Fusarium Infection and Mycotoxin Contents of Oats Under Different Tillage Treatments

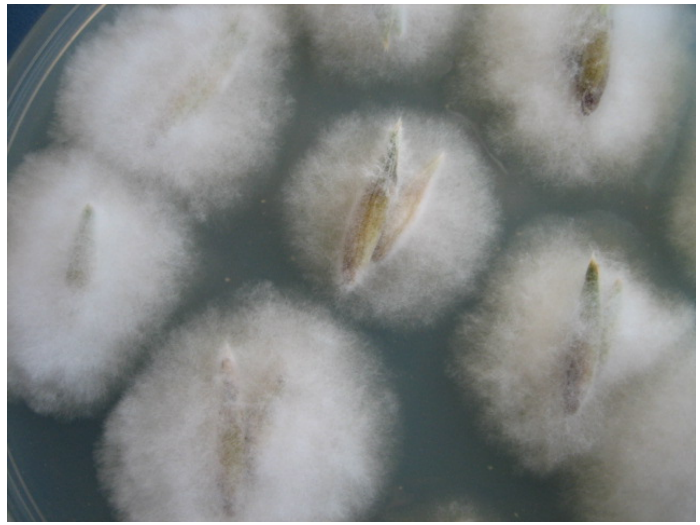
Päivi Parikka, Veli Hietaniemi, Sari Rämö and Heikki Jalli

MTT Plant Production Research and

MTT Laboratories

Fusarium Head Blight on Oats

- Fusarium head blight occurs every year in some extent in Finnish oats
- reduces grain yield and quality:
  poor grain development, small and light weight grain, mycotoxins harmful in food and animal feed
- oats is very susceptible to *Fusarium* infection
- the highest mycotoxin contents in Finnish cereals are mainly detected on oats
- oat cultivars are often harvested late and suffer from unfavourable weather in autumn
- *Fusarium* species infecting plants survive in soil and plant debris: stubble, straw
- infection and mycotoxin production depend on weather conditions



Cultivation practices and *Fusarium* infection

reduced tillage and direct drilling are increasing also in Finland

results from other countries: less tillage- increasing risk for Fusarium head blight and high mycotoxin contents

EY Directive for deoxynivalenol (DON) contents in cereals and cereal products: 1700 μg/kg for oat grain

proposed maximum content for T-2+HT-2 500μg/kg??

development of *Fusarium* infection in kernels– no earlier studies in Finland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Field trial to study *Fusarium* infection

- in Southern Finland (MTT Jokioinen), on sandy clay soil in 2004-2006

- autumn ploughing/ direct drilling
- four oat cultivars: Roope, Freja, Veli and Belinda
- sampling to detect *Fusarium* infection:
  starting from panicle emergence, continuing every second week until harvest
- *Fusarium* and mycotoxin analyses of the harvested grain

- in 2005 and 2006 mycotoxin analyses also 2 weeks before harvest and of cleaning residue, small grain


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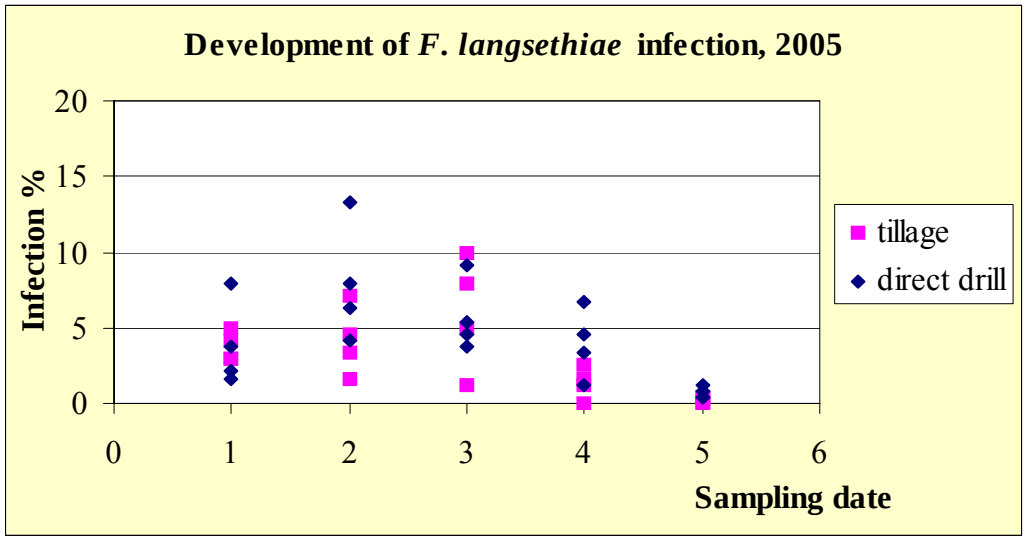
Development of *Fusarium* infection

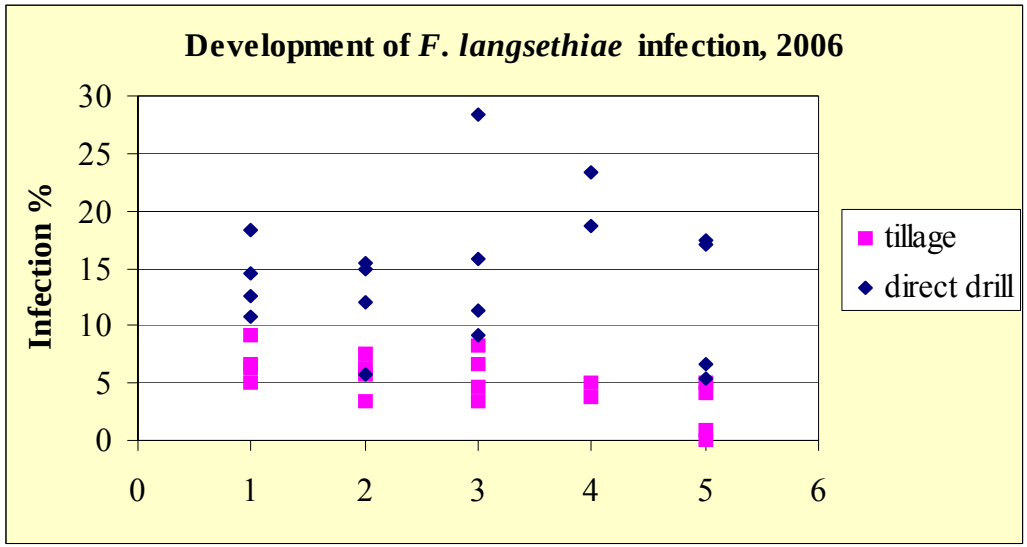
- *Fusarium* infection is first detected at panicle emergence
  - the first species detected is *F. langsethiae*

- infection increases in the developing kernels
  - *F. poae*, *F. avenaceum, F. culmorum, F. sporotrichioides, F. tricinctum, F. graminearum, F. sambucinum and F.equiseti* colonise the kernels during July- early August
- Colonization depending on the weather conditions
  - 2004: very humid growing season- favored *F. avenaceum* and *F. culmorum*
  - 2005: first dry, warm, favored *F. poae*, then humid – *F. avenaceum*, *F. culmorum* and *F. tricinctum* increased
  - 2006: dry, warm season, favored *F. poae and F. langsethiae*

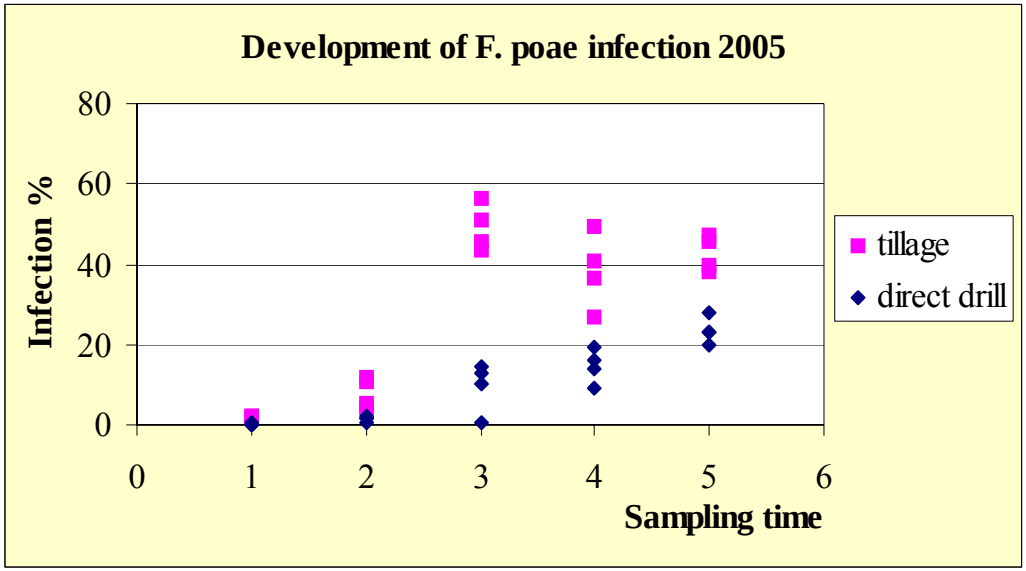
the number of species detected and amount of infected kernels increases towards the end of the season but detection of *F. langsethiae* is normally reduced when grains are maturing



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



Sampling dates
from 3.7. 2006
1= week 27
2= week 29
3= week 31
4= week 33
5= grain



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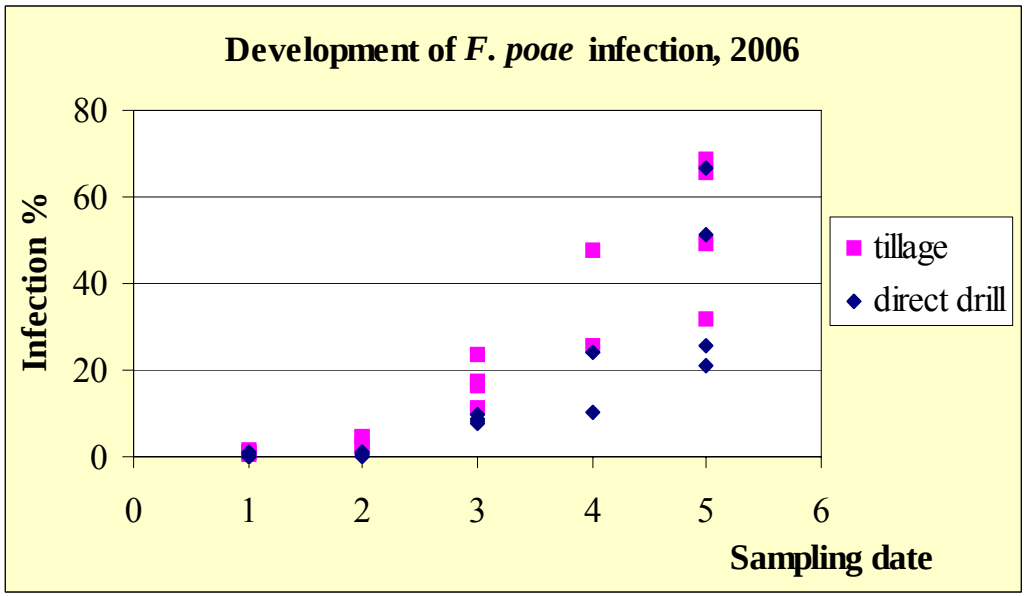

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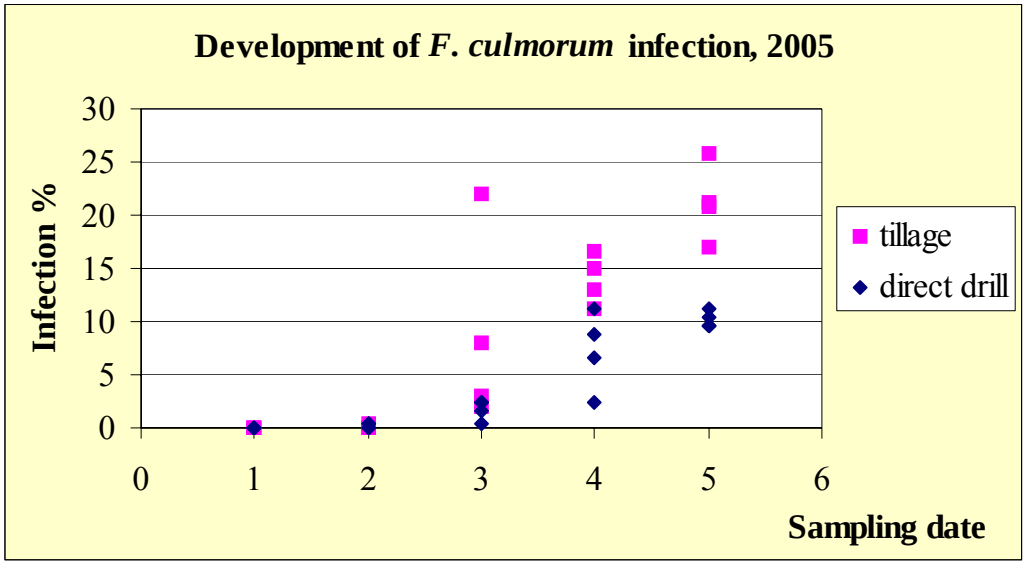

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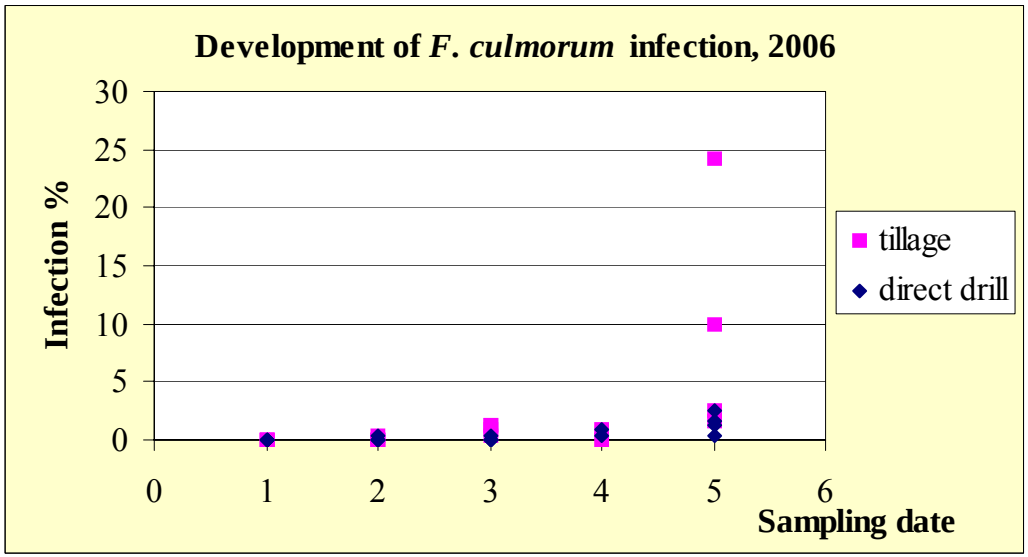

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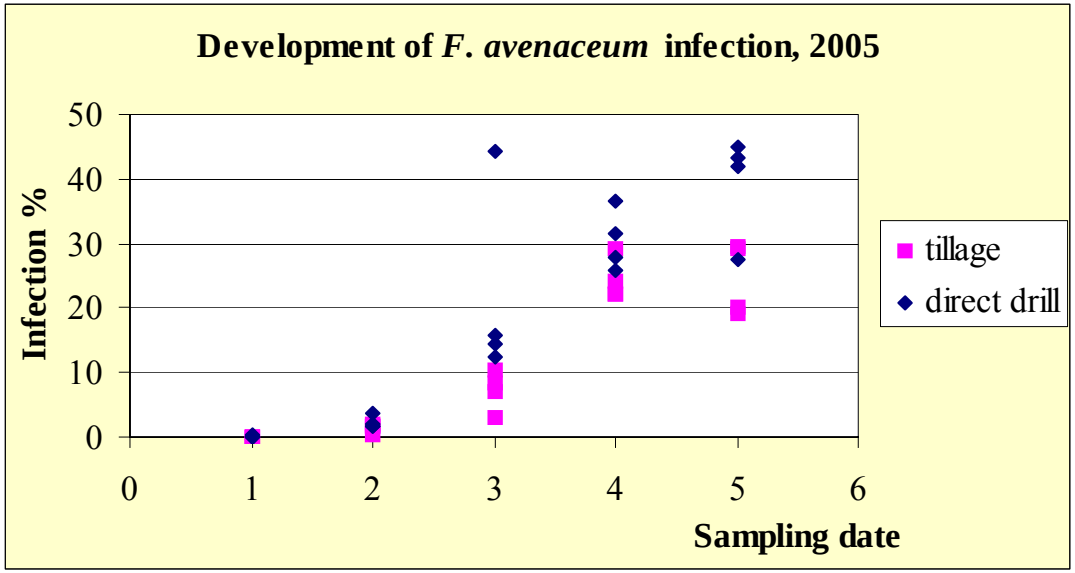

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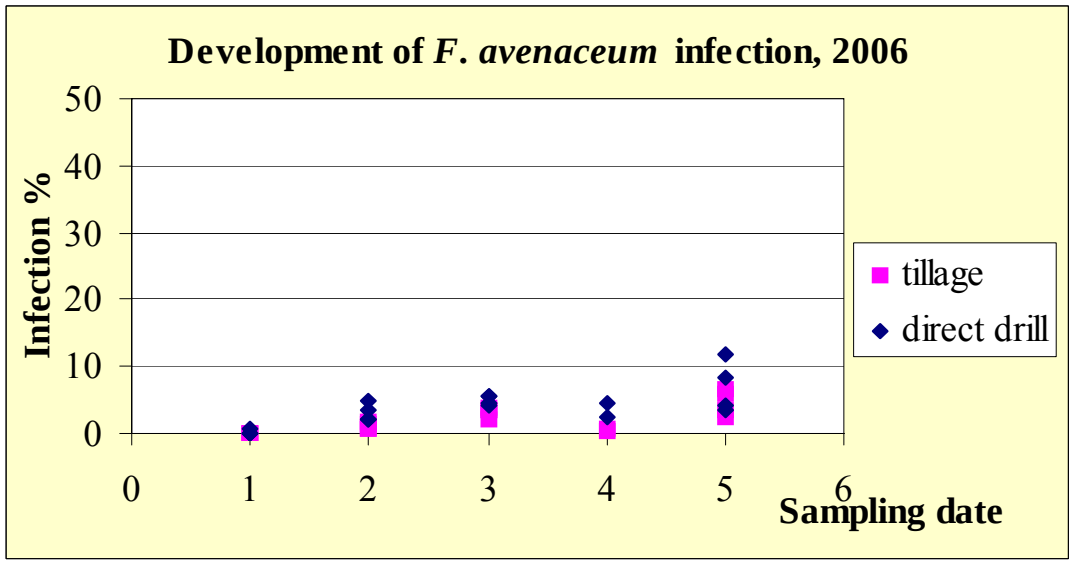

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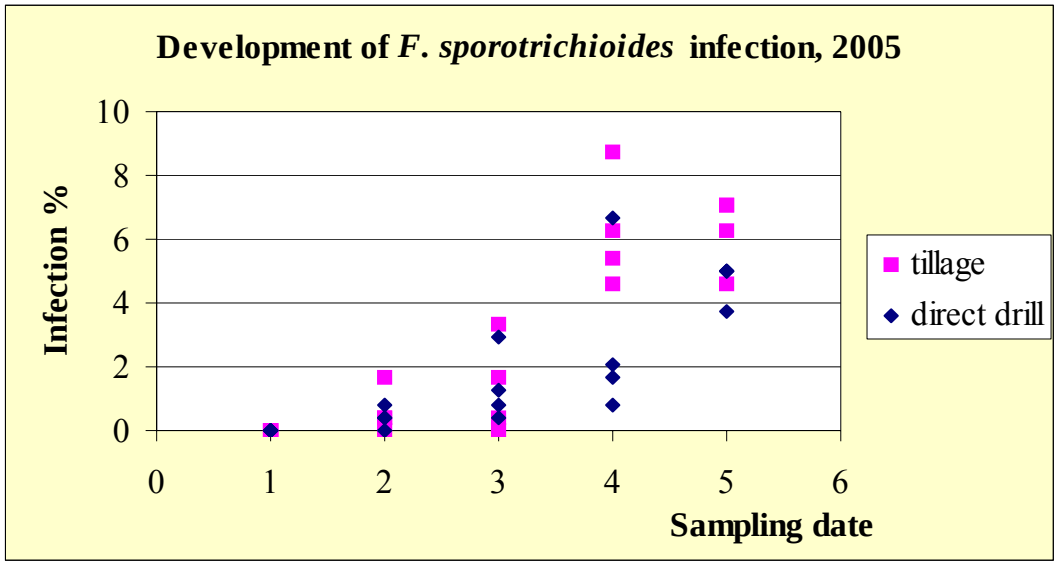
4= week 33
5= grain



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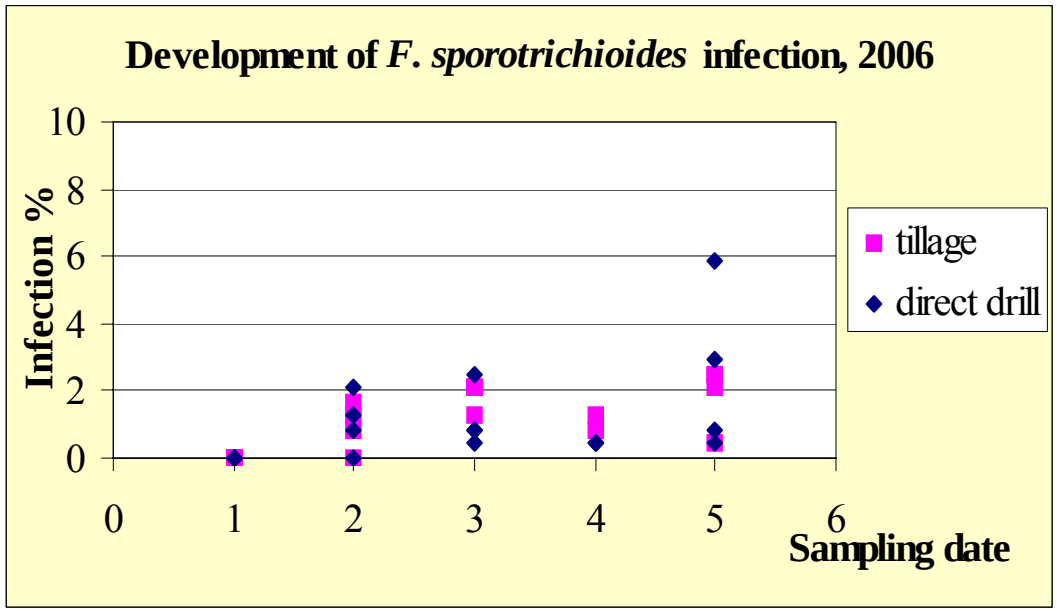
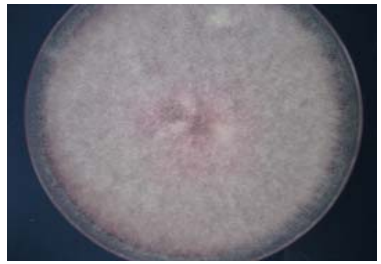
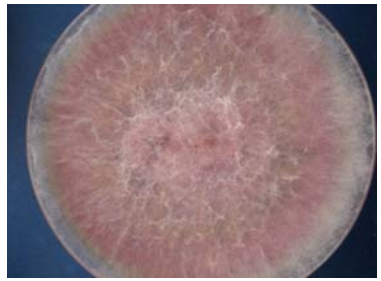
4= week33
5=grain

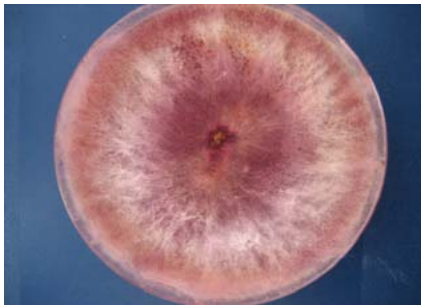
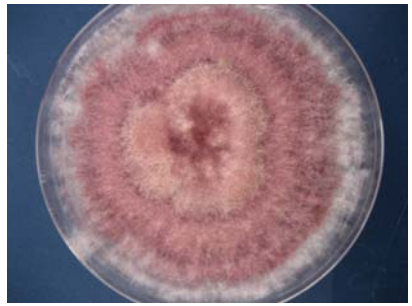


Sampling dates
from 3.7. 2006
1= week 27
2= week 29
3= week 31
4= week 33
5= grain

Early and late colonizers

- early colonizers: *F. langsethiae*, *F. poae*
- mid-season infections: *F. sporotrichioides*, *F. graminearum*, *F. culmorum*
- late colonizers: *F. avenaceum*, *F. culmorum*, infections increase in mature grain

Fusarium species and mycotoxins

Trichotechene toxins: deoxynivalenol (DON), 3-acetyldeoxynivalenol (3-AcDON), nivalenol, diacetylscirpenol (DAS), T-2, HT-2

- producers *F. culmorum* and *F. graminearum* (DON, 3-AcDON)
- *F. sporotrichioides* and *F. langsethiae* (T-2 and HT-2)
- *F. poae*: nivalenol

- Zearalenone
- producers *F. graminearum* and *F. culmorum*

- Moniliformin and enniatins
  producer *F. avenaceum*

Tillage can influence infection

Direct drilling:

can increase T-2/HT-2 producers, especially *F. langsethiae*

- increases risk for T-2/HT-2 in grain

decreases DON-producers, especially *F. culmorum*

- decreases DON contents in grain

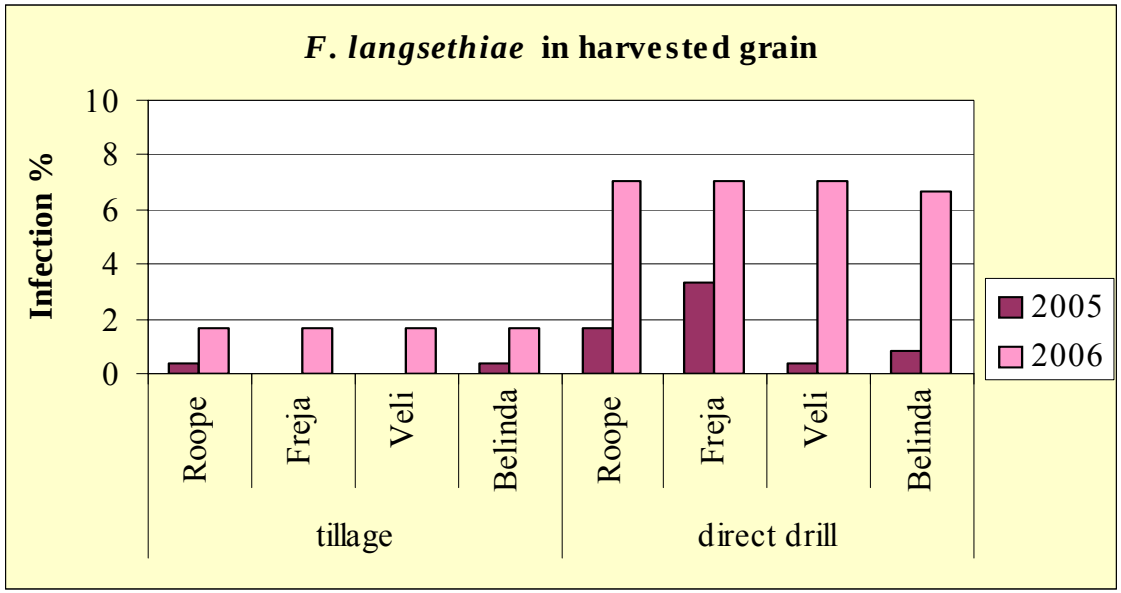
increase *F. avenaceum* infection in humid growing seasons

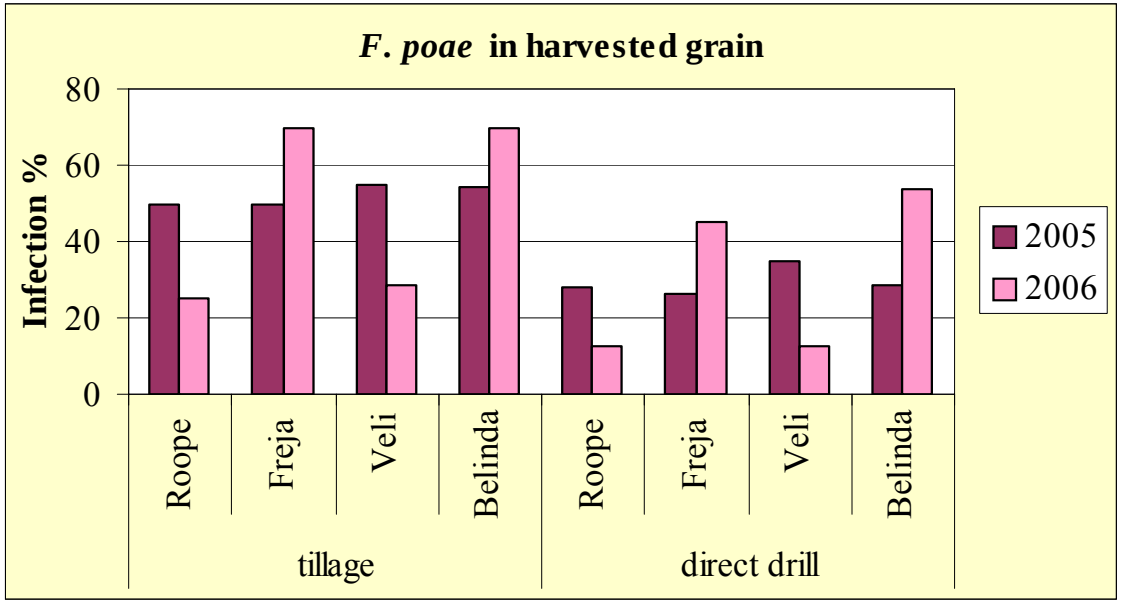
- *F. avenaceum* colonizes kernels rapidly and inhibits growth of other species

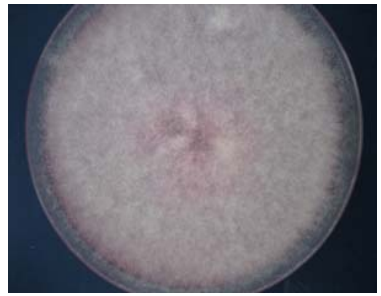
Tillage:

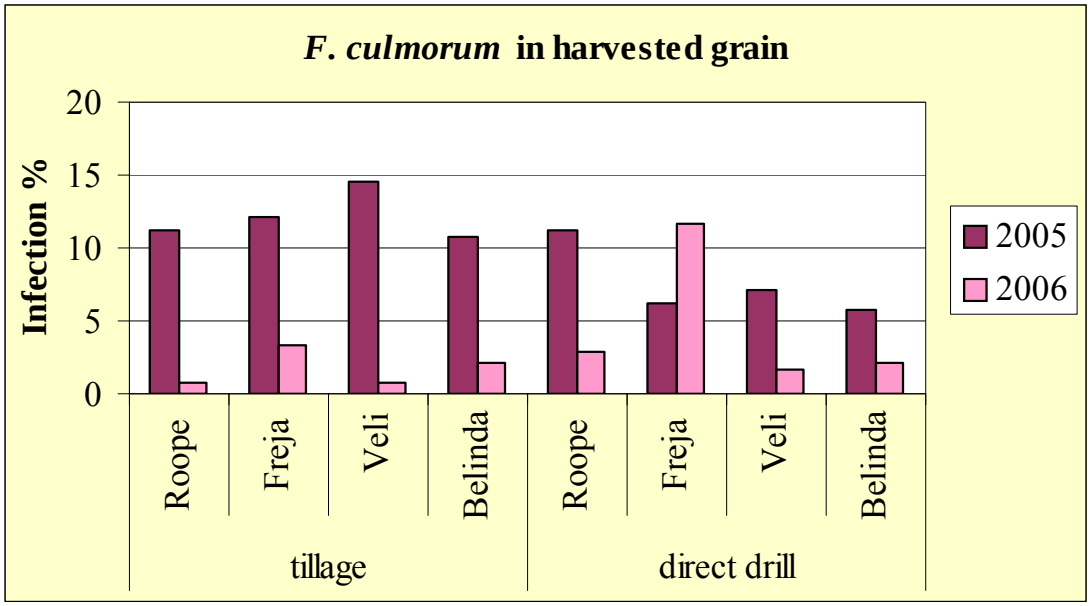
seems to favor *F. poae*-infection

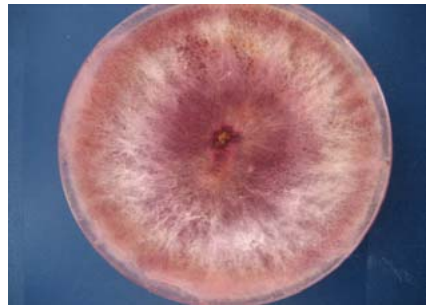
- may increase risk for nivalenol in grain

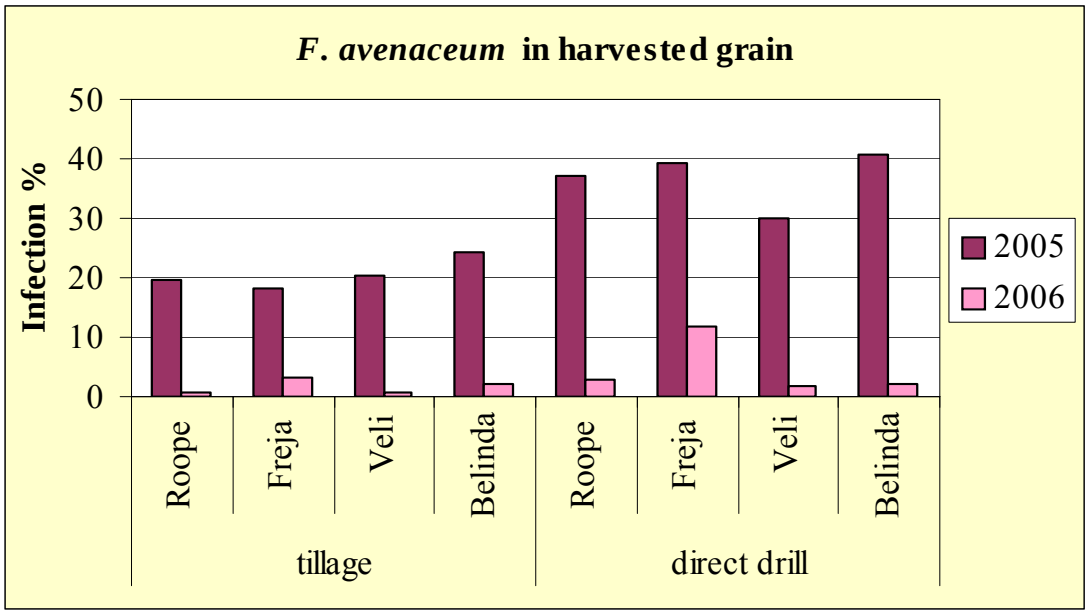

F. langsethiae in harvested grain
Infection %
10
8
6
4
2
0
Roope
Freja
Veli
Belinda
Roope
Freja
Veli
Belinda
tillage
direct drill
2005
2006

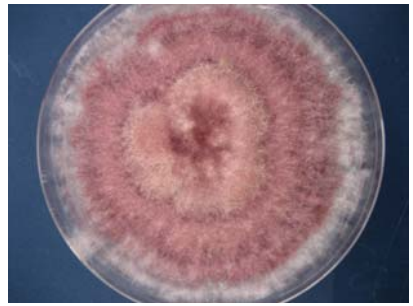

F. poae in harvested grain
Infection %
80
60
40
20
0
Roope
Freja
Veli
Belinda
Roope
Freja
Veli
Belinda
tillage
direct drill
2005
2006




F. culmorum in harvested grain
Infection %
20
15
10
5
0
Roope
Freja
Veli
Belinda
Roope
Freja
Veli
Belinda
tillage
direct drill
2005
2006




F. avenaceum in harvested grain
Infection %
50
40
30
20
10
0
Roope
Freja
Veli
Belinda
Roope
Freja
Veli
Belinda
tillage
direct drill
2005
2006



Mycotoxins before harvest and in harvested grain

- the highest mycotoxin contents in 2005: high temperatures and humidity

- in 2006 T-2/HT-2 contents high in grain*: F. langsethiae* –infections high
  - toxins analysed already 2-3 weeks before harvest: DON, T-2/HT-2

- DON-contents in harvested grain were not near to the EU limits
  - in direct drill often lower toxin contents
    differences between cultivars, late cultivars had higher toxin contents than early ones

- variation between years: humid/dry year
  the high T-2/HT-2 contents on oats correspond to those in the national mycotoxin survey

Cultivars- mycotoxins 2006

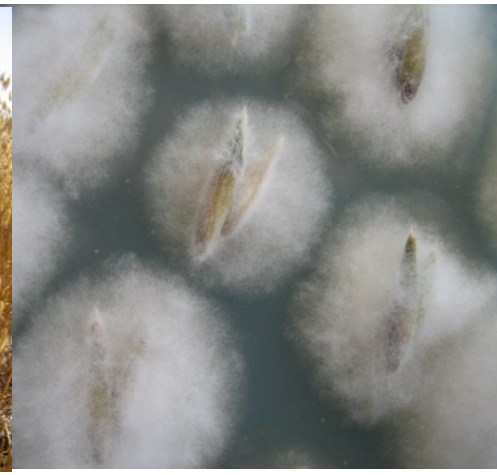
		Uncleaned grain				Cleaned grain			
		DON	NIV	T-2	HT-2	DON	NIV	T-2	HT-2
Roope	tillage	610-790	71-160	0	0-49	440-680	0	0	0
	direct drill	290-480	0	0-220	0-390	370-390	0-<25	0	0
Freja	tillage	220-340	70-96	0-84	0-110	300-330	0	0	0
	direct drill	180-220	0-120	120-300	120-300	130-230	0	0	0
Veli	tillage	320-400	160-340	0	0	290-430	0	0	0
	direct drill	340-430	75-250	45-95	140-230	280-380	0-<25	0	0
Belinda	tillage	370-470	220-300	0	0-140	230-390	0-72	0	0-31
	direct drill	170-330	0	210-280	320-490	250	44	0	0

Normally cleaning reduces both DON and T-2/HT-2 contents, but the dry year 2006 was exceptional in case of DON

Conclusions

- *Fusarium* infection can take place in early kernel development
- the first infecting species is a T-2-producer *F. langsethiae* which is not highly dependent on weather conditions
- late cultivars more susceptible to DON producers- infections still near maturity
- poor knowlegde of resistance in cultivars
- T-2/HT-2 potential risks under reduced tillage or direct drilling
- cleaning reduces effectively mycotoxin contents of harvested grain



Acknowledgements

This study was supported by the Finnish Ministry of Agriculture Forestry, Raisio Ltd, Nestle Nutrition and Viking Malt Ltd




Thank you