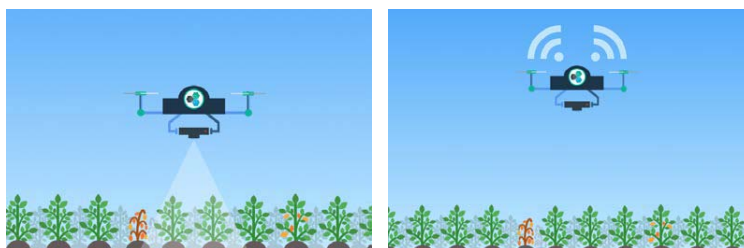




Fjärranalys - ett hjälpmedel i växtskyddet ?

Erland Liljeroth, Erik Alexandersson (SLU, Alnarp)
 Kristin Piikki, Mats Söderström (SLU Skara)
 Oscar Bagge, Hanna Blomquist, Mats Persson (IBM, Malmö)



- Pilotflygningar med HS drönare/RGB kamera 2014 i bladmögeförsök.
- Partnerskap Alnarp projekt 2016: "Fjärranalys av bladmögelangrepp i potatis" (Liljeroth m flera)
- Nyligen erhållit Vinnova-projekt: "EnBlightMe! – ett automatiserat stödsystem för upptäckt av potatisbladmögel" (Alexandersson m flera)



Fältgradering av växtsjukdomar

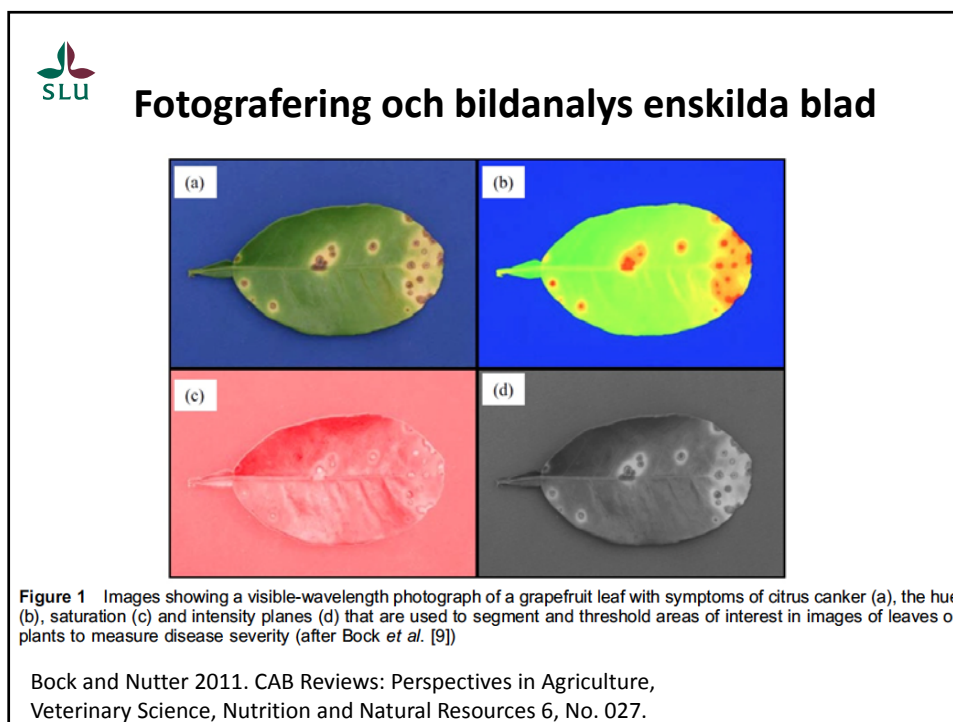
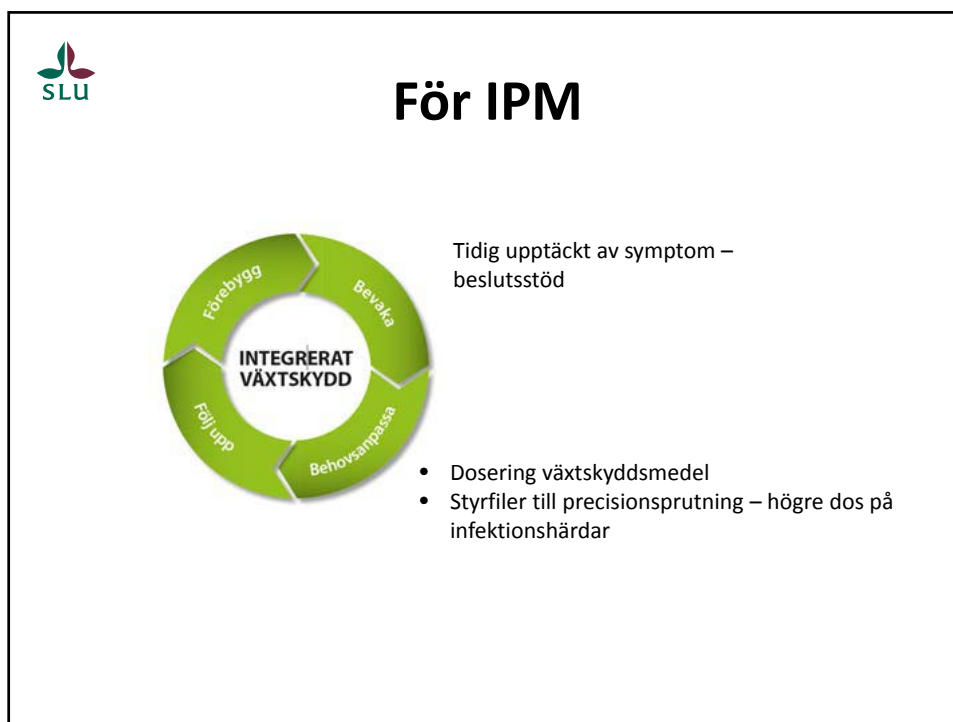
Till vad?

- Tidig upptäckt av infektion – beslutstöd för bekämpningsinsats
- Gradering av försök – bekämpningsförsök – screeningar i växtförädling
- Studier av grundläggande biologi

Fjärranalys

- "remote sensing" = "obtaining information without direct physical contact"
- Visuella graderingar – bildanalys
- Behov av automatiserade metoder!







Fotografering och bildanalys enskilda blad

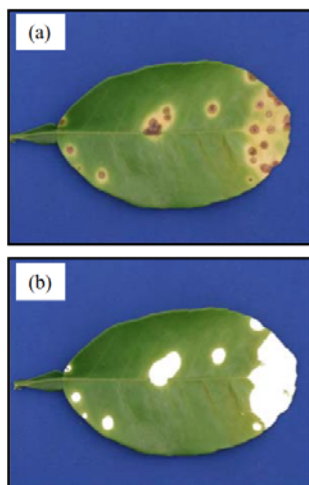


Figure 2 Detail of a canker-infected grapefruit leaf (a) showing thresholding of the diseased area (b) using the image analysis software program for plant disease measurement, ASSESS[®] V2.0 [67] (after Bock *et al.* [9])

“...the vast majority of recent work suggest that image analysis most often provides a more accurate and precise, but generally more time-consuming way of rating disease.” Bock *et al.* 2010.

Bock and Nutter 2011. CAB Reviews: Perspectives in Agriculture, Veterinary Science, Nutrition and Natural Resources 6, No. 027.



Hyperspektrala bilder – mer information

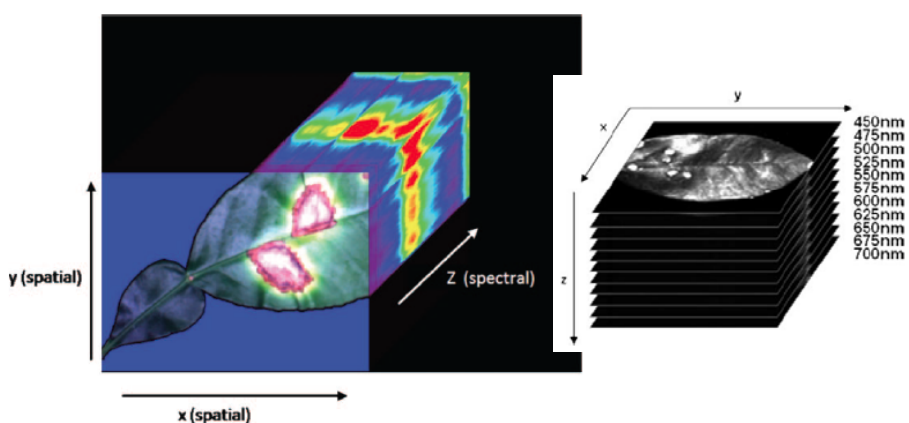


FIG. 15. Hyperspectral datacube (or “hypercube”) of a grapefruit leaf with lesions of citrus canker. Notice the two spatial dimensions (X and Y) and the spectral dimension (Z).

Bock *et al.* 2010. Critical Reviews in Plant Science 29, 59-107



Än så länge ganska få praktiska exempel med växtsjukdomar i fält...

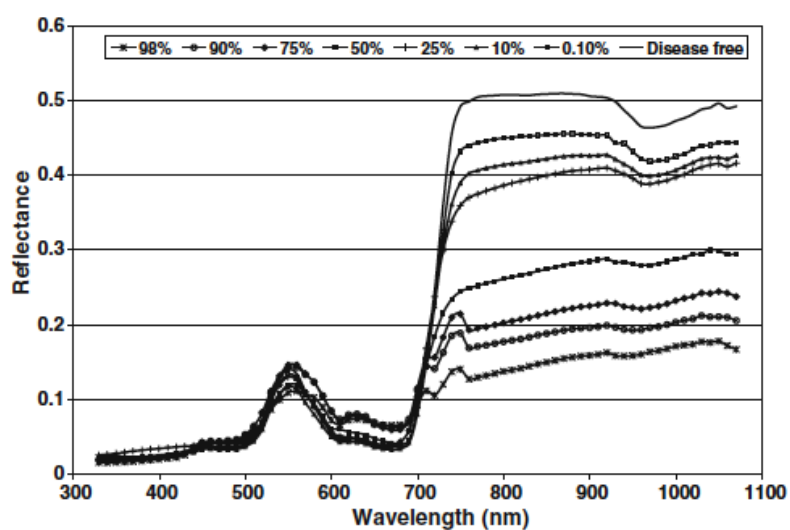
- Yellow rust in wheat. Huang et al 2007. Concluded: Fairly reliable compared to visual assessment
- Apple scab. Delalieux et al (2007) Concluded:has potential
- More than one stress. Moshou (2006) were able to distinguish between yellow rust infection and nitrogen deficiency in wheat using 5 wavelengths in the visible and NIR section

References in:

Bock et al. 2010. Critical Reviews in Plant Science 29, 59-107



Reflektans vid olika grad av bladmögelangrepp i potatis – Studie i Indien 2011



Ray et al. (2011) Utility of Hyperspectral data for potato late blight disease detection. J Indian Soc Remote Sens 39(2), 161-169



Varit svårt med fjärranalys av växtsjukdomar i fält – vad nytt ger hopp?

- UAV – bilder på lägre höjd – bättre upplösning
- Datorkapacitet – förbättringar
- Bättre algoritmer för bildanalys
- Billigare hyperspektralkameror?
- Snabbare överföring av data



Advantages/Disadvantages

Visual assessment

- Can be quick
- With training assess multiple diseases
- No equipment required

- Substantial inter and intra-rater variability
- Need to develop standard area diagrams
- Raters need training
- Raters prone to various illusions

Digital photo +image analysis

- Can be quick if automated
- Can be made reliable and accurate
- Equipment inexpensive

- Coping with variation in color and with image artefacts not straightforward. Dependent on incoming light and weather (wind).
- Problems with multiple diseases
- Requires training

Hyperspectral imagery

- Massive amounts of data about target is acquired
- Large potential if automated, still few examples

- Handling of large data amounts
- Still new technology
- Problems with multiple diseases
- Expensive
- Substantial training and expertise required



Potatisbladmögel



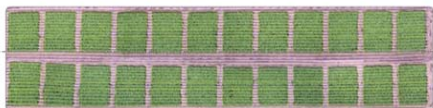
Inte Bladmögel!



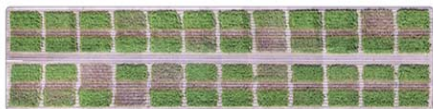


Pilotstudie i bladmögelförsök 2014

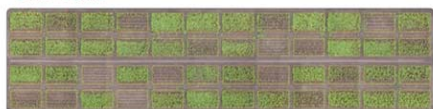
2014-07-01



2014-07-21



2014-08-06

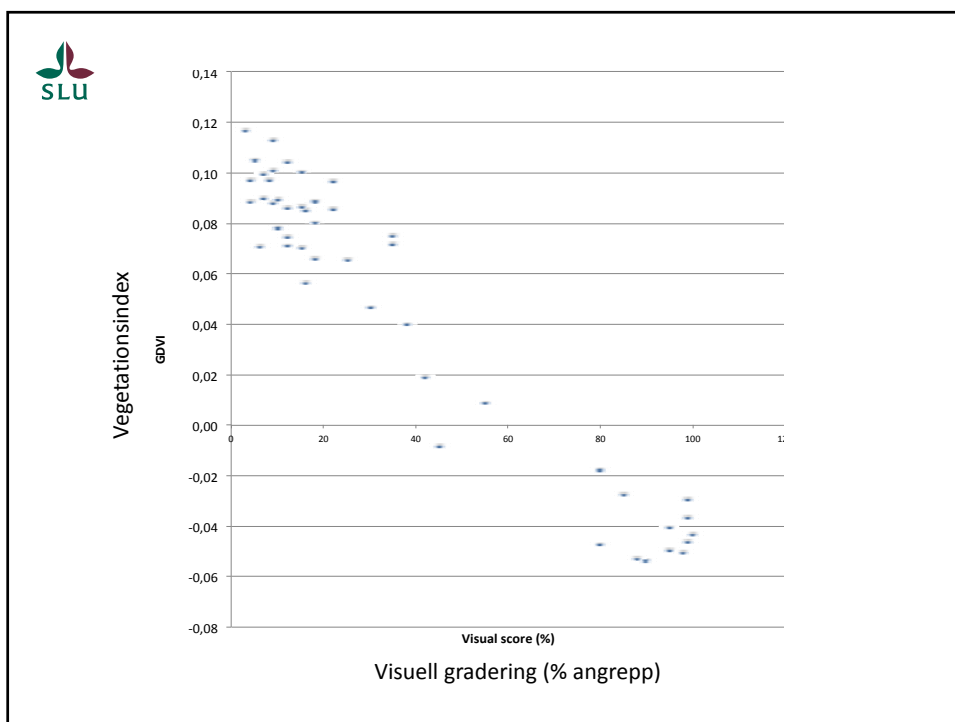


2014-09-02



HS multikopter







Flygningar – fotografering 2016

Fältförsök i Mosslanda, behandlingar mot bladmögel

Flera tidpunkter under säsongen



- Drönare RGB+Rededge+NIR
- Handkamera RGB
- Bildanalys
- Symptom-igenkänning
- Analyser pågår

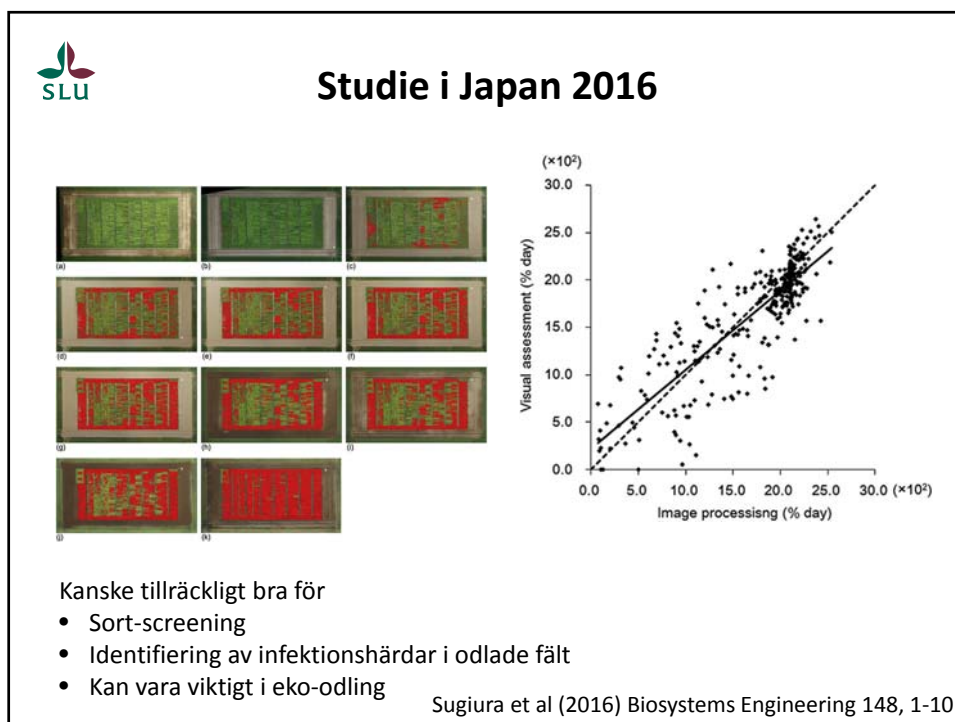
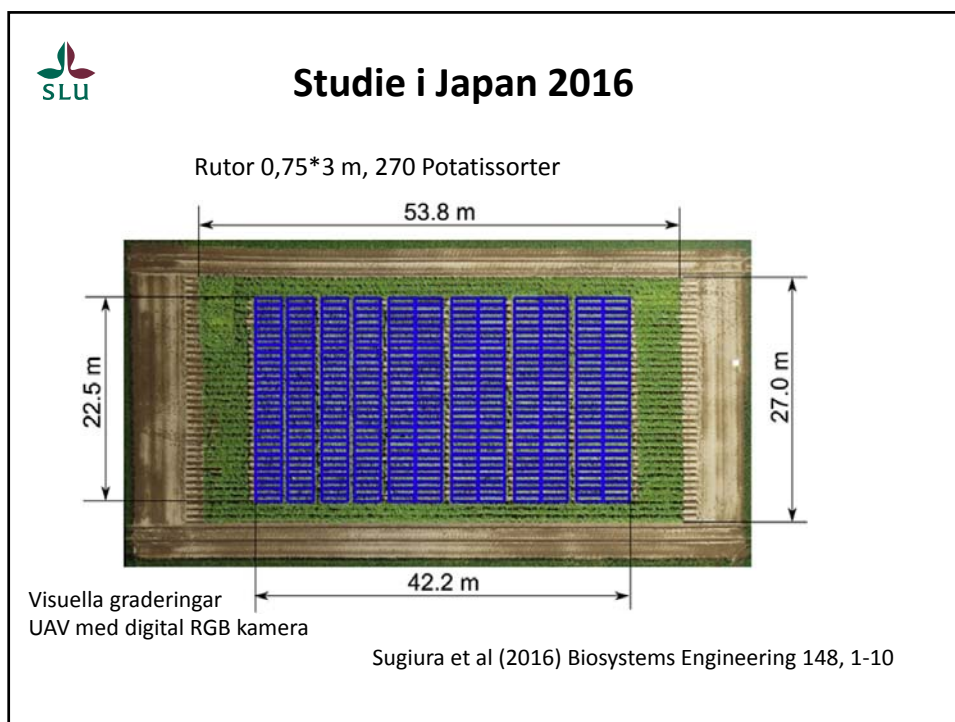


Hur många bladmögelfläckar finns det i bilden?



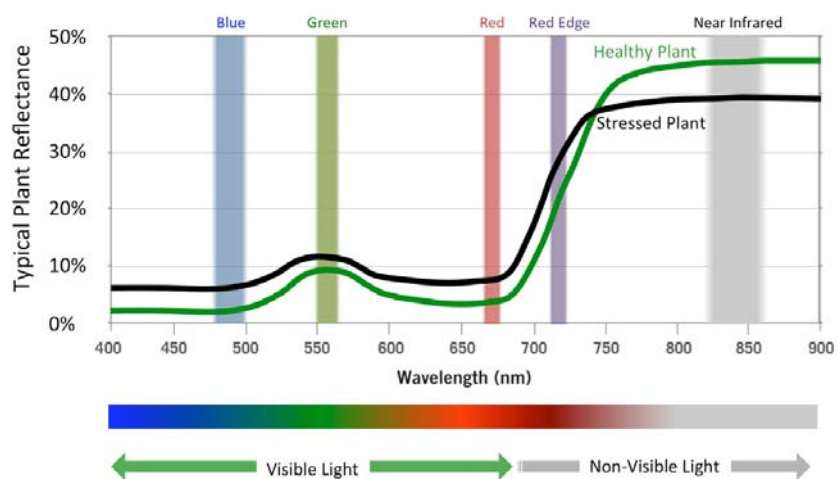
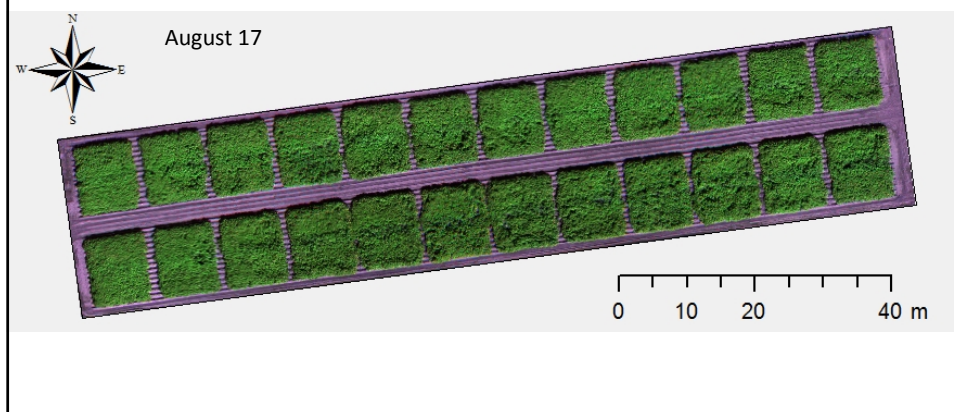
Framtida möjlighet?

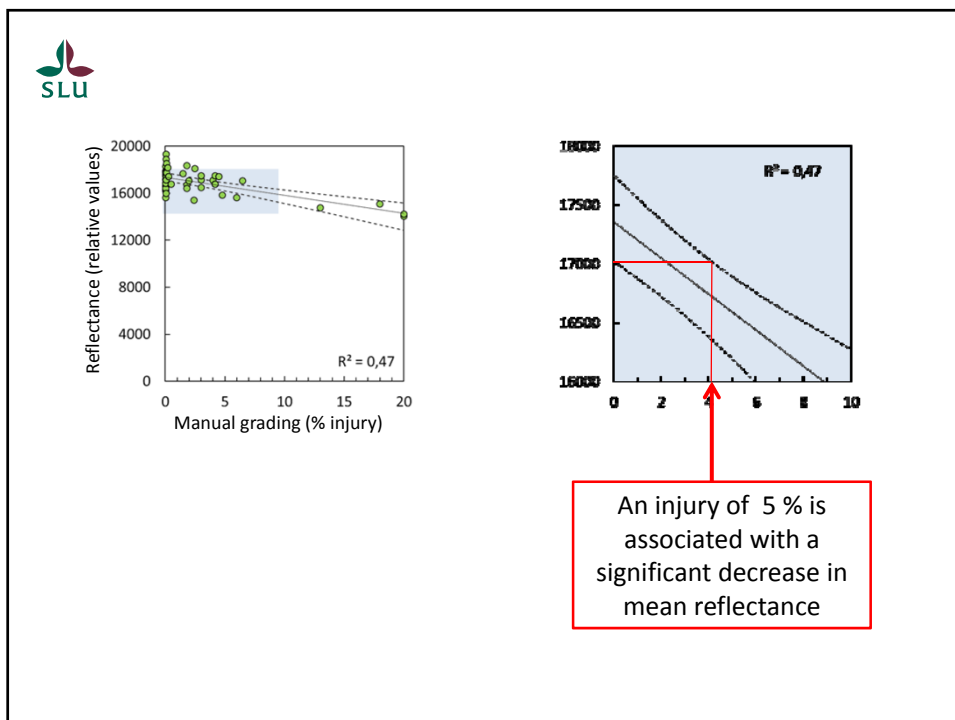
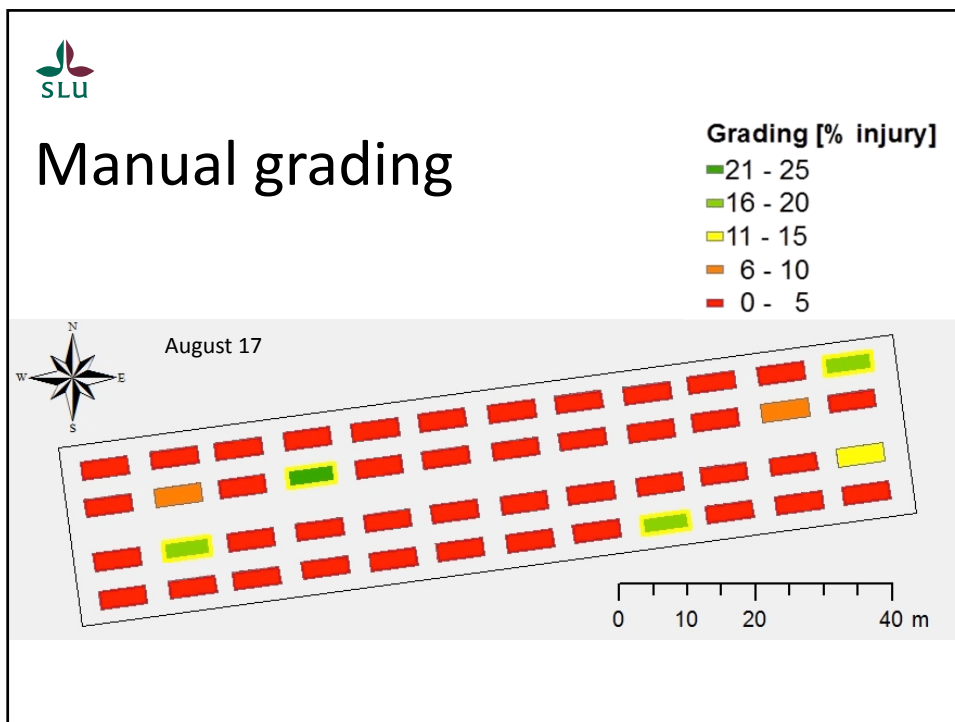
1. Drönare skannar fält
2. Dataöverföring
3. Bildanalys för att konstatera enstaka fläckar
4. Snabb rapport till odlaren





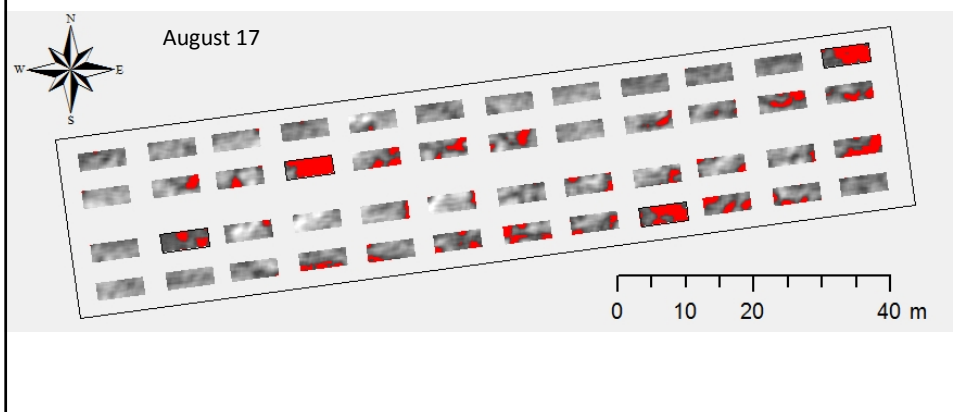
Resultat från Mosslunda, 2016



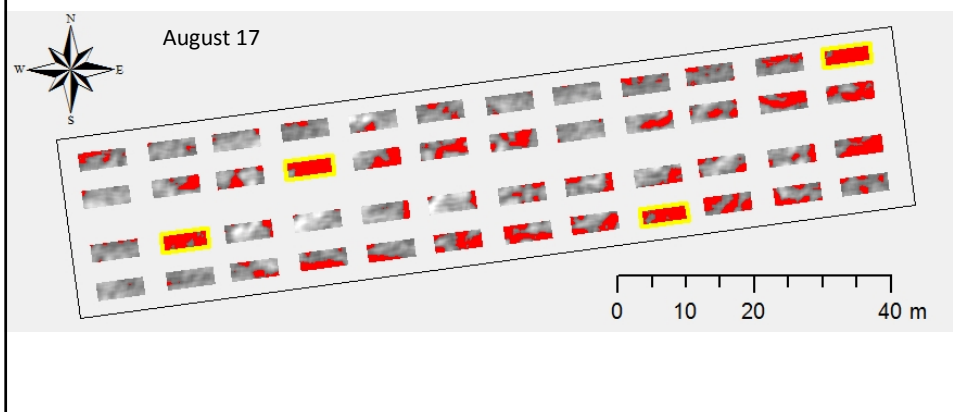


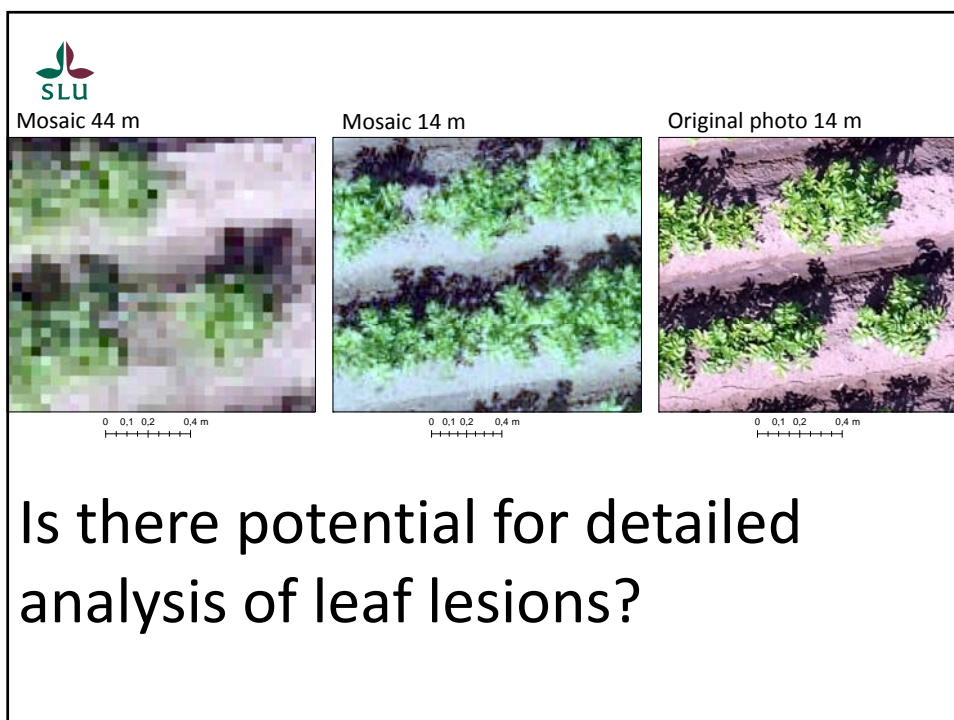
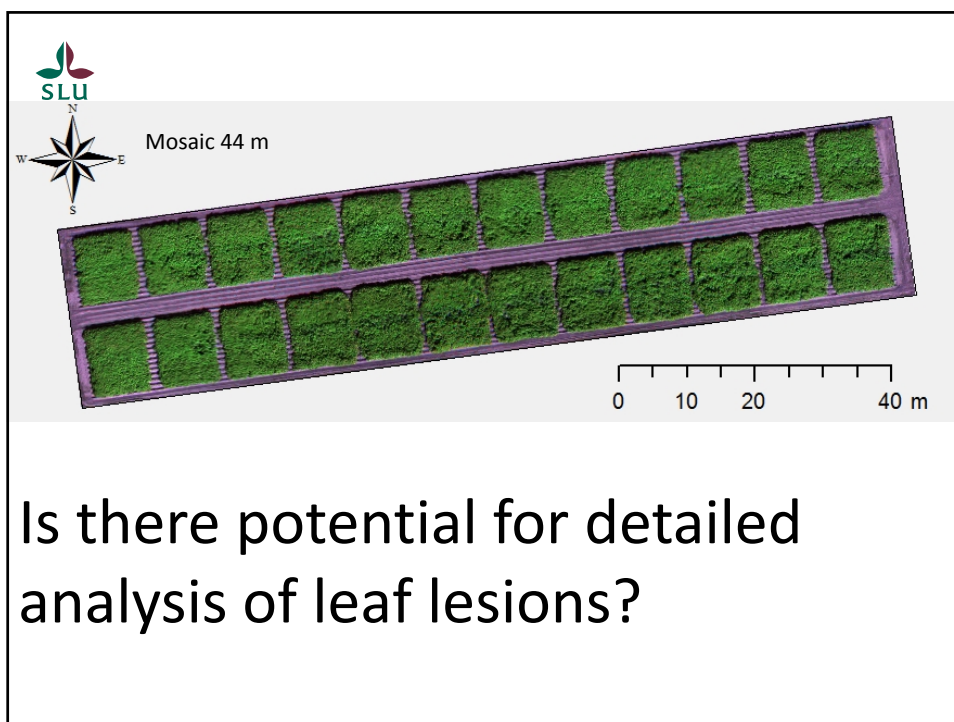


Significantly reduced reflectance



Untreated (most injured) plots







Summary

- 5 % injury was associated with a significantly reduced mean reflectance in the RedEdge band.
- Possible field application: Find suspected spots. More work need to be done.
- Better imagery may be needed for detailed detection at the leaf level.



Sammanfattning – slutsatser

- Detektera tidiga enstaka infektioner svårt – bildigenkänning möjlig väg?
- Möjlig användning i screening av sortmaterial – växtförädling
- Möjligt identifiera infektionshärdar
 - styrfiler till sprututrustning
 - varierad dos av bekämpningsmedel
 - Kan vara viktigt i eko-odling
- Samarbete SLU-IBM etablerat (Vinnova-proj.)

