
Reduced pesticide doses: Experiences in the Nordic-Baltic region and risk of selecting for resistant biotypes

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Content of presentation

- › Background
- › Experiences with reduced herbicide doses
- › Experiences with reduced fungicide doses
- › Dose and risk of resistance

Background

- › Interest in reduced doses dates back to the 70'ies
- › Denmark and Sweden were the first countries in Europe to implement a pesticide action plan (mid 80'ies)
- › The pesticide action plans increased the interest in reduced doses (considered the easiest and least risky approach to meet the target)
- › Experiences from Denmark and Sweden was adopted by other countries in the Nordic-Baltic region

Herbicides

- › Herbicide performance is affected by many parameters such as:
 - › weed flora
 - › growth stage of weeds
 - › crop competitiveness
 - › climatic conditions
 - › application technique
 - › formulation
 - › the presence of other pesticides in the spray solution

Crop Protection Online

Plantevaern Online - Demo version Free demo, conditions for use ⓘ 11.1.2007 Pl@nteInfo

Weeds - Recommendations for control ◀ ▶

Conditions for calculation: Season plan ⓘ

Crop

Crop: Wheat, winter Undersown: None

Season: Spring and summer ⓘ

Expected yield: 50-75 hkg/ha

Growth stage: 27. 7th shoot visible ⓘ

Growth conditions

Min.temp.: 8°C ⓘ Max.temp.: 14°C ⓘ

Weeds found by field inspection

Weed species ⓘ	Growth stage ⓘ	Density ⓘ	Control level ⓘ	Delete ⓘ
Com Chamomile ⓘ	5-6 leaves ⓘ	11 - 40 pl./m² ⓘ	<input type="text"/>	<input type="checkbox"/>
Common Chickweed ⓘ	>6 leaves ⓘ	41 - 150 pl./m² ⓘ	<input type="text"/>	<input type="checkbox"/>
Select ⓘ	Select ⓘ	Select ⓘ	<input type="text"/>	<input type="checkbox"/>

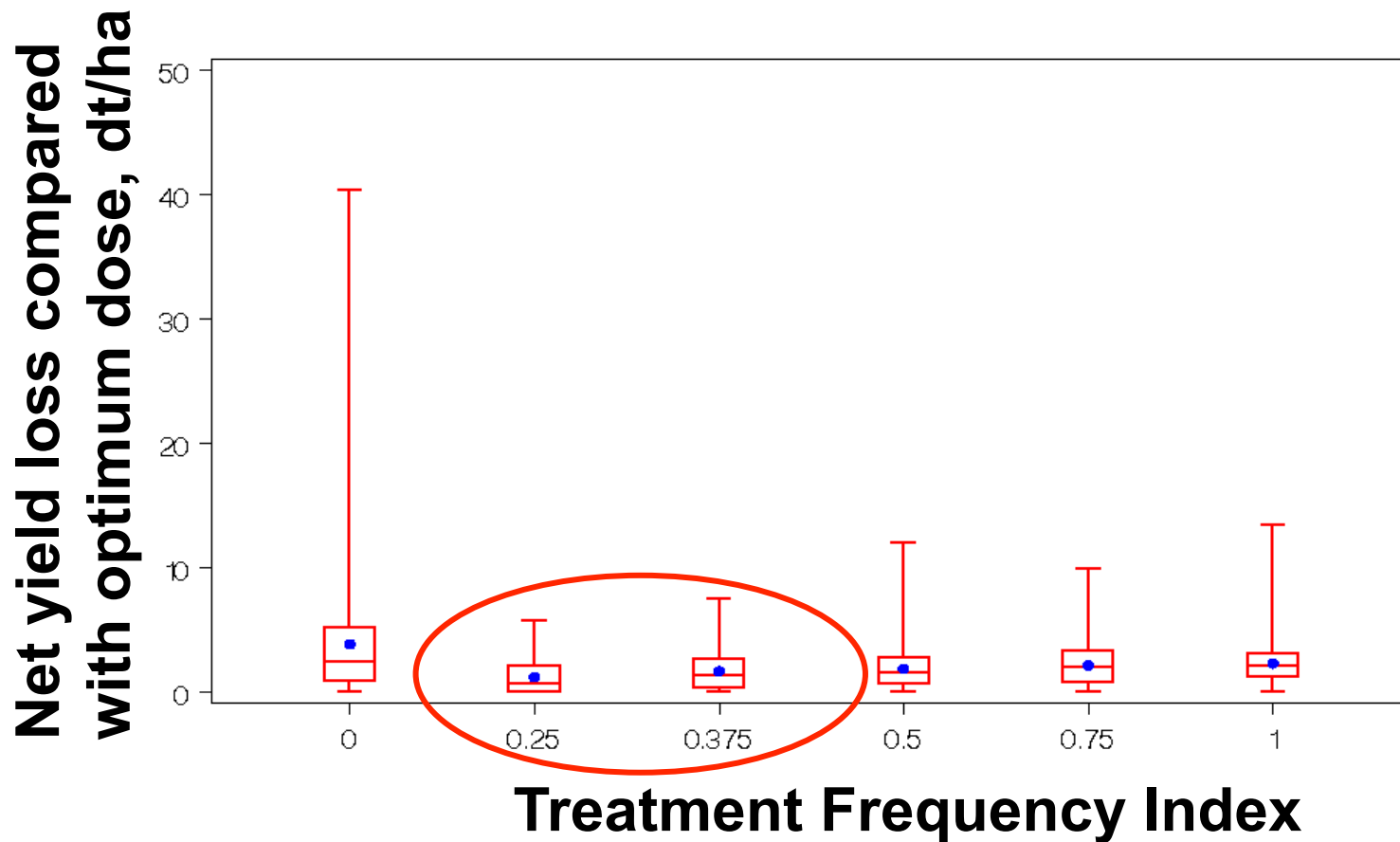
Water stress: None

Calculation conditions

Find best treatment options as to Cost ⓘ

Save settings for this page in URL address ⓘ Treatment options >>

Herbicides-Denmark (130 trials in spring barley)



Herbicides-Sweden

- › Two trial series (10 locations) in spring cereals (1987-1997 & 1988-1997)
- › Reduced doses and guideline recommendations compared with standard treatments
- › One herbicide

Herbicides-Sweden

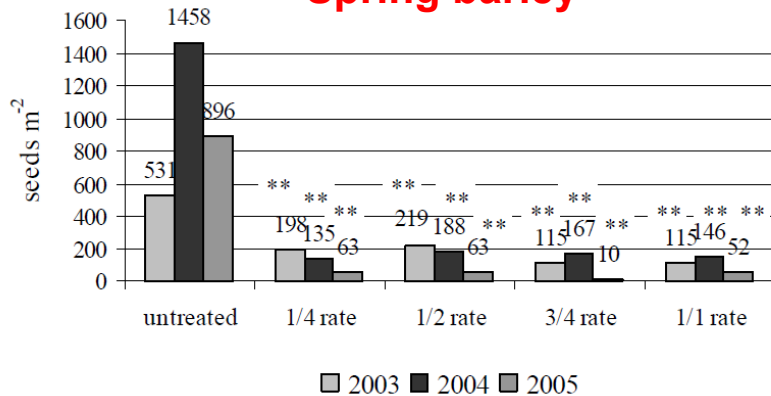
- › Weed densities following application of 25, 50, 75 and 100% of the recommended dose was reduced 43, 58, 64 and 67% compared to the control
- › Exclusion of herbicides every second year resulted in 43 to 178% higher weed densities than 50% of the recommended dose every year
- › Herbicide dose reduction using guidelines: 30 to 80%
- › No significant yield penalties
- › Weed flora shifts

Herbicides-Latvia & Estonia

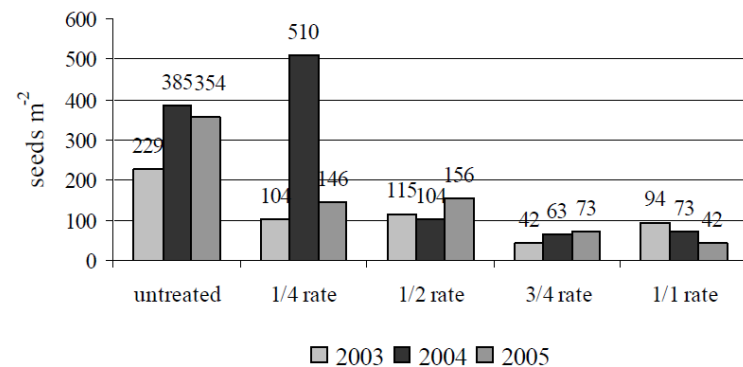
- › 6 herbicides at 25, 50 and 100% of the recommended dose in 2006-2007 (Latvia) and 2005-2007 (Estonia)
- › Reduced doses provided good control
- › Reduced doses most profitable (Latvia)

Herbicides-Lithuania

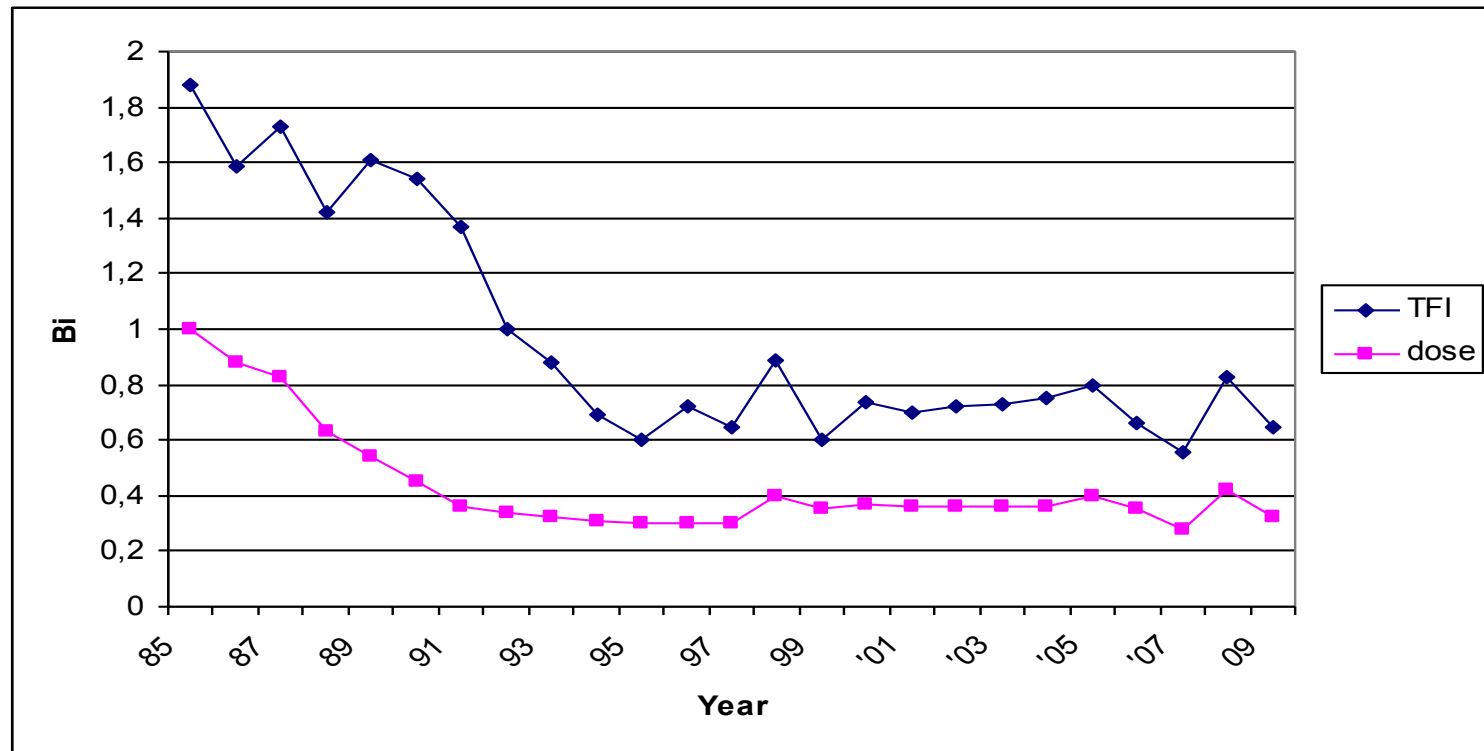
Spring barley



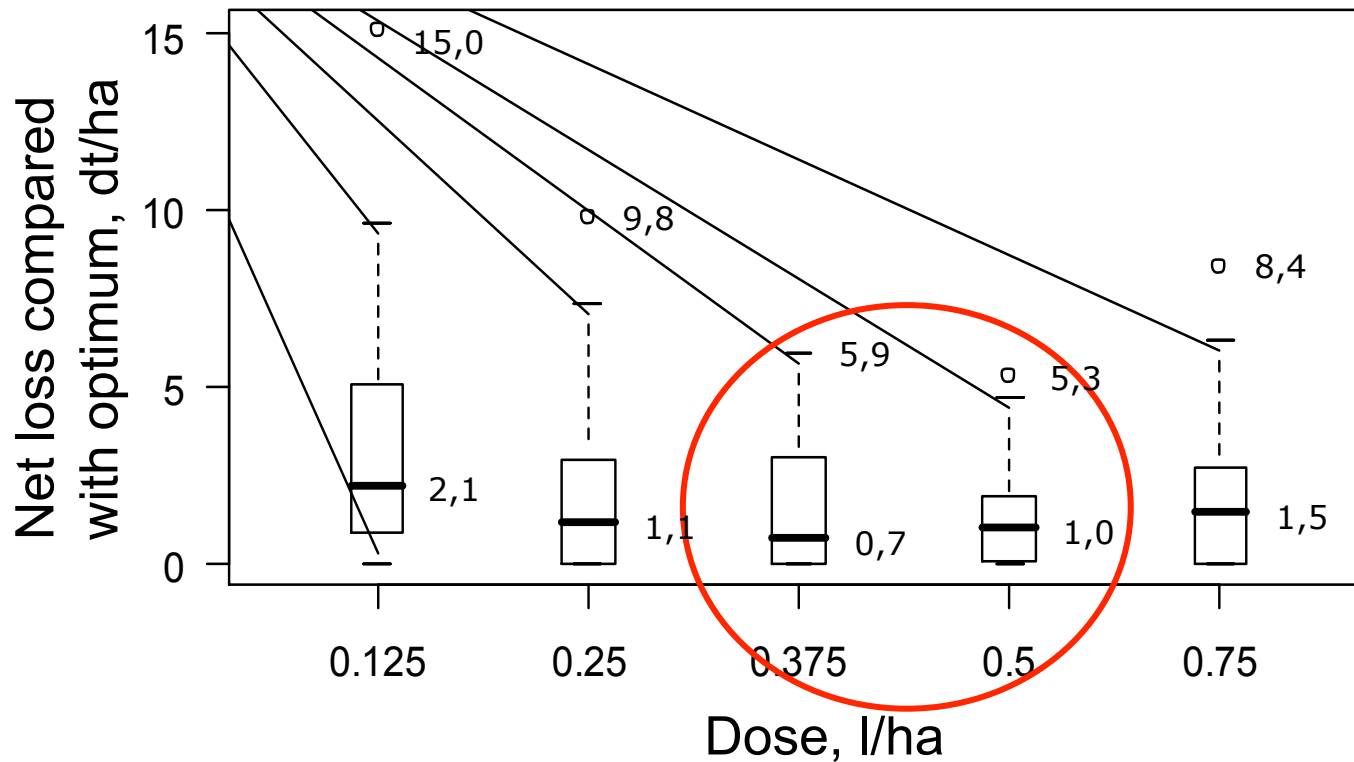
Spring wheat



Cereal fungicides-Denmark

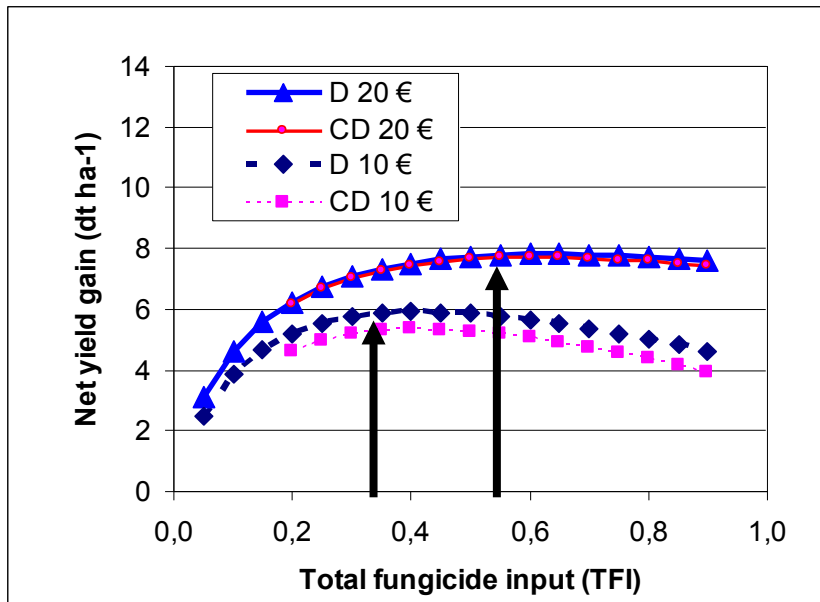


Septoria in wheat (73 trials)

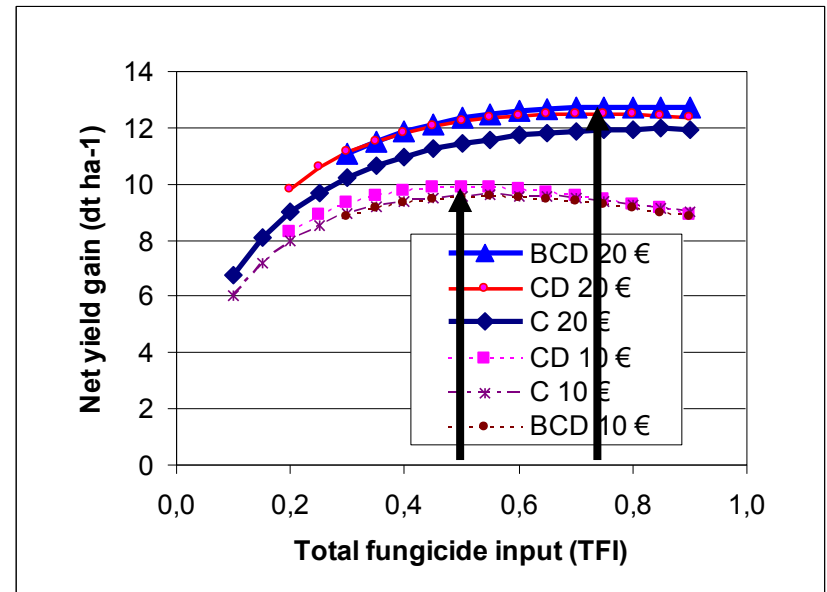


Septoria in wheat

Resistant cultivar



Susceptible cultivar



A: GS 25-31, B: GS 32-36, C: GS 37-50, D: GS 51-64

Why are reduced doses effective in the Nordic-Baltic region?

› Herbicides

- › Competitive crops and many non-competitive weed species
- › Climatic conditions optimum for maximising herbicide action
- › Focus on timing
- › Ample documentation from field trials and effective dissemination

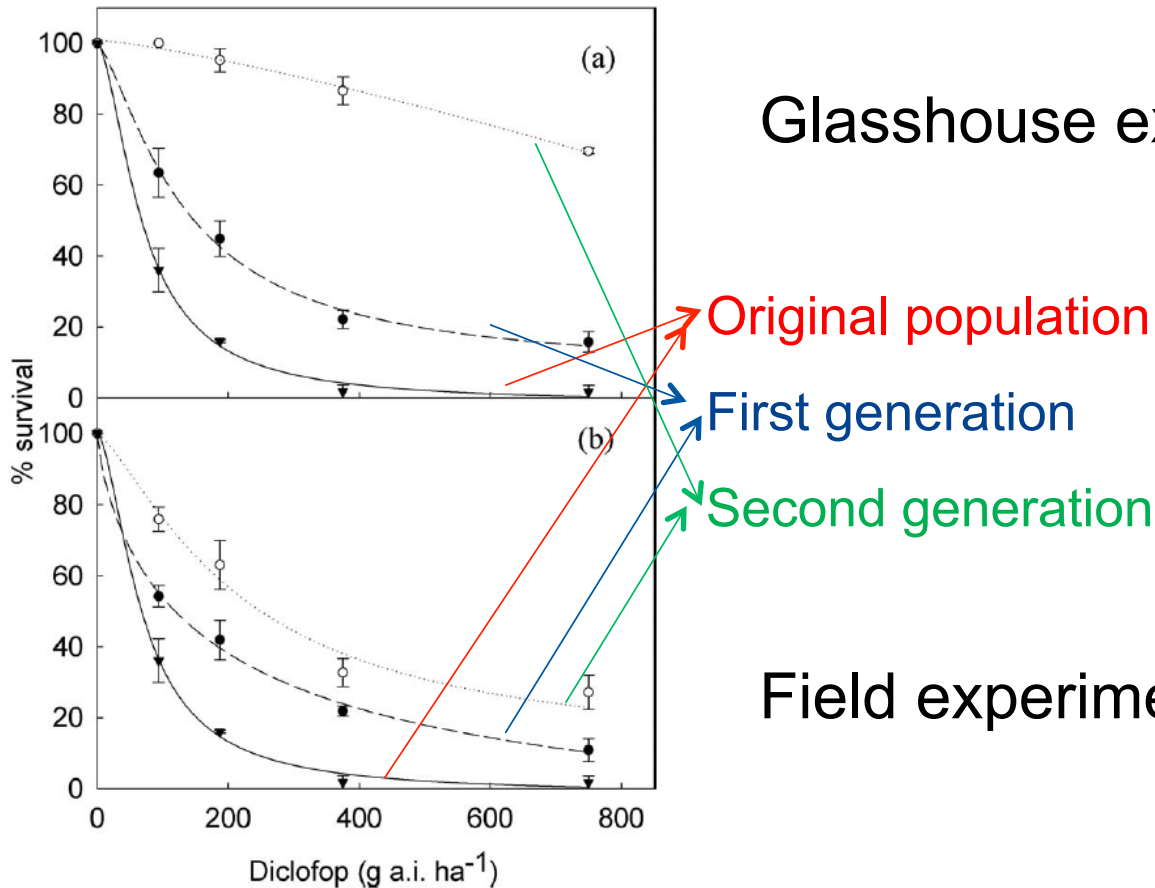
› Fungicides

- › Monitoring and thresholds
- › Focus on timing
- › Resistant varieties
- › Focus on net profit
- › Ample documentation from field trials and effective dissemination

Does the use of reduced doses increase the of selecting herbicide resistant biotypes?

- › Target site resistance (single major gene mutation, high level of resistance)
 - › With a few exceptions the cause of resistance in broadleaved weeds
 - › Also widespread in grass weeds (ACCase and ALS inhibitors)
 - › High doses speed up the selection of resistant biotypes
- › Metabolic resistance (multiple minor genes, low level of resistance)
 - › Only found in grass weeds (with one exception)
 - › Low doses may result in an accumulation of minor genes in the offspring

Low doses and metabolic herbicide resistance



Glasshouse experiment

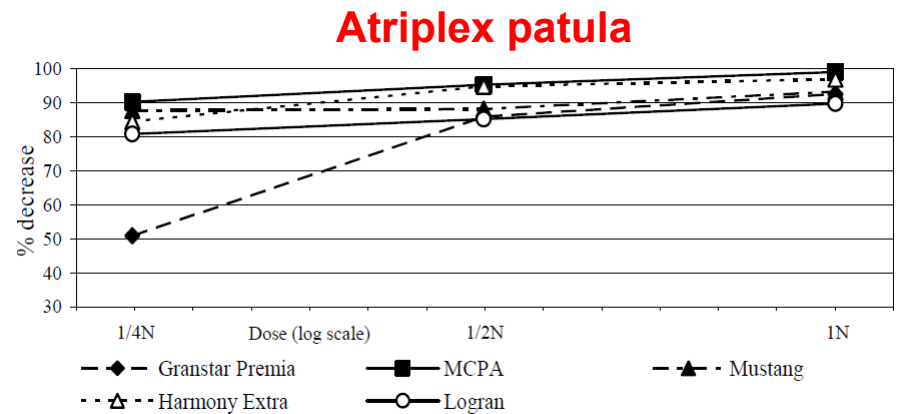
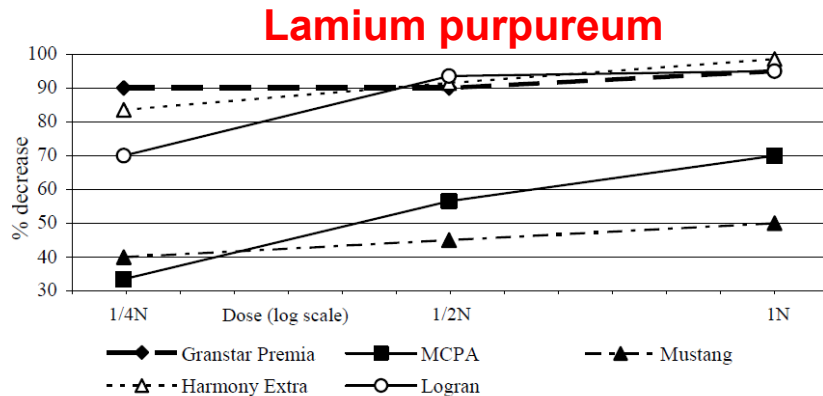
Original population

First generation

Second generation

Field experiment

Weed species respond differently to low herbicide doses

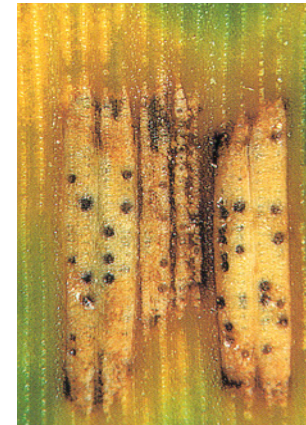
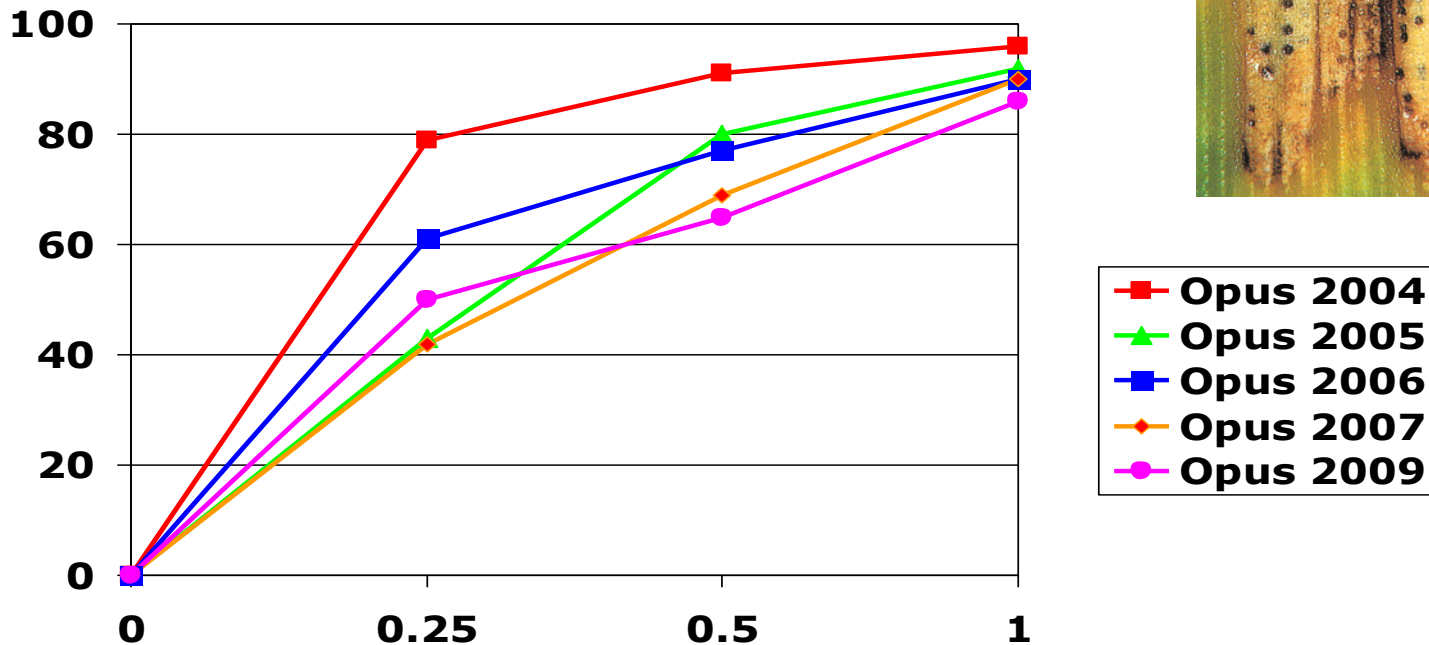


Low doses and herbicide performance

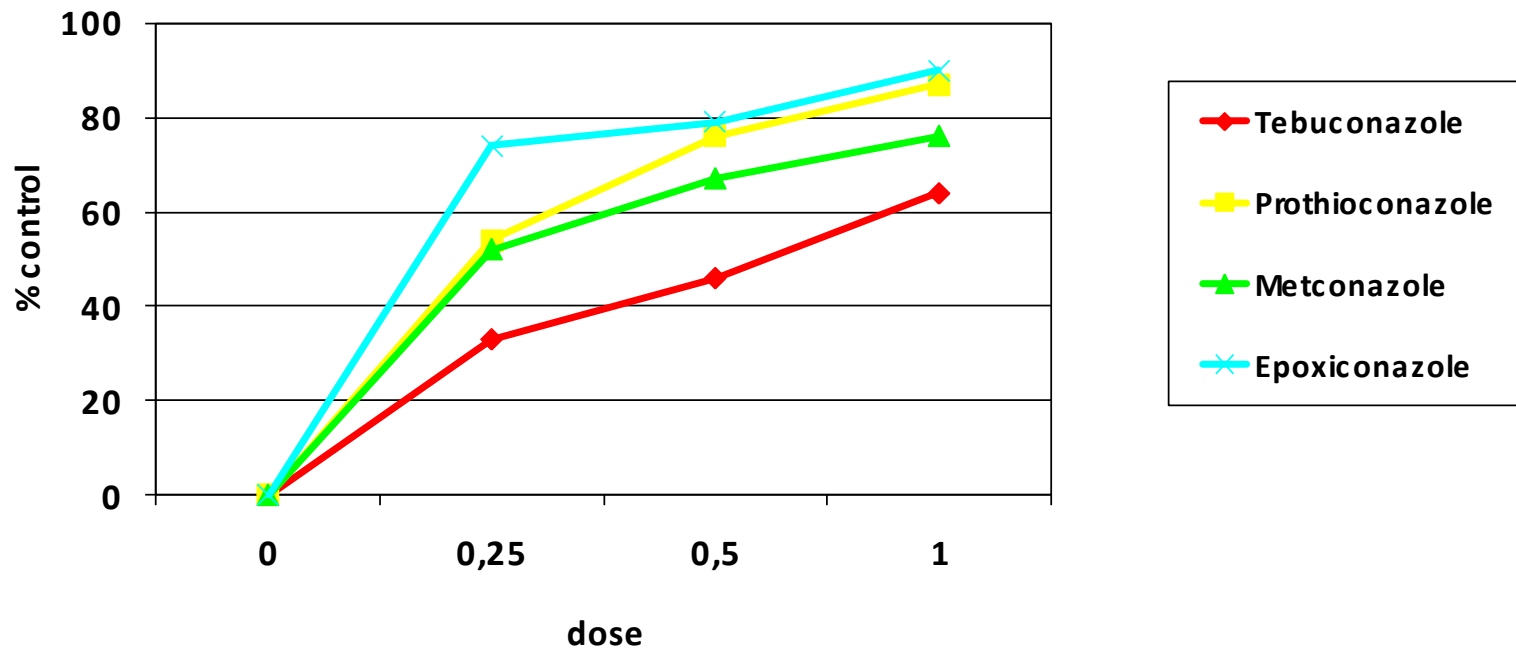
- › Reduced herbicide doses do often provide effect levels comparable to those of the recommended dose due to:
 - › High susceptibility of the weed species to the herbicide
 - › Optimum time of application

- › Omitting the word “dose” and instead using the word “effect level” when discussing the risk of resistance would clarify the discussion

Effect of epoxiconazole (Opus) on Septoria in Denmark in 2004-2009



Effect of triazoles on Septoria



Low doses and fungicide resistance

- › Fungi differ from weeds and insect in being haploid or diploids/dikaryons that are largely clonal
- › Recently van den Bosch et al. (2011) reviewed the existing literature and concluded that "high doses will increase the speed at which fungicide resistance develops"

Conclusions

- › Experimental evidence and practical experiences have shown that satisfactory control of weeds and diseases can often be obtained with less than the recommended dose
- › The use of reduced doses fit into the concept of integrated pest management
- › No clear evidence that reduced doses increase the risk for selecting resistant biotypes but low effect levels on weed species prone to develop metabolic resistance should be avoided
- › Adopting an anti-resistance strategy (herbicide rotation, herbicide mixtures, non-chemical control methods etc.) are more pertinent than focusing on the “dose issue”