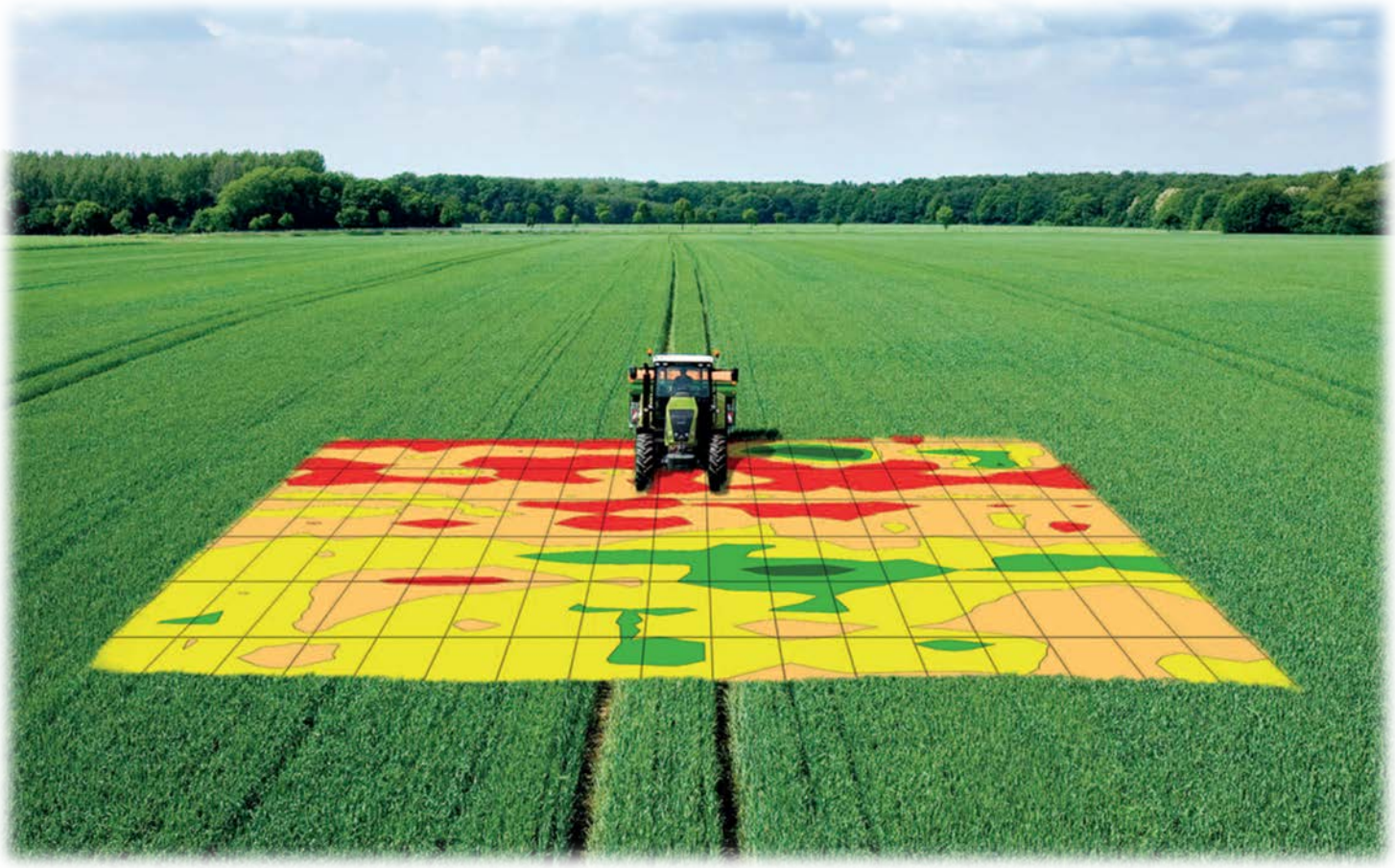
The Potential of Precision Farming

Richard Godwin

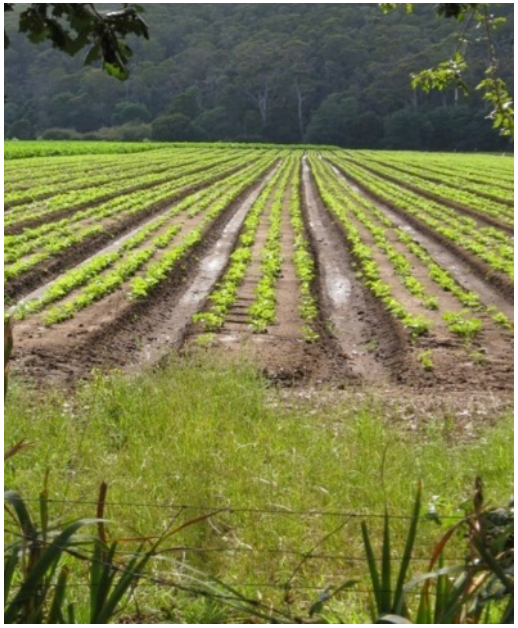
Harper Adams University



Godwin, Precision Farming, Royal Academy of Engineering, INGENIA ISSUE 64, SEPTEMBER 2015

Managing variability with the aid of technology and automation

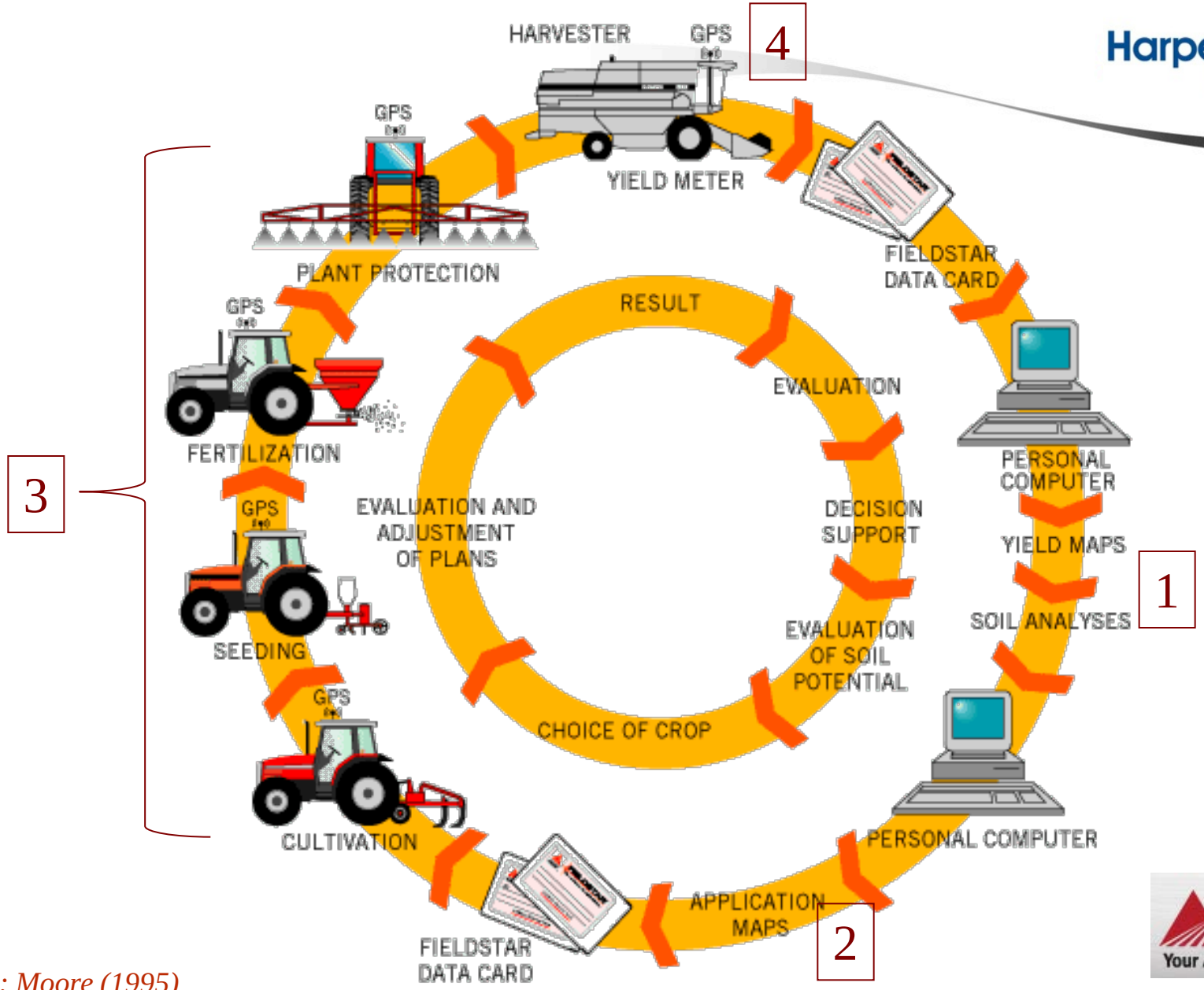
Harper Adams University



Sources of variability:

- Soil type - texture
- Available water
- Soil Nutrition
- Crop Pests
- Diseases
- Weeds

Precision Farming



After: Moore (1995)

Global positioning systems

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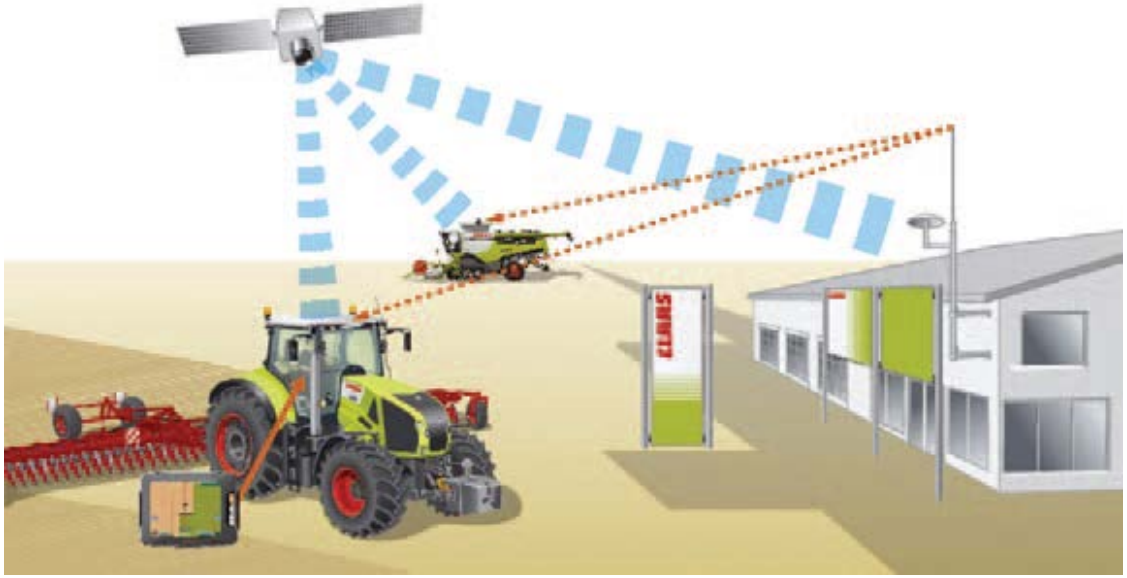
GPS became “useable” in 1991
with Real Time Kinematic accurate to 2-3 cm



Auto guidance: Northern China

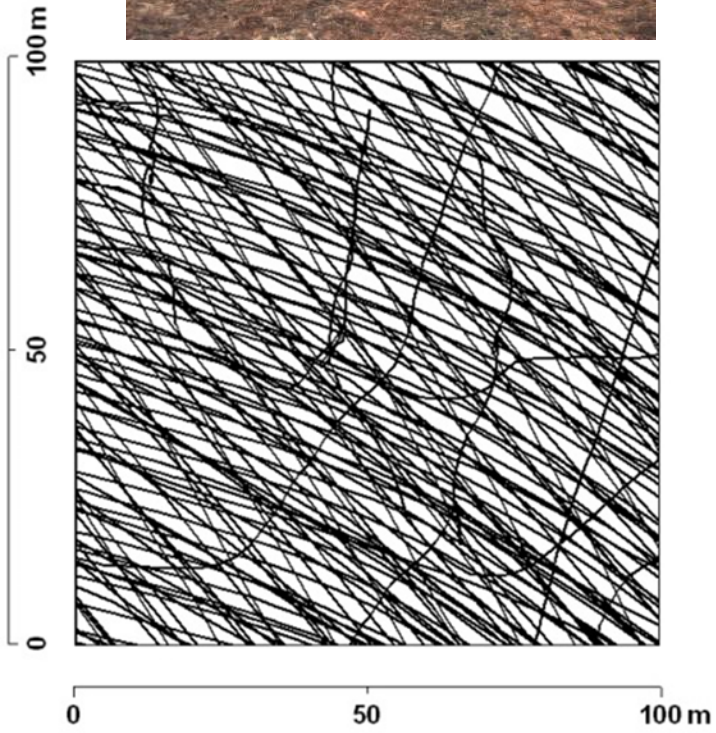
Harper Adams University

40% improvement in productivity on large farms

Random traffic farming (RTF)

Extensive areas of the field are exposed to trafficking

- Plough tillage
  = 85% covered
- Minimum Tillage
  = 65% covered
- Direct Drilling
  = 45% covered



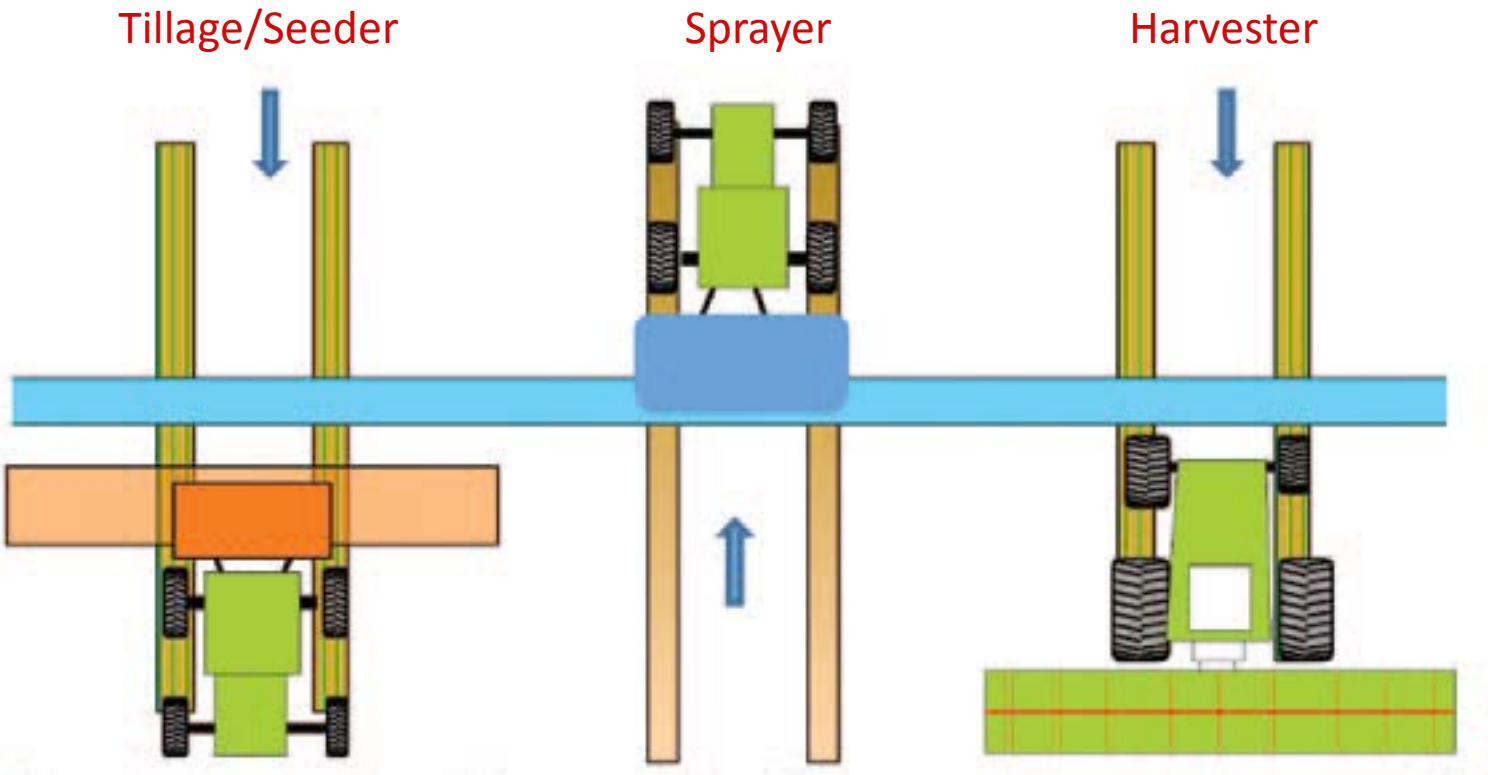
Wheat crop

- harvest
- presowing soil preparation
- straw baling
- ploughing
- straw carting
- spraying rows
- liquid manure transport
- liquid manure application
- seeding
- grain carting

Kroulik et al, 2011

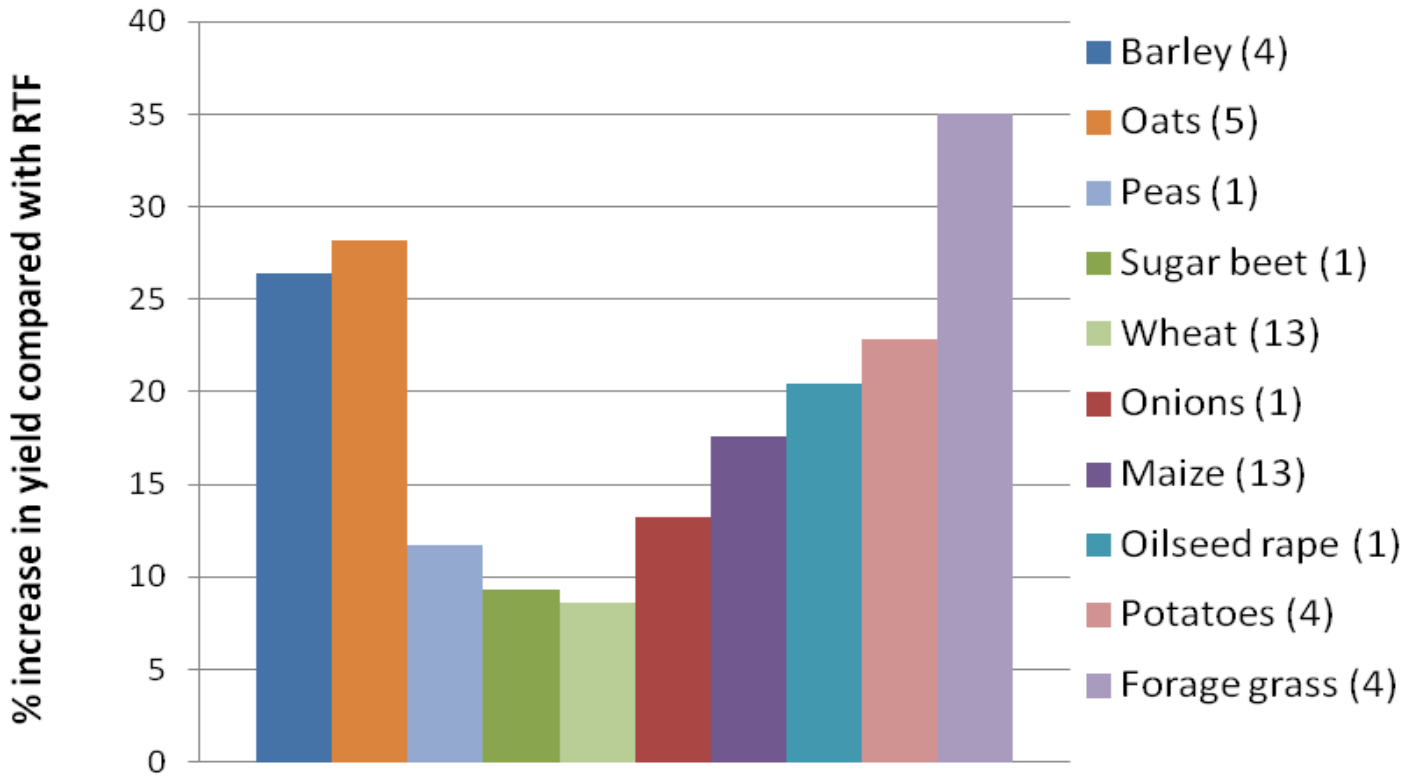
Controlled traffic farming

Harper Adams University



Chamen, CTF Europe

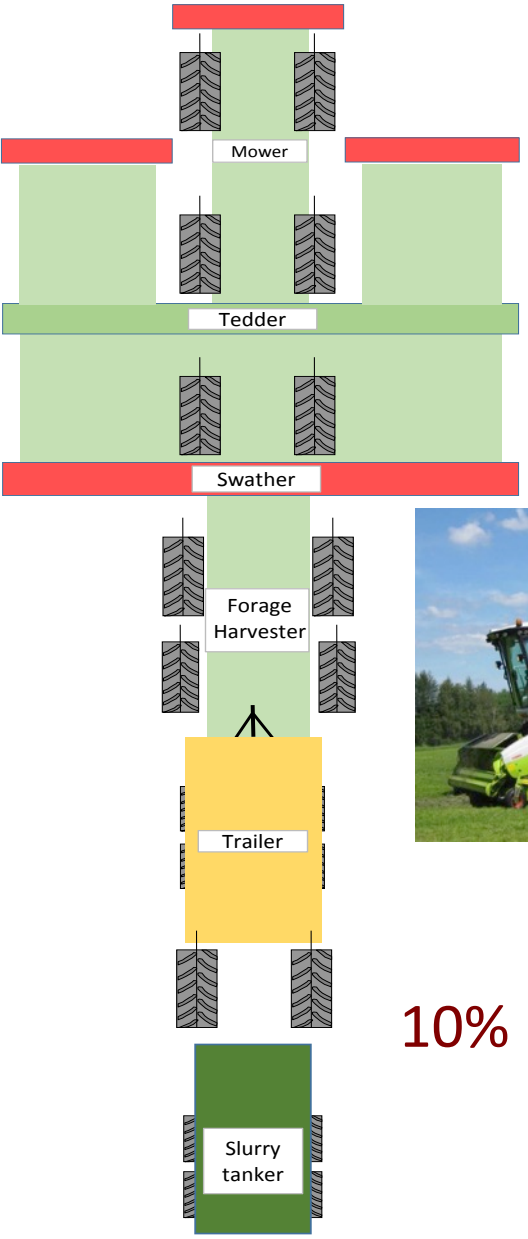
Average yield benefit from CTF

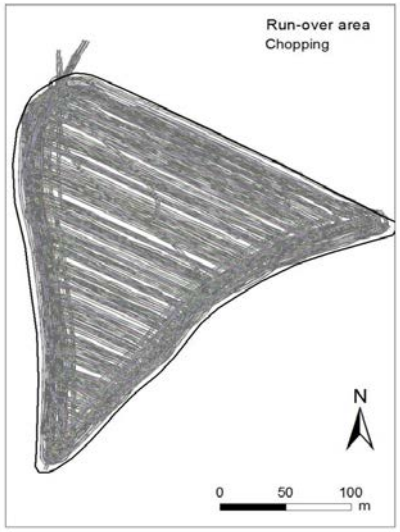


Average yield benefit from CTF compared to random traffic farming.

Numbers in parenthesis indicate the number of studies reported. *Chamen, 2011*

Grassland CTF





10% improvement in dry matter yield from 2nd and 3rd cut silage.

Hargreaves, Chamen, Peets, Misiewicz, White, and Godwin, 2017

Automation and machine control

Harper Adams University

Leader – Follower tractors

Fendt

National Centre for Precision Farming

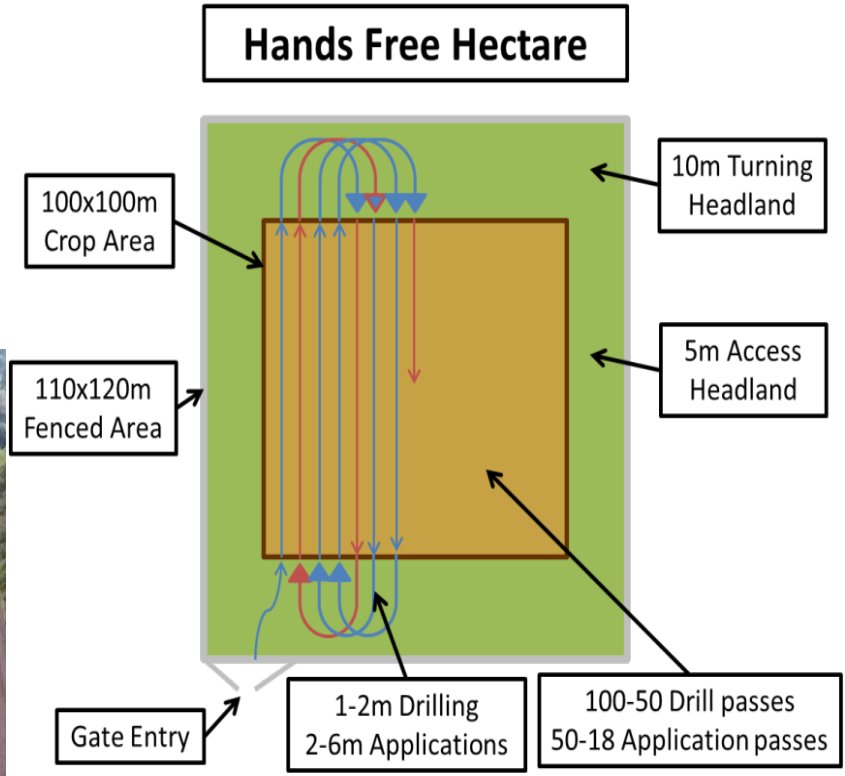
Hands Free Hectare

www.handsfreehectare

Harper Adams University

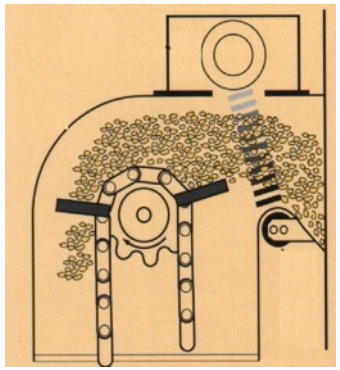
Automated machines growing the first arable crop remotely, without operators in the driving seats or agronomists on the ground.

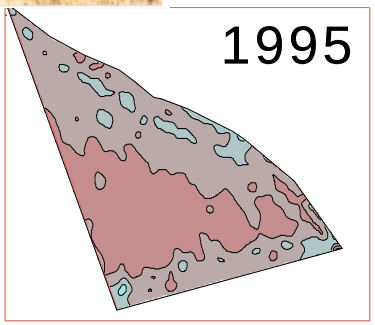
- Commercial compact Ag machinery
- "Open source" automation
- 1 year project!!

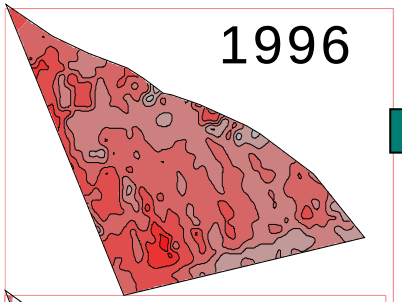


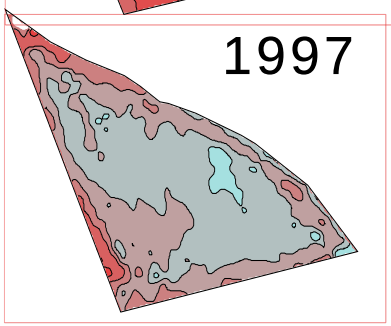
Precision Decisions

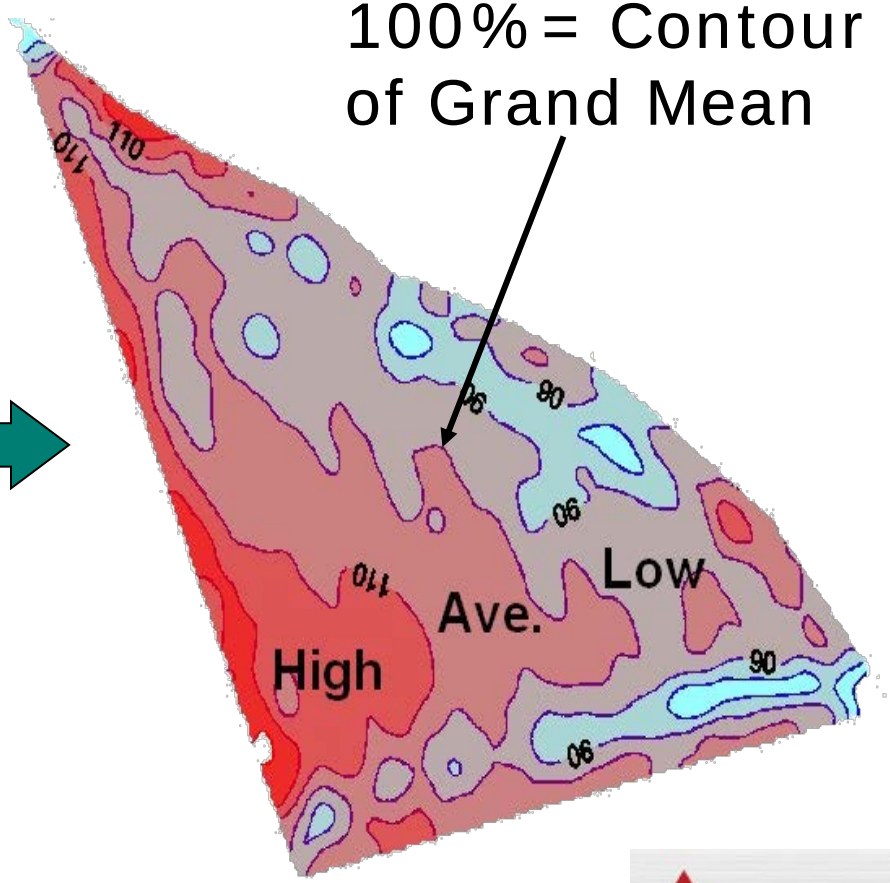
Yield maps




1995


1996


1997

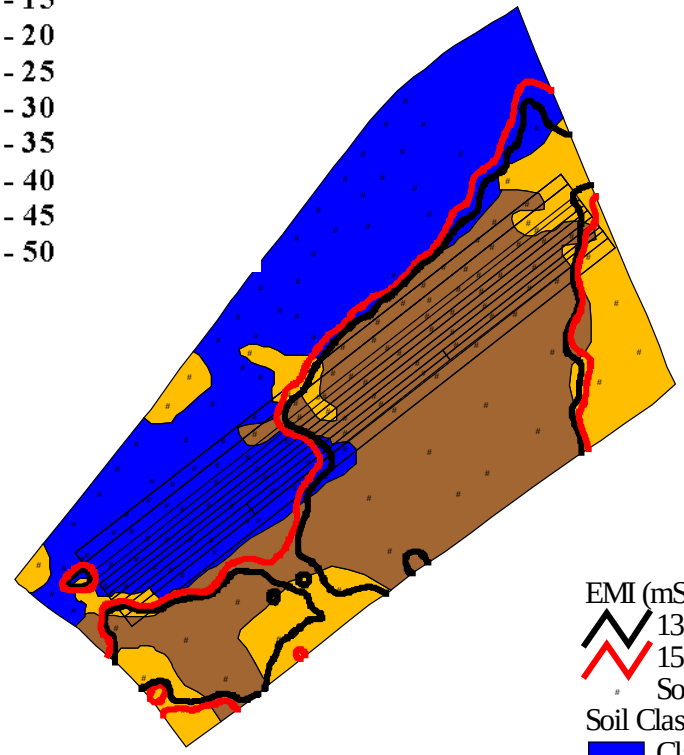

100% = Contour of Grand Mean
110
110
90
90
90
110
High
Ave.
Low
90
90

Soil uniformity

Soil electrical conductivity map, sampled on a 10 m x 24 m grid

Harper Adams University

EMI measured EC (mS/m)
- 0 - 5
- 5 - 10
- 10 - 15
- 15 - 20
- 20 - 25
- 25 - 30
- 30 - 35
- 35 - 40
- 40 - 45
- 45 - 50



EMI (mS/m)
- 13
- 15
- Soil core location

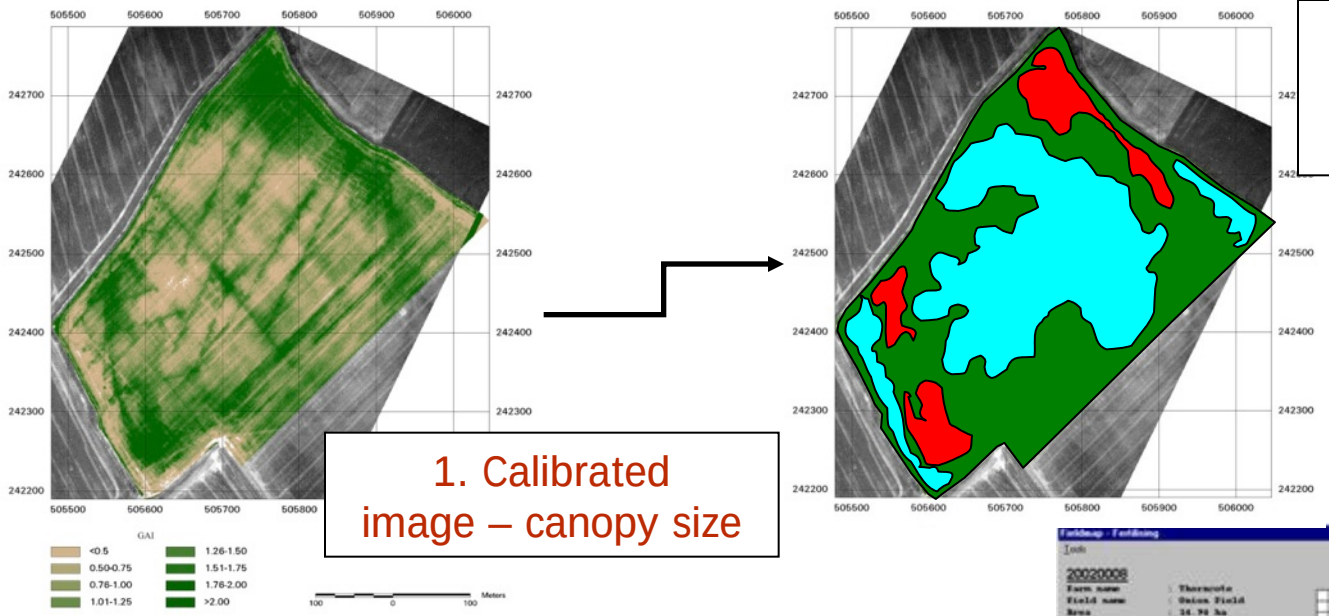
Soil Classification
- Clay loam over sandy clay
- Sandy loam
- Sandy loam over loamy sand

100 0 100 200 300 Meters

After: Waine, Blackmore and Godwin (2000)

Managing spatial variability

Harper Adams University



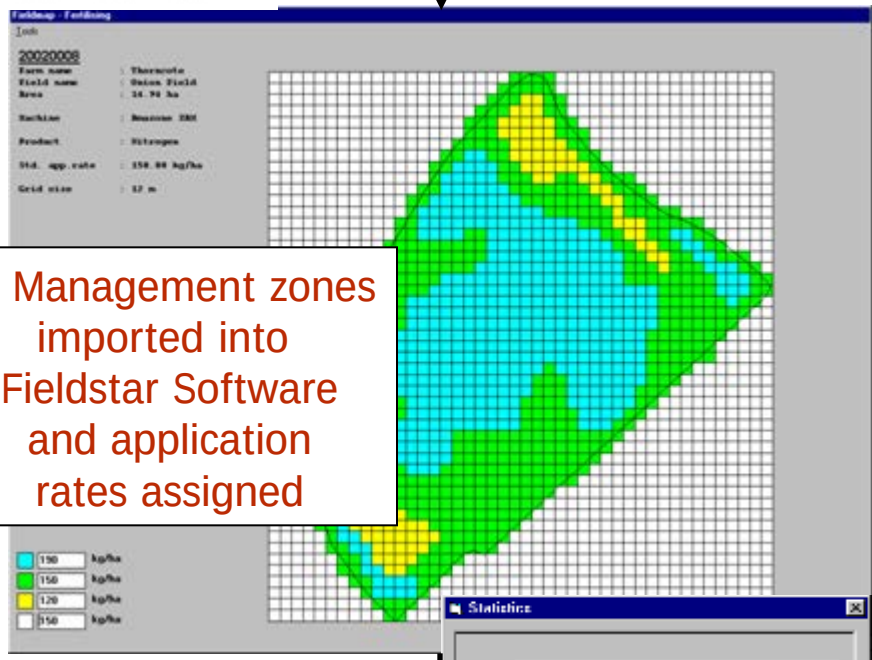
1. Calibrated image – canopy size

2. Image processed into management zones according to canopy size

Canopy Size

- Above-target
- On-target
- Below-target

HGCA



3. Management zones imported into Fieldstar Software and application rates assigned

4. Application plan implemented

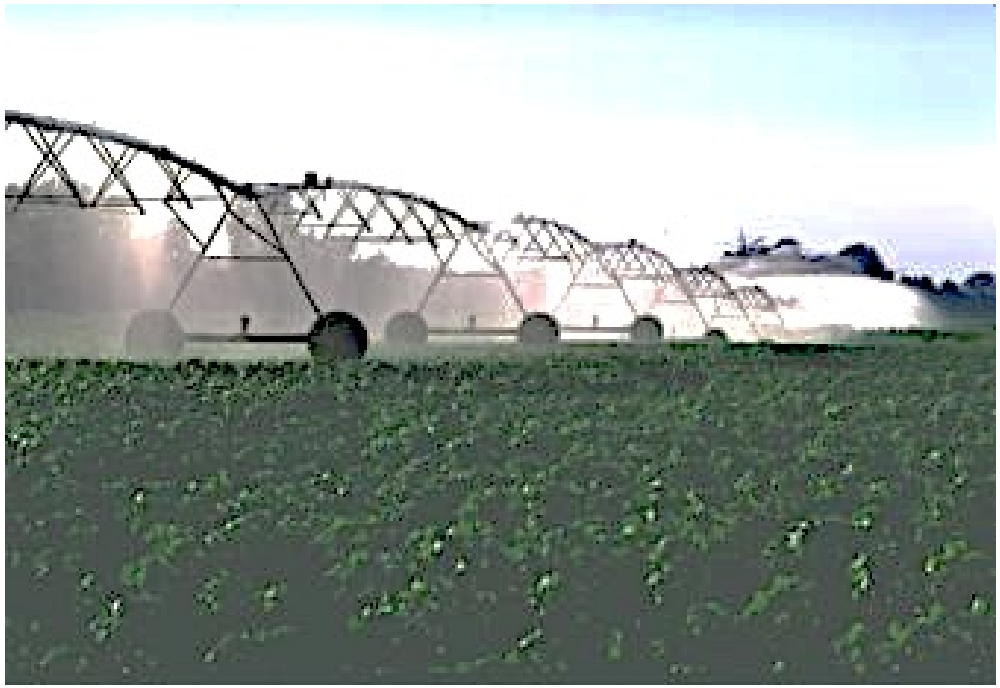
5. Economic Benefit – CZK 950/ha

Godwin, Wood , Taylor, Knight, Welsh, Blackmore, Earl, 2003

Water application rate control

Linking irrigation scheduling to soil variability

Harper Adams University



Shielded band sprayer with Auto-steer

Harper Adams University

Miller, NIAB – TAG & Micron Sprayers

Weed control

20 row machine in celery

Harper Adams University

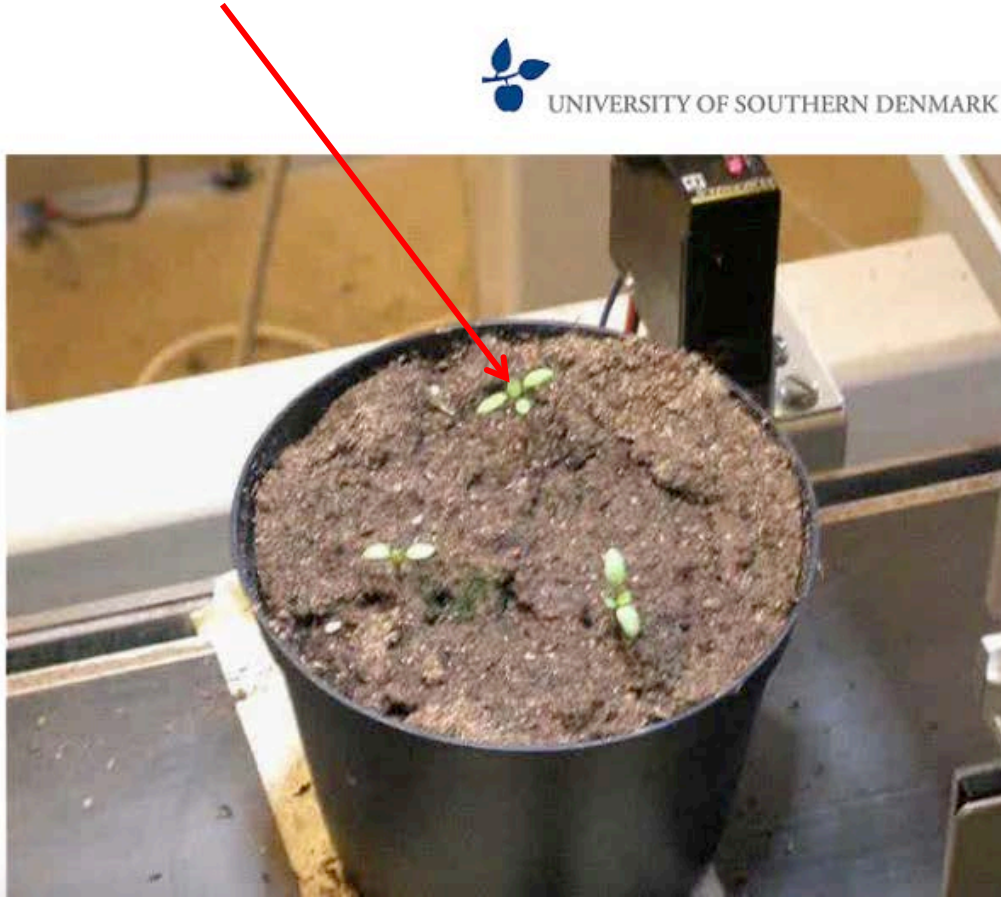
Tillett and Hague Technology & Garford Engineering

National Centre for Precision Farming

Laser Weeding

Harper Adams University

- Machine vision recognises the growing point of the weed
- Laser kills the weed by heating the growing point
- Saving 100% herbicide
- Harper Adams University is now building a real-time robot to laser and microdot weeds
- Funded by a major agrochemical company 2014-2017



Recommendations from the UK agricultural industry

Feeding the Future, 2013,

1. **Use modern technologies to improve the precision and efficiency of key agricultural management practices**
   - Develop remote monitoring, control and application technologies to optimise input use efficiency, ... , sustain product quality and safety, reduce the impact of machinery traffic on land ...
   - Integrate and use the increasing volume of yield mapping & recording, and soil, crop and animal data, in order to develop better decision making tools...
   - Improve machine and instrument flexibility, inter-operability, applicability ... to promote delivery of the above.
   - Develop integrated strategic approaches to the use of nutrients and substrates to reduce environmental impact.
7. **Extend training , professional development and communication channels of researchers, practitioners and advisors to promote delivery of the above.**