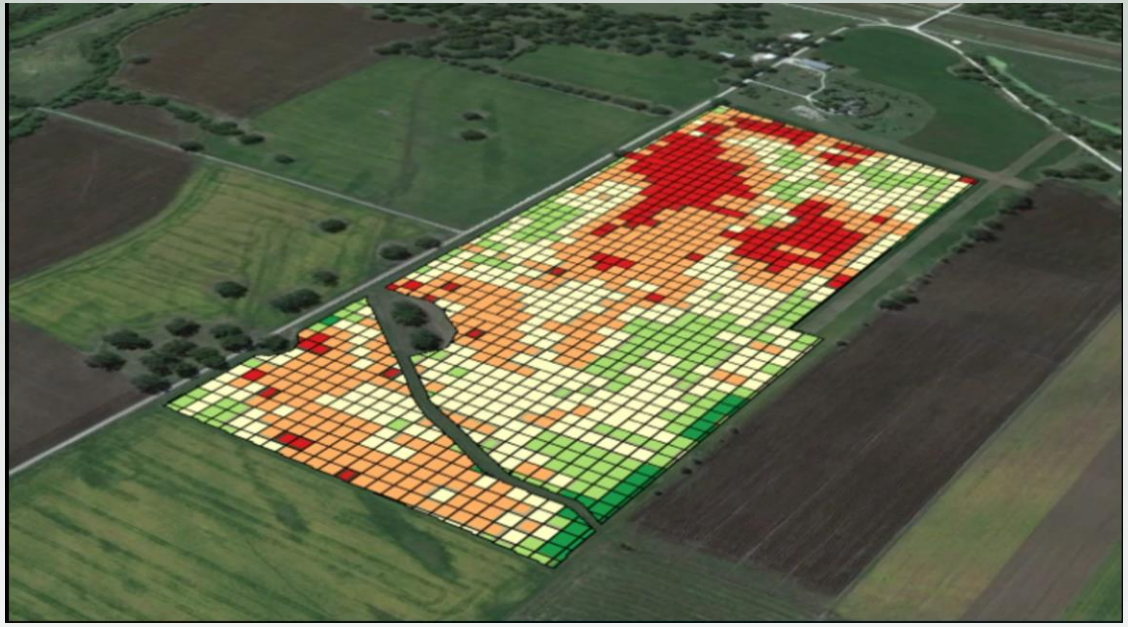
Precision Weed Management

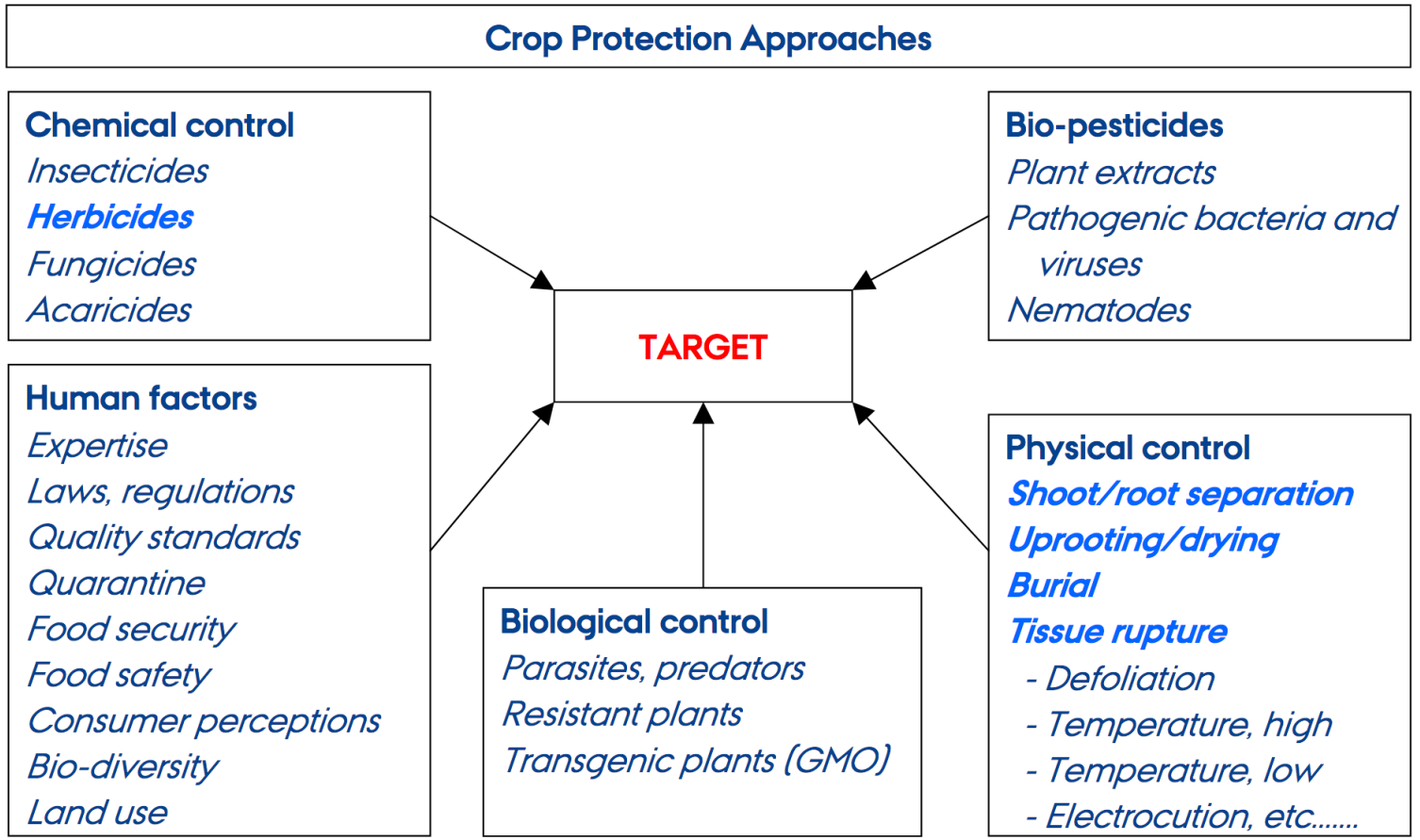


Dr. Heather Darby, UVM Extension Agronomist,

Precision Weed Management – Interest Grows

- Concern for possible impact of herbicides on farmers and environment
- Potential for financial savings

Crop protection



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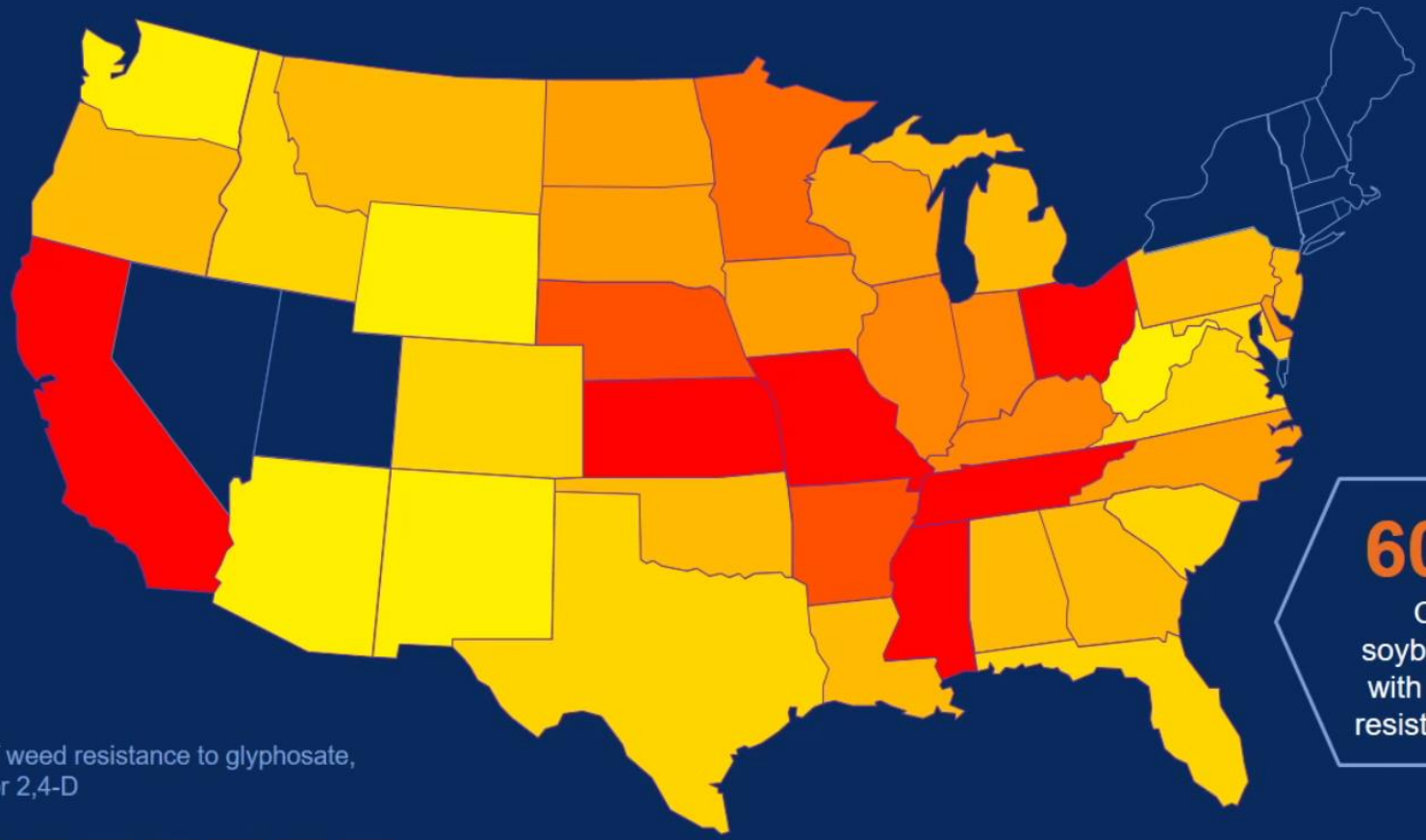
CULTIVATING HEALTHY COMMUNITIES

2015 | Weeds Are Winning the Battle



60M+
Corn & soybean acres with herbicide resistant weeds

cases of weed resistance to glyphosate, dicamba or 2,4-D

1	2	3	4	5	6	7	8+

Source: www.weedscience.org,
Stratus 2012 farmer survey, USDA NASS

A new era in Agriculture

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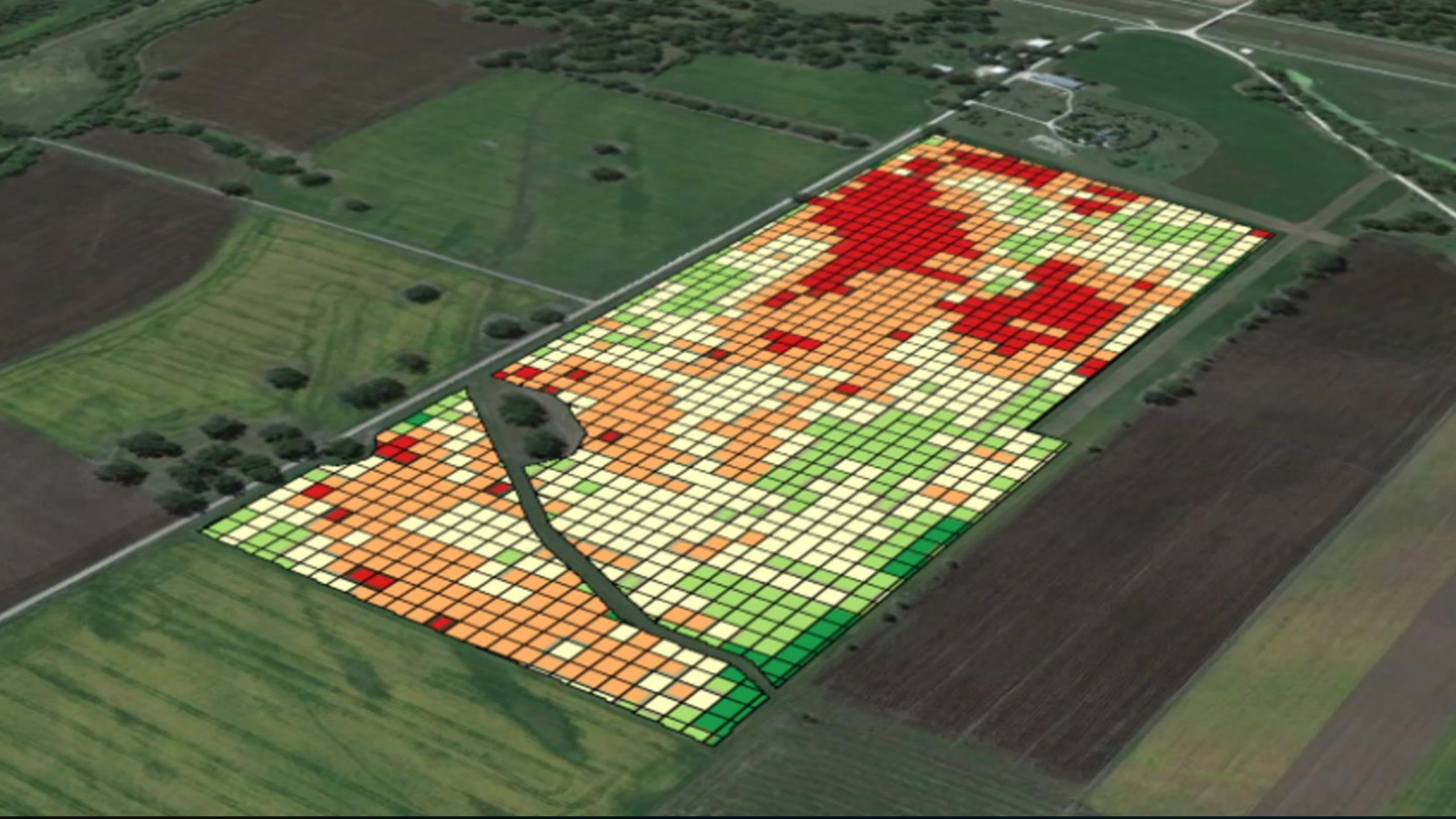
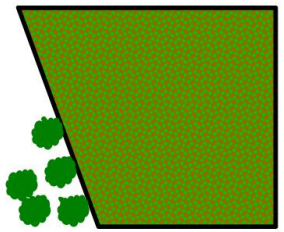
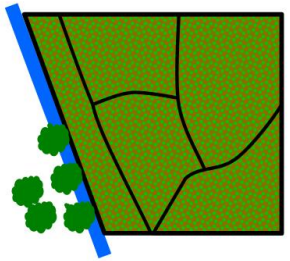
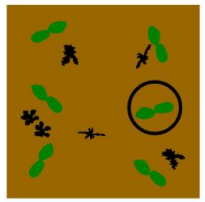
CULTIVATING HEALTHY COMMUNITIES



Crop management scale

Conventional or traditional field management	Field *One rate*	
Optimised management	Sub-Field *Variable rate*	
Single plant management	Single plant *Individual rate*	
Leaf scale management	Leaf *Leaf rate*	

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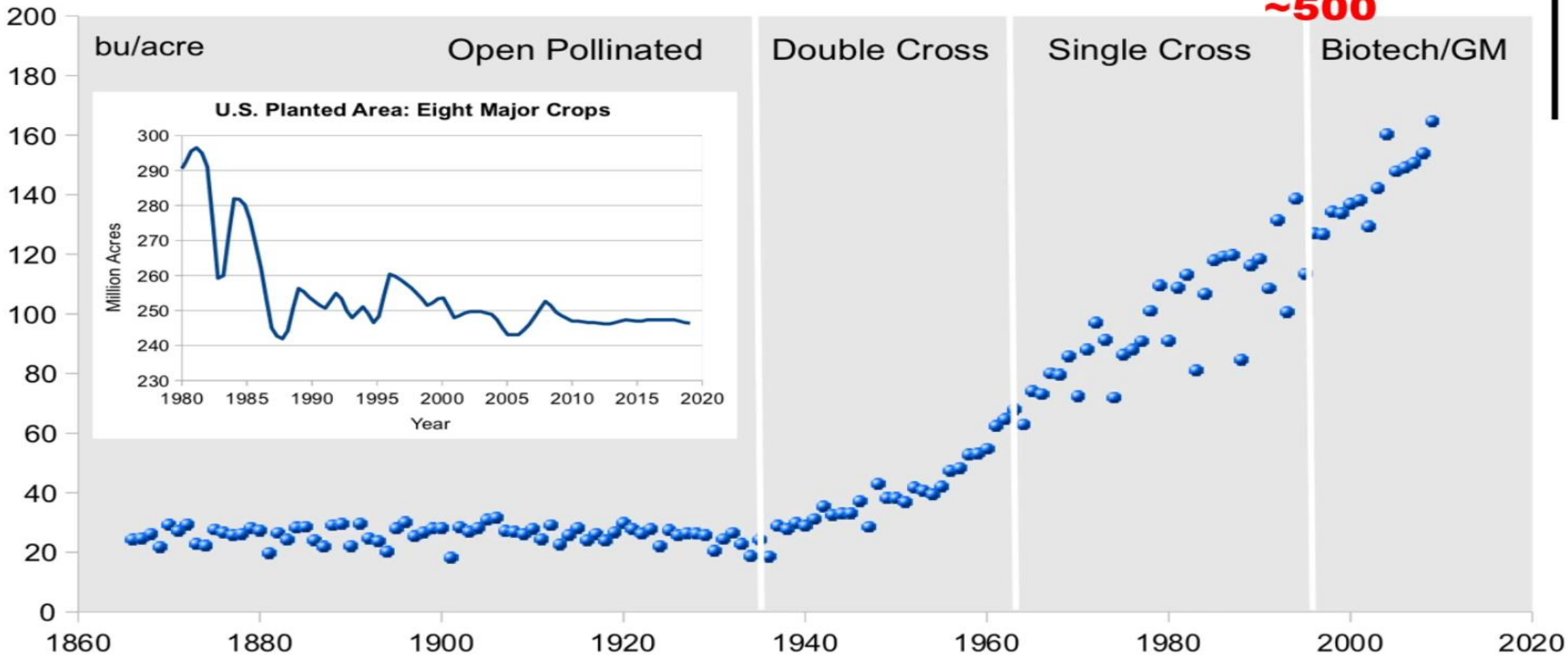
Average US Corn Yields: No End in Sight

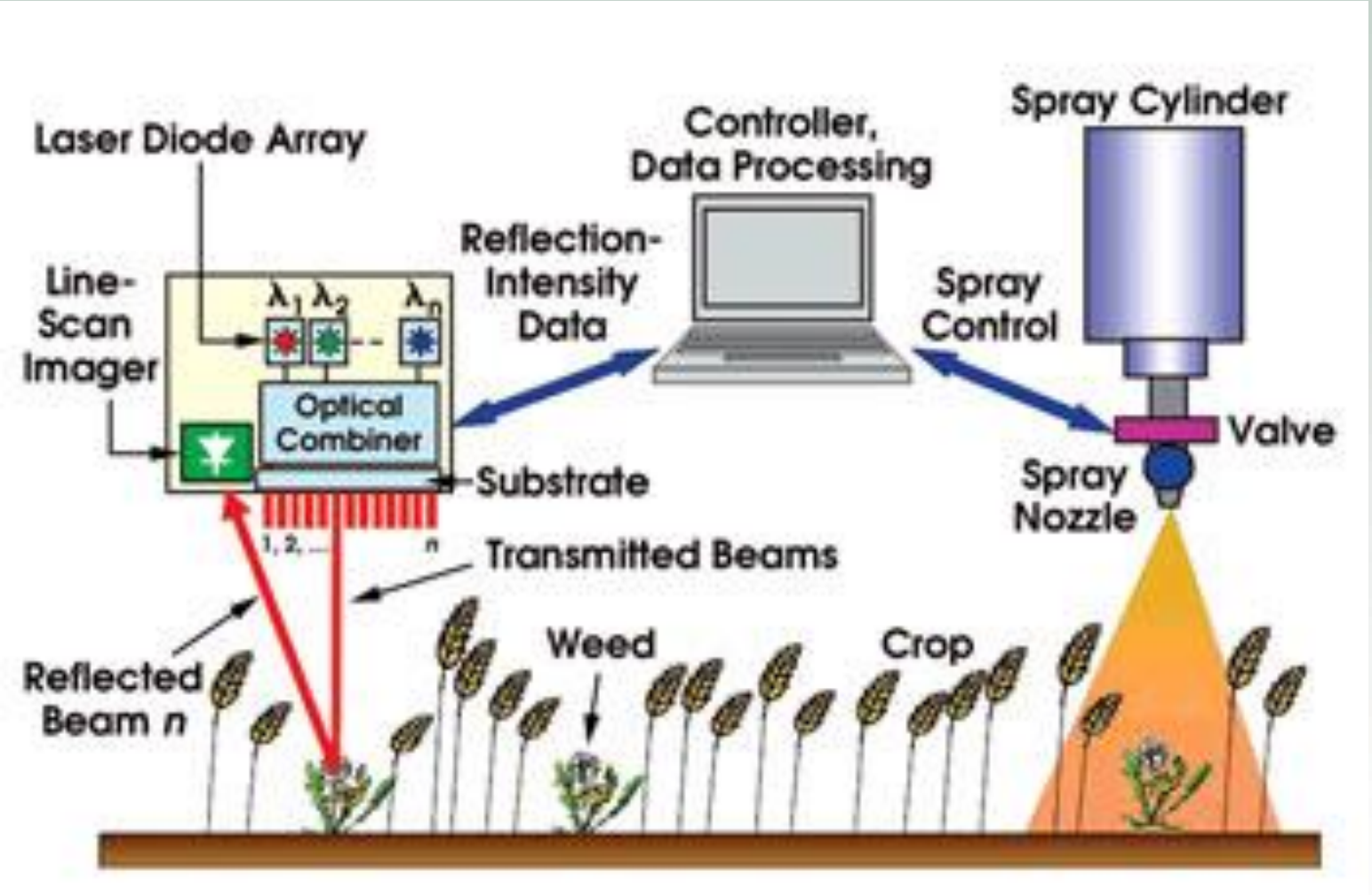
Current Test Yield:
~~~300~~ bu/acre
~500

Average US Corn Yield, 1866-2009



Sources: USDA-NASS; Troyer, *Crop Science* 46.2 (2006): 528; Pioneer (Rupert and Butzen, Crop Sci, 19(2))

© 2010 Biodesic



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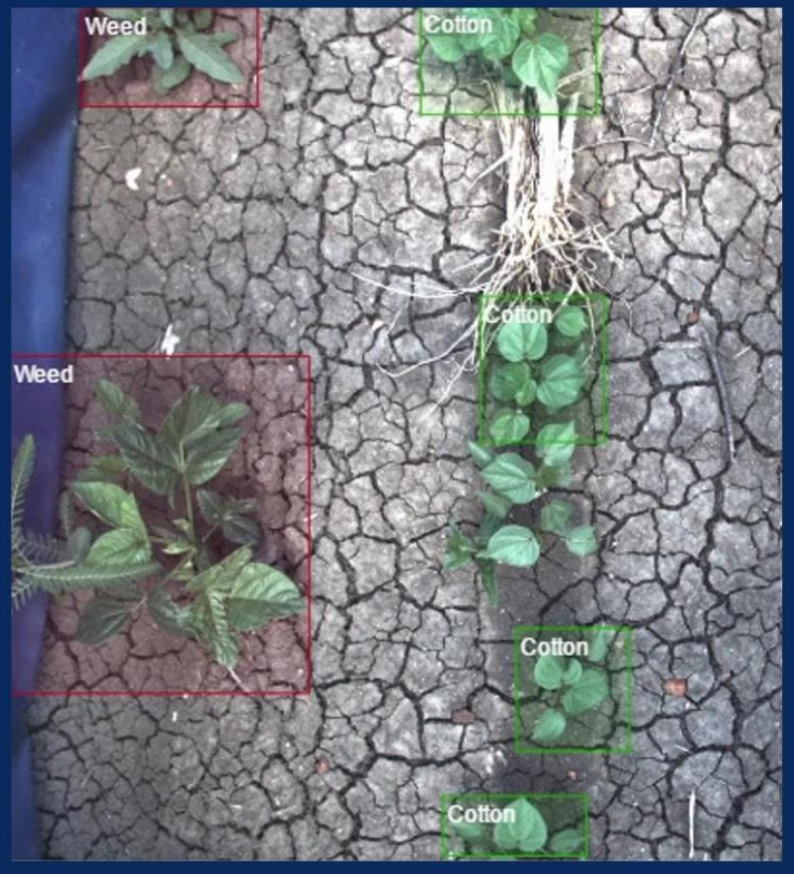
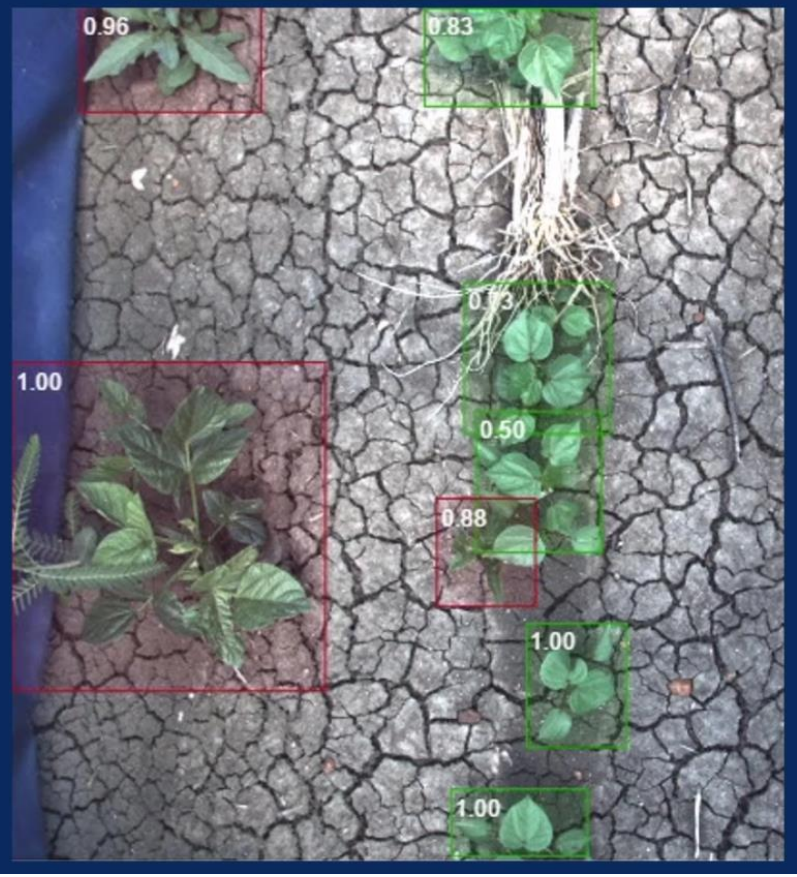
After teaching our system to identify cotton and weeds, it performed better than our agronomist

Agronomist labels



Deep learning labels



Proof of concept in California lettuce

5,000 decisions per minute with ¼-inch spray accuracy

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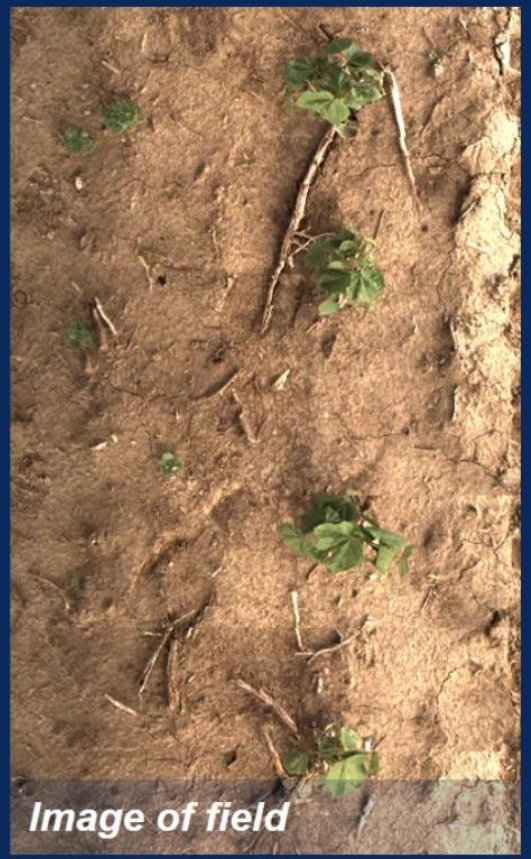
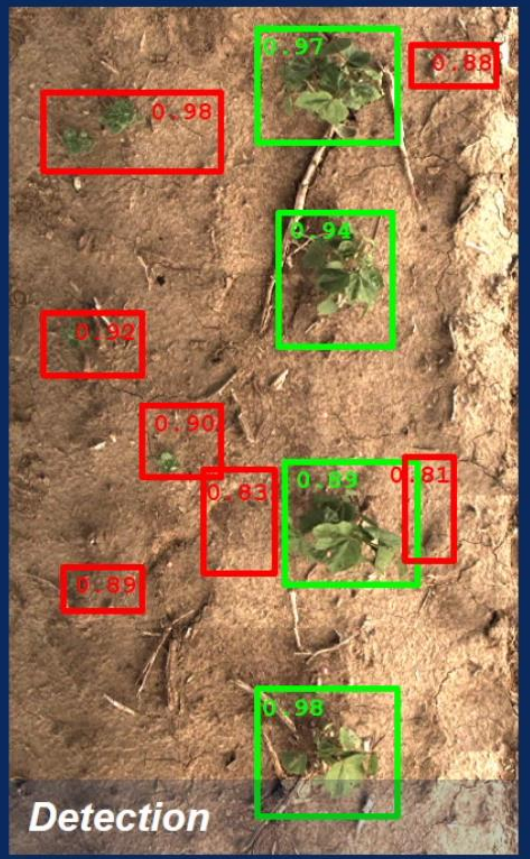
See & Spray uses artificial intelligence to identify and spray individual plants in milliseconds

Sense & Decide: Blue River's artificial intelligence identifies subtle differences between crops (green) and weeds (red)

Act: Only weeds are sprayed, reducing chemicals by >90%

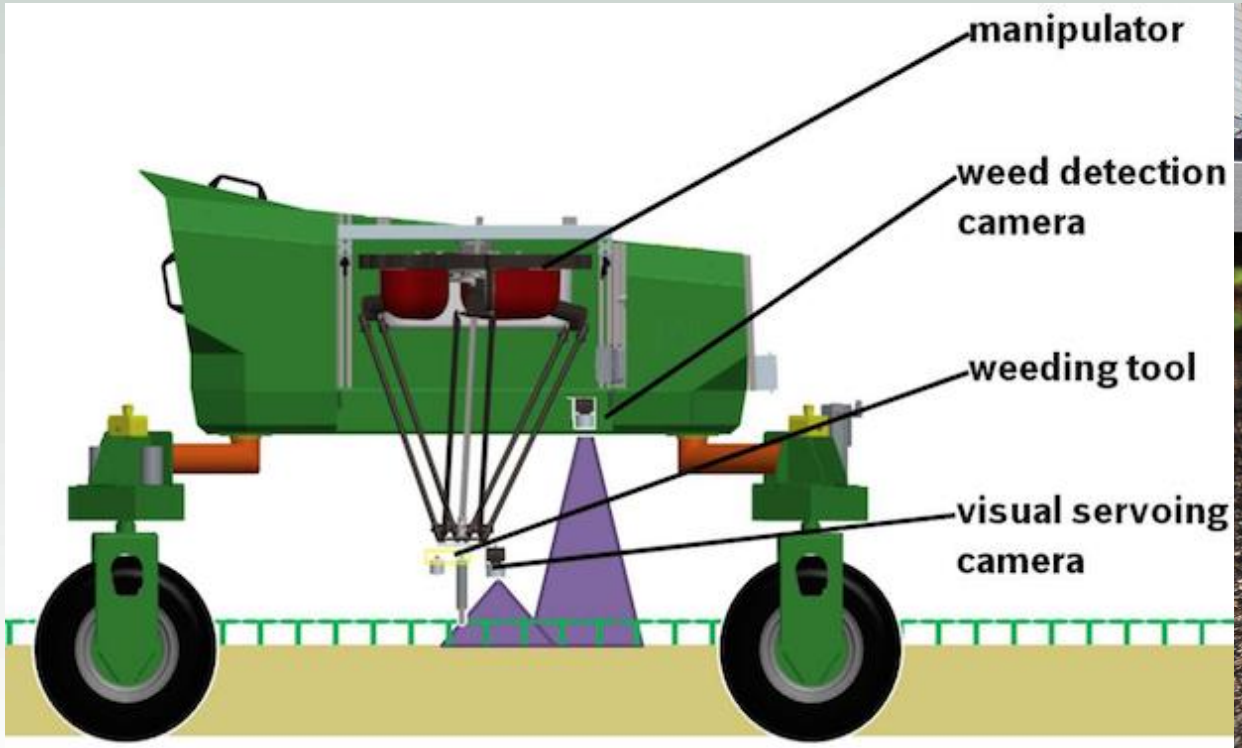




This robot is designed to work fields on its own and mechanically kill weeds. Photo: Deepfield

- Weeds all day and night
- Tiny rods and sensors
- Video, lidar, and remote sensing
- Locates weeds
- Punches them!
  - 20 weeds per second
  - 3 acres an hour
  - 2mm accuracy

Robotic Weeders



Jati - Light Saber Technology

- Name not a coincidence
- High resolution camera collects images in a 12” path
- Uses real-time by self-learning object recognition software
- Weeds zapped with laser beams

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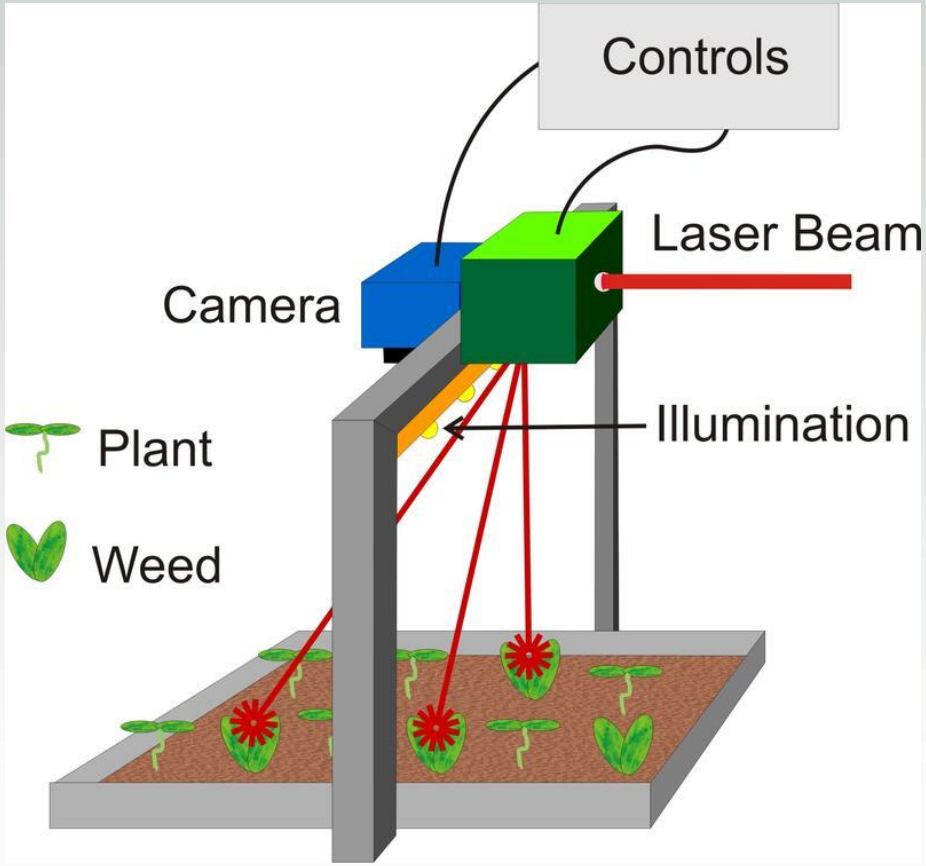
Laser Beam Weed Control



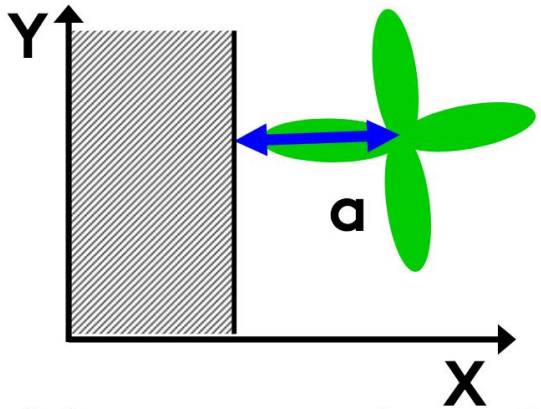
- Need optimum laser intensity
- Too weak makes the weeds grow more
- Too strong blow up machine

Commercialised machinery for precision physical weed control

Precision of machine vision based intra-row physical weed

(source: Tillett and Hague Technology Ltd)

(source: CLAAS Agrosystems)



max(a) = 30-40 mm (P 0.95)

On Farm Experiences with Camera-Guided Cultivation

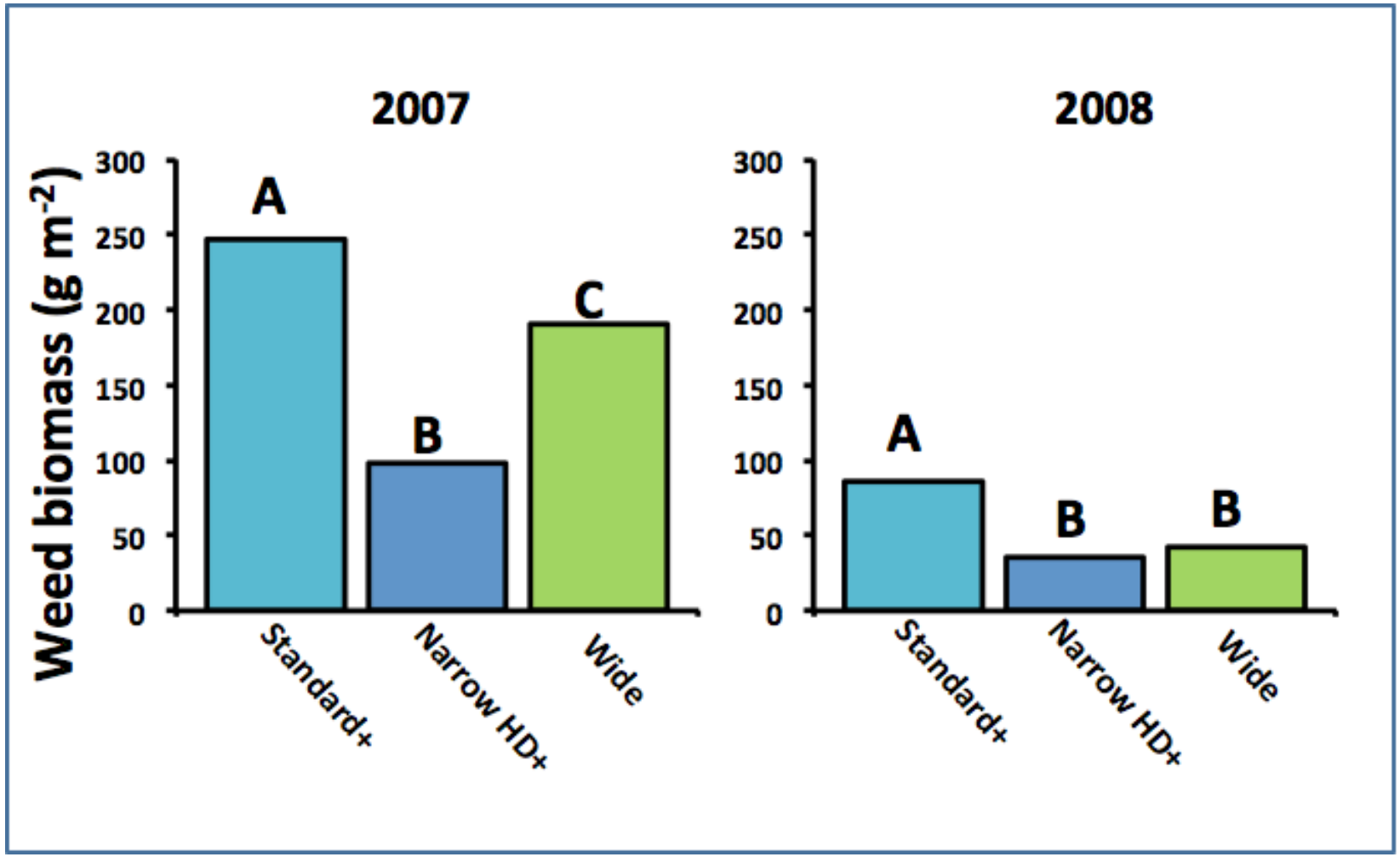
Elm Farm

Pinewood

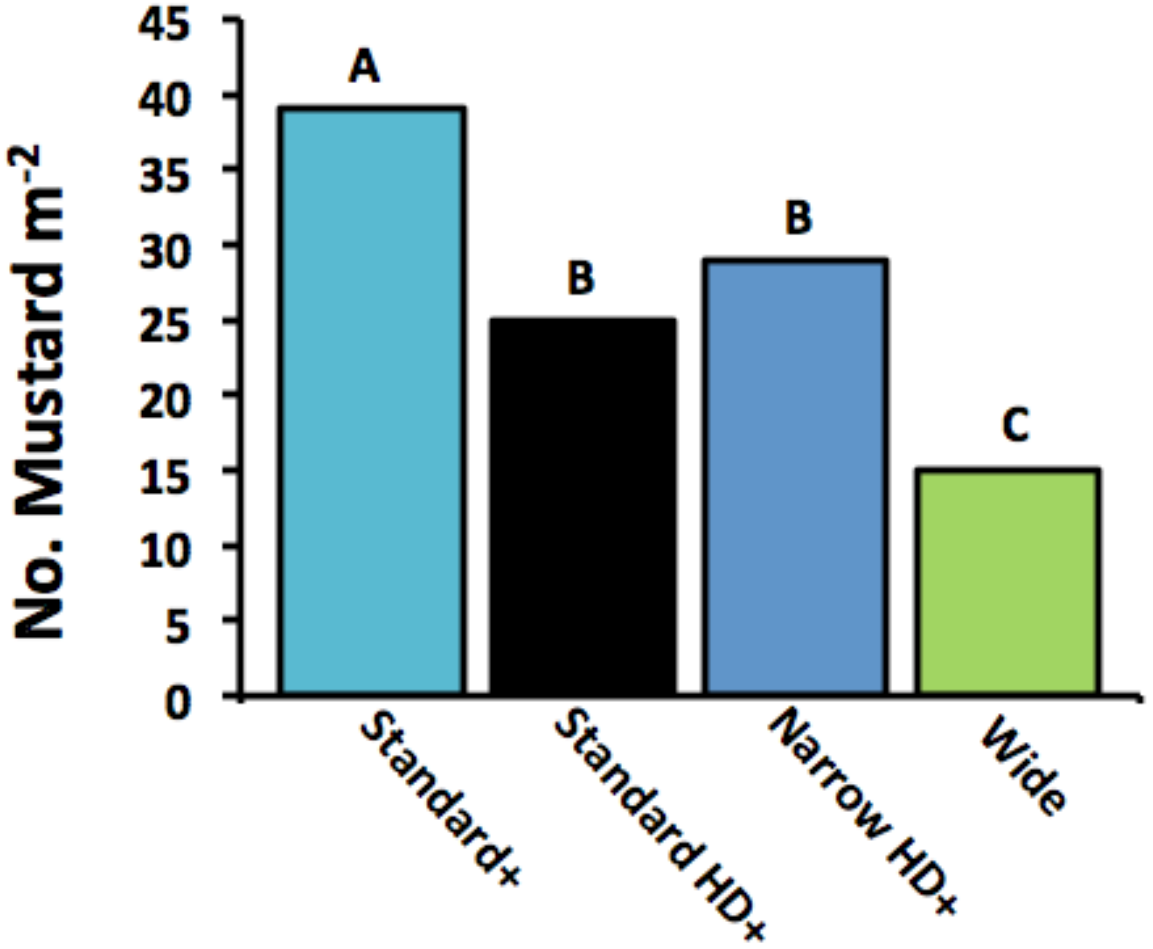
Treatments

200
Standard
200
Standard+
200
Two-Pass
200
Narrow+
500
Narrow HD+
200
Wide

Weed biomass in organic barley



Mustard density in organic spring wheat



Band Sowing with Cultivation

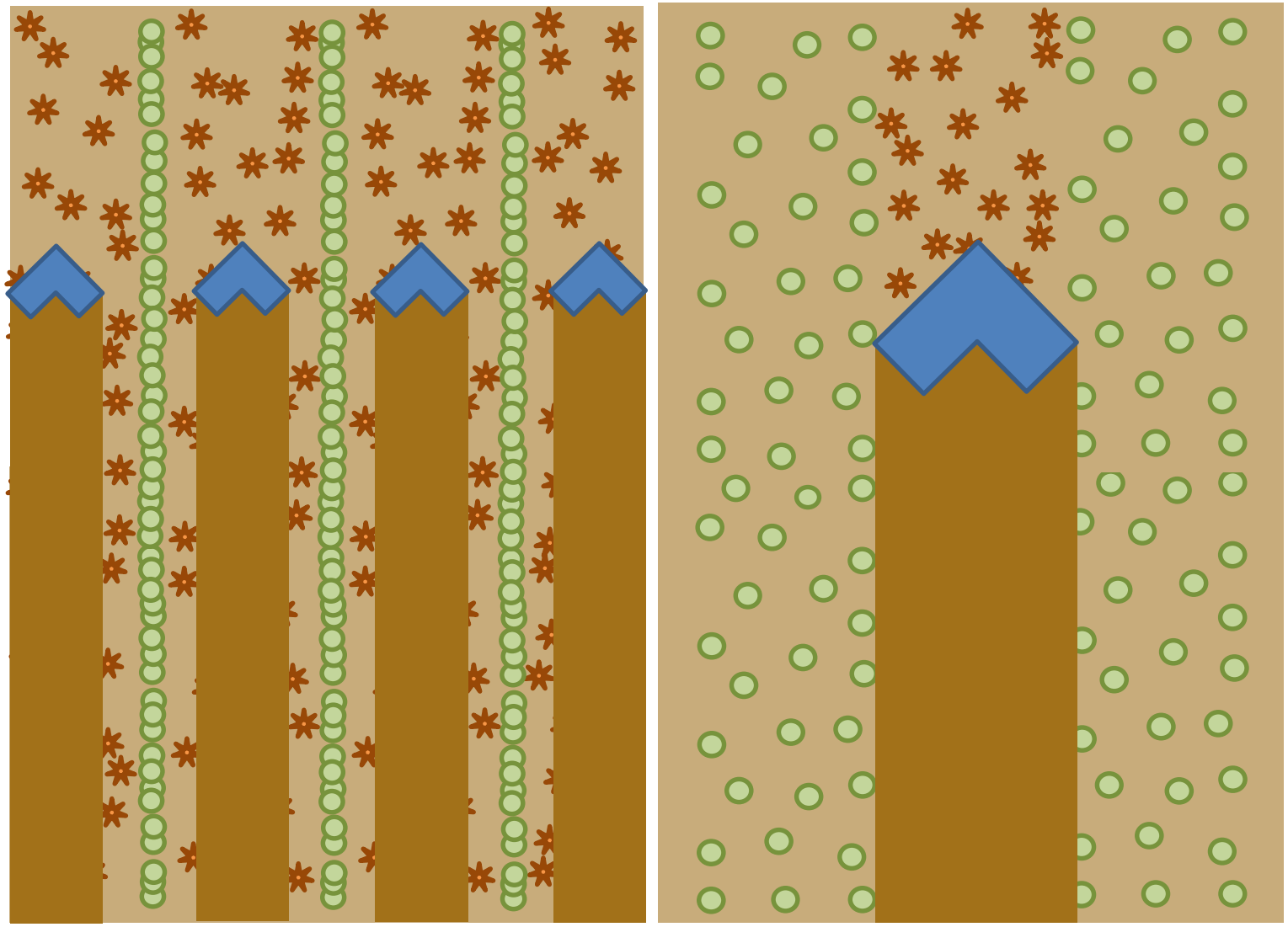
Band-sowing and inter-band hoeing for improved weed control in organic cereals

Funding: USDA NIFA OAREI

Rogers Farm, September 2015

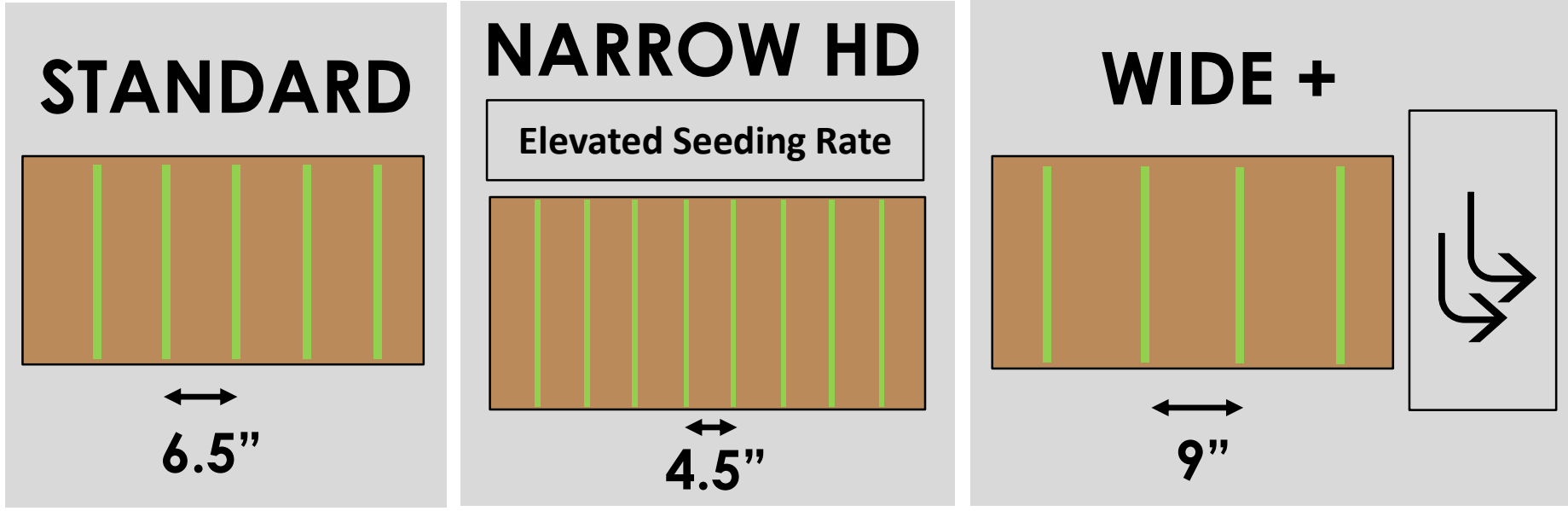
Row Cultivation

Band Cultivation

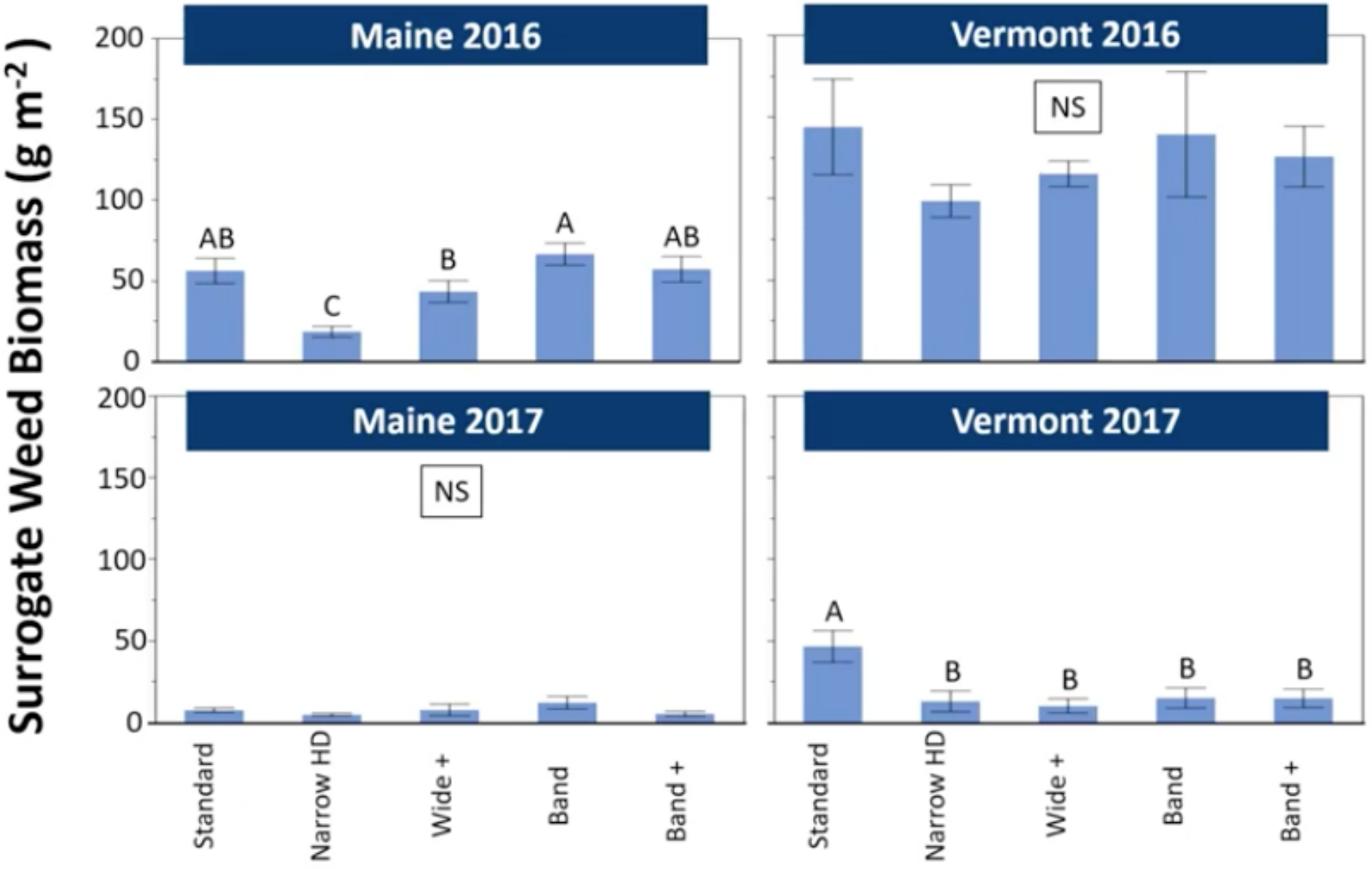


All treatments planted to Barley, var. Newdale

All treatments receive pre- and post-emergence tine harrowing



Weed Biomass in Barley Band Sowing Experiment



Precision Hoeing

- Precision hoe operated by tractor that is guided by GPS.
- Utilizes RTK-GPS tracking technology.
- High resolution cameras to differentiate between crops & weeds.
- Plants must be planted in straight rows (no curves).
- Rows must be equally spaced.

garford
robocrop
Image Quality
20
10
0
kph
-6
0
+6
Offset
Manual
Tillett & Hague
Vision Guidance

garford

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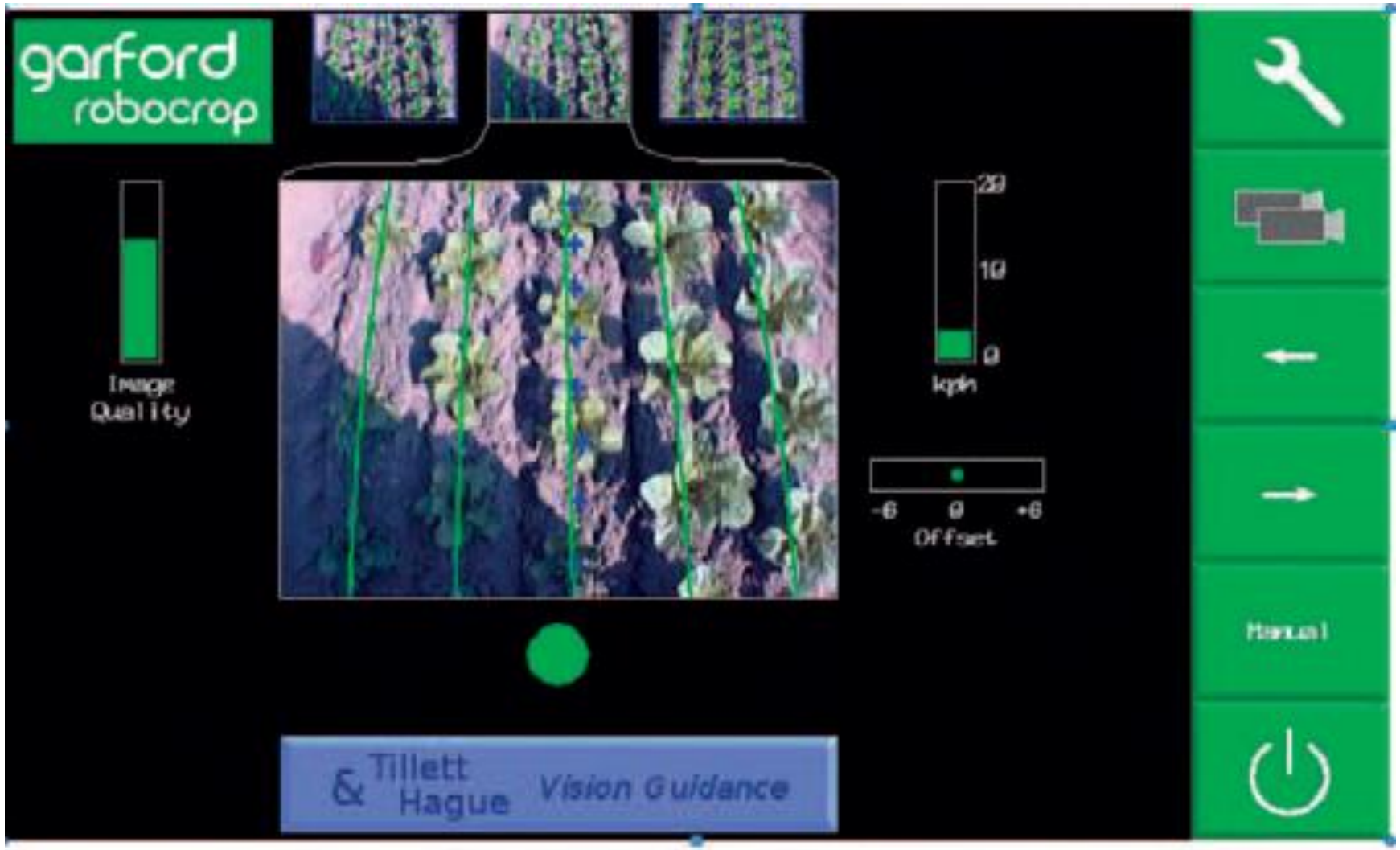

garford
robocrop
Image
Quality
20
10
0
kph
-6
0
+6
Offset
Manual
&
Tillett
Hague
Vision Guidance

Smith Farms
Westfield, Me.

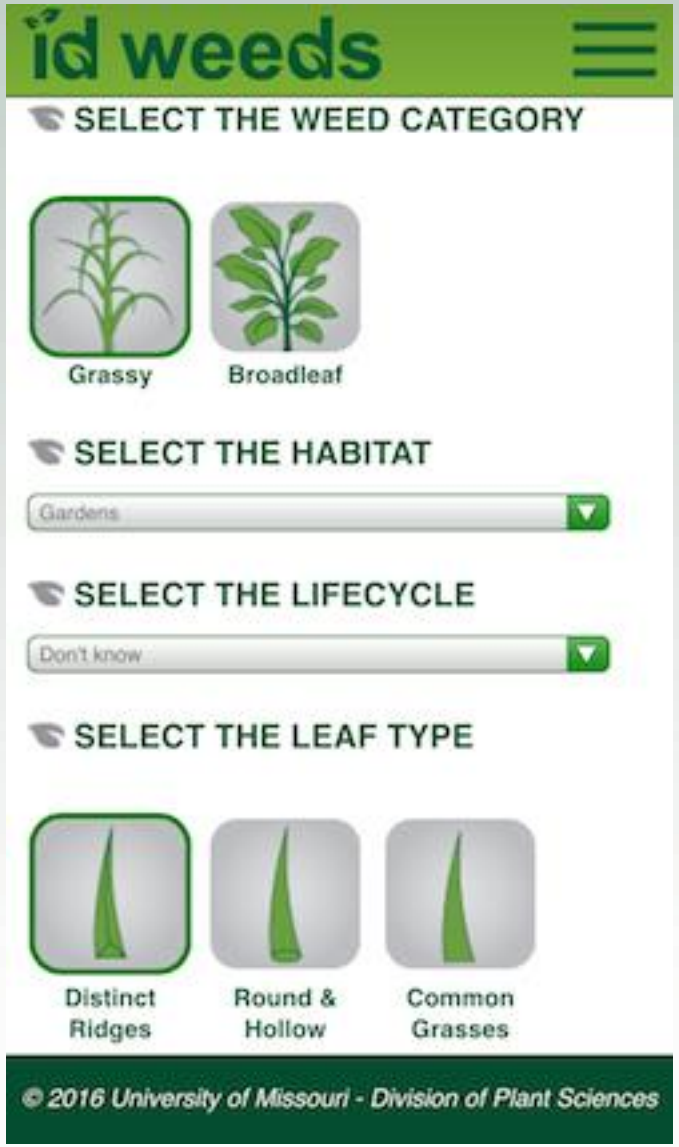
CASE IH

CombCut Weeder

Combcut

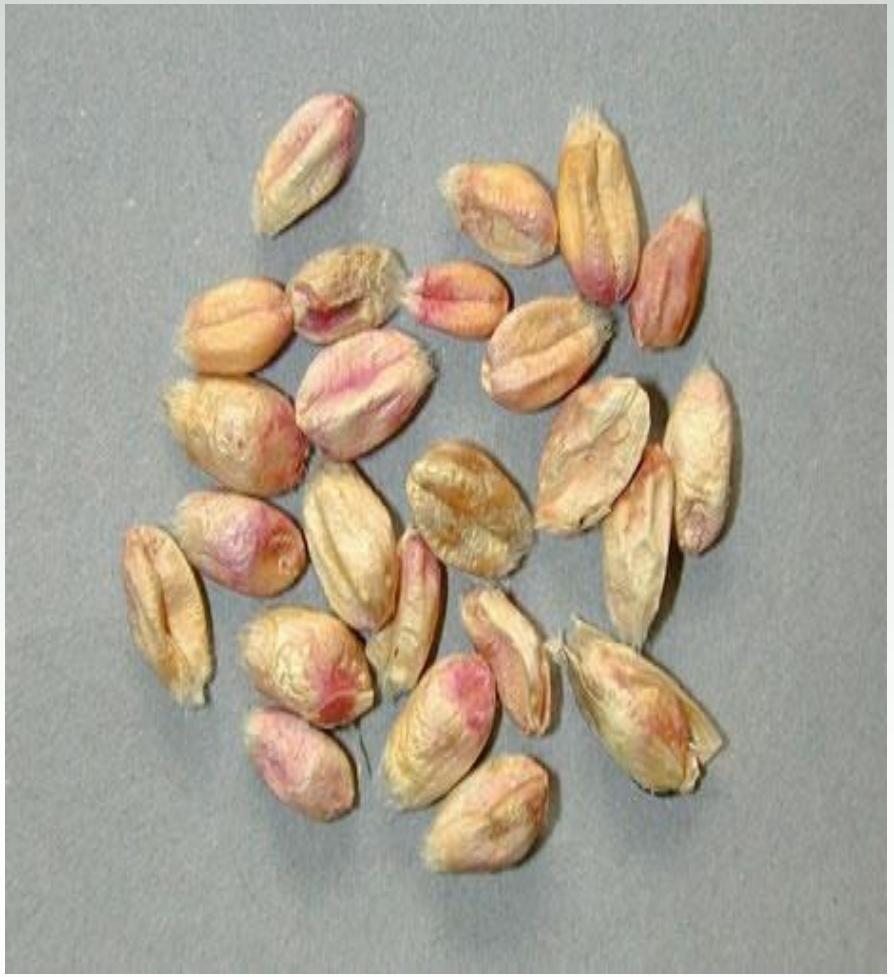
University of Missouri

- ID Weed Application
- Dichotomous key
- Imagine library

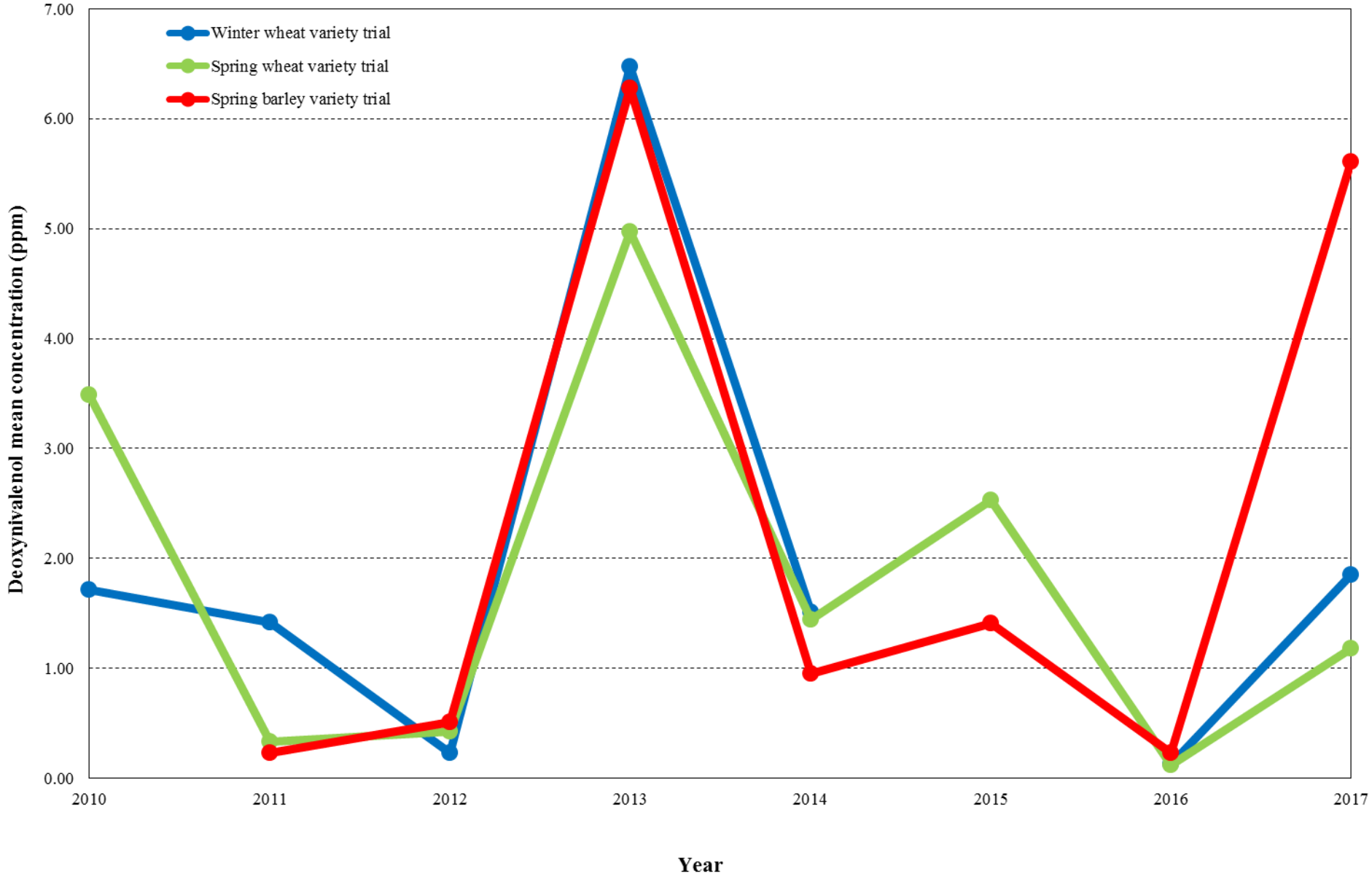


Fusarium crown rot/root rot/head blight

Kernels-shriveled with white chalky appearance and pinkish



2010-2017 DON Means:



Note: No 2010 spring barley trial & 2015 winter wheat trial

2017 SPRING BARLEY VARIETY TRIAL:

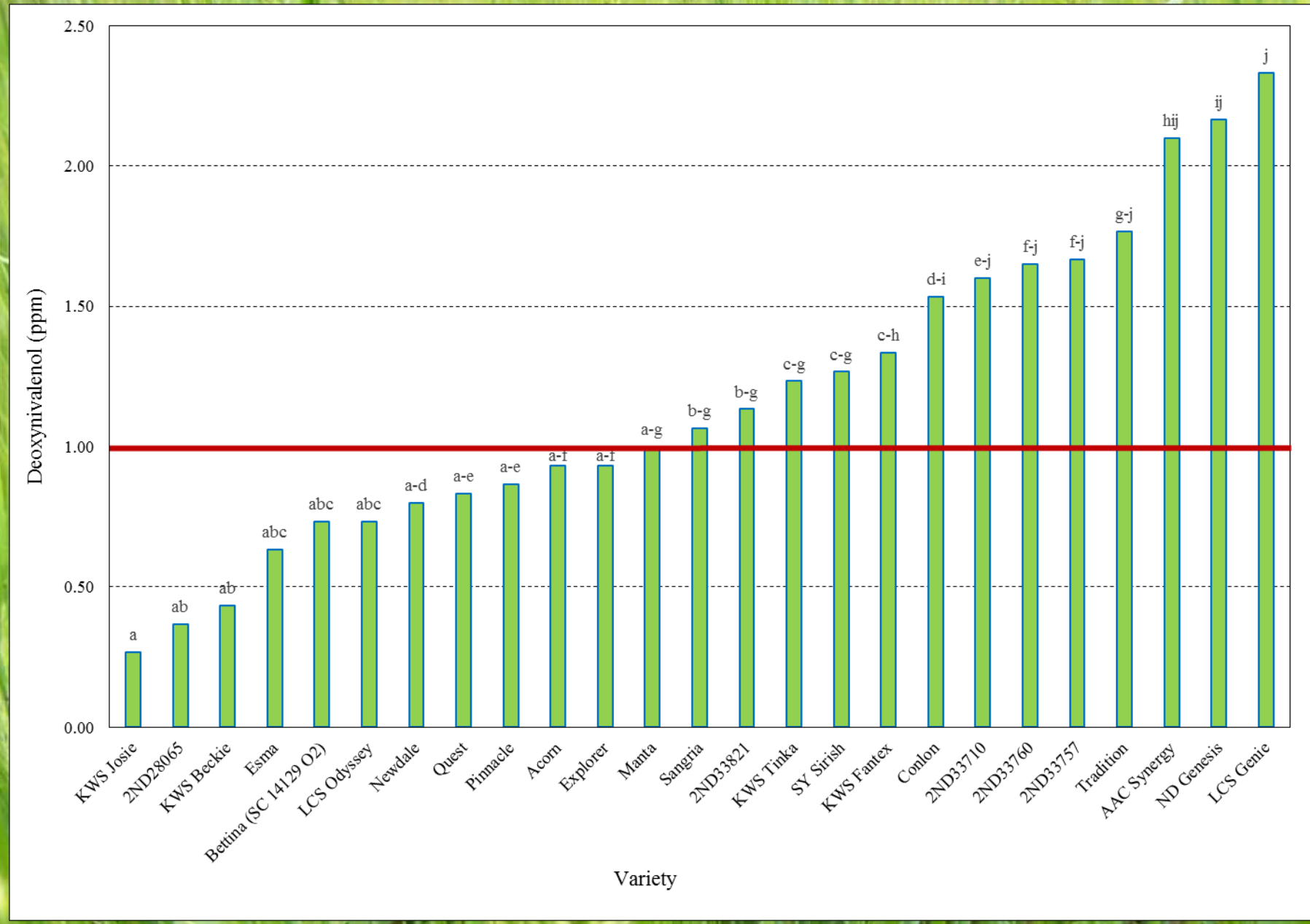


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Figure 1. Stages of wheat at or near flowering.

Figure 2. Stages of barley at or near spike emergences.

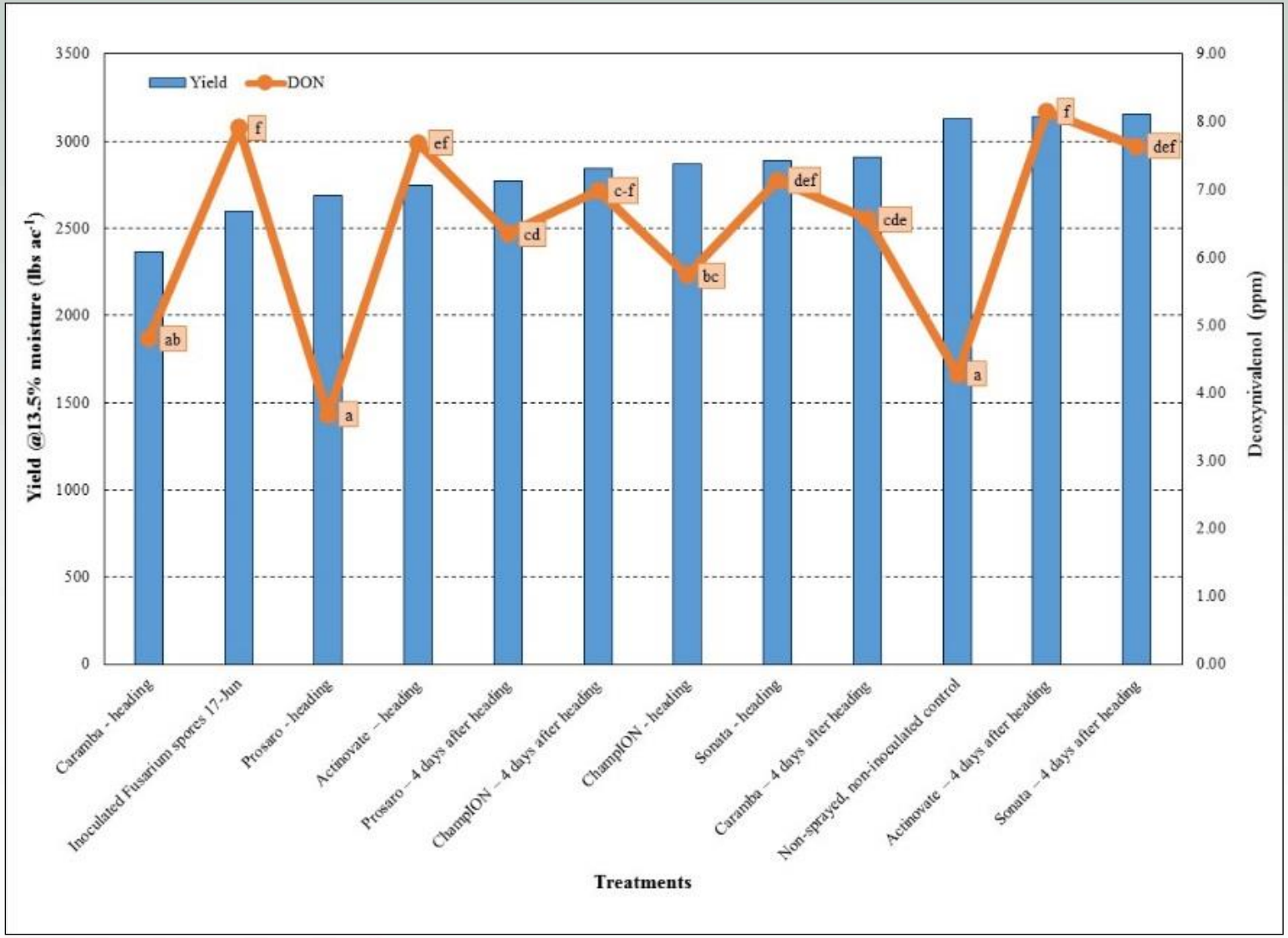
Spring Barley

News Feed Economist expects slightly higher grain prices, input costs...

Most Effective Fungicides

Brand	Rate	Timing	Efficacy
Prosaro (Bayer)	6.5 to 8.2 fl oz per acre	Full Head Emergence (Feekes 10.5)	Good
Caramba (BASF)	13.5 to 17 fl oz per acre	Full Head Emergence (Feekes 10.5)	Good
Proline (Bayer)	5 to 5.7 fl oz per acre	Full Head Emergence (Feekes 10.5)	Good
Tebuconazole (Generics)	4.0 fl oz per acre	Full Head Emergence (Feekes 10.5)	Fair

2017 SPRING BARLEY FUNGICIDE:



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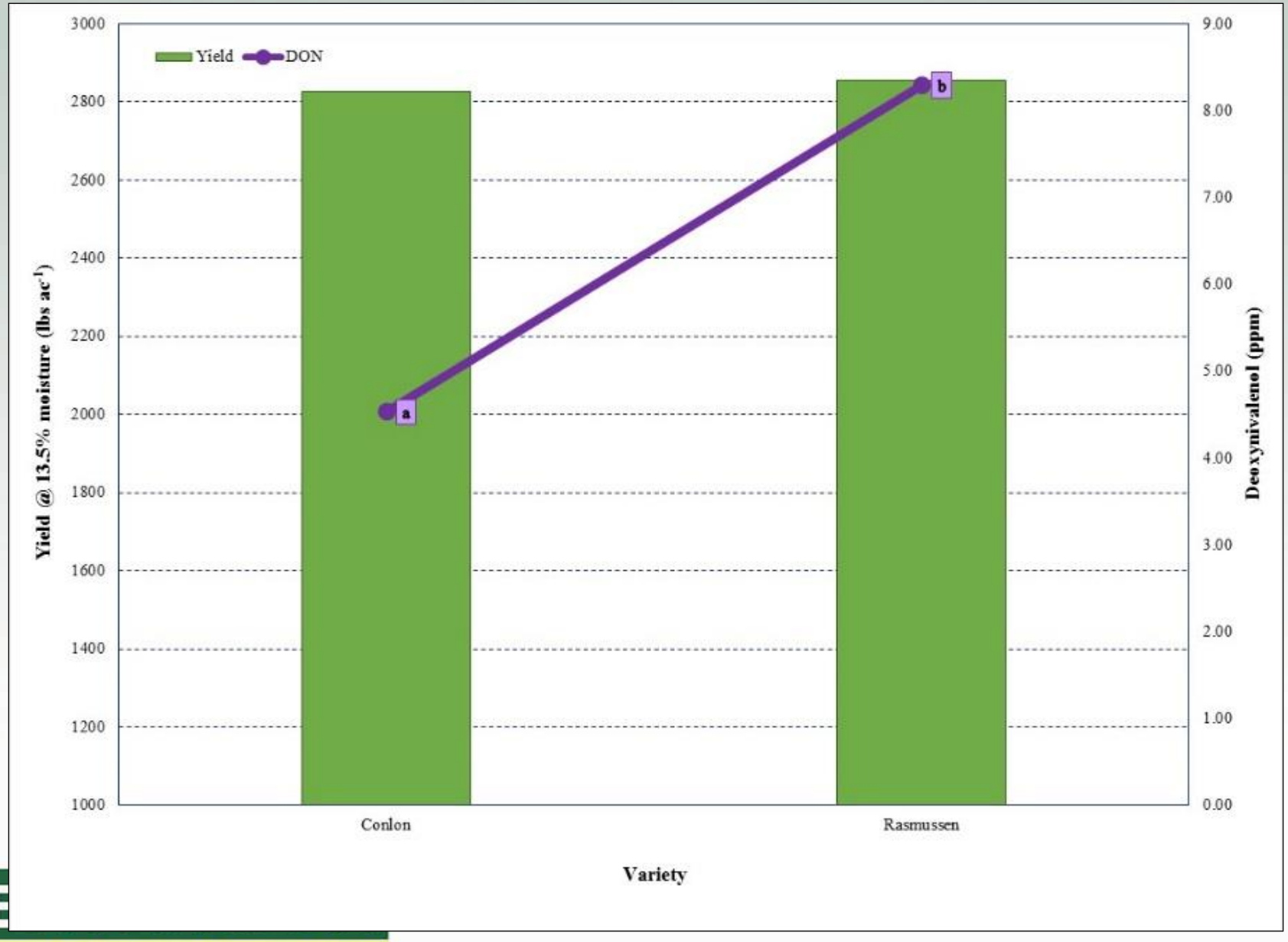
2017 SPRING BARLEY FUNGICIDE: