

Building of expert systems

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Expertsystems

- Prediction models
 - ▶ ErosPredict
 - ▶ Malt Barley
- Diagnostic/Troubleshooting
 - ▶ Mycoplasma model
 - ▶ Tail biting models

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Prediction models

- Replaces mechanistic simulation models
- Input - output models
- "Reasoning follows arrows"

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Diagnostic/Troubleshooting

- Tries to diagnose "malfunction", e.g. disease
- Combines evidence of symptoms and risk factors
- "Reasoning against arrows" or both ways
- No examples within agricultural domain with real troubleshooting

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ErosPredict

ErosPredict — A Program for Predicting Soil Erosion
S. Højsgaard, H. H. Rasmussen & J. Djurhuus

The aim of the project is to establish an expert system for predicting soil erosion caused by surface drainage for both

- the risk of erosion occurring p and
- the amount of erosion if present μ .

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ErosPredict



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ErosPredict



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Project structure

- Long term observational study
- Implicit project goal.
- Data collection primary effort.
- End of project – Expert system

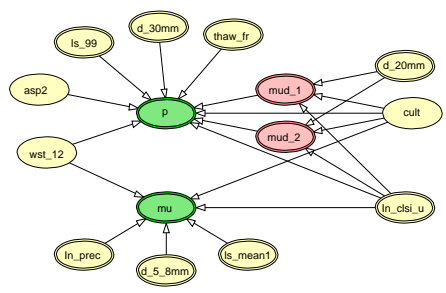
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Data

- Amount of furrows due to erosion by water
- 89 sloping fields, 20 different locations in Denmark
- Data collected over a 7 year period (1983-1989)
- Erosion = furrow volume (m³) pr. ha
- Climatic, soil physical and topographical measurements.
- Erosion in about 20% of the cases.
- Missing data

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ErosPredict



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Easy Covariates

Type I — covariates

d_20mm	Days with precipitation greater than 20 mm
d_30mm	Days with precipitation greater than 30 mm
d_5_8mm	Days with precipitation between 5 and 8 mm
thaw_fr	Precipitation and thaw on frozen soil; mm
ls_99	L(ength)-S(lope) 99% quantile
ls_mean1	Mean of LS-calculations for the region
ln_clsi_u	Ln of sum of clay and silt (2-20 μm) at upslope; ln(%)
ln_prec	Ln of precipitation; ln(mm)

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Easy Factors

cult	System of cultivation
1	grain
2	Christmas trees
3	ploughed
4	stubble harrowed
asp2	Aspect
1	northwest, north, northeast, east
2	southeast, south, southwest, west

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Easy Factors

wst_l2	Water impermeable layer
1	no/some
2	yes
year	Identification of the erosion year
region	Region where the slope unit belongs to

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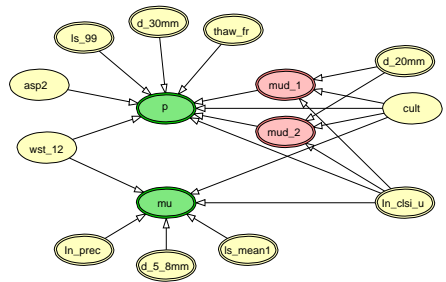
Difficult covariates

Type II — covariates

mud_1 Roughness of the soil in the direction parallel to the plowing direction, ln of Mean Upslope Depression (MUD) at 0 degree slope; ln(mm)

mud_2 Roughness of the soil in the direction perpendicular to the plowing direction, ln of Mean Upslope Depression (MUD) at 0 degree slope; ln(mm)

ErosPredict



Eros Predict: Summary

- Statistical analysis of graphical model straightforward for complete data
- Conceptual/graphical model before data collection
- Prediction of erosion
 - On a national scale. (Prior distributions ?)
 - In exposed sites
 - After heavy rain fall.
- Focused data collection. Important and less important variables.

Malt Barley

A Decision Support System for growing malting barley without pesticides
K. Kristensen & I. A. Rasmussen

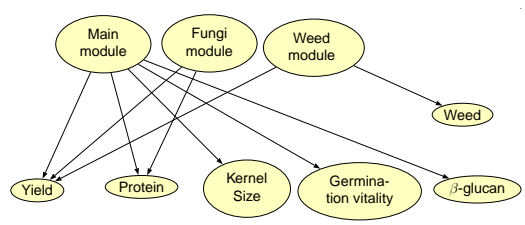
The aim of DSS

- choose suitable fields for growing malting barley
- predict yield an quality in case of pathogens or weeds

Malt Barley

- Part of a larger project
- Combines results from a series of experiments
- Final project phase
- Prototype

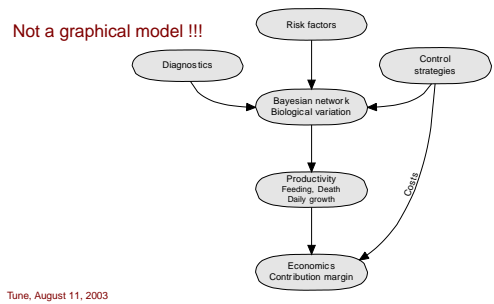
Malt Barley: Overview



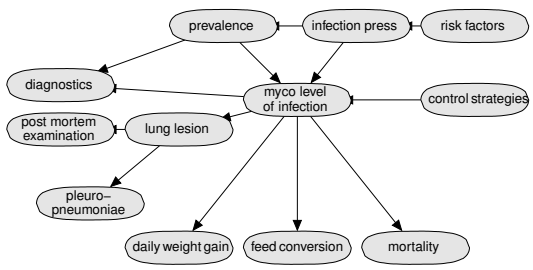
Revised Approach

- Obtain evidence.
- Find the probability of different causes
- (obtain further evidence)
- Cost benefit calculations comparing removal of probable causes

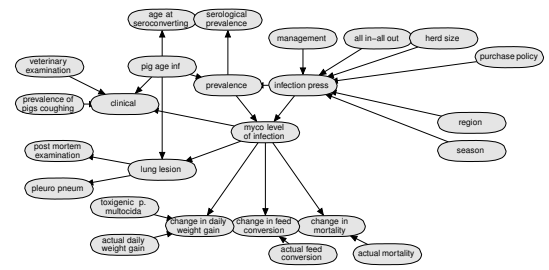
Mycoplasma project: Overview



Mycoplasma



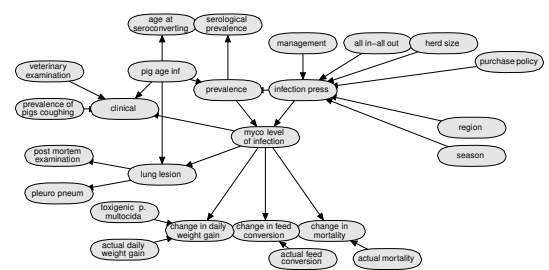
Mycoplasma



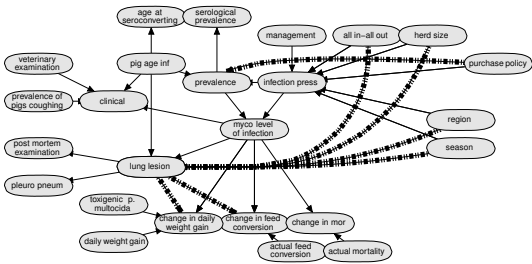
Quantification

- First step : (Scientific/Veterinary) Literature review
- Few studies - fewer replicates in studies
- Confoundings !!!
- Interactions ignored in the papers
- Experts in project (veterinarian researchers) contributed

Mycoplasma

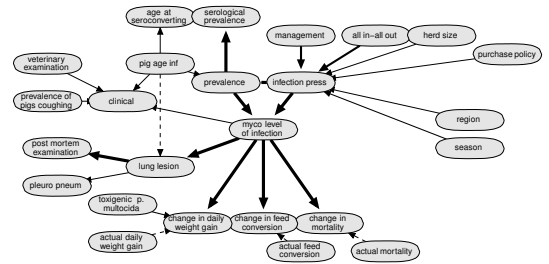


Mycoplasma



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Mycoplasma



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Mycoplasma Hyopneumoniae

- Surprisingly little prior expert knowledge
- Small benefit from intervention
- Interventions influence several diseases
- Next step: model with several diseases

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Tail biting

- A widespread problem
- A so-called multifactorial problem
- Docking of tails illegal, if not necessary
- Lots of "good" advice and recommendation
- Climate regulation ?

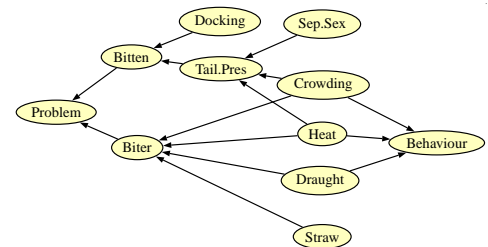
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Systematic approach:

- Build causal model based on existing knowledge: **Expert system**
- Compare troubleshooting attempts in herds
- Refine causal model based on results.

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Tail Bite



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Intervention experiment

- Observe problem herd
- Identify most probable cause(s) (A and B) using expert system
- Compare
 - No change
 - removal of cause A
 - removal of cause B

Tail bite

- Trouble shooting problem (?)
- Self - repairing system
- Good framework for interaction with experts (scientific and practitioners)
- Little (and anecdotal) knowledge
- Difficult to simplify knowledge

Outlook

- Cause-effect description
- Un-observable constructs
- Little analytic modelling
 - What to observe in order to distinguish causes???
- Research and experimental studies
- problem solving expert.

References

- Otto, L. & C.S. Kristensen (2002). Et beslutningsstøttesystem for dyresundhed - et Bayesiansk netværk for almindelig lungesyge. Rapport nr. 143. Fødevarøkonomisk Institut. pp. 102.
- Højsgaard, S., H. H. Rasmussen & J. Djurhuus (2002). ErosPredict - A Program for Predicting Soil Erosion. Dina Notat No. 100 pp. 12
- Kristensen, K. & I. A. Rasmussen (2002). A Decision Support System for growing malting barley without pesticides