Introduction to diseases assessments methods and sampling methods.

Lise Nistrup Jørgensen
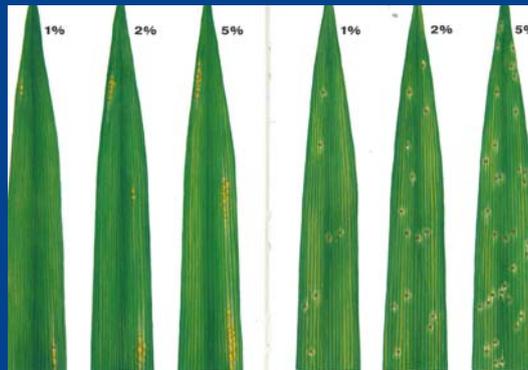
How and what to assess?

› <u>Purpose of assessments</u>

- › Background for quantifying disease management
- › Important for disease forecasting and surveys
- › Description of disease progress over seasons and between seasons
- › Good for assessing differences between:
  - › Differences in cultivars susceptibility
  - › Differences between fungicides
- › Correlate often well with potential yield losses
- › Government agencies for determining priorities

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Different methods of assessments

› Incidence
› Severity
› Classes and index calculation
› Qualitative keys (e.g. rust virulence)
› Green leaf area
› Spore trapping
› Germination of seeds – diseased grain
› Remote sensing (relative vegetation index =RVI)

› ELISA
› PCR
› QPCR Quantify the amount of fungi related to plant DNA

3

How and what to assess?

› Assessments should be
  › Random, representative, objective
  › Metods can be destructive or non-destructive
› Incidence= percent plants infected.
  › Control threshold use often incidence as treatments are needed at early levels of attack
  › Used to assess disease prevalence in a country
› Severity = % area of diseased tissue
  › good for assessing differences between treatments:
    › Differeces in cultivars susceptibility
    › Differences between fungicides
    › Correlate often well with potential yield losses

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How and what to assess?

› Traditional sampling – 50 tillers at random in survey picted along a diagonal
  › Sample should be adjusted according to whether the attack is scattered or uniform
› In experimental plots 10 or 20 tillers are used.
  › Replication produces the needed accuracy.
  › The size of sample is given by EPPO -guidelines
  › Adjusted to given capacity

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How and what to assess?

› A linar percentage scale is most commonly used
› Problems with assessments
  › Scales and description keys have been developed to support even assessments
  › Avoid terms like slight, moderate or severe
  › Variation can be big between assessors
  › Most difficult area of assessment: In the central part of the scale (50%)
  › The eye has been discussed to assess diseases in logaritmic steps
  › Above 50% the eye reads healthy tissue
  › Overestimate in the area below 25%.

› Which part to assess
  › Varies from case to case, choose the part with the best differences
  › Choose the part which contribute best to yields.
› One or several assessments
  › Monocyclic (smut or bunt in cereals)
  › Polycyclic (late blight, septoria tritici)

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Incidence

› Incidence is quicker and easier to assess than severity
  › Requires less training and none expert can do the job
  › Severity give a better description of severe attack and correlate better to yield losses
  › Incidence correlate well to severity at low disease levels. (not above 5%)

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Major thresholds in wheat in DK based on incidence

Disease	Examples of threshold in CPO
Eyespot	>35% plants attacked at GS 30-32
Mildew	>10% plants attacked from GS 29 (S) >25% plants attacked from GS 29 (R) No treatments after GS 40
Septoria	**4 days with precipitation from GS 32 (S)** **5 days with precipitation from GS 37 (R)** **Or attack on third leaf from GS 45-60**
Brown rust	>25% plants attacked (S)
Yellow rust	GS 29-60 > 1% plants attacked (S)

Mildew development in different years

Vinterhvede 2001 - 2006, meldug
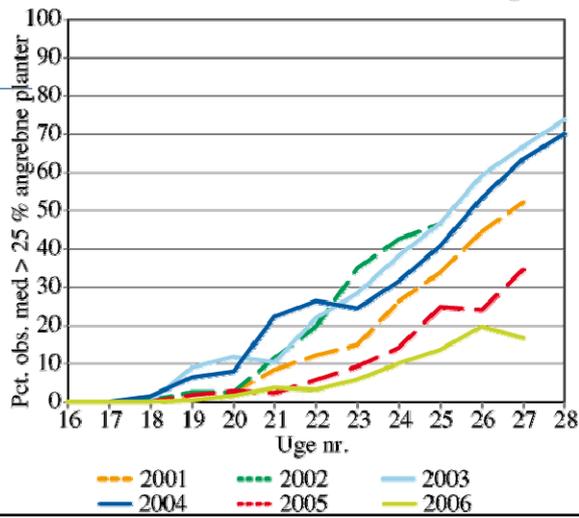
Monitoring network
mildew in wheat -susceptible cultivars
May 2006 – use of incidence!
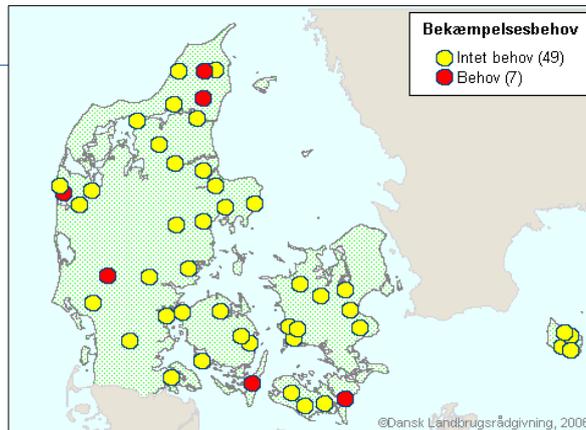
Crop protection online

Crop Protection Online - Microsoft Internet Explorer

Filer   Rediger   Vis   Foretrukne   Funktioner   Hjælp

Crop Protection Online
Diseases and pests - Field inspection [?]

11. oktober 2002 Pl@nteInfo

◆ Crop/Variety

Winter wheat , Ritmo

Growth stage:
51, Beginning earing

Percent of plants infected:*)

Mildew	11-25	Eyespot*)	Not counted
Septoria		Aphids	0
Brown rust		Cereal leaf beetle larva	0
Yellow rust			

Dropdown: 0 / 1-10 / 11-25 / 26-50 / 51-75 / 76-100 / Not counted

*) Assessment of leaf diseases [...] leaves on the main straw from growth stage 32. Assessments of pests as percent of straws/ears infected.
1) In growth stage 51 infection of the disease or pest has no economic importance.

Precipitation during the past 30 days:
Number of days with precipitation of more than 1 mm: 8

5 days weather forecast:
Are temperatures above 20 degrees C expected:
Is heavy rain expected:

Other:
Is a simultaneously treatment against weeds necessary:
Has yellow rust been observed in the field earlier this season

Calculate need for treatment >>

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ranking of spring barley - Fusarium suceptibility

Varieties (top to bottom): Anakin, Quench, Afrodite, Keops, Conchita, Kontiki, Sebastian, Henley, Prestige, Simba, Class, Fairytale, Charmay, Secura, Alexis, NFC tipple, Barke, Publican, Umbrella, Iron, Varberg, Power, Scarlet, Hellana

Legend: ■ 100 kg N   ■ 0N

X-axis: 0, 10, 20, 30, 40, 50, 60, 70, 80

% ears attacked

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Severity

› Severity requires pictures or descriptive tools in order to work

> › Severity gives a better description of severe attack and correlate better to yield losses
> › Correlate relatively well with yields
> › Is often seen to overestimate in the region of 10-25%
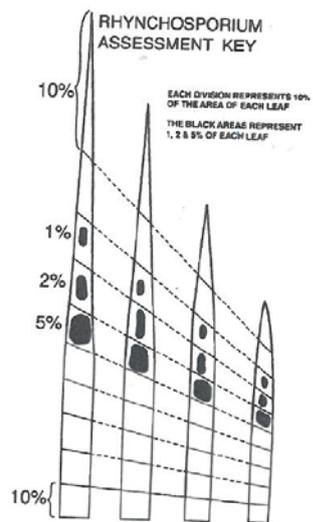
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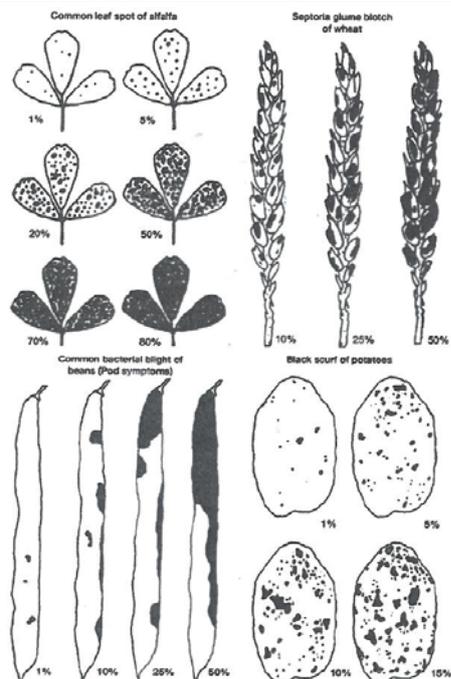
Rhynchosporium in barley

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Descriptive assessment key for potatoes

Table 2.3. Descriptive key for assessment of late blight of potatoes caused by Phytophthora infestans (Anon., 1947)

Blight (%)	Disease severity description
0	Not seen on field
0.1	Only a few plants affected here and there; up to 1 or 2 spots in 12 yards radius
1	Up to 10 spots per plant, or general light spotting
5	About 50 spots per plant or up to 1 leaflet in 10 attacked
25	Nearly every leaflet with lesions, plants still retaining normal form: field may smell of blight, but looks green although every plant is affected
50	Every plant affected and about half of leaf area destroyed by blight; field looks green flecked with brown
75	About $^3/_4$ of leaf area destroyed by blight: field looks neither predominantly brown nor green. In some varieties the youngest leaves escape infection so that green is more conspicuous than in varieties like King Edward, which commonly shows severe shoot infection
95	Only a few leaves left green, but stems green
100	All leaves dead, stems dead or dying

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EPPO guidelines

› Demanded to be used in relation to pesticide efficacy trials

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Assessment data must be qualified by the growth stage at the time of assessments

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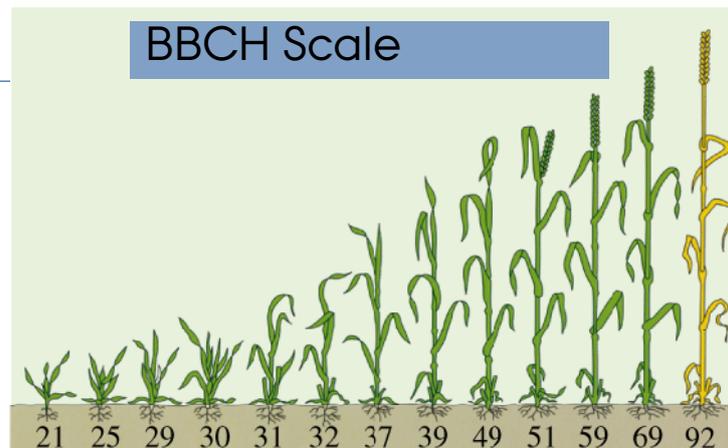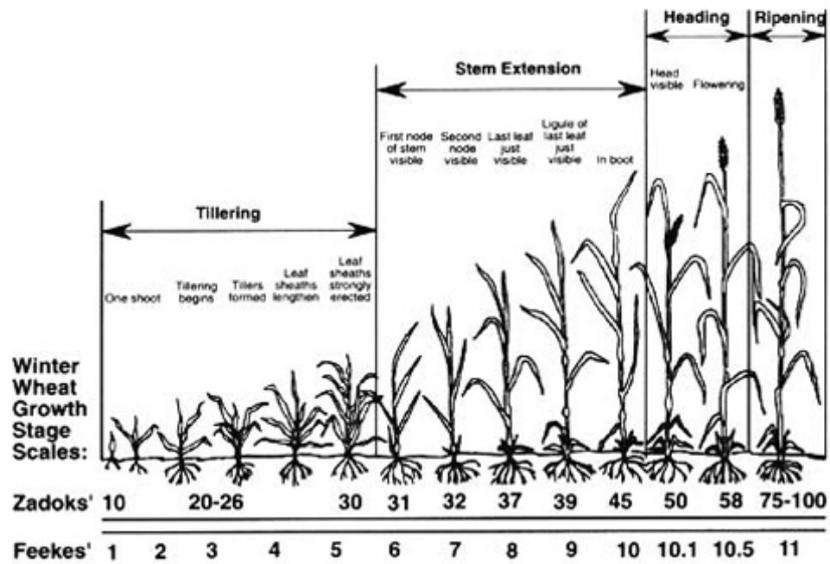
Accuracy and precision
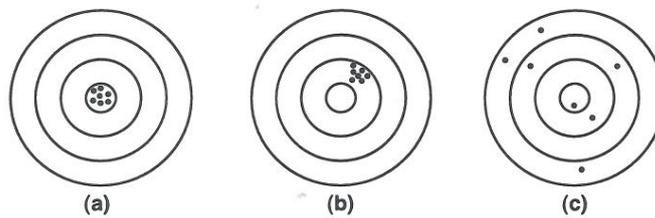
Figure 2.4. Accuracy and precision of an archer when the objective is to place all arrows in the central circle: (a) accurate and precise; (b) not accurate, but precise; (c) not accurate and not precise. (From Campbell and Madden, 1990a).

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Disease progress curves

› Disease progress curves represent plant disease epidemics plotting
› disease versus time

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Effect on mildew from Talius leaf 1 (09314)

- untreated
- Talius vs 31 0,25
- Talius vs 32 0,25
- 0,125 Talius + 0,1 Opus vs 31
- 0,125 Talius + 0,1 Opus vs 32
- 2 x (0,063 Talius + 0,1 Opus) vs 31+32

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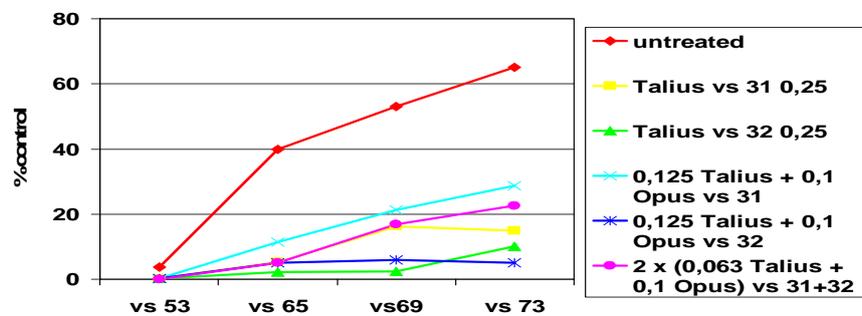
Area under disease progress curve

$$AUDPC = \sum_{i}^{n-1}\left(\frac{y_i + y_{i+1}}{2}\right)(t_{i+1} - t_i)$$

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Untreated   1,0 Opus   0,5 Opus   0,25 Opus

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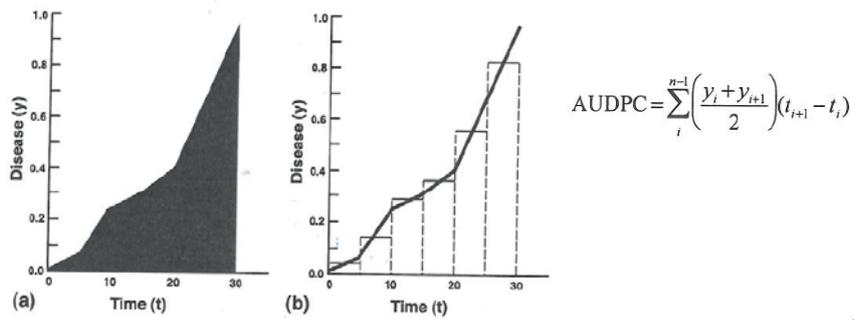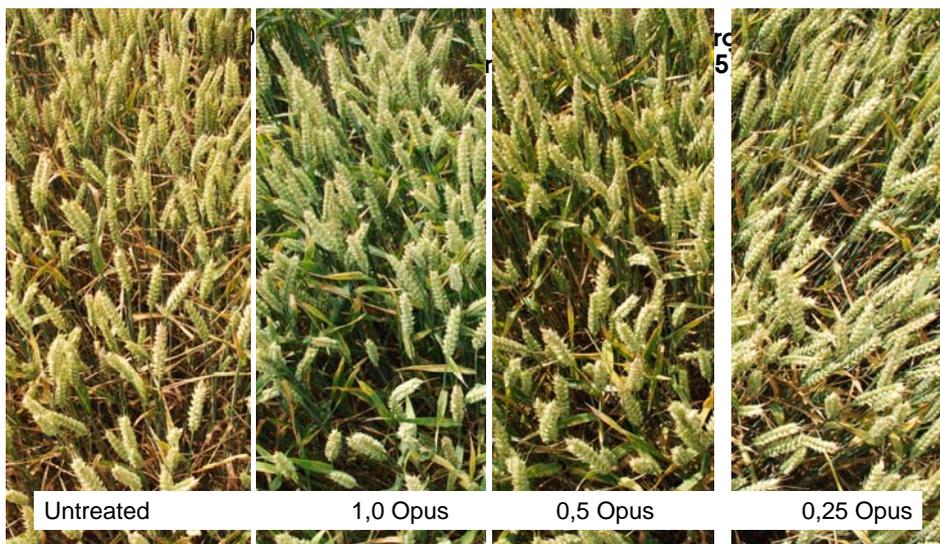
Disease development

› Epidemic describes the development of a disease
› Changes goes on with time

› Slow or fast epidemic

› Monocyclic development

› Polycyclic development

Fusarium in beans

Late blight

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Different ways for disease epidemic to develope- monocyclic or polycyclic epidemic

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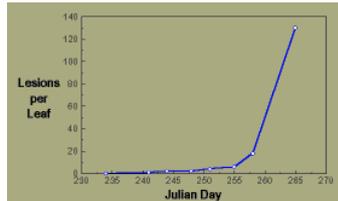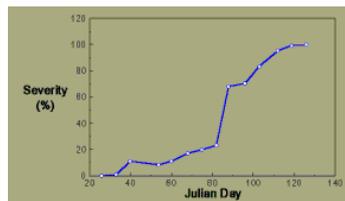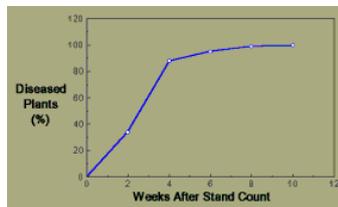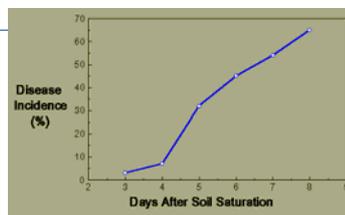
Different disease development

Potato late blight — Disease severity vs Time (day of year), 3 potato cultivars

Cassava mosaic virus — Disease incidence vs Time (month), 5 cassava cultivars

Fusarium wilt of chickpea — Disease intensity vs Time (days after inoculation), 6 inoculum densities

Soybean bud blight — Disease incidence vs Time (days from emergence), 4 planting dates

Dutch elm disease — Disease incidence vs Time (year)

Sorghum fungal diseases — Disease severity vs Time (days after emergence), Anthracnose & leaf blight

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Spatial development of a disease

› First one plant is infected
› Disease spread by foci
› E.g rust, Rhynchosporium etc

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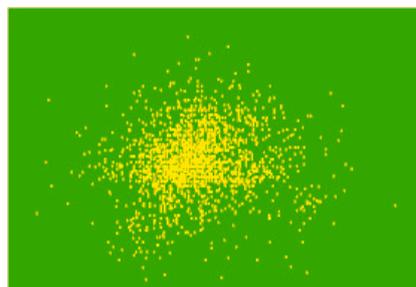
Diseases impact on yield

› Investigation on yield comparison between infected and healthy plants originating from field plots often with different cultivars or different fungicide treatments

› Not always good correlations
› Yield gross yield and net yield (margin over fungicide cost= economic yield)

› Confounding factors
  › Within plant compensation
  › Between plant compensation
  › One lesion of equal size can have different impact
  › Attack tissue not identical with symptoms assessed.
  › Number of green area (leaves) correlate well with yield

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% attack of DTR in treated plots and yield increase for control (02302)

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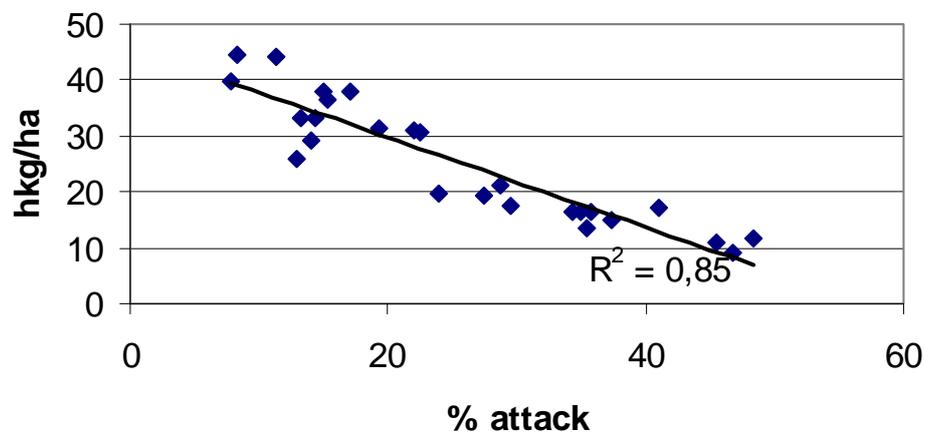
% DTR –
3 x ½ dosis af forskellige fungicider

1 forsøg 2002

%DTR

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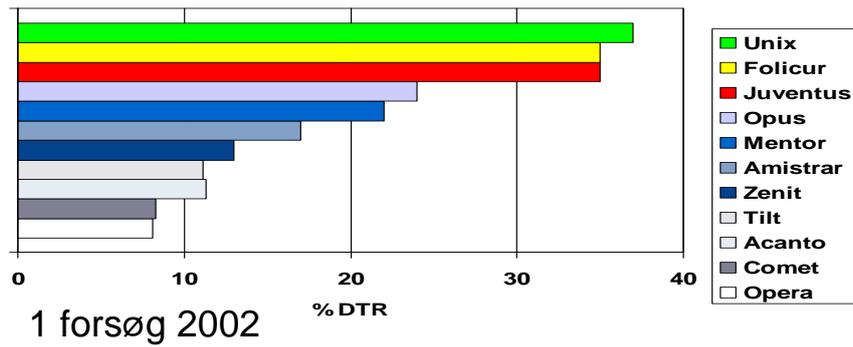
Relationship between attack of septoria in different cultivars and yield increase from fungicides

$$y = 0,30x + 10,94$$
$$R^2 = 0,67$$

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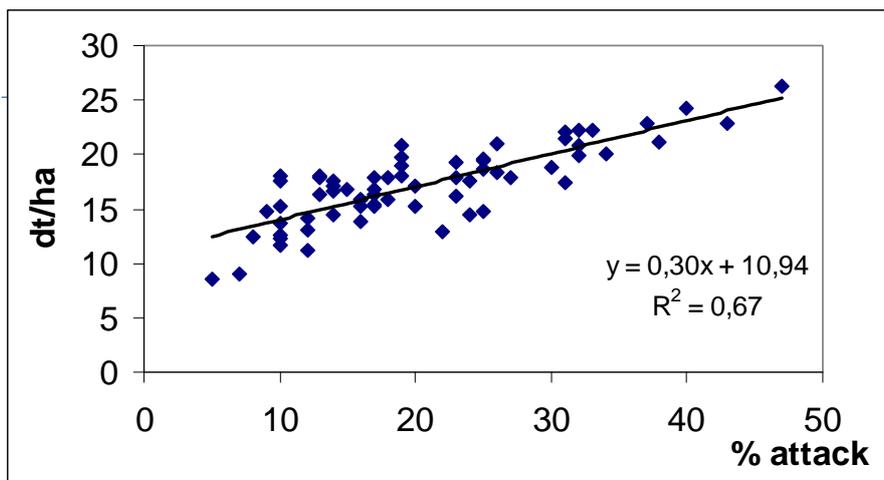
Yield levels and crop loss e.g. wheat

Theoretical yield 18 tones/ha

Attainable yield 12 tonnes/ha

Econoamical yield 10 tonnes/ha

Actual yield 8 tonnes/ha (DK average)

Primitive yield 6 tonnes/ha

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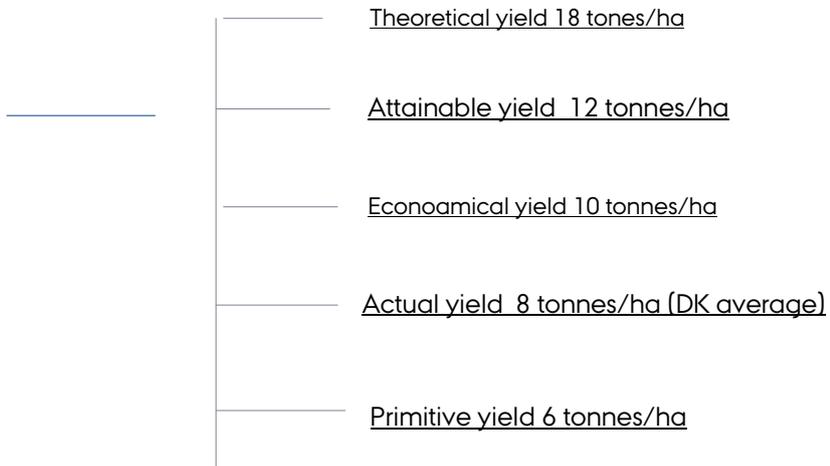
Hands on assessments

› Train your eye using Distrain (Computer program)
› Train your eye in the field doing practical assessments
› Train your eye seperating different pathogens.

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How to get started?

› Do a general assessment of most pronounced diseases
› Check always untreated
› Are all plants attacked ? Give a frequency assessment.
› Choose an indicator leaf and assess that in the field
› Assess on all green parts e.g. 3 upper leaves
  › Add up the average attack on each leaf level and divide by 3

› Assess % green parts on indicator leaf.

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Table 2.4. Calculation of a disease index for eyespot of wheat caused by Pseudocercosporella
herpotrichoides (Scott and Hollins, 1974)

Infection category	Disease severity description
0	**Uninfected**
1	**Slight eyespot** (one or more small lesions occupying less than half the circumference of the stem)
2	**Moderate eyespot** (one or more lesions occupying at least half the circumference of the stem)
3	**Severe eyespot** (stem completely girdled with lesions; tissue softened so that lodging would readily occur)

Notes on assessment
1. Examine 20 tillers per 20 m^2 plot.
2. Assign each tiller to one of the infection categories above.
3. Write the number of tillers in each category on the record sheet.
4. An index will be calculated from the data as follows:

$$\text{Disease index} = \frac{(0 \times a) + (1 \times b) + (2 \times c) + (3 \times d)}{(a + b + c + d)} \times \frac{100}{3}$$

where a, b, c and d are the number of tillers examined which fall into the categories
0, 1, 2, and 3, respectively.

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Take-all