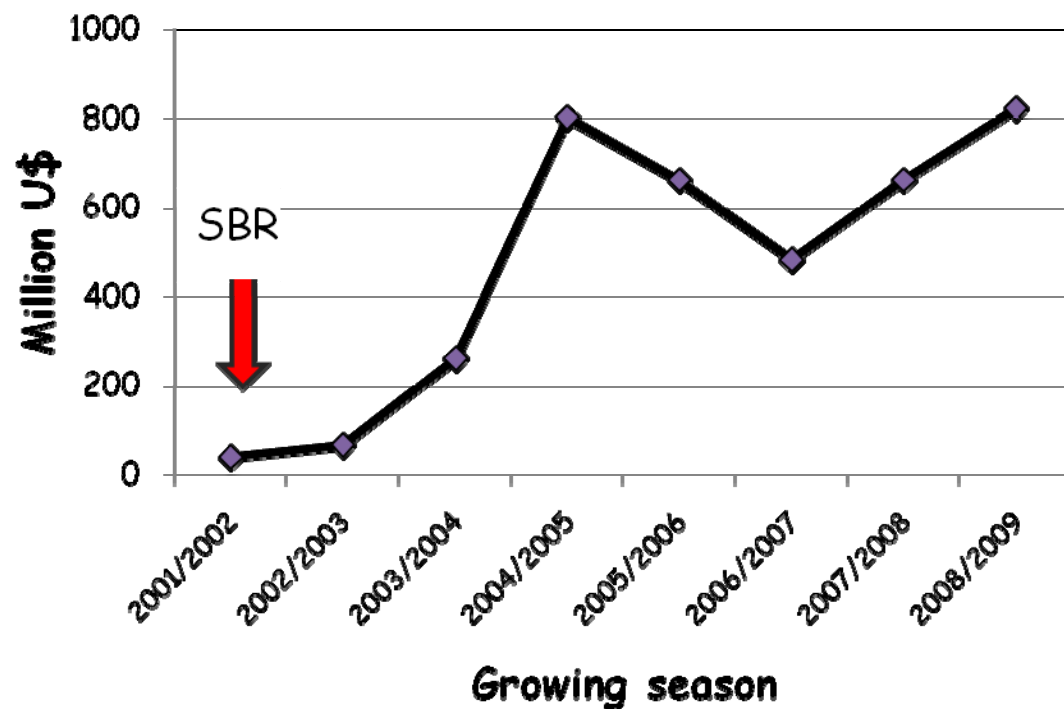


# Strategies adopted by ARC

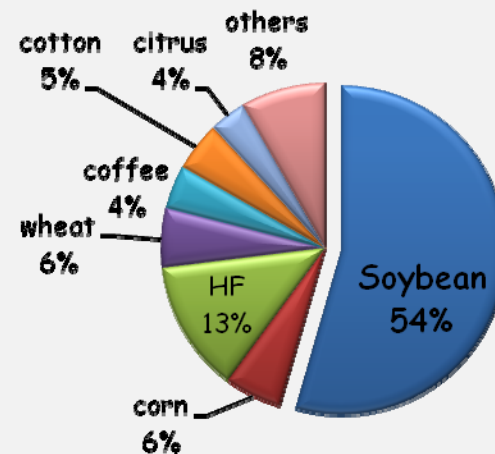
- **Crop Management in the winter season**
  - ✓ Eliminate volunteer plants;
  - ✓ Avoid Second summer crop;
  - ✓ "Free host period" (FHP) - no soybeans in the winter season (July - Sep)
- **Early sowing with early maturity cultivar**
- **Monitor disease presence in the field and region**
  - **Fungicides at first symptoms or preventive**
  - **Resistant cultivars**

# Fungicide soybean market

Fungicide soybean market evolution in Brazil  
Million U\$

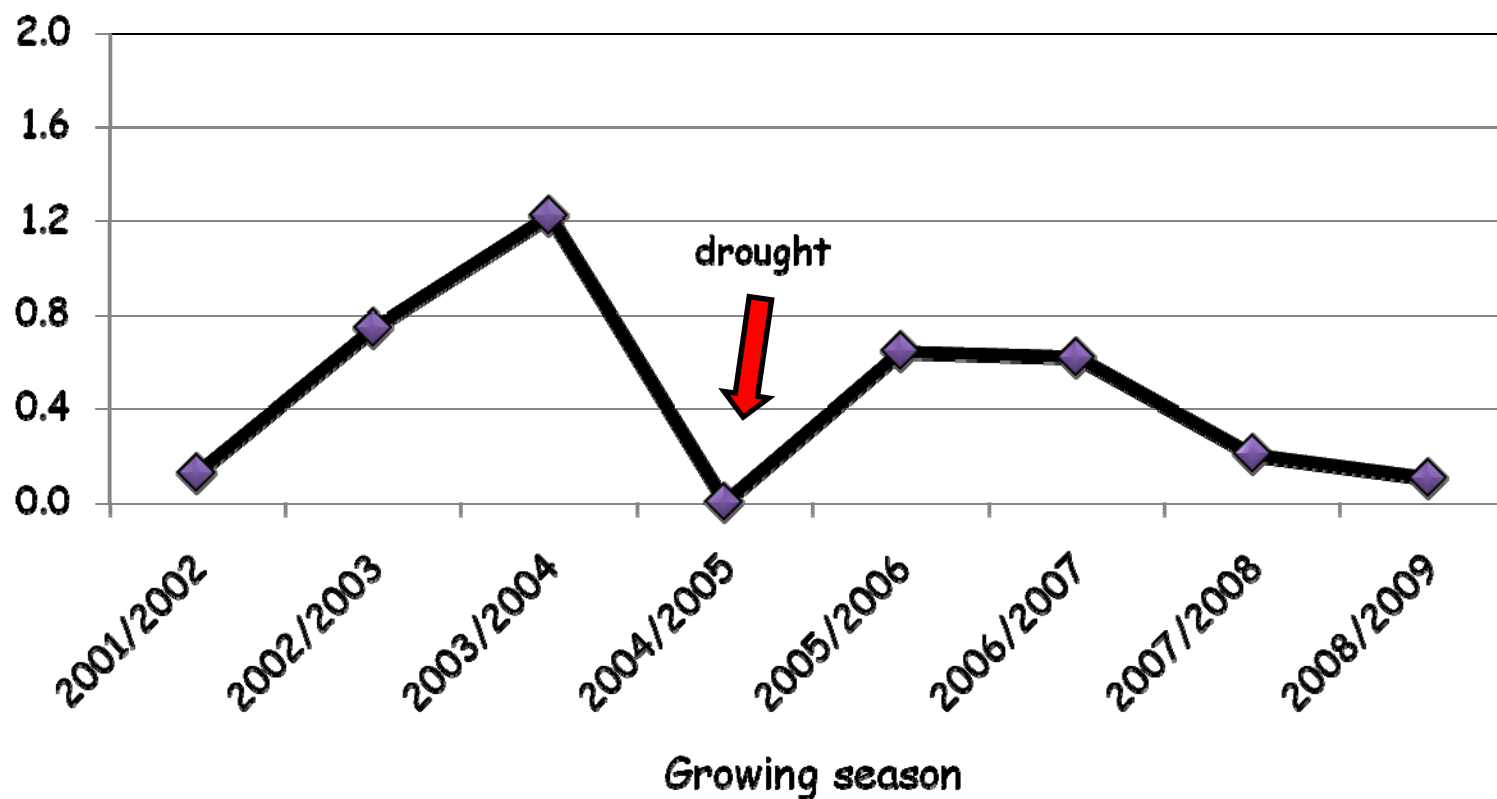


Fungicide market in Brazil  
U\$1,5 B (2008)



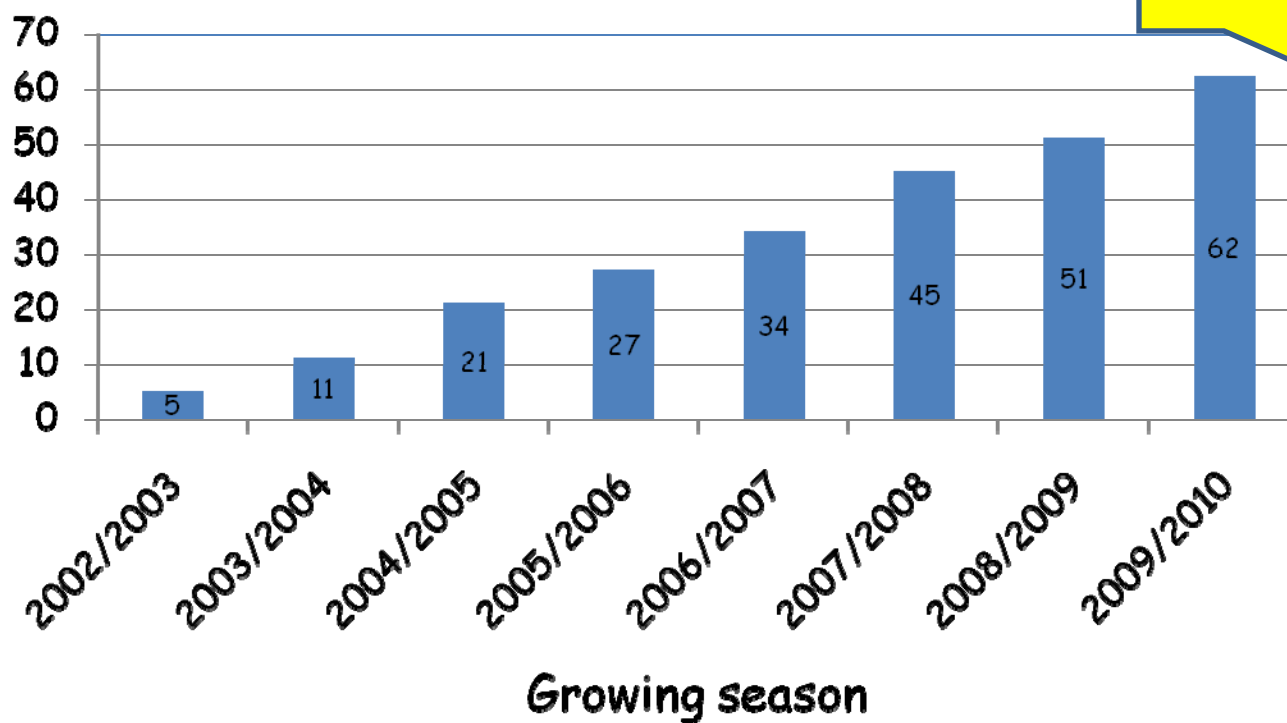
# Grain losses due to SBR

## Grain losses (Million U\$)



# Labeled fungicides

## Number of labeled fungicides



6 triazoles  
2 strobilurin  
5 triazoles + strobilurin  
1 triazole + benzimidazole



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# Trial network for chemical control

## Objective:

compare fungicides in the same situation (later in the season)

## Material and methods (standard protocols):

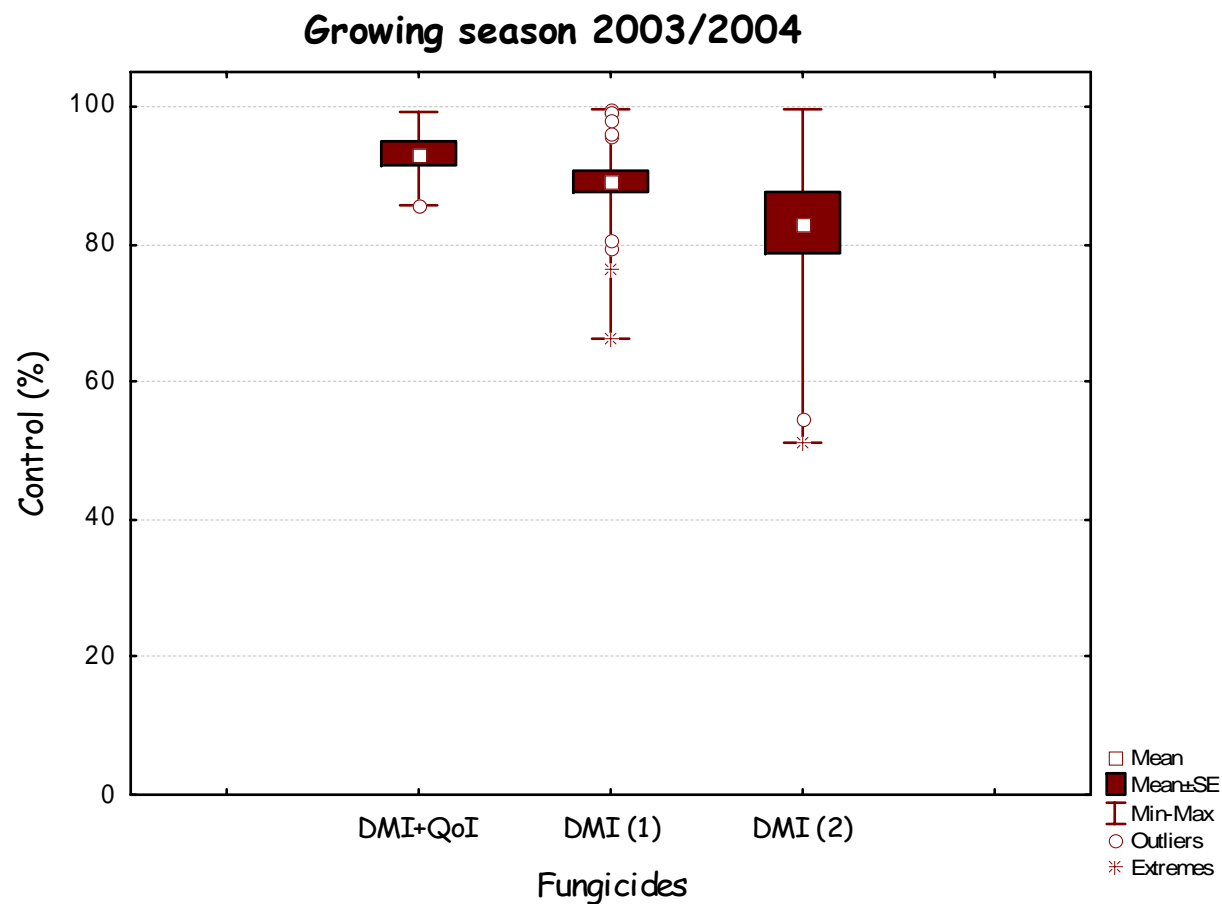
- ✓ randomized complete block with four replications (6 rows wide and 6 m long);
- ✓ two or three sequential application (maximum interval 21 days), starting at R2 or at first symptoms (vegetative);
- ✓ CO<sub>2</sub> pressurized back pack sprayer;
- ✓ 150 - 200 l ha<sup>-1</sup>;
- ✓ severity assessment in the application time and at R5-R6;
- ✓ yield
- ✓ all soybean region (Universities, Embrapas, foundations, and private extension companies)



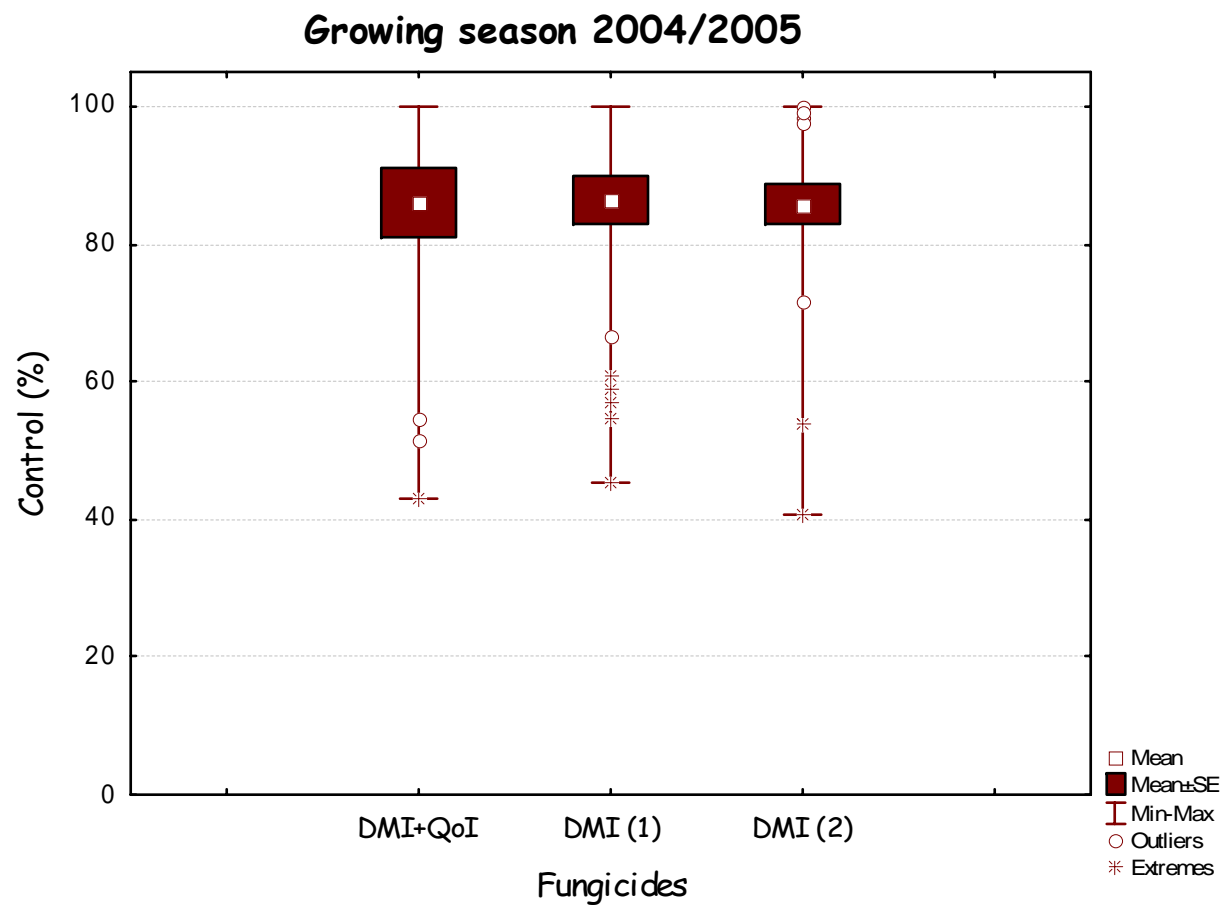
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# DMI + QoI x DMI - 2003/2004

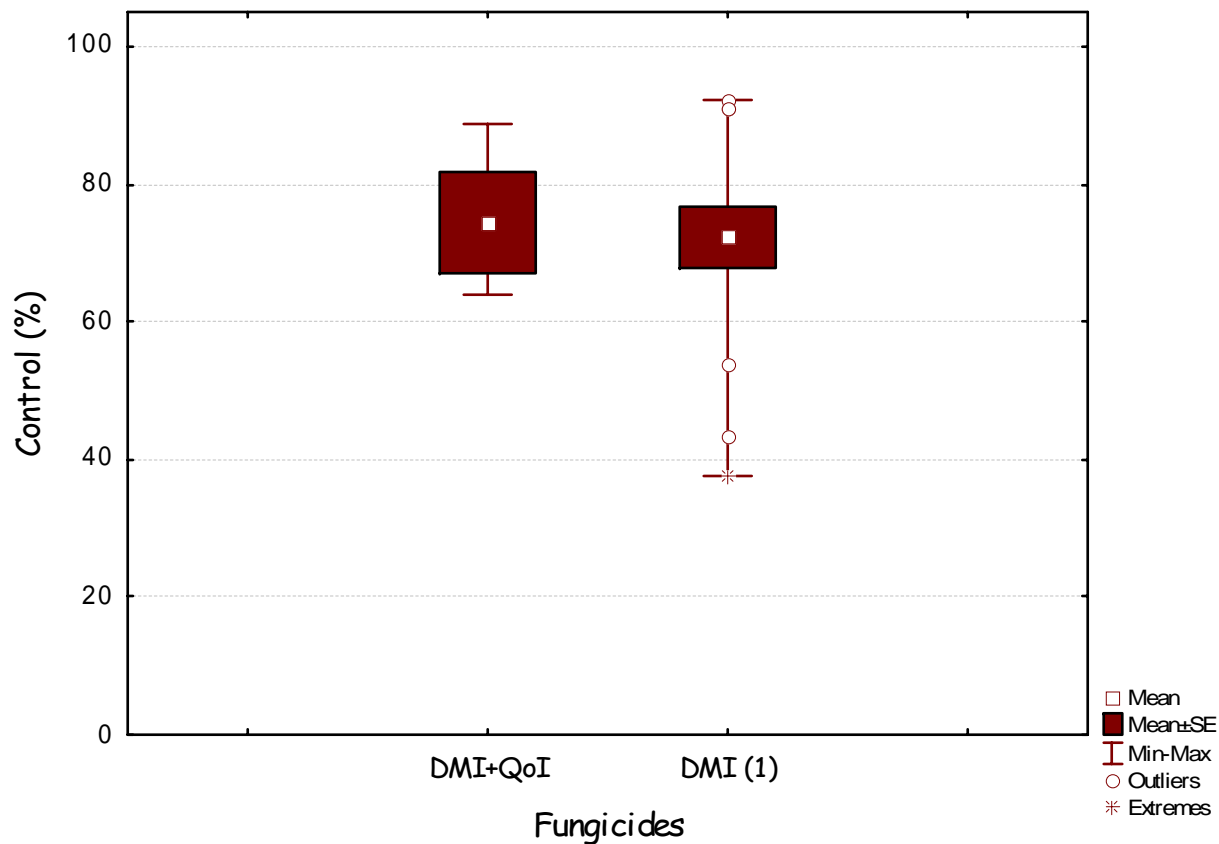


# DMI + QoI x DMI - 2004/2005

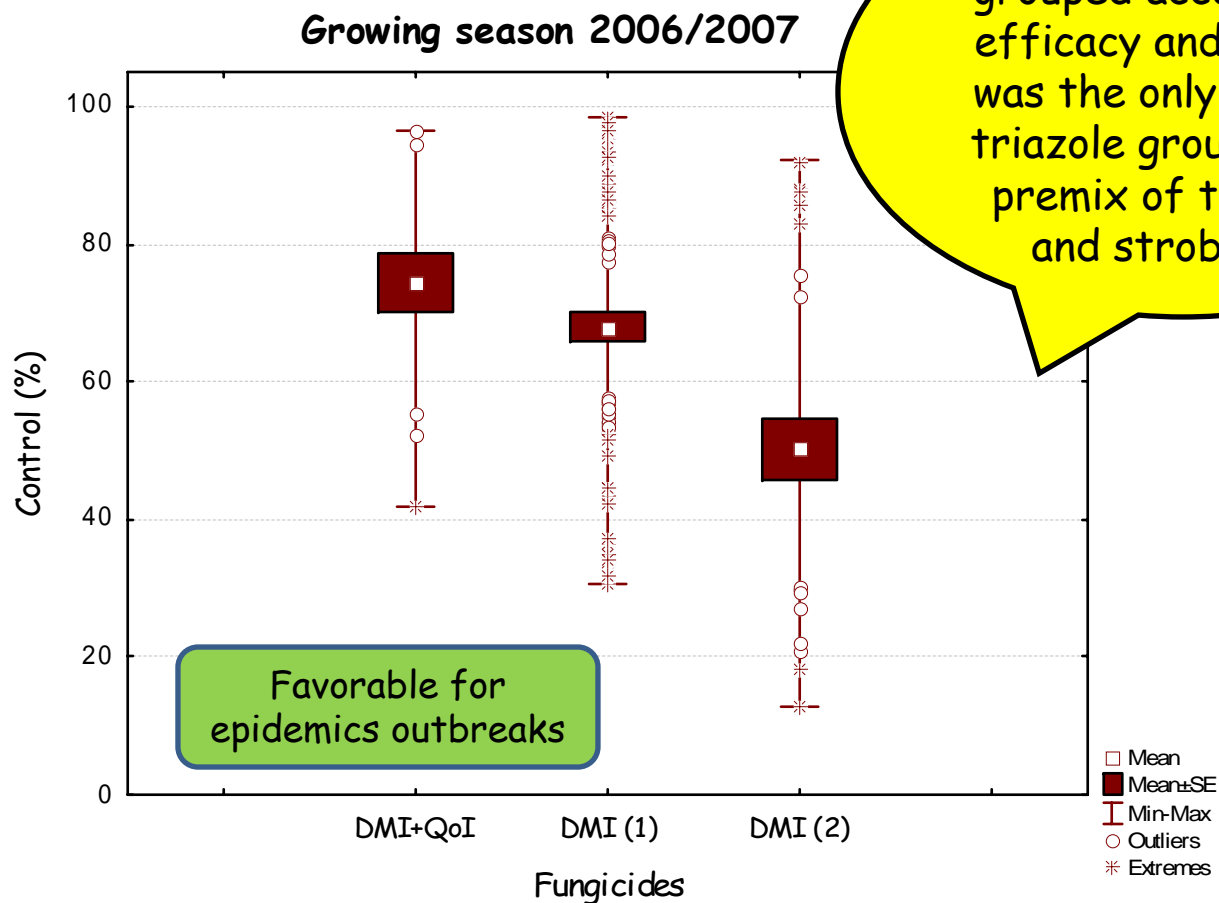


# DMI + QoI x DMI - 2005/2006

Growing season 2005/2006



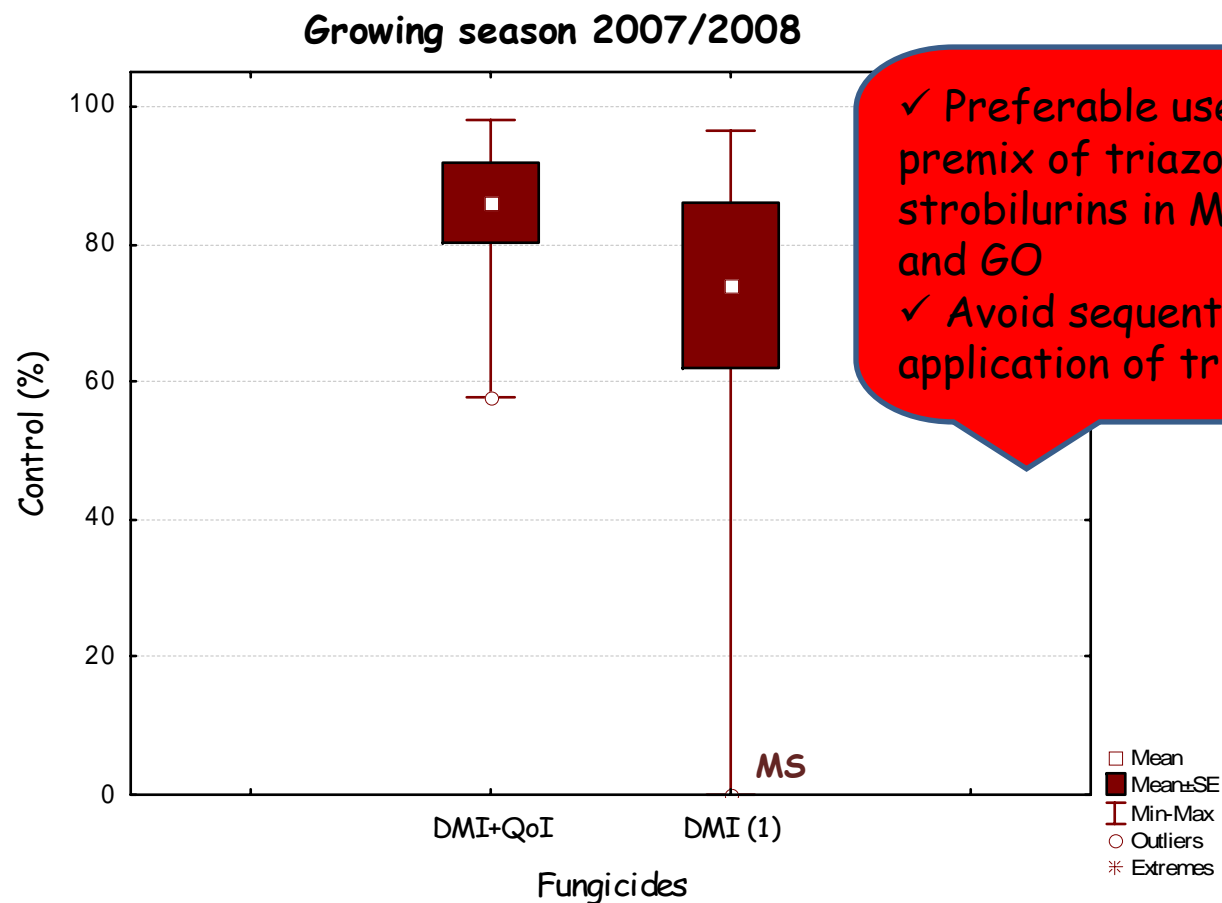
# DMI + QoI x DMI - 2006/2007



Fungicides were grouped according to efficacy and DMI (1) was the only straight triazole grouped with premix of triazoles and strobilurin.

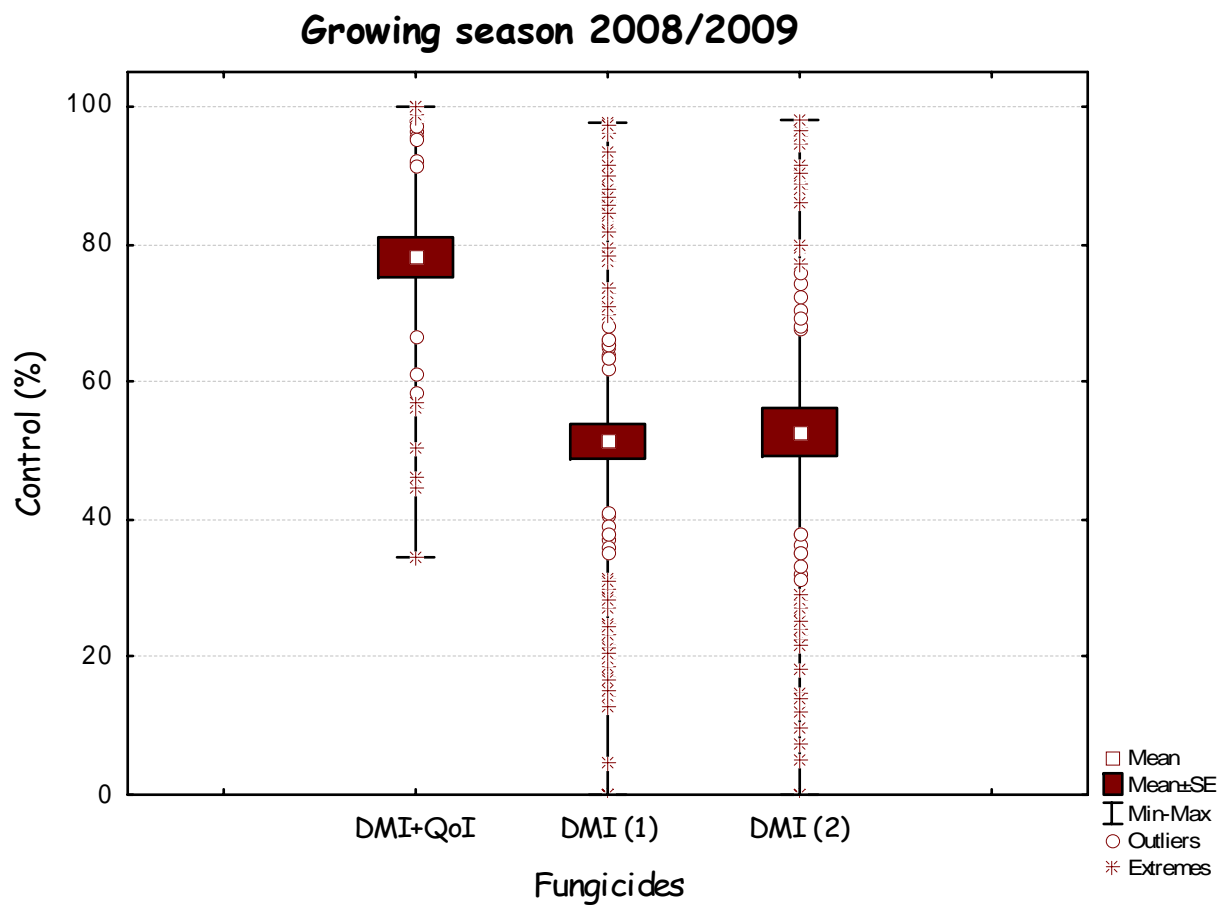
Crop protection 28:774-782 (2009)

# DMI + QoI x DMI - 2007/2008



✓ Preferable use of premix of triazoles and strobilurins in MT, MS and GO  
✓ Avoid sequential application of triazoles

# DMI + QoI × DMI - 2008/2009





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# Sensitivity monitoring tests

Bayer CropScience monitoring data are supporting FRAC recommendation (<http://www.frac.info/>)

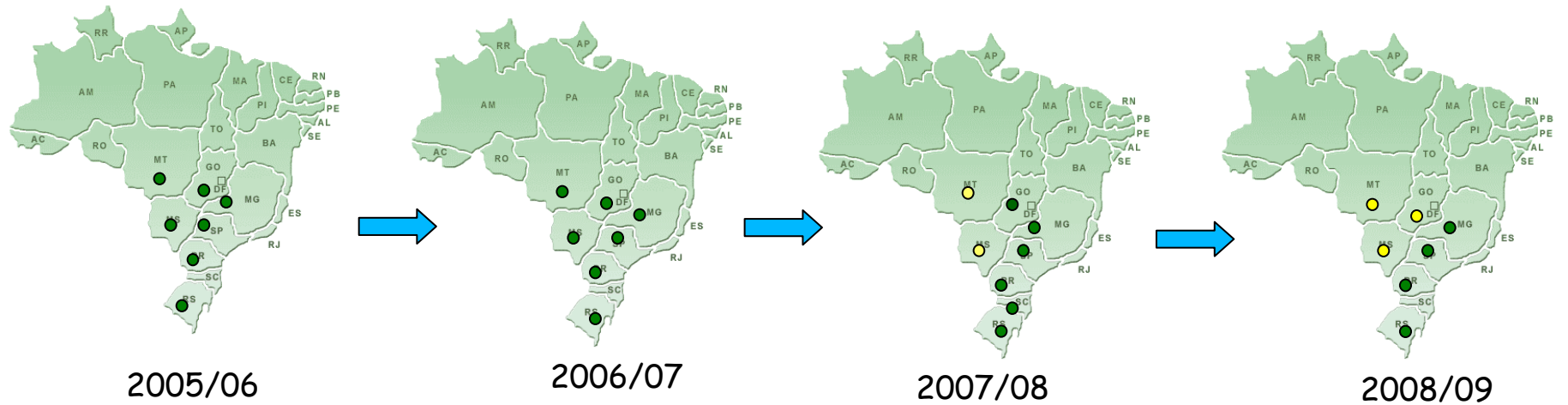
2005 until 2009 - detached leaf method

Within the first 6 hours of germination no significant sterol biosynthesis can be detected



The  $EC_{50}$  (half maximal effective concentration) value is used to compare among the regions and during season time

# Sensitivity monitoring tests



$EC_{50}$ : 0.15  
range: 0.02 - 0.52 ppm

$EC_{50}$  mean: 0.73  
range: 0.17 - 2.69 ppm

$EC_{50}$  mean: 0.65  
range: 0.04 - 3.9 ppm

$EC_{50}$  mean: 0.63  
range: 0.07 - 4.50 ppm



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# Sensitivity monitoring tests

## EC50 values within the growing season



## Londrina - Paraná

The less sensitive parts of the *P. pachyrhizi* population disappeared in the winter season period

back-shift / sensitivity recoverage observable between seasons

# Why does this selection happened?

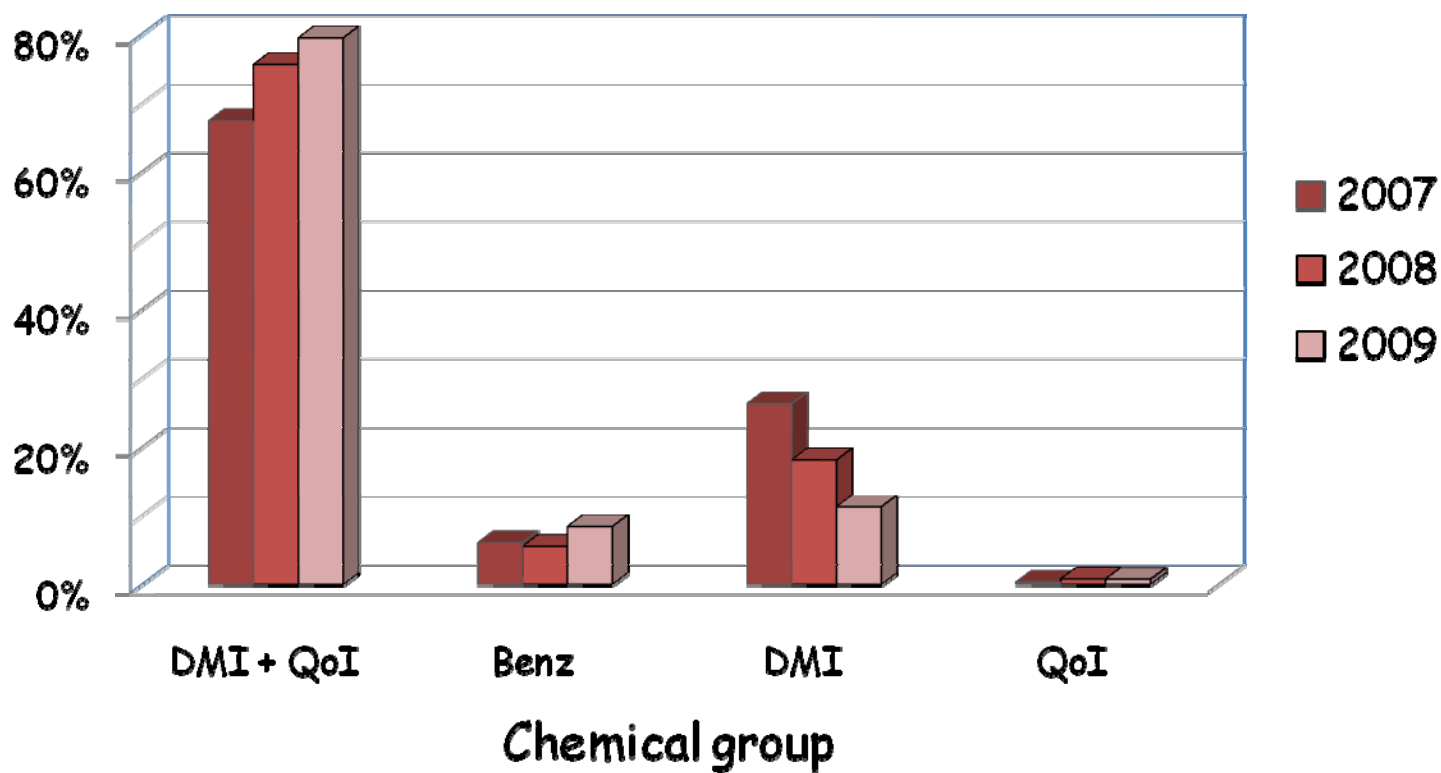
↓ Fungicide Classes *	↓ Fungicide Risk	Combined Risk		
benzimidazoles dicarboximides phenylamides QoI fungicides **	high = 3	3	6	9
carboxamides SBI fungicides anilinoimidinones phenylpyrroles phosphorothiolates	medium = 2	2	4	6
multi site fungicides (e.g.dithiocarbamates Copper, Sulphur) MBI-R inhibitors SAR inducers	low = 1	1	2	3
	Pathogen risk →	low = 1	medium = 2	high = 3
	Pathogen groups * →	seed borne pathogens (e.g. <i>Pyrenophora</i> spp. <i>Ustilago</i> spp.) soil-borne pathogens (e.g. <i>Phytophthora</i> spp.) rust fungi <i>Rhizoctoma</i> spp. <i>Tapesia</i> spp.	<i>Rhynchosporium secalis</i> <i>Septoria tritici</i>	<i>Erysiphe graminis</i> <i>Botrytis cinerea</i> <i>Penicillium</i> spp. <i>Magnaporthe grisea</i> <i>Venturia inaequalis</i> <i>Mycosphaerella fijiensis</i> <i>Phytophthora infestans</i>

Source: FRAC

# Why does this selection happened?

- ✓ Large number of applications, curative applications;
- ✓ Use of straight azole in sequential applications;
- ✓ Underrate;
- ✓ Large areas treated with the same product

## Market share of foliar fungicides (%)





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# Resistant cultivars

## BRS GO 7560 - maturity group 7.5

**Source:** [(Tracy x **Abura**) x (D67 x R48)] x Embrapa 59  
Single recessive major gene (PI 203398)

*Genetic and molecular biology 31:505-511 (2008)*



**Recommendation:** same than susceptible cultivars  
fungicides at first symptoms or preventive

**Advantage:** stability in cases of delayed control



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# Resistant cultivars

BRS GO 7560



Susceptible



# Resistant cultivars

**TMG 801 - maturity group 8.2**

**TMG 803 - maturity group 8.7**

**Source:** different major genes  
(Rpp2, Rpp4 or Rpp5)

## **Recommendation:**

scouting until R3;

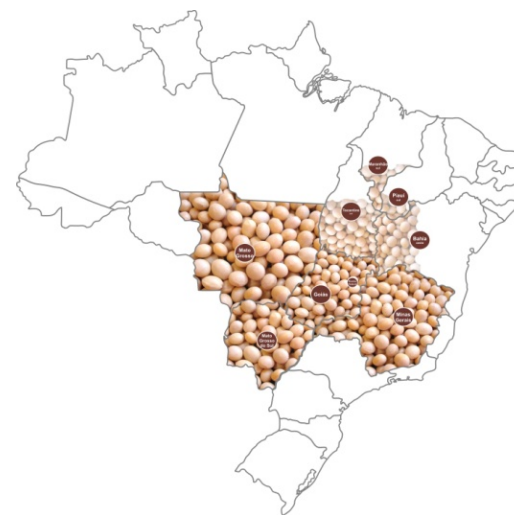
only apply fungicide before if you have symptoms otherwise apply at R3;

scouting for second and third reapplications

## **Advantage:**

reduce the number of fungicide application

stability in cases of delayed control



# Resistant cultivars

**TMG 803**



**Susceptible**



# Resistant cultivars

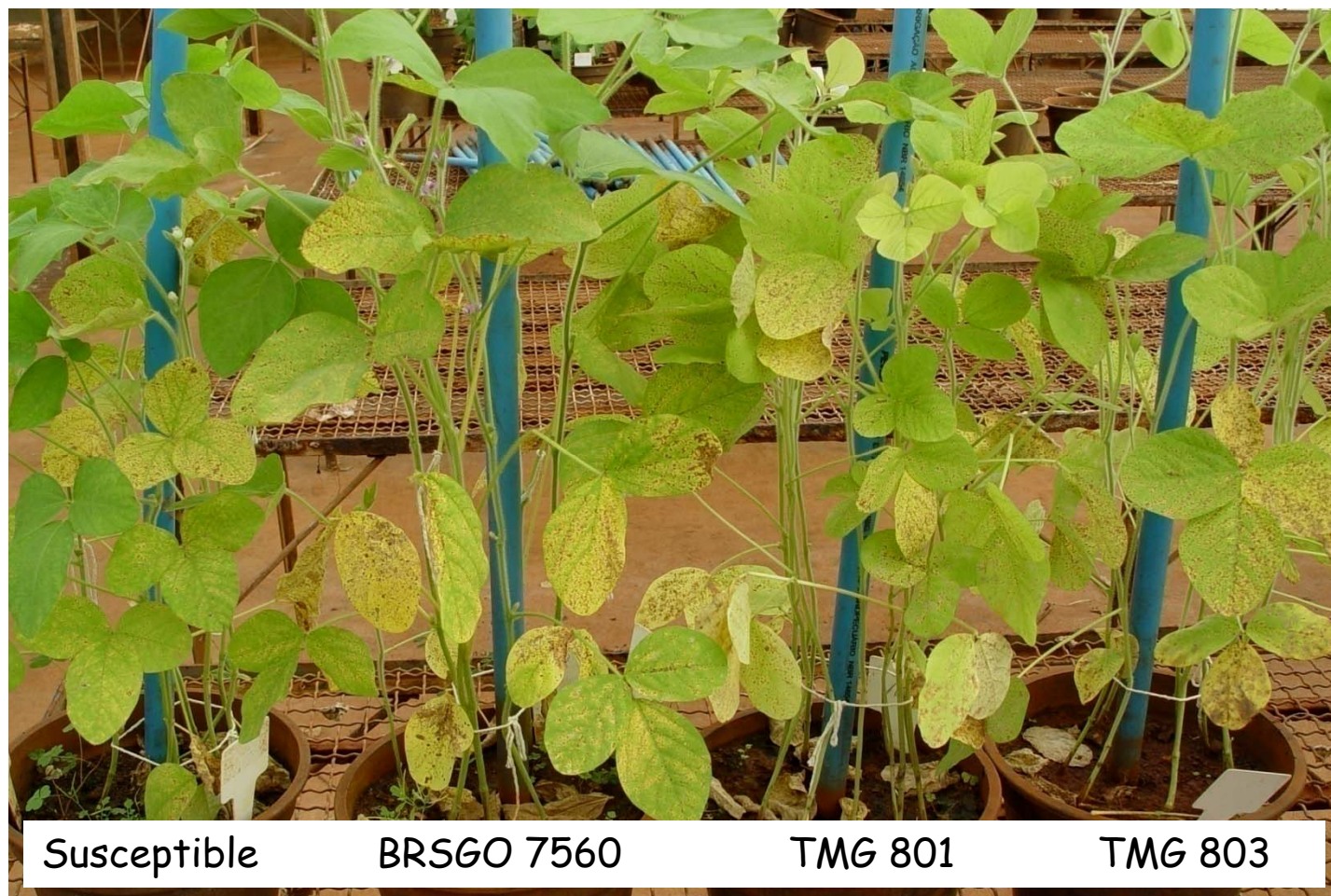
**TMG 801**



**Susceptible**



# Resistant cultivars



Susceptible

BRSGO 7560

TMG 801

TMG 803



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# 2009/10

- ✓ Unusually mild and wet winter;
- ✓ *El Nino* Southern Oscillation (ENSO) phenomenon forecast with well distributed rain until the end of December for most soybean region in Brazil;
- ✓ ASR started in commercial crops one month before 2008/09 but most of the cases after flowering stage;
- ✓ Resistant cultivars are in test in the field

**SBR has shown that no crop season is alike;  
new challenges appear every year**



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# Acknowledgements

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