



Fusarium infection and mycotoxins on cereals in reduced tillage



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Fusarium infection and mycotoxins

- background

- *Fusarium* species have a wide range of hosts and they survive in crop debris
 - infections to growing plants: from seed or crop debris
 - *Fusarium* head blight: reduced grain quality and risk for mycotoxin contamination
- EU Commission regulation 1881/2006, limits for DON and ZEN contents in cereals and cereal products for food, for T-2/HT-2 maximum contents have not been set yet
- Risk for mycotoxins increasing also in nordic countries:
 - climate is changing- has already changed
 - farming practices are changing- tillage practices, cereal production systems, crop rotation
 - mycotoxin producers are changing: species relations, new races

Fusarium species and mycotoxins in Finnish cereal grain

- Surveys every year of harvested grain: beginning from 1999
 - samples from all growing regions, mainly oats and barley
- DON, 3-AcDON, DAS, NIV, F-X, T-2, HT-2, ZEN analysed
- Background data: factors affecting mycotoxin contents- crop rotation, soil type, plant protection, lodging, tillage
 - differences between cereal species and growing regions: weather conditions
- *Fusarium* infection of grain: analysed from 2007
- The main species: *F. avenaceum*, *F. culmorum*, *F. poae*, *F. graminearum*, *F. tricinctum*, *F. sporotrichioides*, *F. langsethiae*, *F. equiseti*
- The main mycotoxins: DON (*F. culmorum*, *F. graminearum*), T-2/HT-2 (*F. langsethiae*, *F. sporotrichioides*), NIV (*F. poae*)
moniliformin and enniatins (*F. avenaceum*, *F. tricinctum*)- not surveyed

Fusarium infection and reduced tillage

- Reduced tillage and direct drilling are increasing
 - environmental effects, economical aspects, need of labour
- *Fusarium* infection and tillage:
 - less tillage- increasing risk for *Fusarium* head blight and high mycotoxin contents
- Question to answer: is reduced tillage or direct drilling a risk for cereal grain quality?
 - differences between oats and barley in *Fusarium* infection and mycotoxin contents?



Studies on reduced tillage

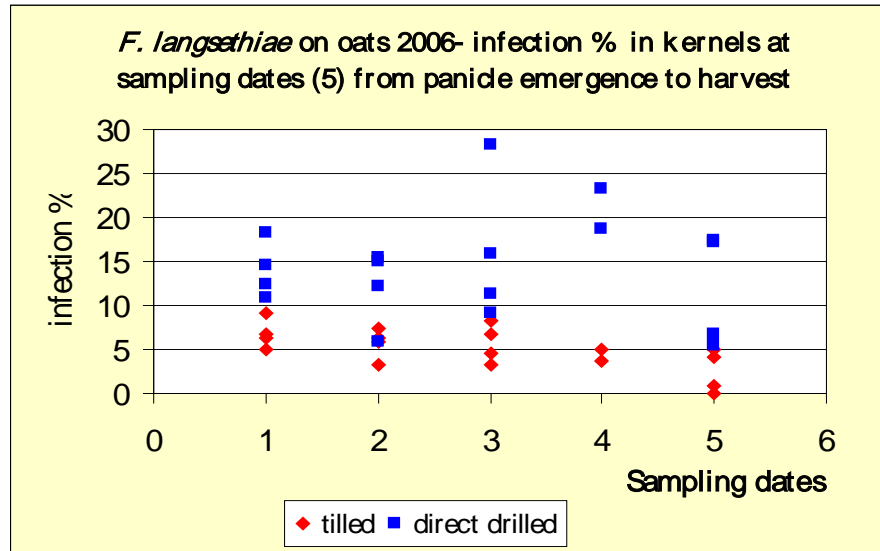
- *Fusarium* infection during the grain development –the effect of cultivation practices:
 - studied in a field trial 2004-2006, pre-crop barley, four oat and barley cultivars
 - autumn ploughing/ direct drilling
 - fungicide treatment at flag leaf stage (prochloraz Sportak 45 EC)
- Tillage practices on barley: trials in Ylistaro, Jokioinen and Mietoinen
 - direct drilling, reduced tillage, ploughing
 - fungicide treatment, glyphosate
 - pre-crops



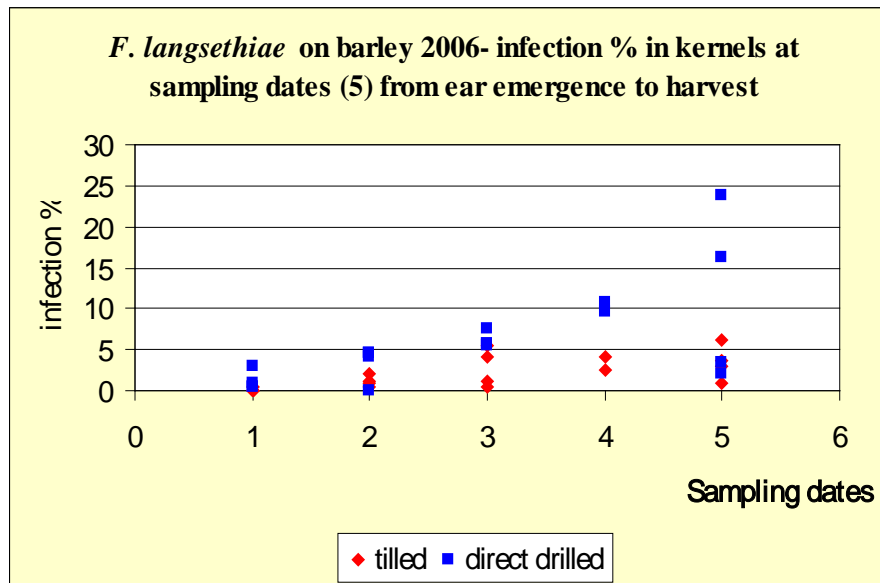
Development of *Fusarium* infection

- Differences between oats and barley and ploughing/direct drill
- Species relations changed during the trial period:
 - weather influences: wet and cool season- dry and warm season- different infection patterns
- The first species detected at ear emergence: *F. langsethiae*, *F. poae*
 - both species in dry and warm conditions, *F. langsethiae* also in humid and cool conditions
- *F. culmorum*, *F. graminearum* early in humid and warm conditions
- *F. avenaceum* in cool and humid, *F. sporotrichioides* in warm and humid conditions
 - *F. culmorum*, *F. avenaceum* and *F. tricinctum* infections increase until harvest
- Direct drilling favor *F. avenaceum* infections and also *F. langsethiae*
- More *F. culmorum* and *F. poae* on ploughed areas compared to direct drill
 - *F. avenaceum* competes with *F. culmorum* and *F. poae* in direct drill
- *F. graminearum*: not enough data to see differences

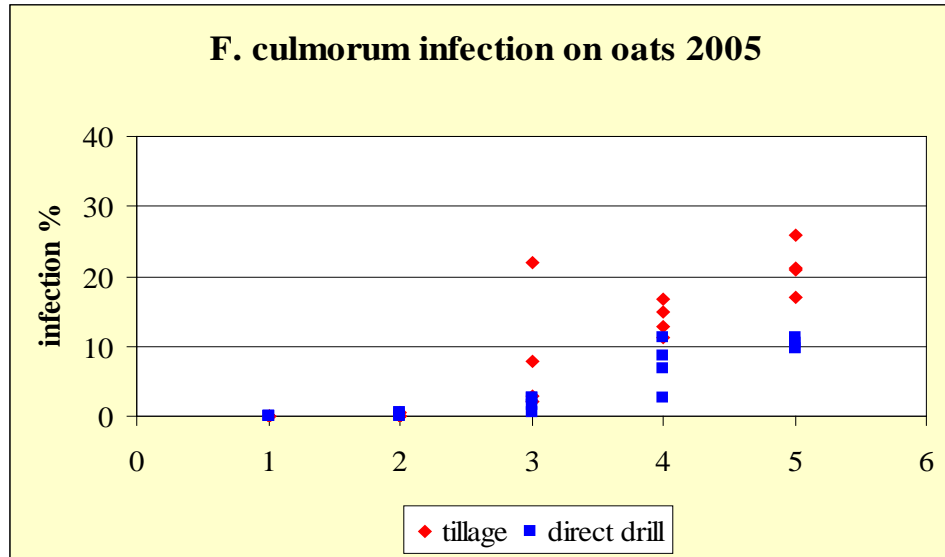
Development of *Fusarium* infection



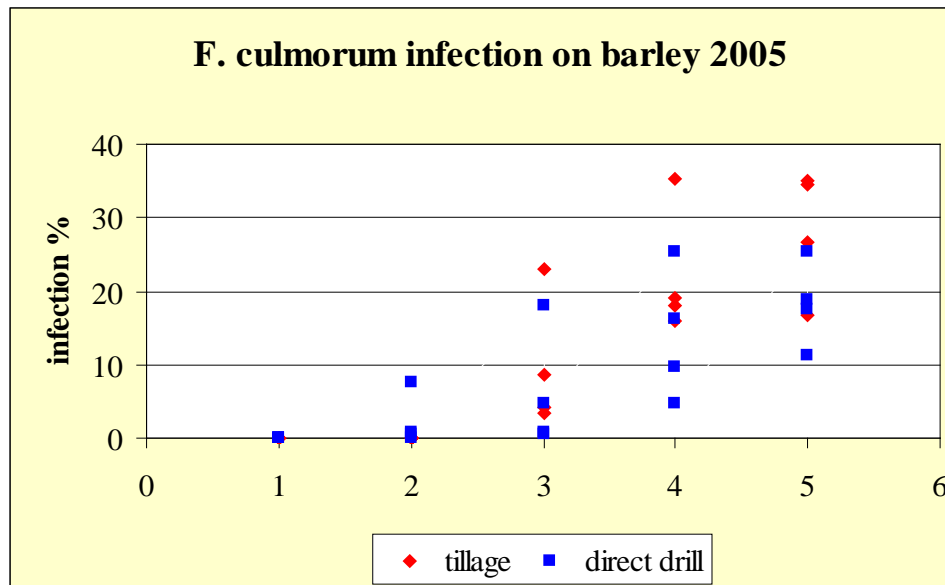
Sampling from
 3.7. 2006
 1 = week27
 2 = week29
 3 = week31
 4 = week33
 5 = grain



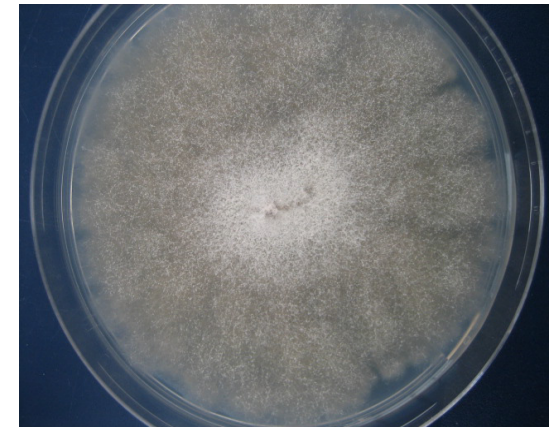
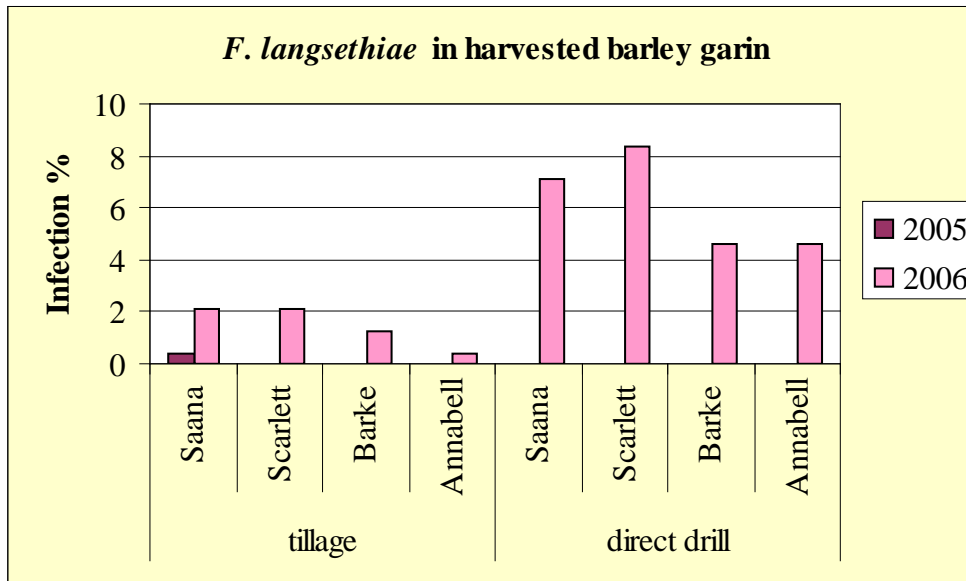
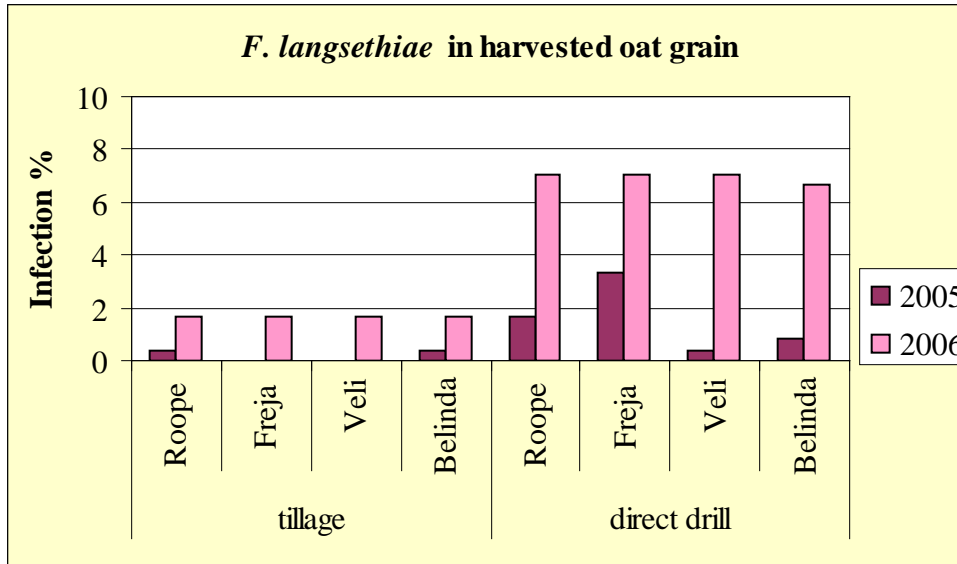
Development of *Fusarium* infection



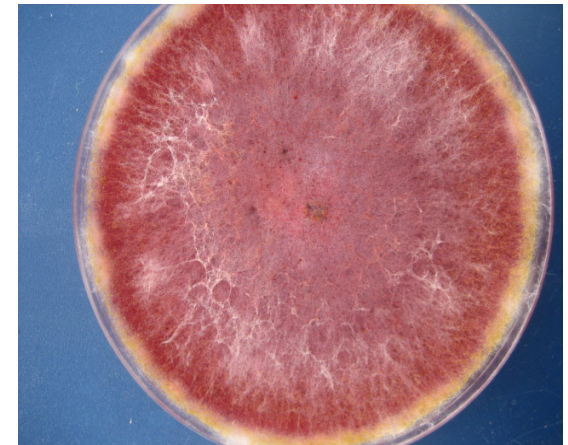
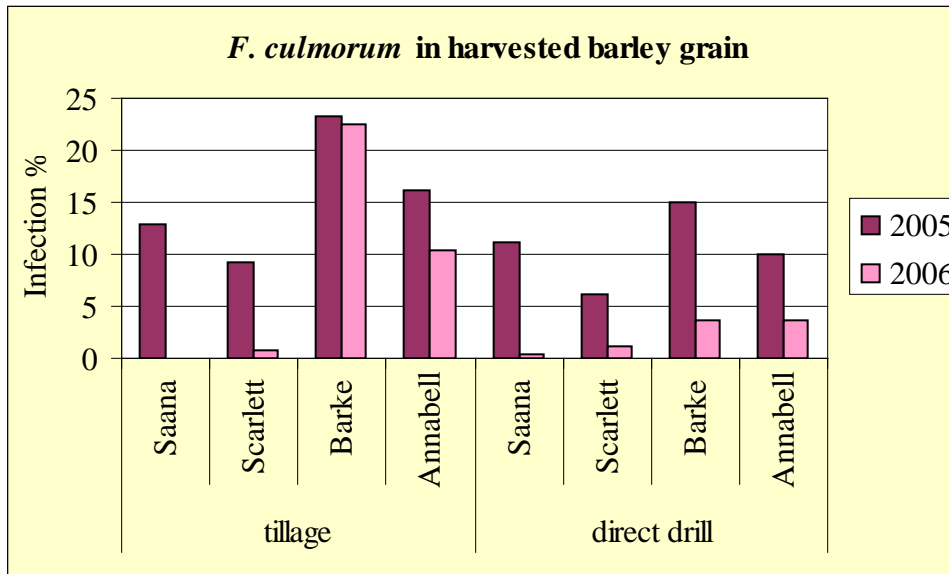
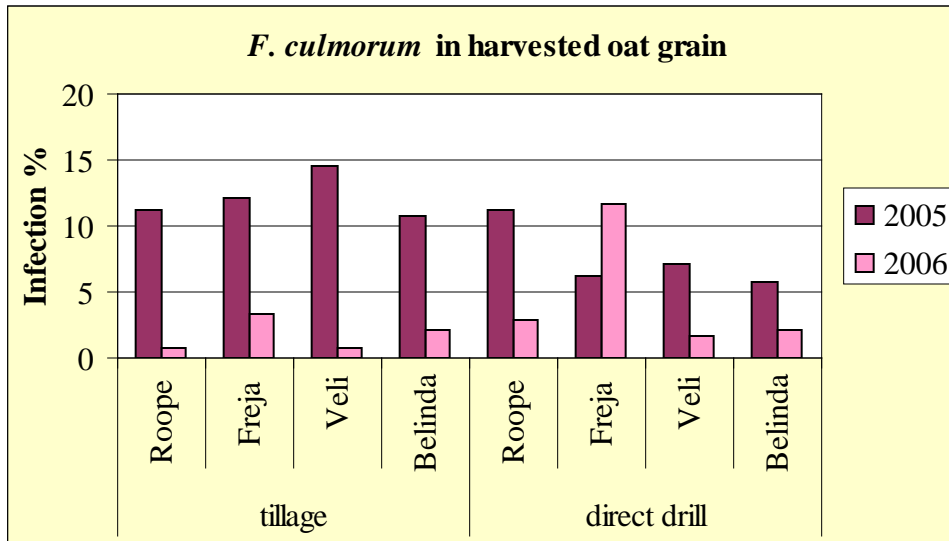
Sampling from 4.7. 2005
 1= week27
 2= week29
 3= week31
 4= week33
 5=grain



Fusarium infection in harvested grain



Fusarium infection in harvested grain

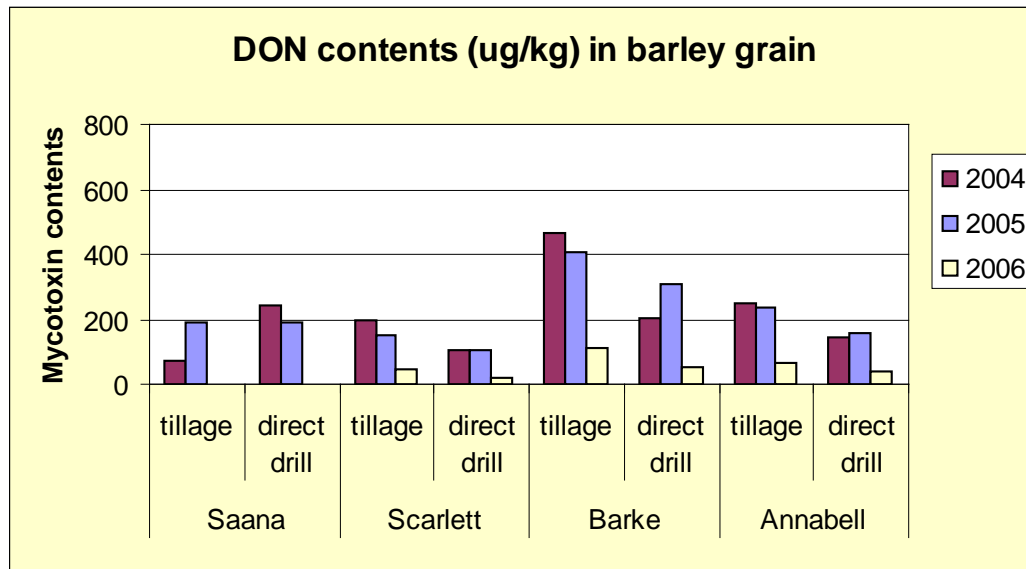
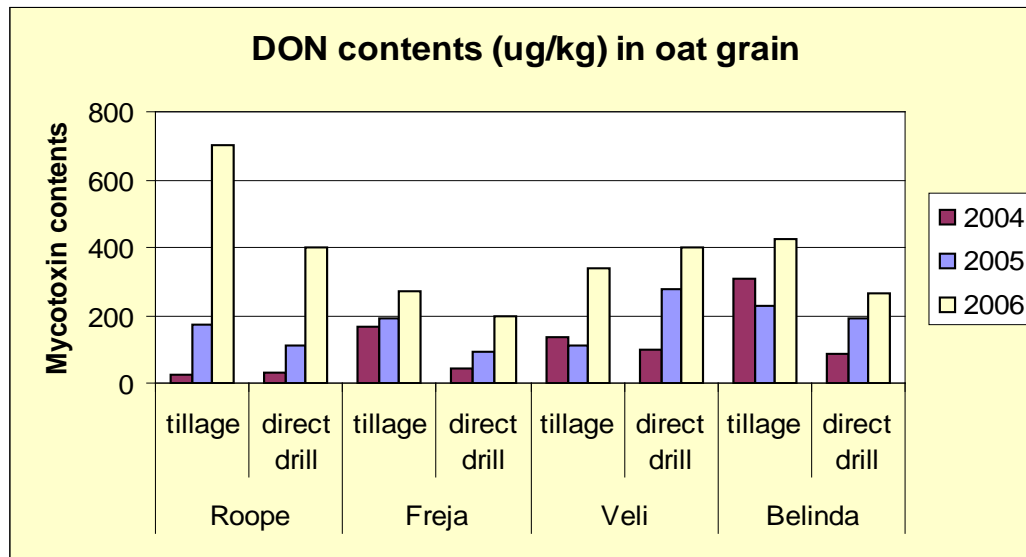


Mycotoxins and tillage

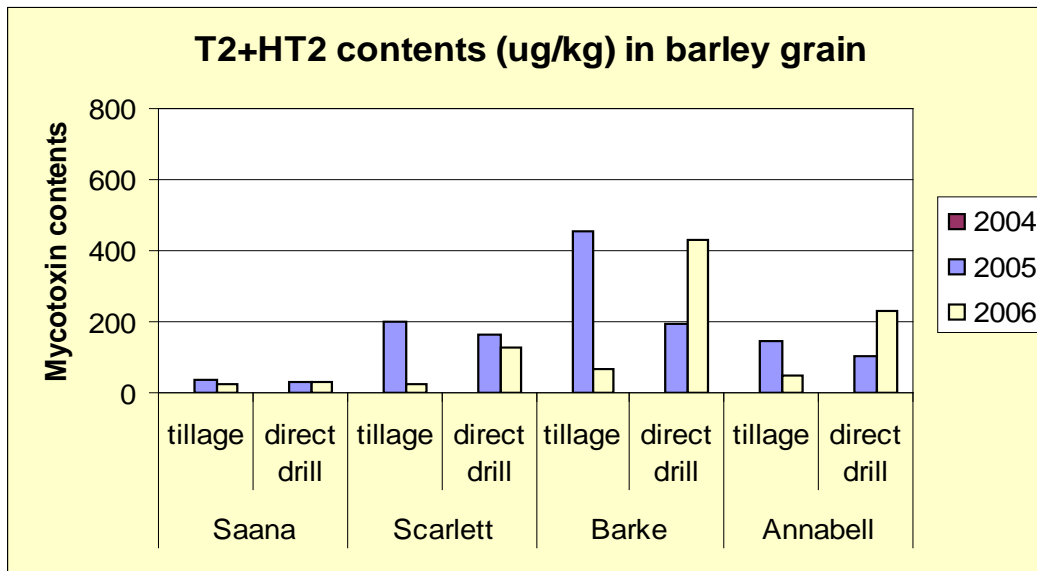
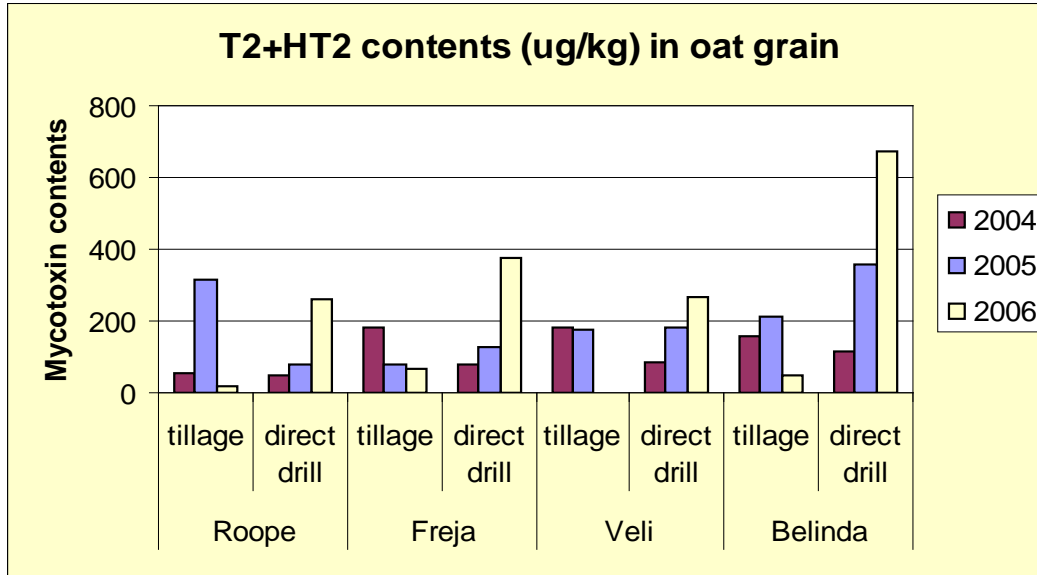
- The highest mycotoxin contents in high temperatures and humidity:
 - DON producers are favoured by humid conditions
 - in dry conditions more DON on oats than barley
- In dry conditions T-2/HT-2 contents high in grain:
 - *F. langsethiae* -infections high
- T-2/HT-2 in direct drilling
- DON-contents in harvested grain were not near to the EU limits
 - in direct drilling often lower DON contents: trial in Jokioinen and Ylistaro- opposite results from other trials
 - differences between cultivars, late cultivars often have higher toxin contents than early ones
- Variation between years: humid/dry year



Mycotoxins in grain

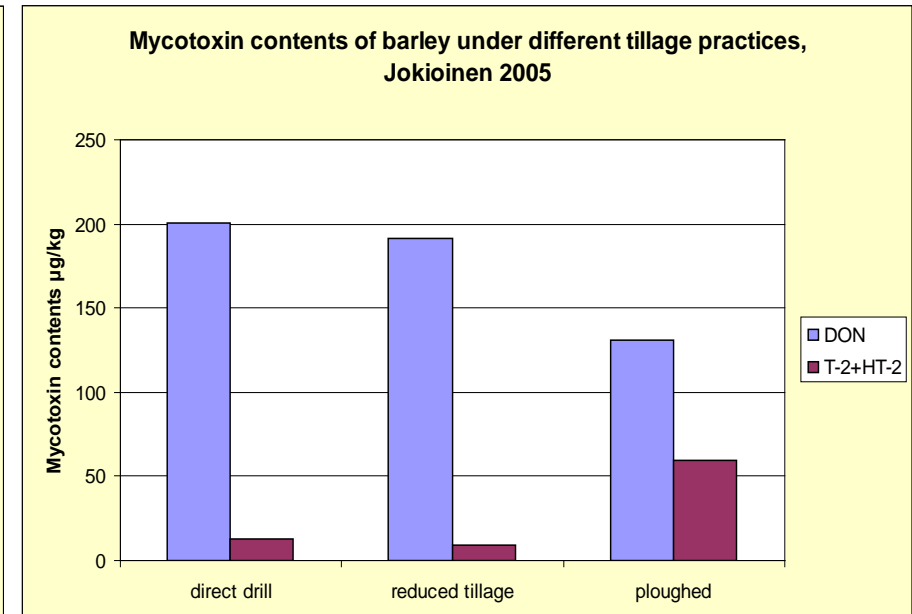
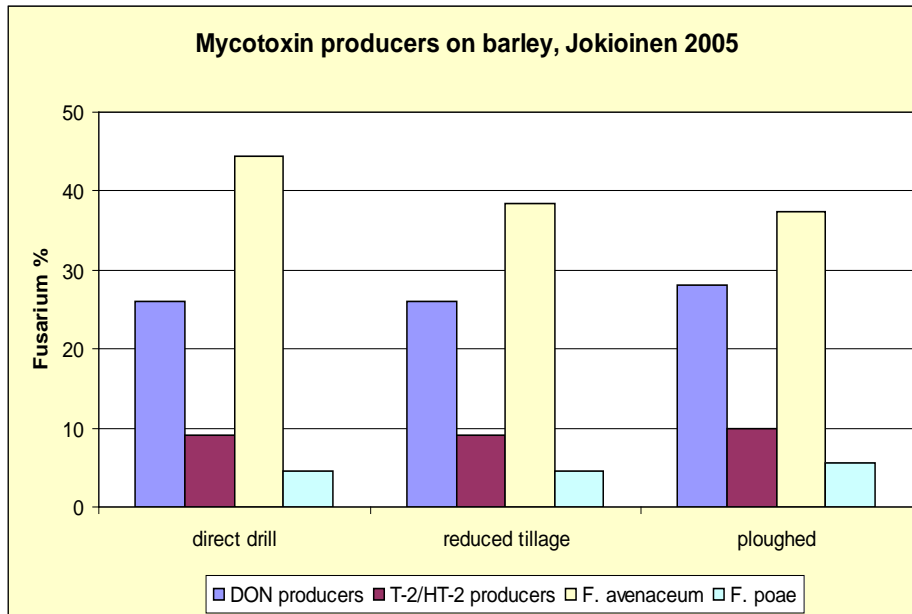


Mycotoxins in grain



Mycotoxins and tillage practices

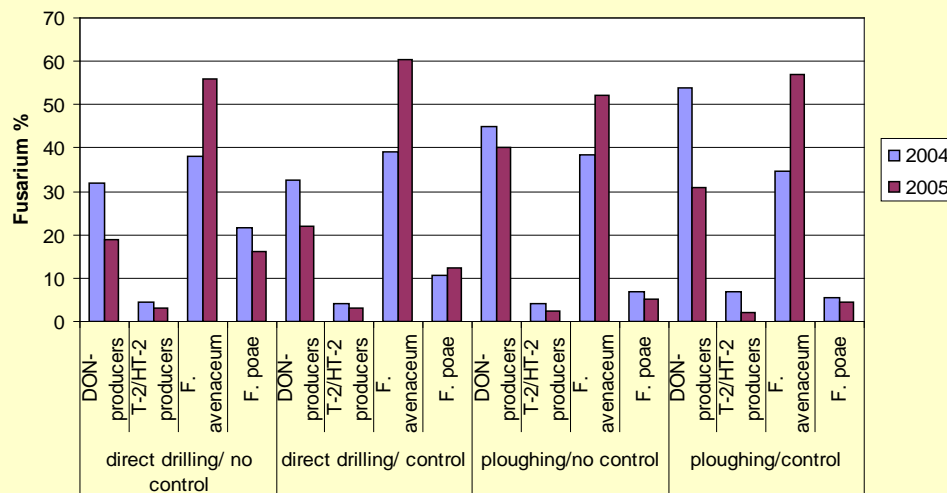
- Mycotoxin producing *Fusarium* species > mycotoxins: weather conditions affect
- Sometimes more *Fusarium*= more mycotoxins, but infection time also affects, cereal species, cultivar
- Relations between *Fusarium* species change, but what is the situation after 10 years?



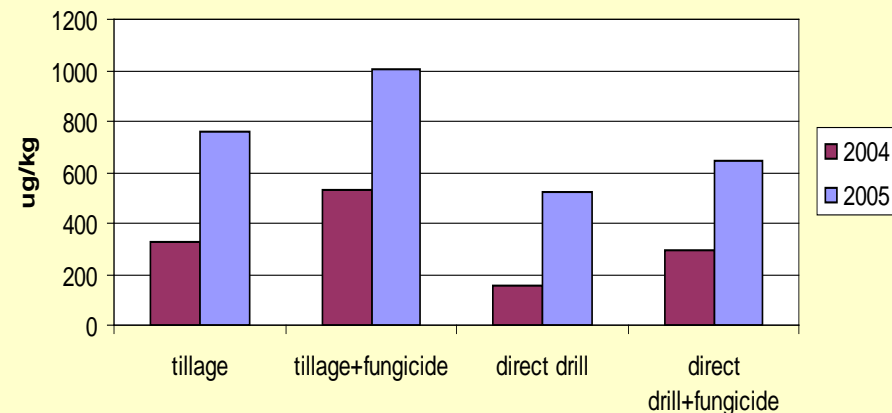
Fungicide treatment

- The effect of fungicide treatments in trials:
 - no significant effect on *Fusarium* infection
 - no effect on mycotoxin producers, no effect on mycotoxins
 - fungicide applications before ear emergence not effective
 - late infection: not possible to control

Fungicide use and mycotoxin producers, Ylistaro

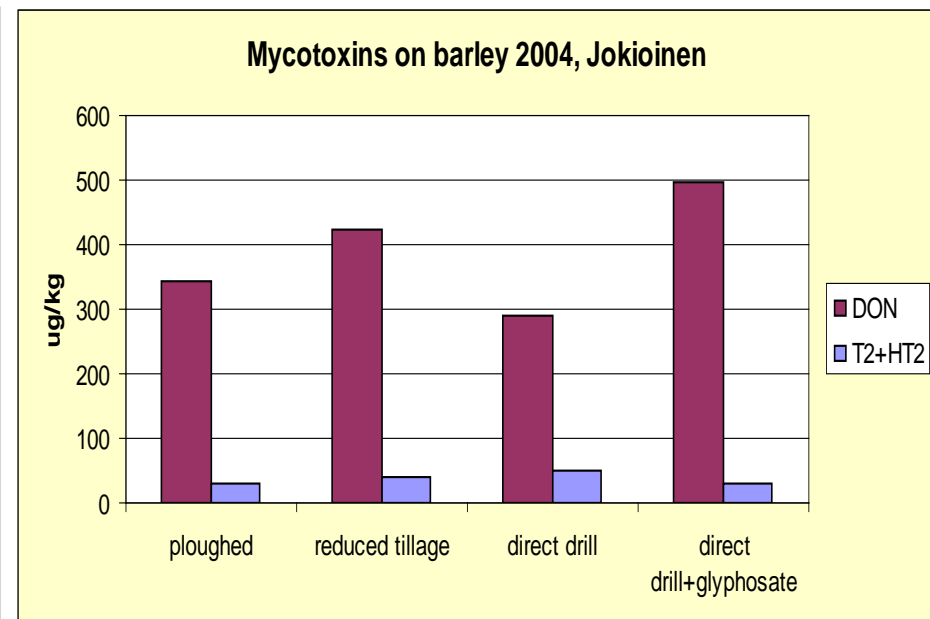
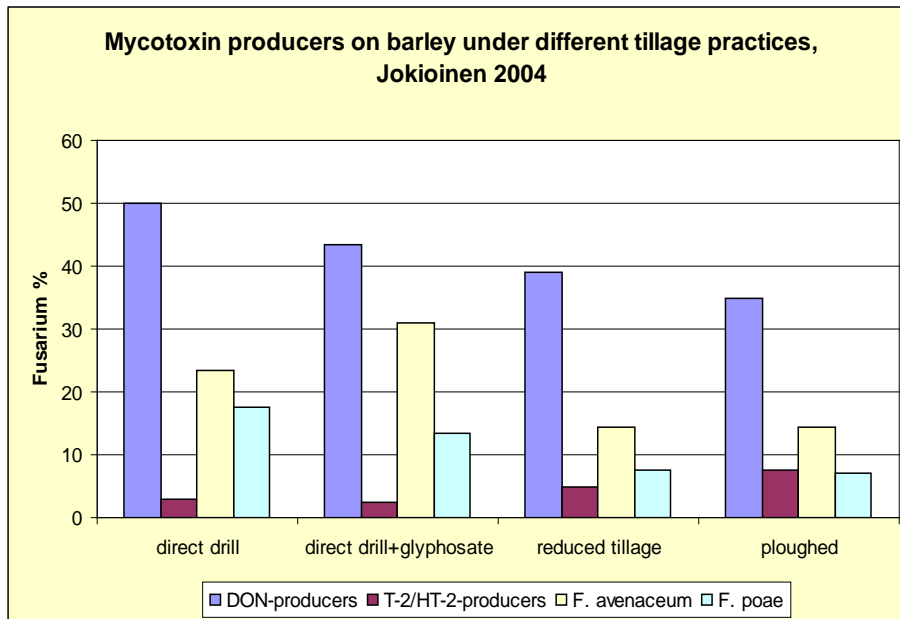


The effect of tillage and fungicide treatment on mycotoxin contents of barley, Ylistaro.



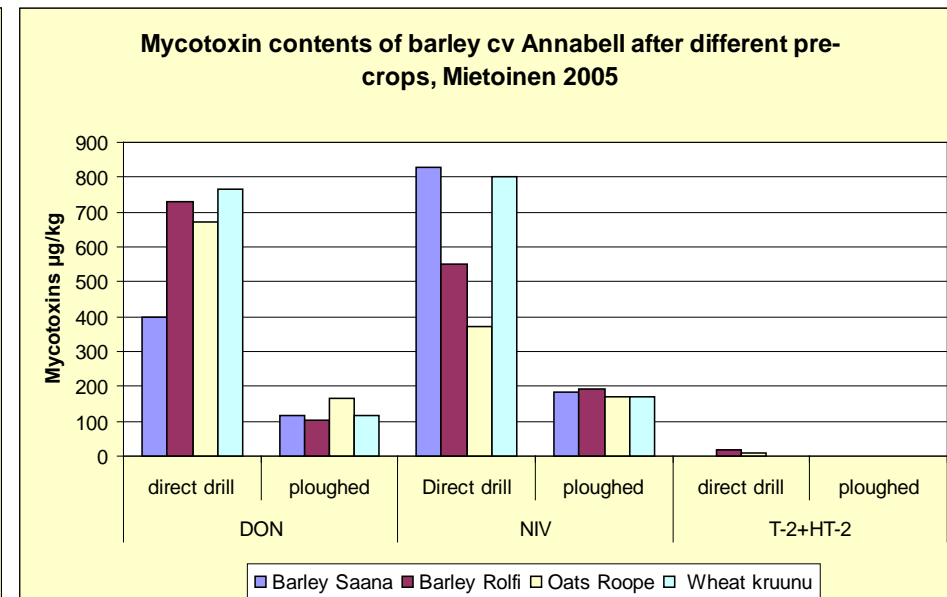
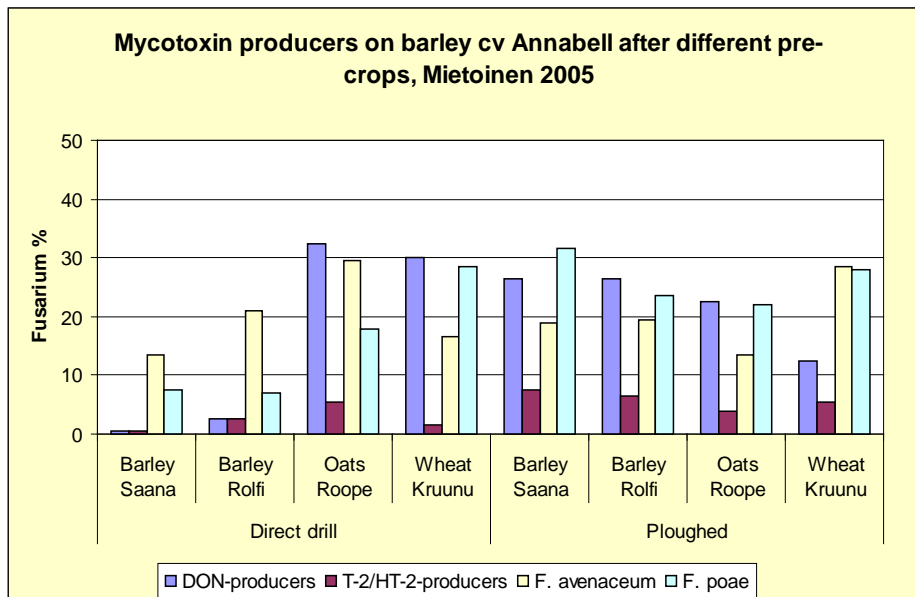
Weed control in reduced tillage

- Weed control necessary for high quality grain
- Glyphosate use has increased: increase in direct drilling and reduced tillage
 - does it increase *Fusarium* infection and possibly mycotoxins?
 - not enough data to make conclusions



Pre-crop

- The effect of pre-crop:
 - observed in the survey material- crop rotation= less mycotoxins
 - not much differences between cereal species as pre-crops
 - break crops in cereal cultivation useful: oilseed rape, leguminous crops, grasses



Conclusions

- **Direct drilling and reduced tillage:**
 - may increase T-2/HT-2- producers, especially on oats
 - may decrease DON-producers, especially *F. culmorum* > is it long lasting effect?
 - an increase *F. avenaceum* infection in humid growing seasons - effect on *F. culmorum*
 - less *F. poae* -infection especially on oats
 - effect on *F. graminearum*: - not detected, the species is quite common but perithecia are not often detected
 - *F. graminearum* is most likely increasing- changes the situation
- **Control of mycotoxin producers in reduced tillage:**
 - fungicide treatments not effective to control *Fusarium* and mycotoxins
 - crop rotation important
 - resistant cultivars

