AARHUS
UNIVERSITET

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Danseed - Seed drying sensors

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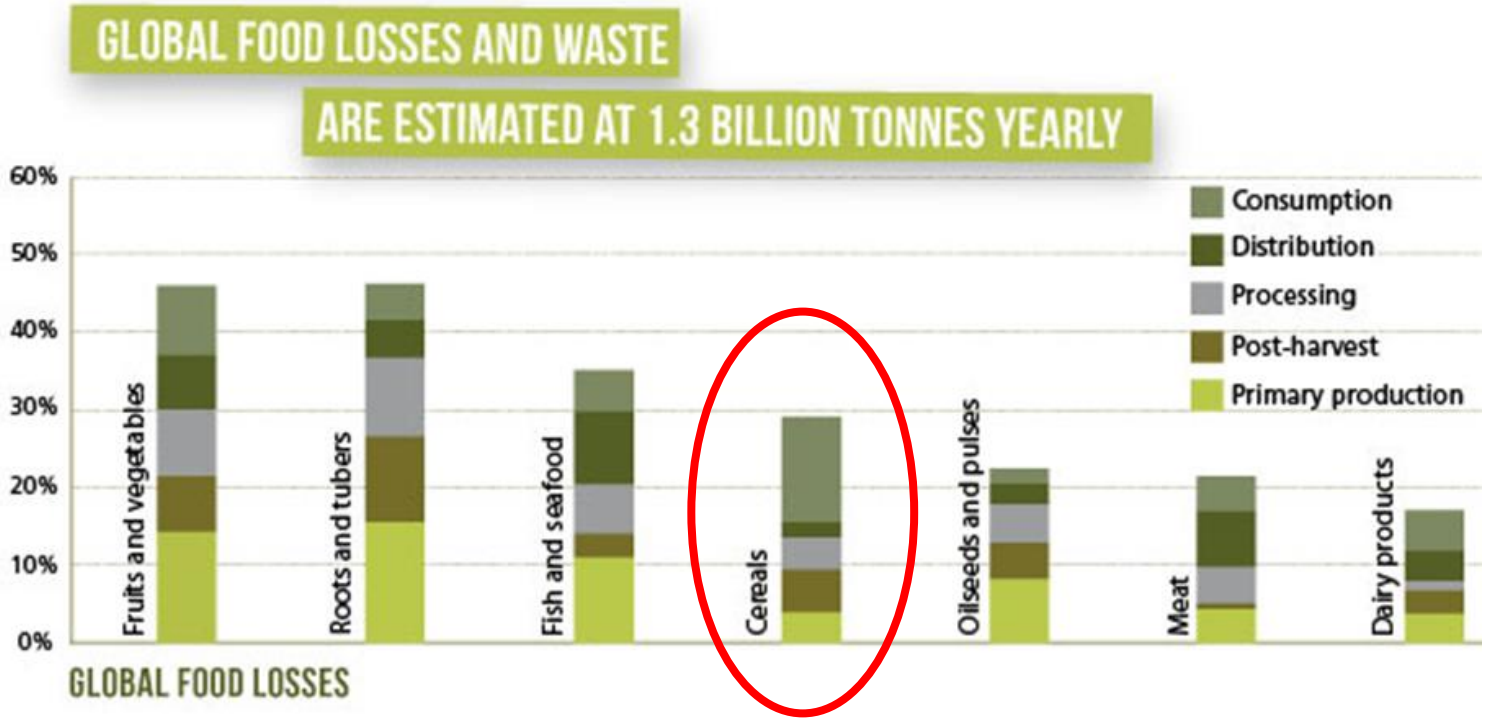
Optiseeddry - Optimized drying of cereals assisted by wireless sensors

› Partners:

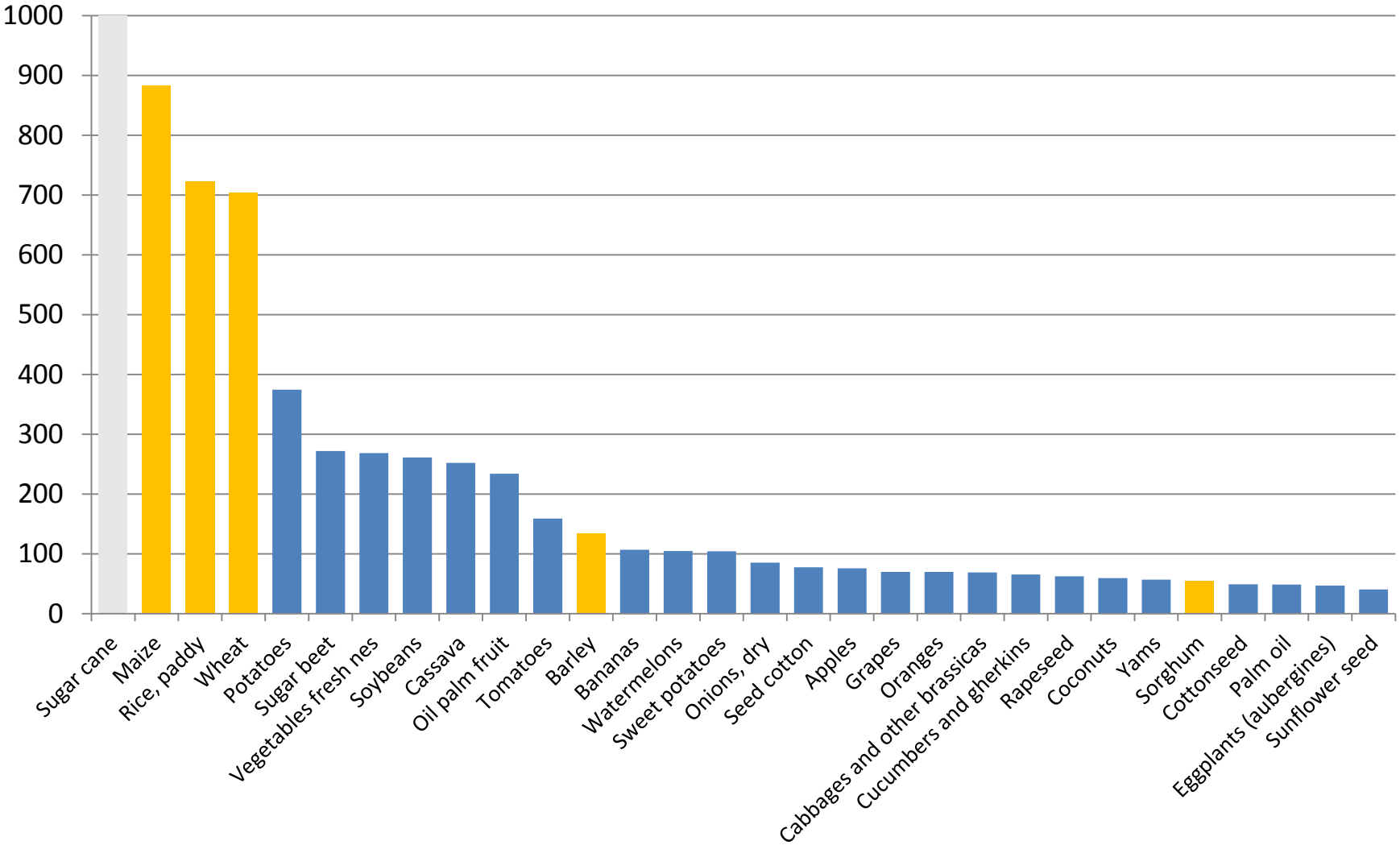
- › Aarhus University – Department of Agroecology
- › Aarhus University – Department of Engineering
- › Dansk Landbrugs Grovvareselskab, dlg
- › WEBStech Aps

Postharvest losses of cereals



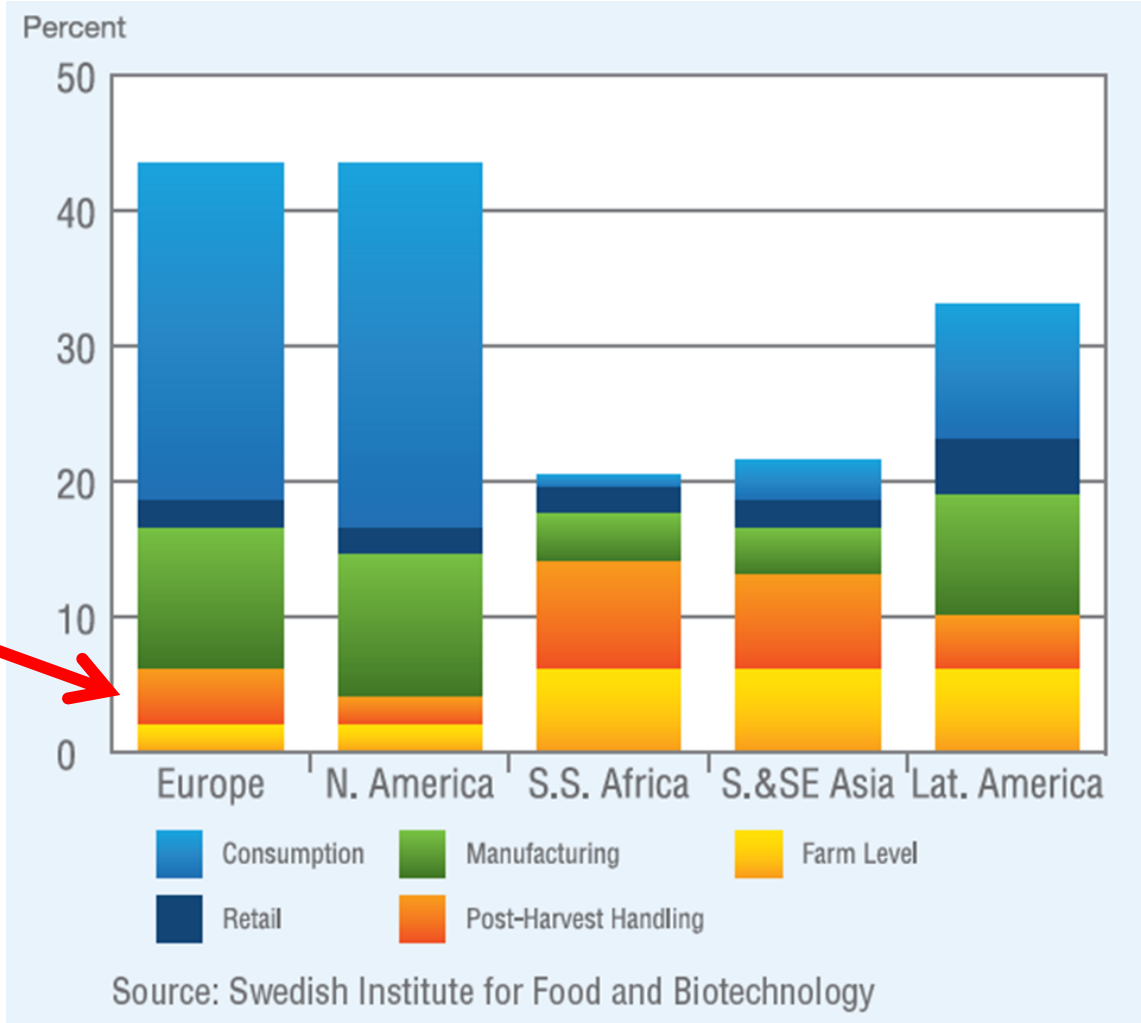
› Up to 1.3bn tonnes of food lost or wasted … yearly. Recent studies commissioned by UN Food Agriculture Organization (FAO) estimated yearly global quantitative food losses and waste at roughly 30% for cereals; 40–50% for root crops, fruits and vegetables; 20% for oilseeds, meat and dairy; and 30% for fish.

World top 30 crop production, 2011, mill. tonnes



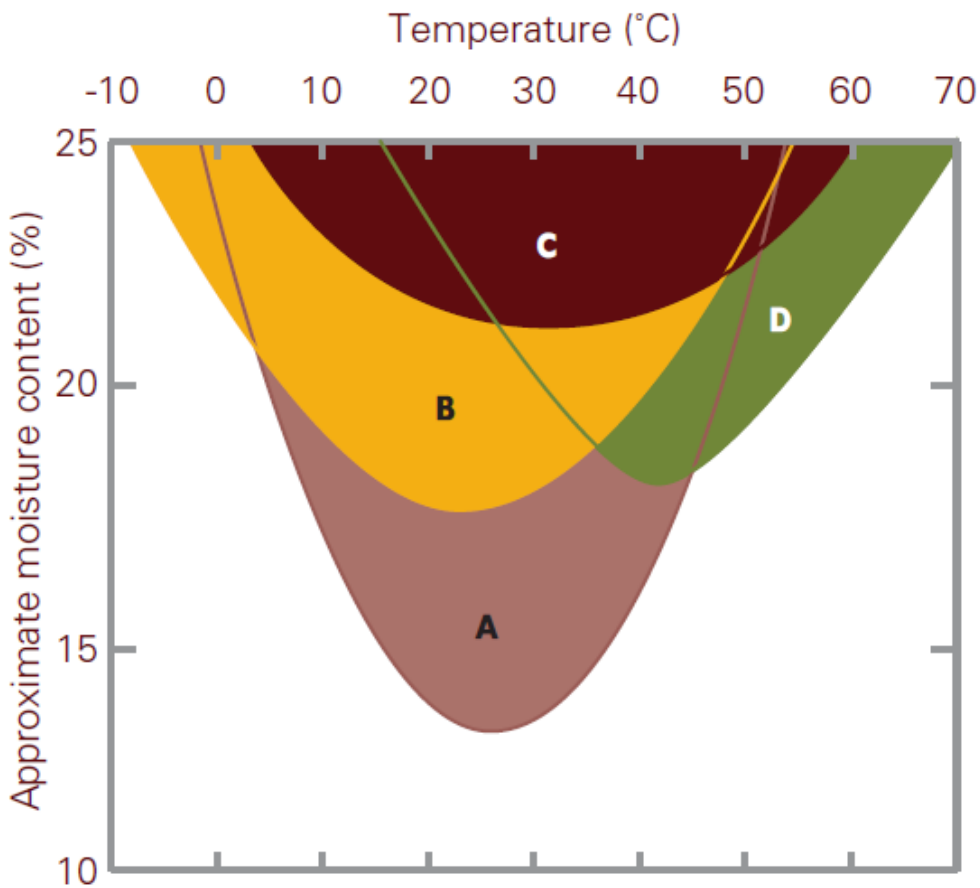
Fagostat, 2013

Sources of Food Waste for Cereals, by Region



Fungi and mycotoxins in stored grain

The principal method by which storage fungi can be controlled is through drying and cooling. No storage fungi will grow below 14.5% mc. They continue to grow slowly at near 0°C, so cooling alone is not sufficient to prevent growth in damp grain.



A – *Aspergillus* species which may damage germination and cause slow heating.

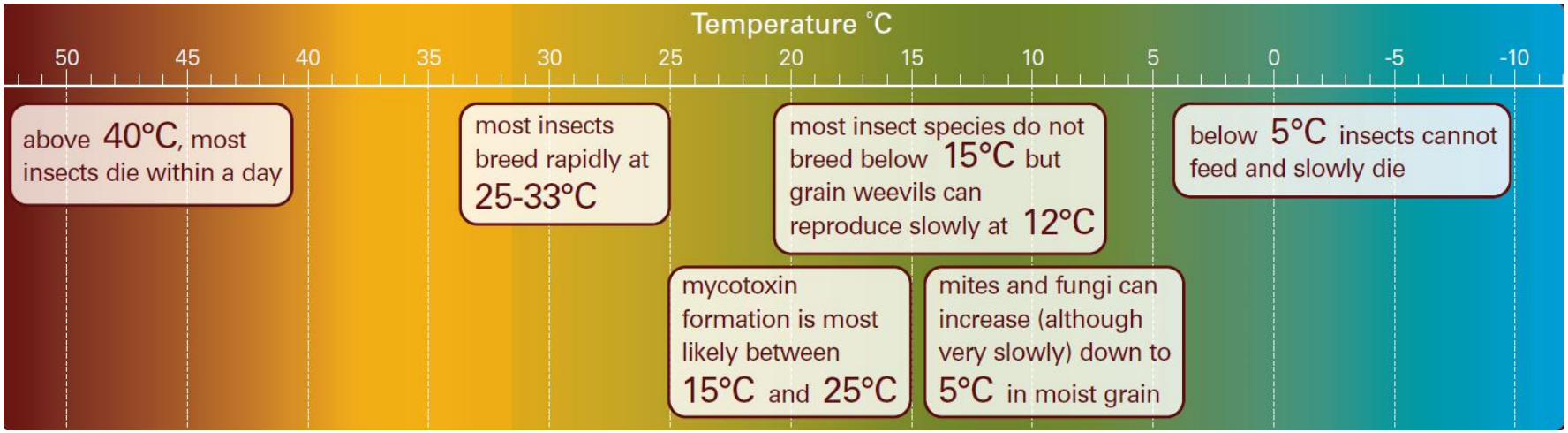
B – *Penicillium* species, including those that produce mycotoxins.

C – Advanced decay/field fungi, eg *Fusarium* species and heating organisms, eg *Absidia* species which may be pathogenic causing, for instance, farmers' lung.

D – Thermophilic fungi, which thrive at very high temperatures, such as those that occur in compost bins.

HGCA, 2011: Grain storage guide 3rd edition

Temperature effects



HGCA, 2011: Grain storage guide 3rd edition

The sensors

Sensor unit containing measuring and transmitting electronic. Right the complete closed shell

MSP430 microcontroller
Combined temperature/humidity sensor is used
Power supply: 1200 mAh battery
Frequency used is 433 MHz

Technical specifications

Sensor unit includes:

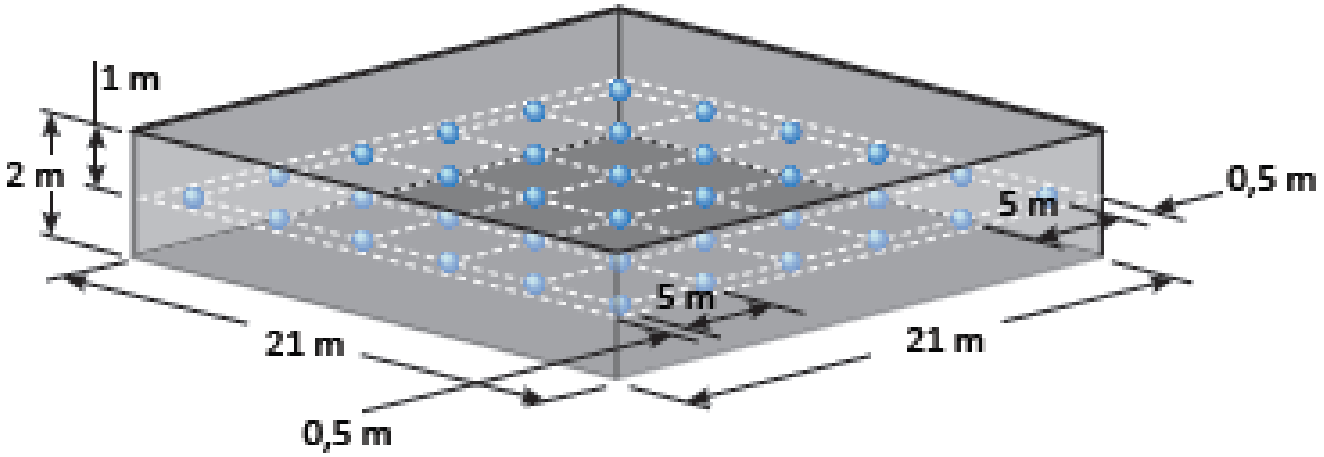
- Digital temperature and RH sensor with
  Operating area: -40 to +80 °C / 0 – 100 % RH
  Resolution: 0,04 °C / 0,5 % RH
  Accuracy: ± 0,4 °C by 25 °C / ±3% RH by 20-80% RH
- Battery with 2 years life span
- Build in data memory
- Sensor cabinet resists pressure of 1,5 ton at 20 °C

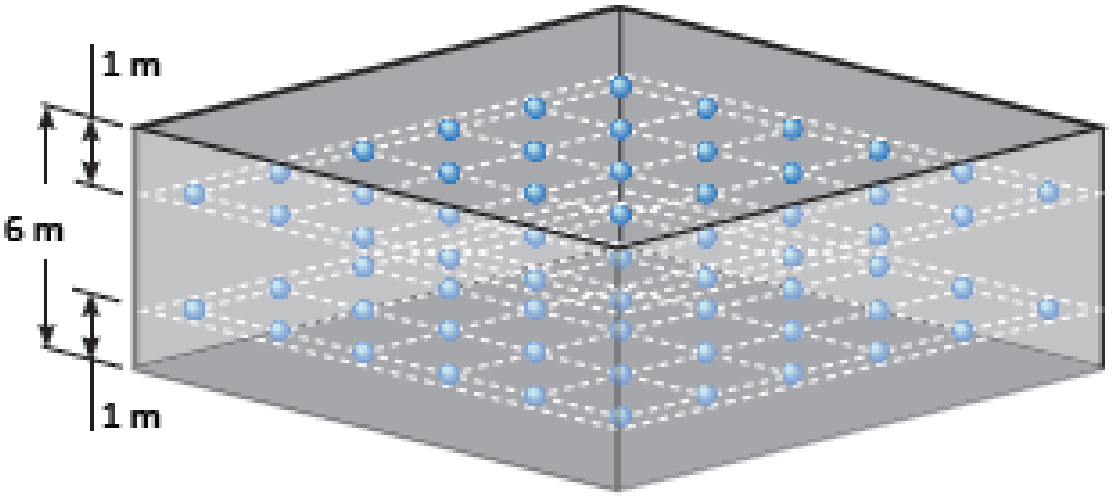
Base station includes:

- GSM module for data transfer
- Build in data memory
- Power supply: 220 V AC
- Operating temperature: -30 to +80 °C

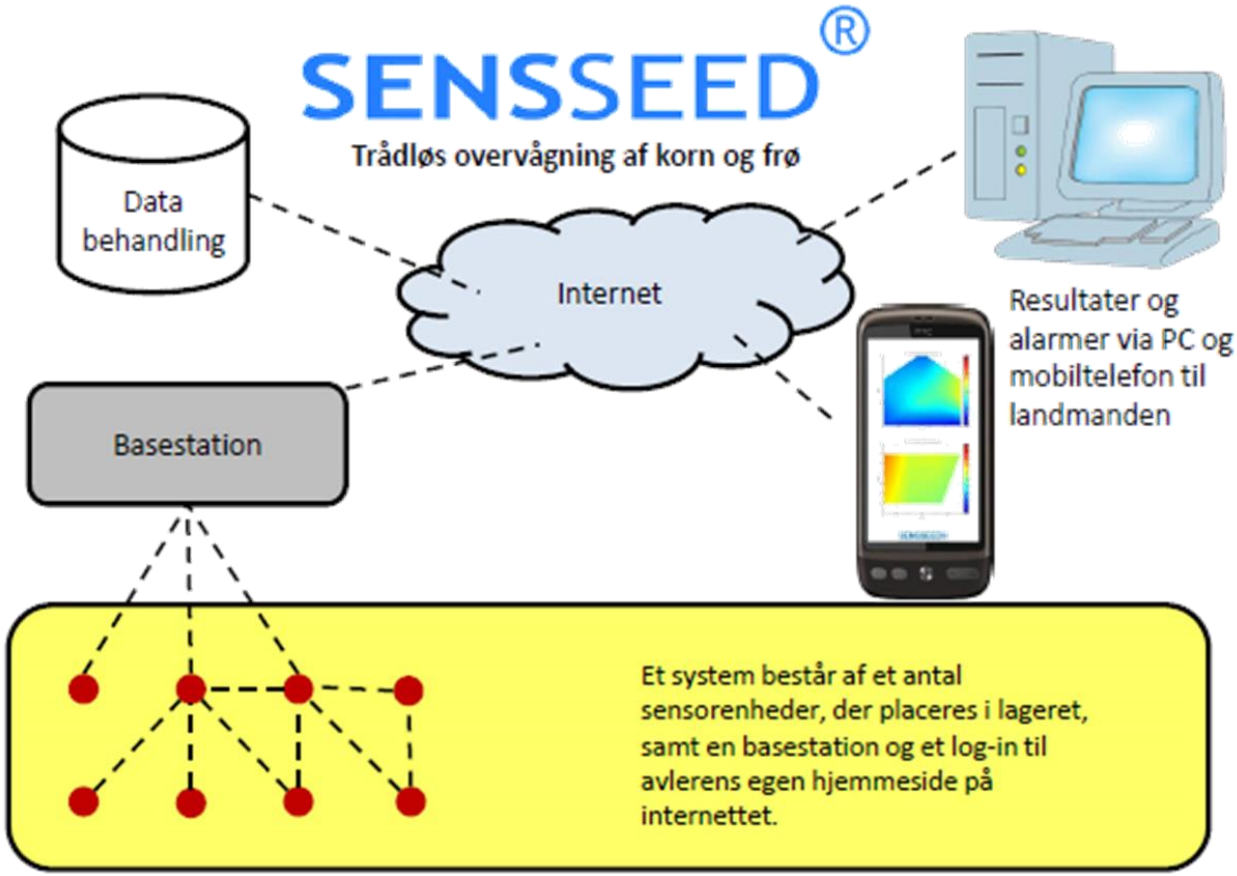
A 433 MHz radio transmitter/receiver is used in both sensor units and base station.

In bedded wireless sensors in storage

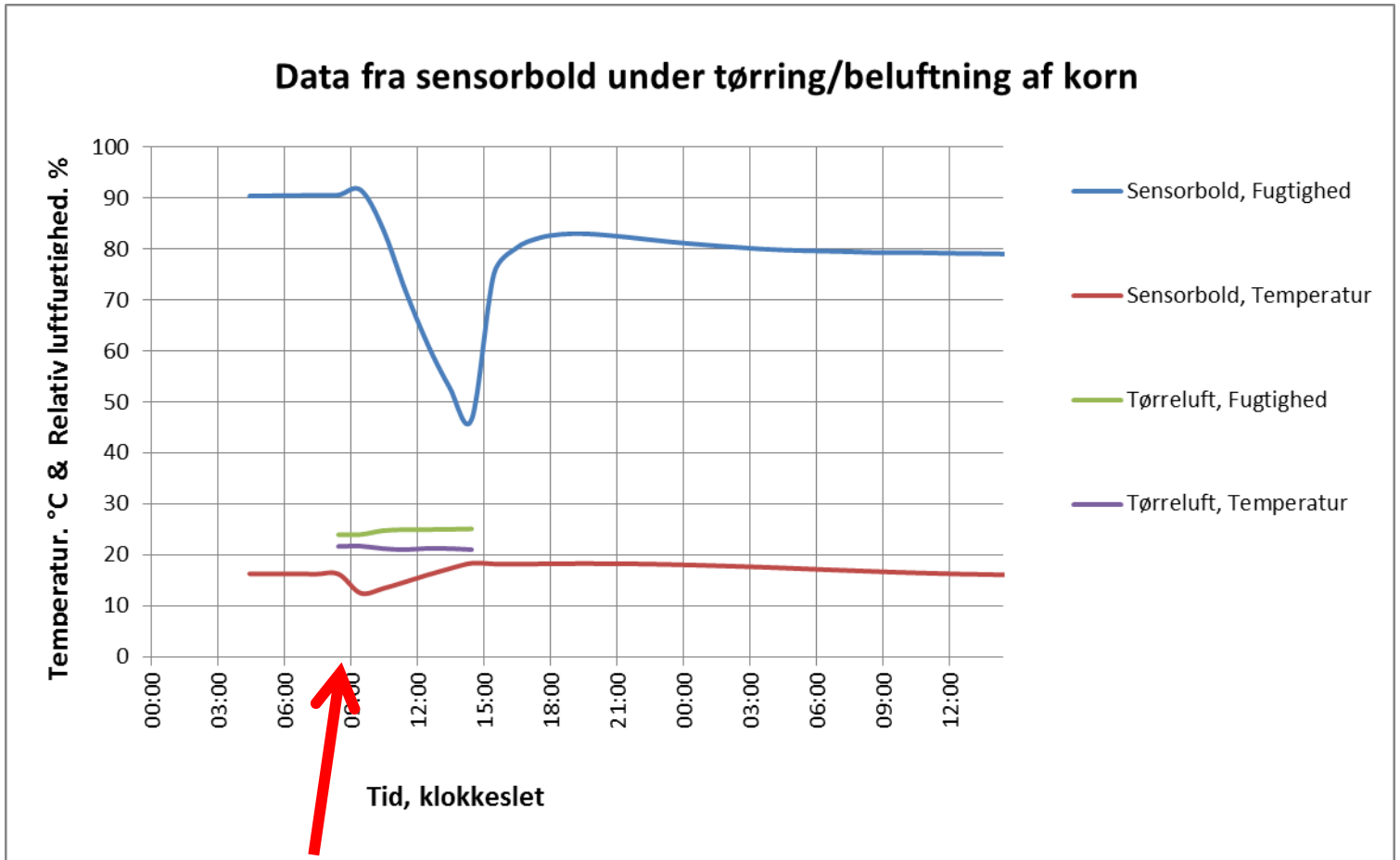




Monitoring via internet and sms



Data from in bedded wireless sensors



Aeration and cooling of the crop

Temperature graph of oat in farmers storage

Projekt overview

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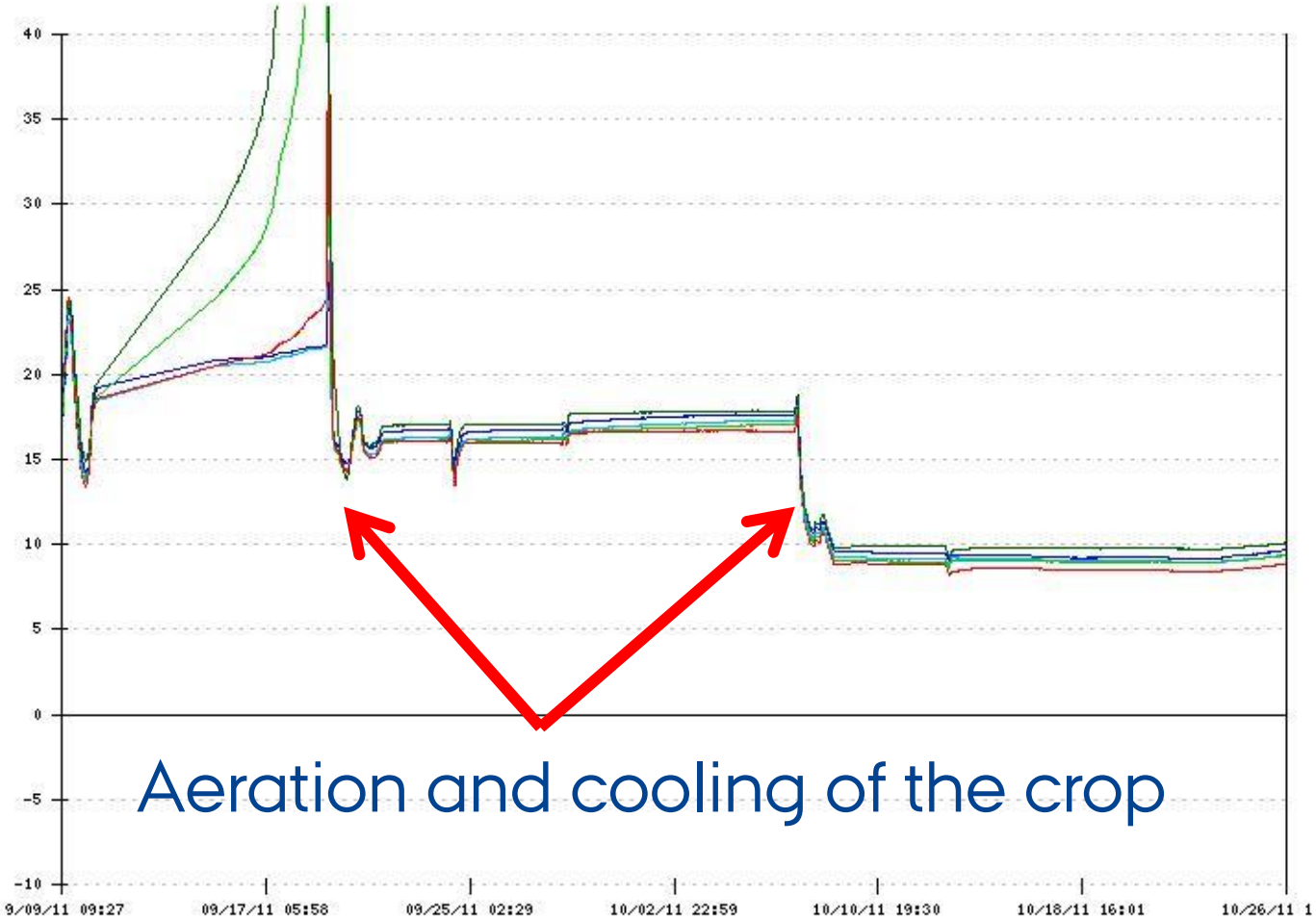
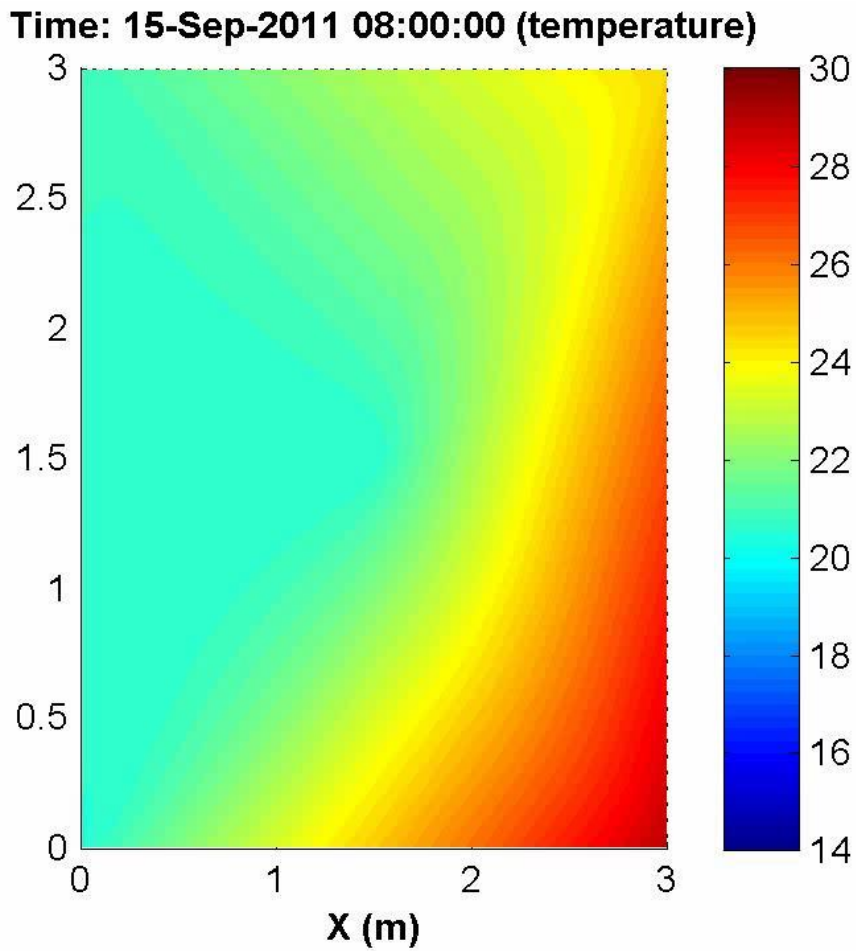
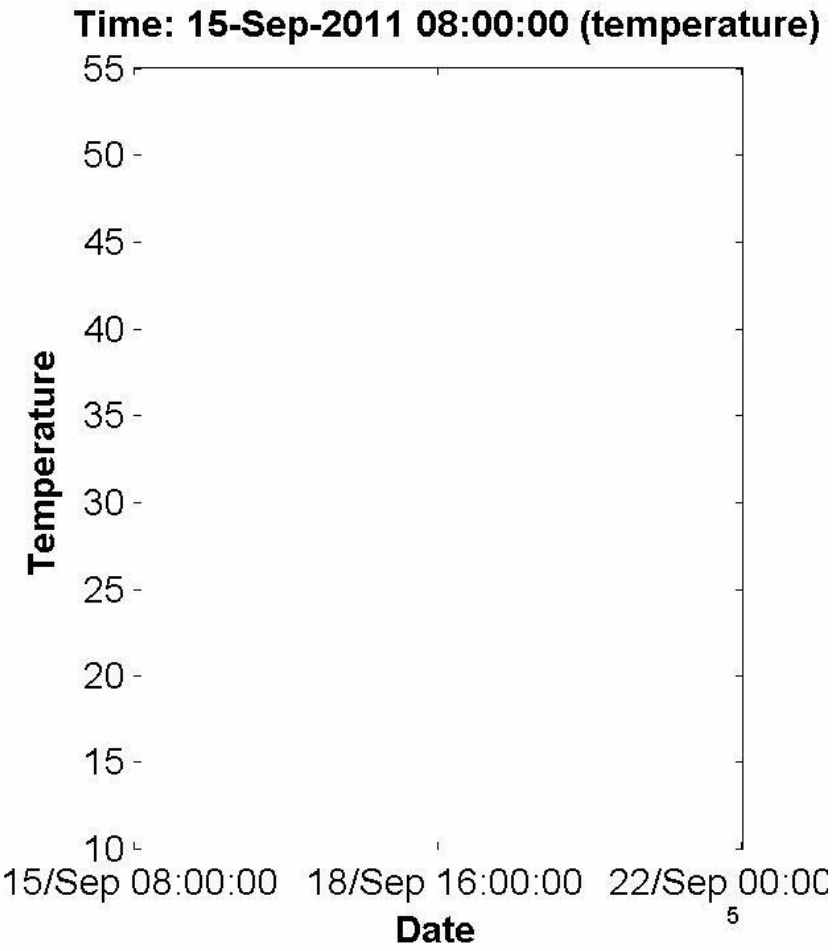


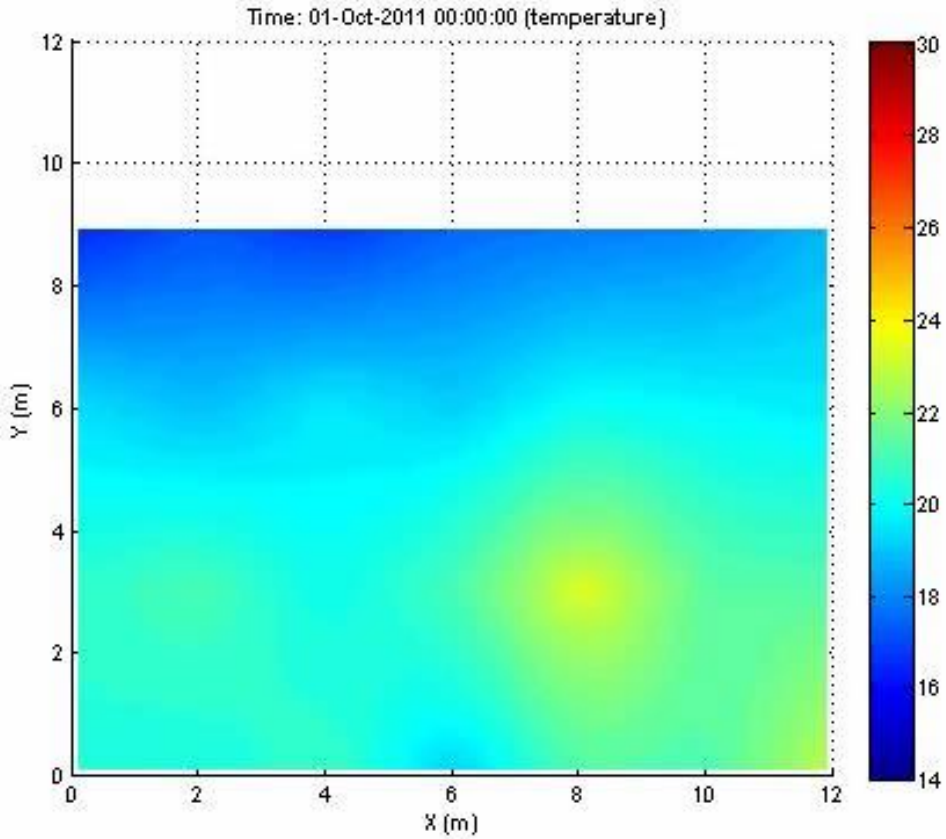
Aeration and cooling of the crop

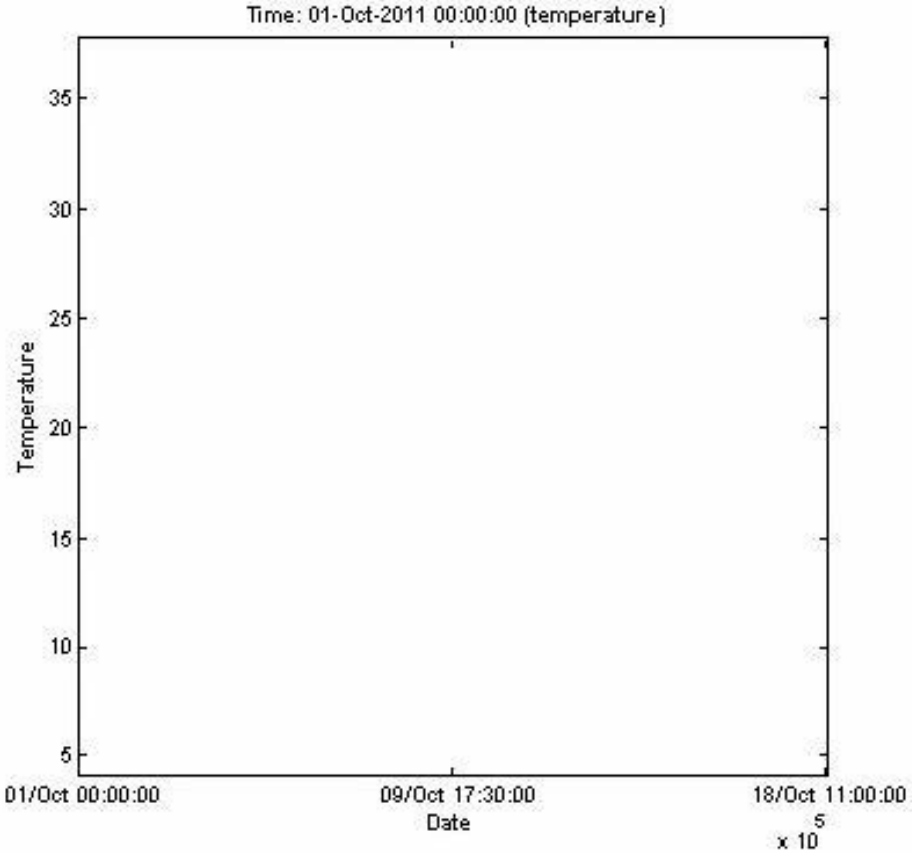
Temperature graph of oat in farmers storage





Temperature graph of spring wheat in farmers storage portable drier





Malting barley harvest 2011

	Protein (%)	Test weight (Kg/hl)	Moisture content (%)	Starch (%)	Grading	Impurities	Aubry 3 days	Aubry 5 days
Lidsø Gods, Rødby	10,1 (±0,4)	63,2 (±0,7)	19,9 (±1,2)	65,0 (±1,1)	97,5 (±0,5)	0,6 (±0,2)	75,3 (±5,5)	77,0 (±5,1)
Hans Jørgen Nielsen, Odense	9,9 (±0,2)	63,5 (±1,1)	19,9 (±1,6)	64,2 (±0,5)	96,1 (±1,9)	1,1 (±1,2)	78,2 (±9,5)	81,4 (±9,1)
Hvidkilde	11,7 (±0,5)	61,4 (±0,5)	20,1 (±0,5)	62,2 (±0,6)	88,8 (±1,7)	2,7 (±0,6)	83,9 (±3,8)	85,2 (±3,5)
Jørgen Strange, Nykøbing F	10,21 (±0,3)	61,93 (±0,6)	18,02 (±0,5)	65,52 (±0,4)	94,47 (±1,0)	1,41 (±0,5)	87,6 (±5,8)	89,5 (±3,1)
Brian Schrøder Jørgensen, Rødekro	10,46 (±0,3)	61,68 (±0,3)	15,92 (±0,8)	65,72 (±0,6)	92,56 (±0,5)	0,54 (±0,1)	79,2 (±5,5)	80,4 (±5,5)

High moisture content at harvest.
Aubry (germination energy) number of germination kernels (100) after respectively 3 and 5 days.

Malting barley harvest 2011
Hans Jørgen Nielsen, Odense

	Protein (%)	Test weight (Kg/hl)	Moisture content (%)	Starch (%)	Grading	Impurities	Aubry 3 days	Aubry 5 days
Høst 23-25 august	9,9 (±0,2)	63,5 (±1,1)	19,9 (±1,6)	64,2 (±0,5)	96,1 (±1,9)	1,1 (±1,2)	78,2 (±9,5)	81,4 (±9,1)
15. November	10,0 (±0,2)	64,4 (±0,5)	13,9 (±0,4)	63,9 (±0,5)	94,2 (±0,6)	1,3 (±0,2)	96,9 (±1,1)	

- Protein and starch unchanged
- Increased test weight,
- Reduced grading
- Dry matter reduced
- Aubry (germination energy) number of germination kernels (100) after respectively 3 and 5 days. High and homogenous at 15. November.

Malting barley harvest 2012, Hvidkilde, Svendborg

Date	Loc.	Protein (%)	Test weight (Kg/hl)	Moisture content (%)	Starch (%)	Grading	Impurities	Aubry 3 days	Aubry 5 days
Harvest	**avg.**	**10,4 (±0,7)**	**64,5 (±1,8)**	**19,2 (±0,7)**	**62,6 (±0,7)**	**92,0 (±1,3)**	**1,0 (±0,1)**		
12.11	Top	10,0 (±0,7)	66,7 (±0,6)	15,5 (±1,9)	63,3 (±0,5)	91,4 (±0,8)	1,4 (±0,2)	97,2 (±2,0)	97,6 (±1,3)
12.11	Bottom	10,3 (±1,2)	67,1 (±1,1)	15,5 (±0,9)	63,2 (±0,4)	91,6 (±1,7)	1,2 (±0,3)	98,1 (±1,3)	98,3 (±0,8)
15.1	Top	10,0 (±0,7)	65,5 (±0,5)	15,8 (±1,9)	62,9 (±0,5)	91,1 (±0,8)	1,4 (±0,1)	96,3 (±3,0)	92
15.1	Bottom	10,2 (±0,5)	66,1 (±0,7)	14,8 (±1,5)	63,0 (±0,6)	91,6 (±0,5)	1,4 (±0,2)	97,6 (±2,1)	94

- High moisture content at harvest
- Protein and starch unchanged
- Increased test weight
- Reduced grading
- Moisture content reduced
- Aubry (germination energy) number of germination kernels (100) after respectively 3 and 5 days. High and homogenous at 15. November.

SENSSEED® - collection of sensors