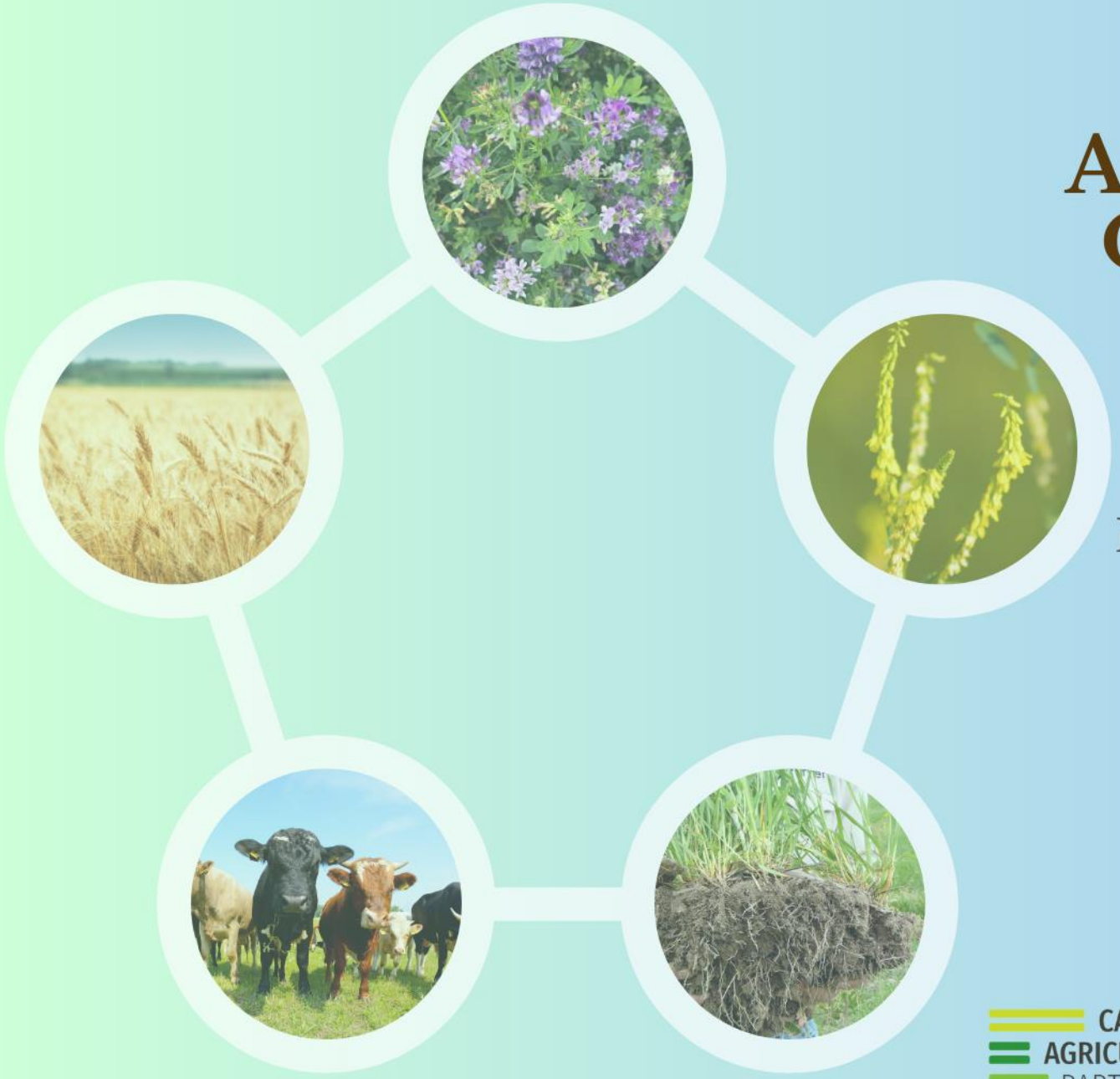


A Systems Approach to Organic Agricultural Production

With Dr. Martin Entz,
Natural Systems Agriculture Lab, U of M

Whole farm planning with crop-livestock integration

CANADIAN AGRICULTURAL PARTNERSHIP
PODF PRAIRIE ORGANIC DEVELOPMENT FUND
Sask Organics Organically Grown in Saskatchewan
Canada

PODF
PRAIRIE ORGANIC DEVELOPMENT FUND

- Investment platform established to develop organic agriculture and marketing in the Canadian Prairies

- Builds resilience in the sector by investing in
  - organic provincial associations (Capacity Fund); and
  - high impact programs (Innovation Fund) related to marketing, research, policy, education and capacity development that have broad public benefit to the organic sector.

www.organicdevelopmentfund.org

Martin Entz, PhD

Professor of Cropping Systems, Natural Systems Agriculture Lab, University of Manitoba

Martin Entz is professor in the University of Manitoba's Plant Science department where he leads the Natural Systems Agriculture lab. He received his PhD from the University of Saskatchewan in 1988 and worked as a farm manager and research agronomist before embarking on his academic career.

"The goal of my program is to discover new ways of farming ecologically; to empower farmers with knowledge to design organic and ecological farming systems adapted to where they live; and to engage students in this exciting process". He leads the Glenlea study – Canada's oldest organic-conventional farming systems comparison study, which is in its 32nd season.

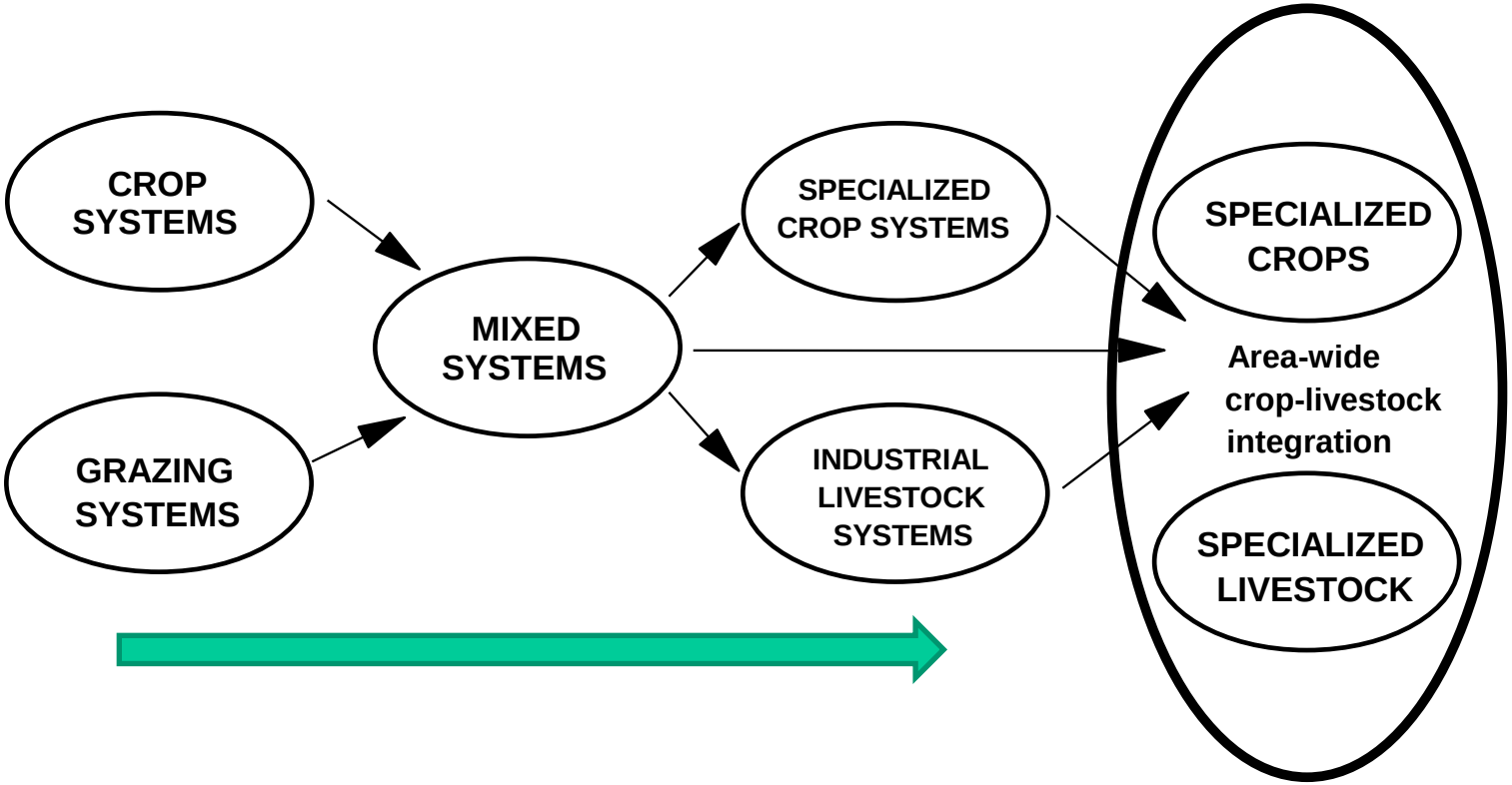
In 2011, Martin started Canada's first farmer participatory wheat and oat breeding program focussed on organic production. "Farmer involvement is an important part of my research program."

Martin teaches courses in crop production and often hosts field-based "Summer Institutes" on sustainable agriculture.

Martin has led agricultural projects in Central America and Zimbabwe, and his lab is currently engaged in "Nature-positive agriculture" in East Africa.

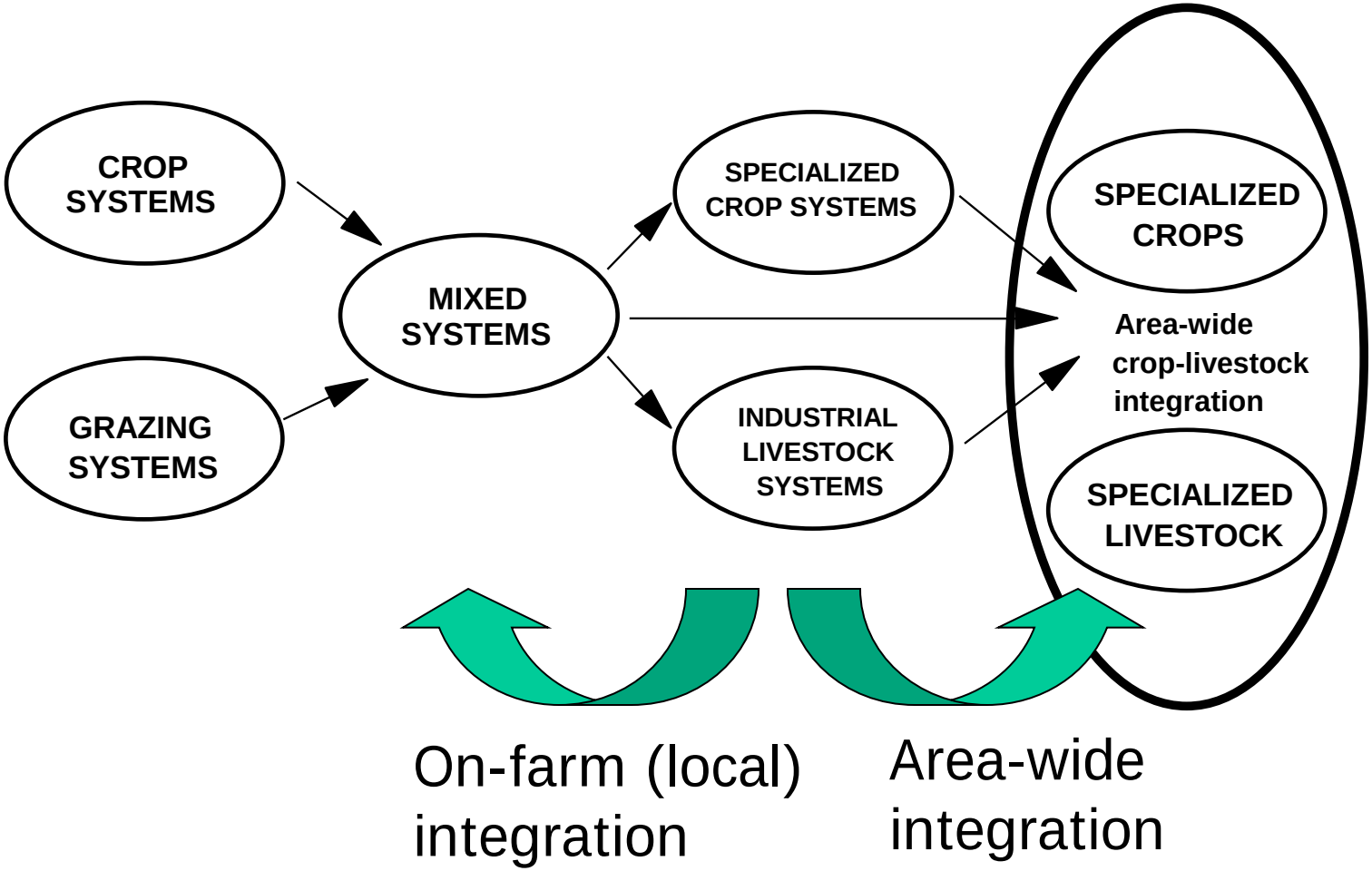
Lesson 6. Crop-livestock integration

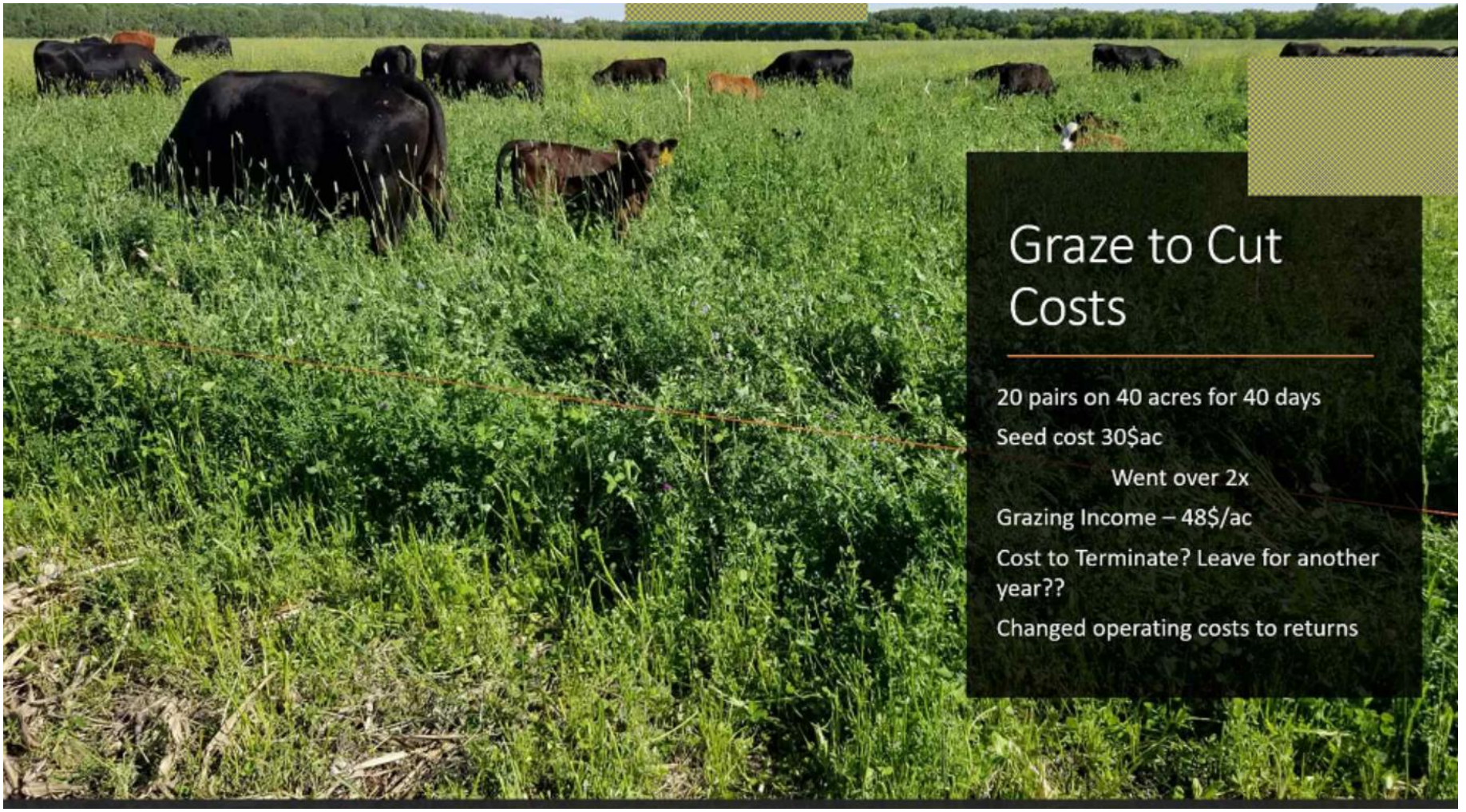
Evolution of crop-livestock integration




Specialized livestock production
Specialized grain farming

Evolution of crop-livestock integration



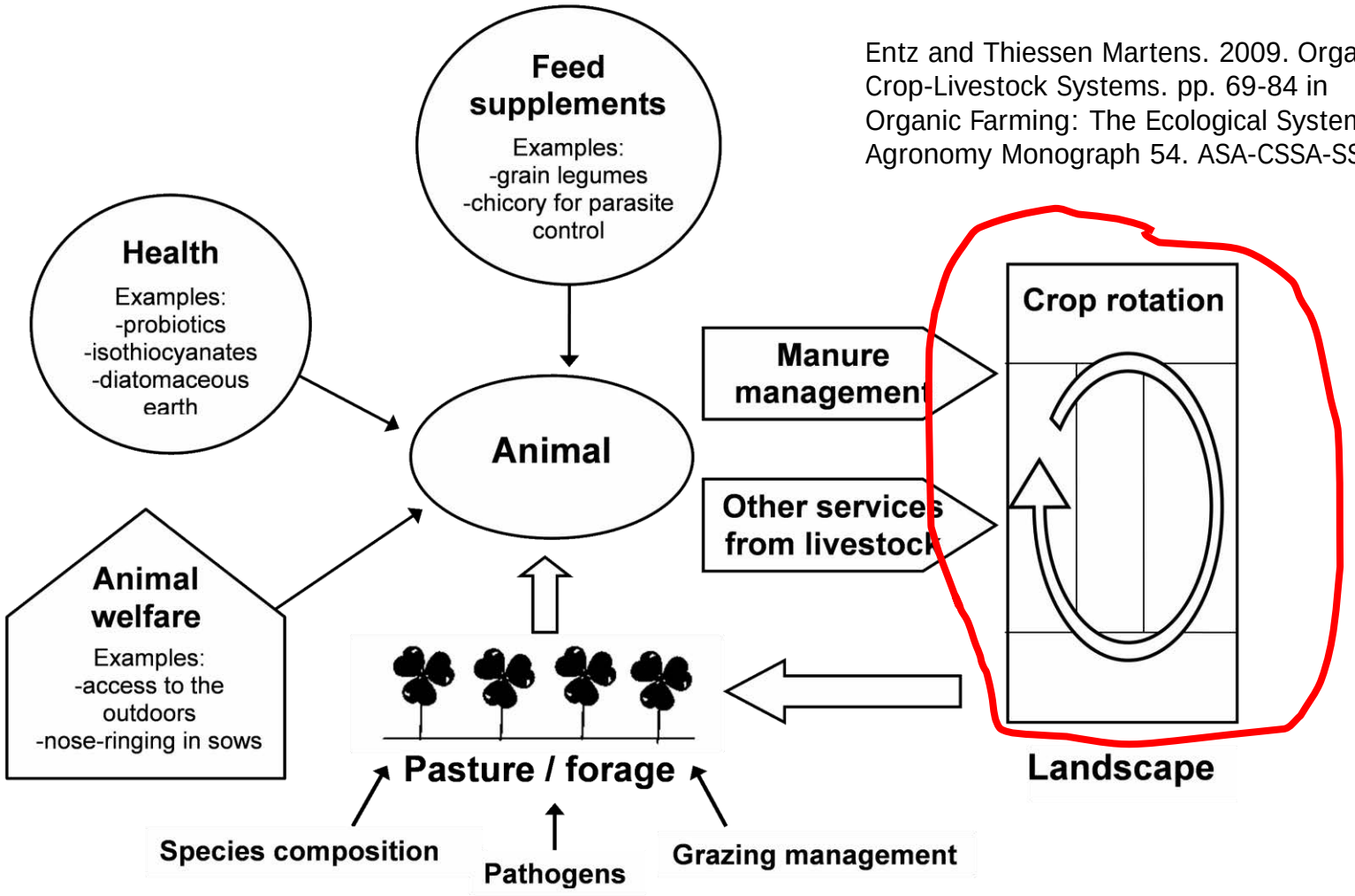


Thanks to Scott Beaton for slides

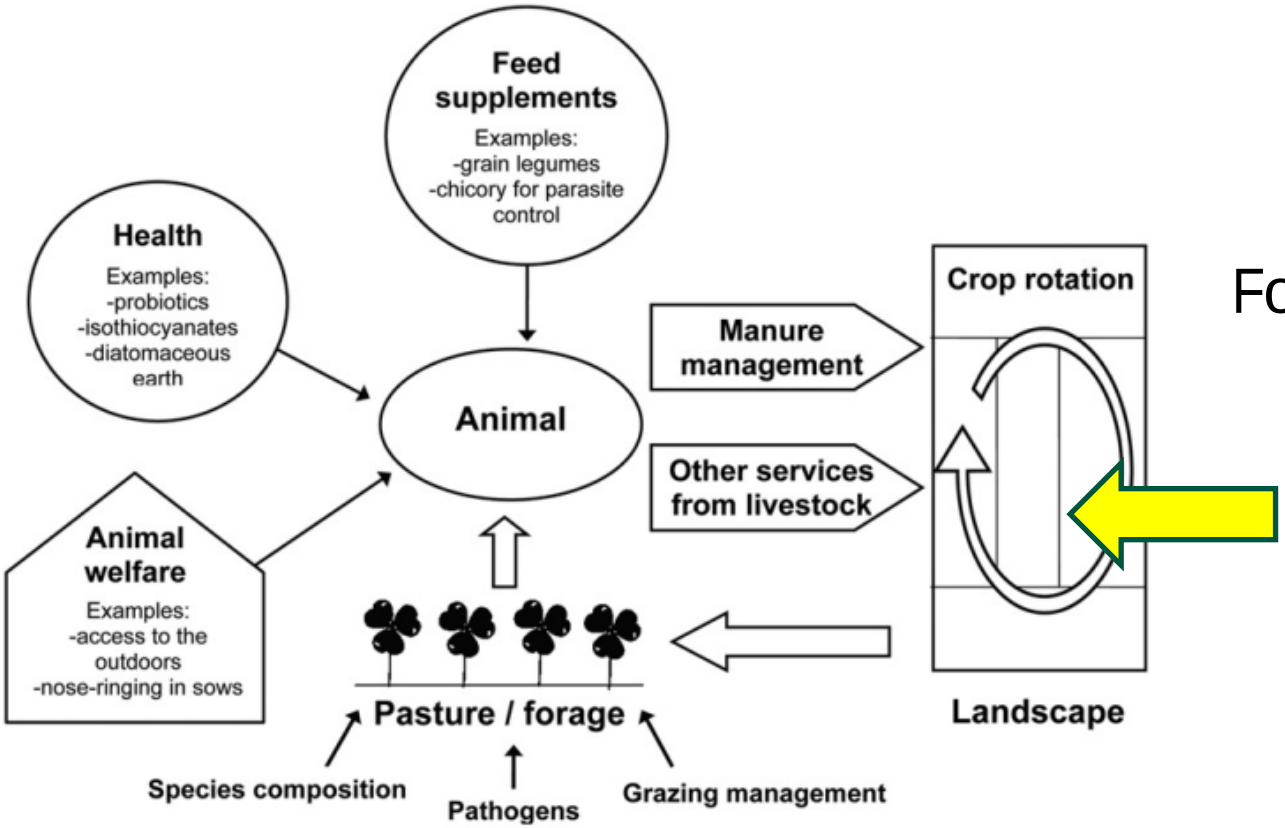
Recent Projects

- Waterline Install Summer 2020
- Solar Project Winter 19/20

Major Components of Organic Crop-Livestock Systems…



Entz and Thiessen Martens. 2009. Organic Crop-Livestock Systems. pp. 69-84 in Organic Farming: The Ecological System. Agronomy Monograph 54. ASA-CSSA-SSSA.

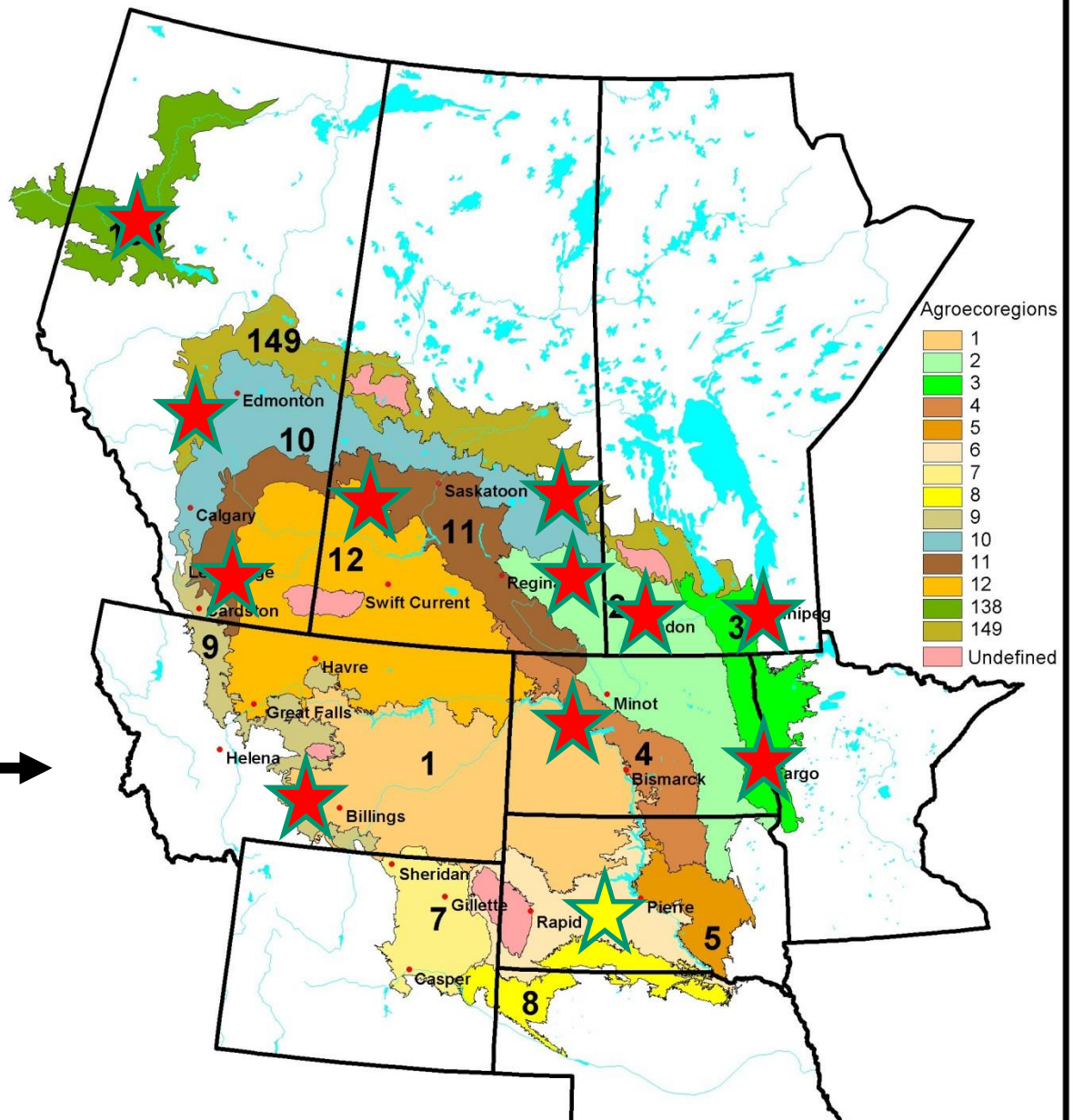


Forage legumes in

Agronomic benefits of perennial hay phases in grain-based cropping systems

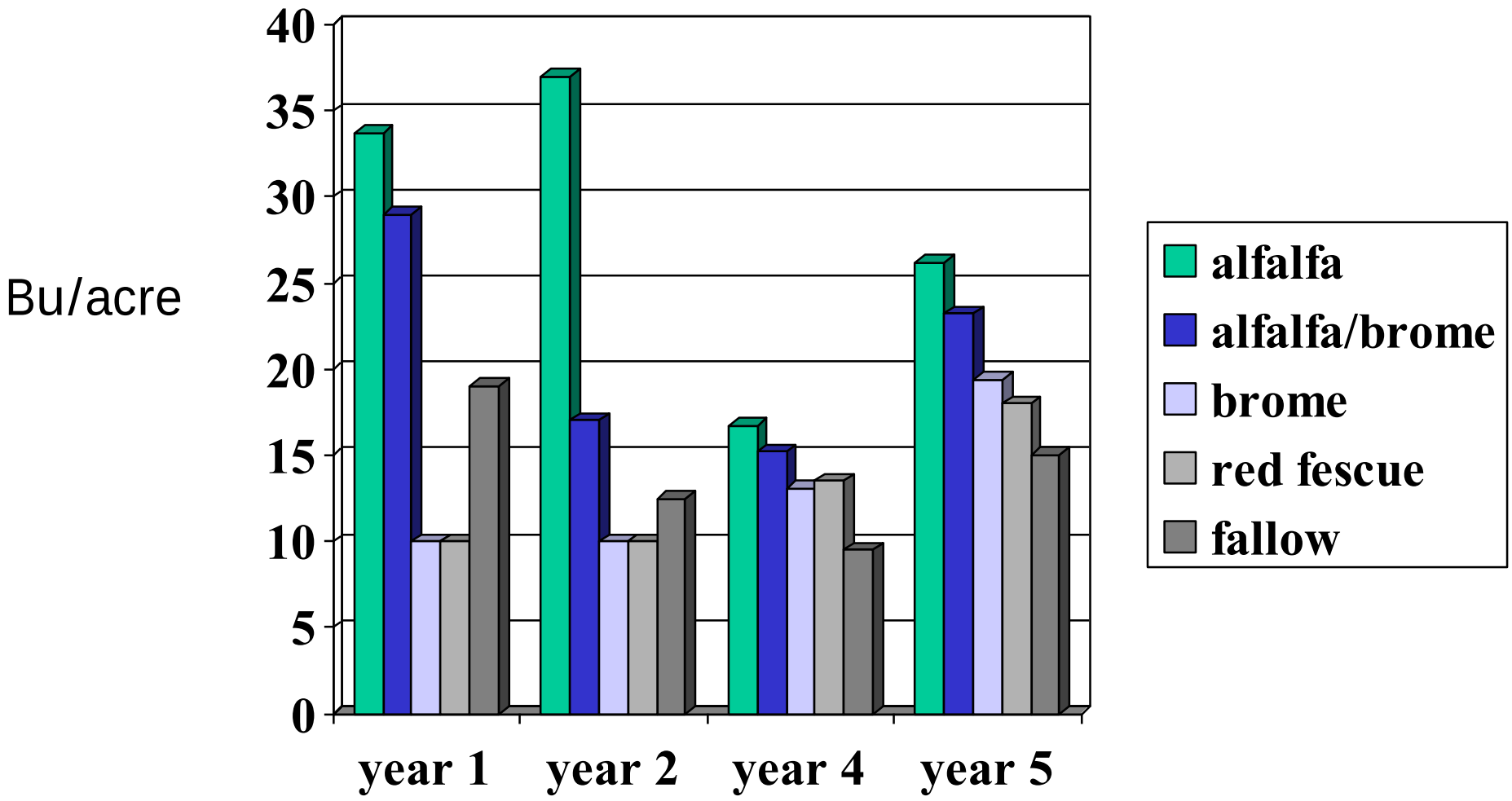
Canada →

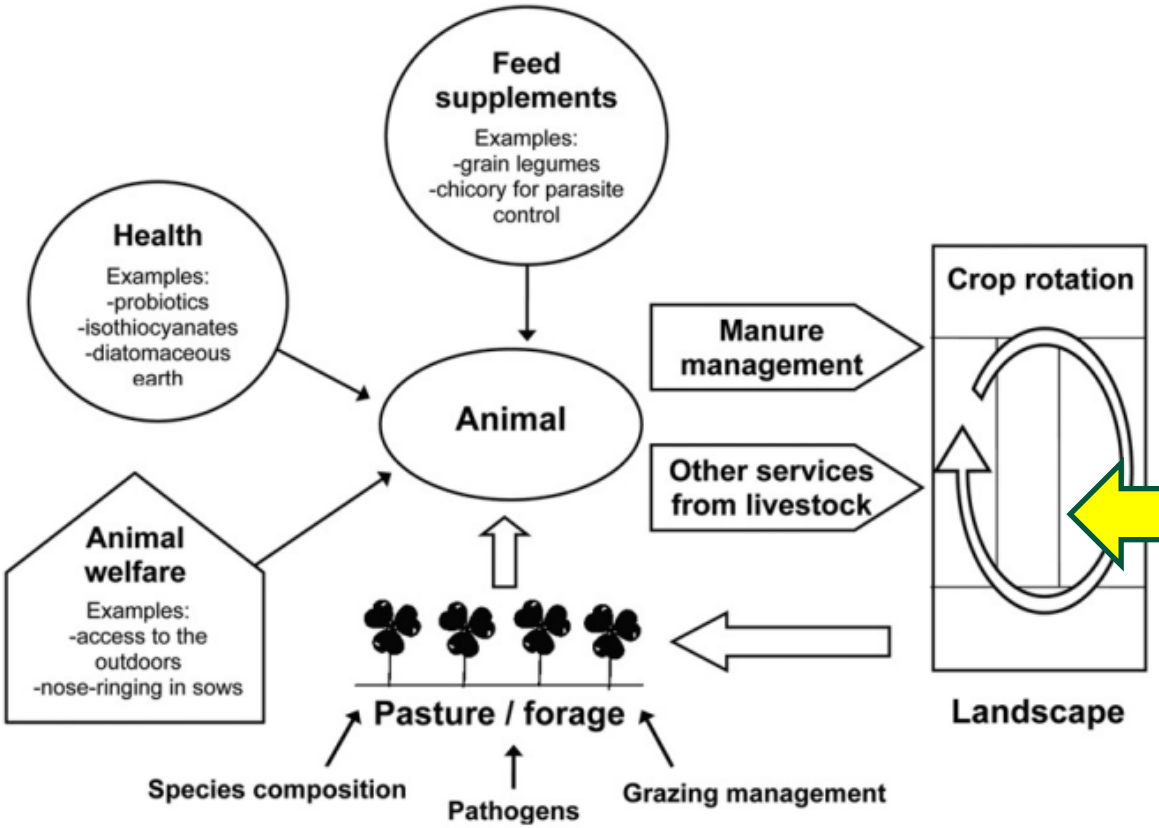
USA →



Yields of wheat grown successively after fallow-wheat or forages Gray Luvisol soil, McLennan, Alberta

Agriculture and Agri-Food Canada | Agriculture et Agroalimentaire Canada

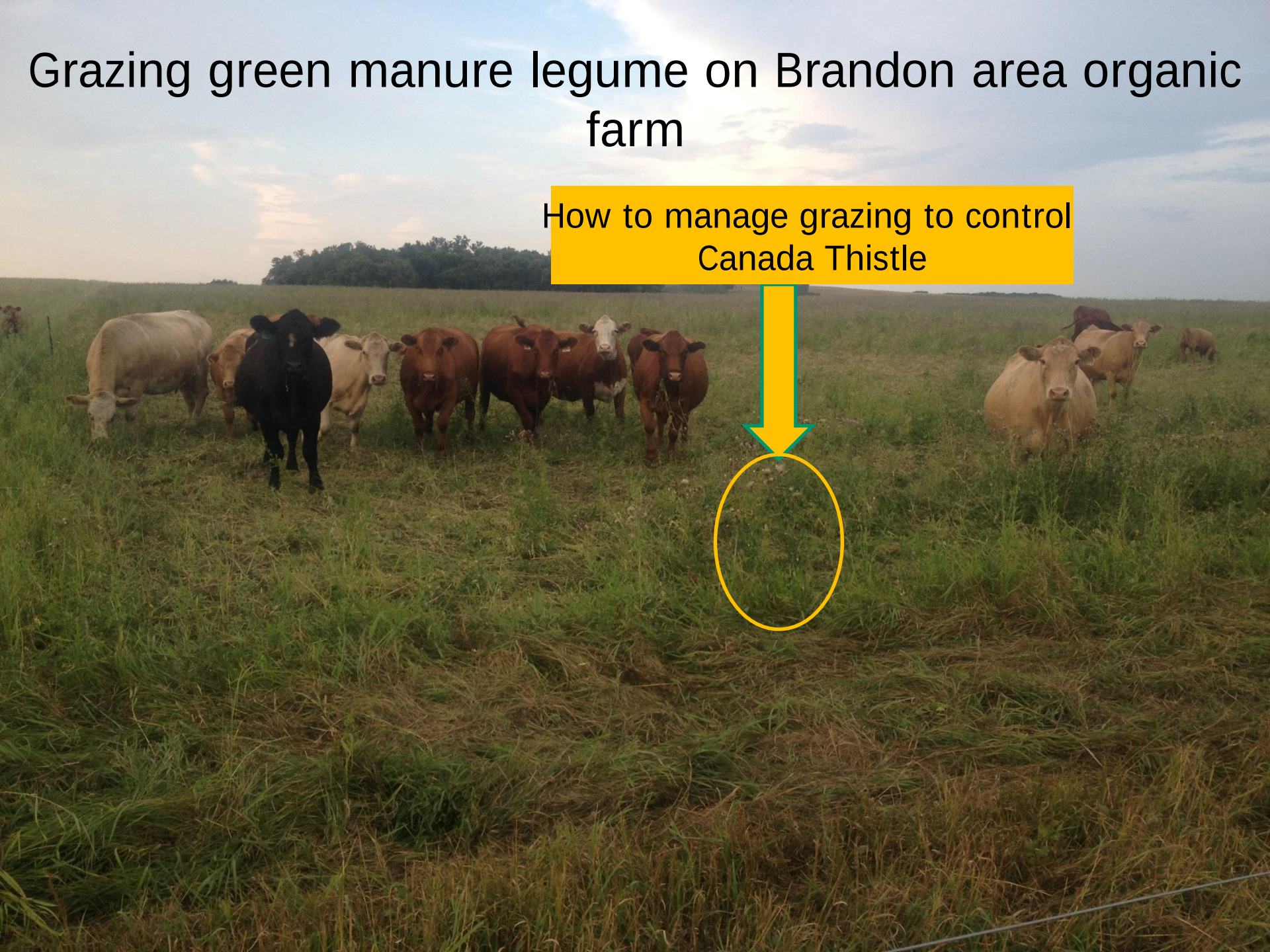


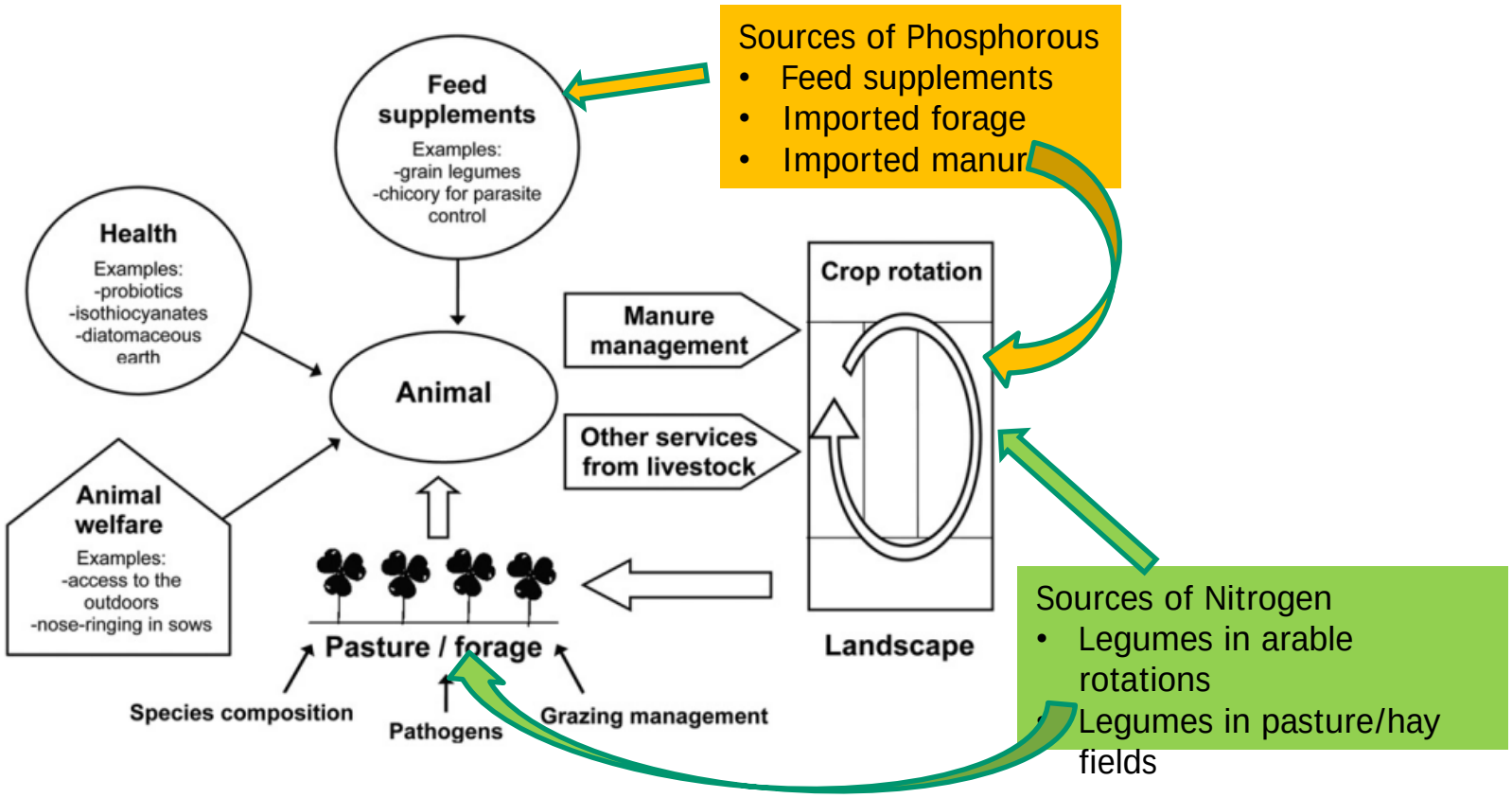


Connecting crops and livestock grazing green manure and cover crops

Grazing green manure legume on Brandon area organic farm

How to manage grazing to control Canada Thistle




Sources of Phosphorous
• Feed supplements
• Imported forage
• Imported manur
Feed supplements
Examples:
-grain legumes
-chicory for parasite control
Health
Examples:
-probiotics
-isothiocyanates
-diatomaceous earth
Animal
Animal welfare
Examples:
-access to the outdoors
-nose-ringing in sows
Manure management
Other services from livestock
Crop rotation
Landscape
Pasture / forage
Species composition
Pathogens
Grazing management
Sources of Nitrogen
• Legumes in arable rotations
• Legumes in pasture/hay fields

Soil test to establish nutrient content

Crop rotation

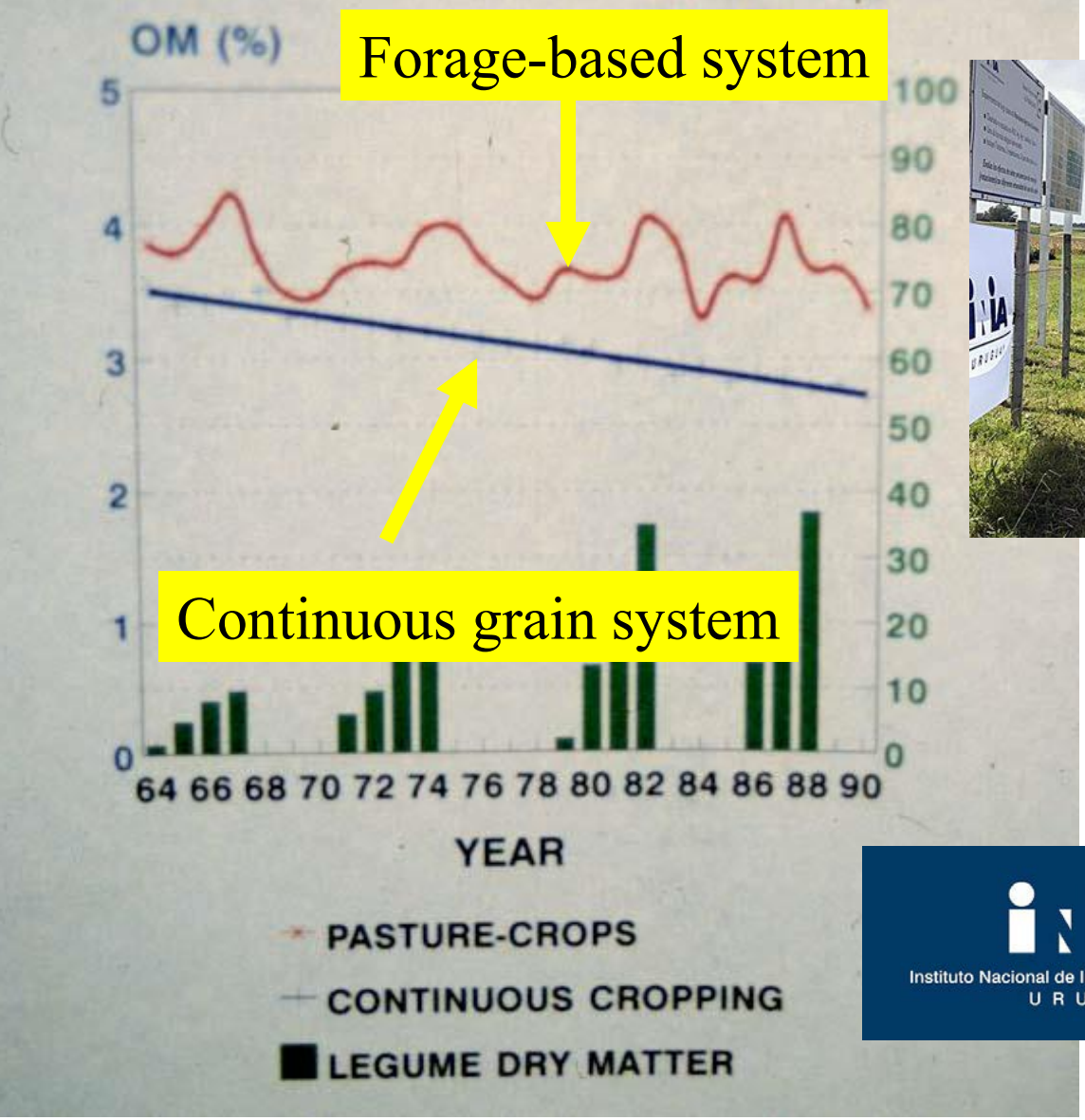
Analyze manure nutrient content

Nutrient content in feed dictates nutrient content in manure

Analyze plant nutrient content

Forages And The Soil

Figure 1. Change in OM and Dry matter (DM) from 1964 to 1990



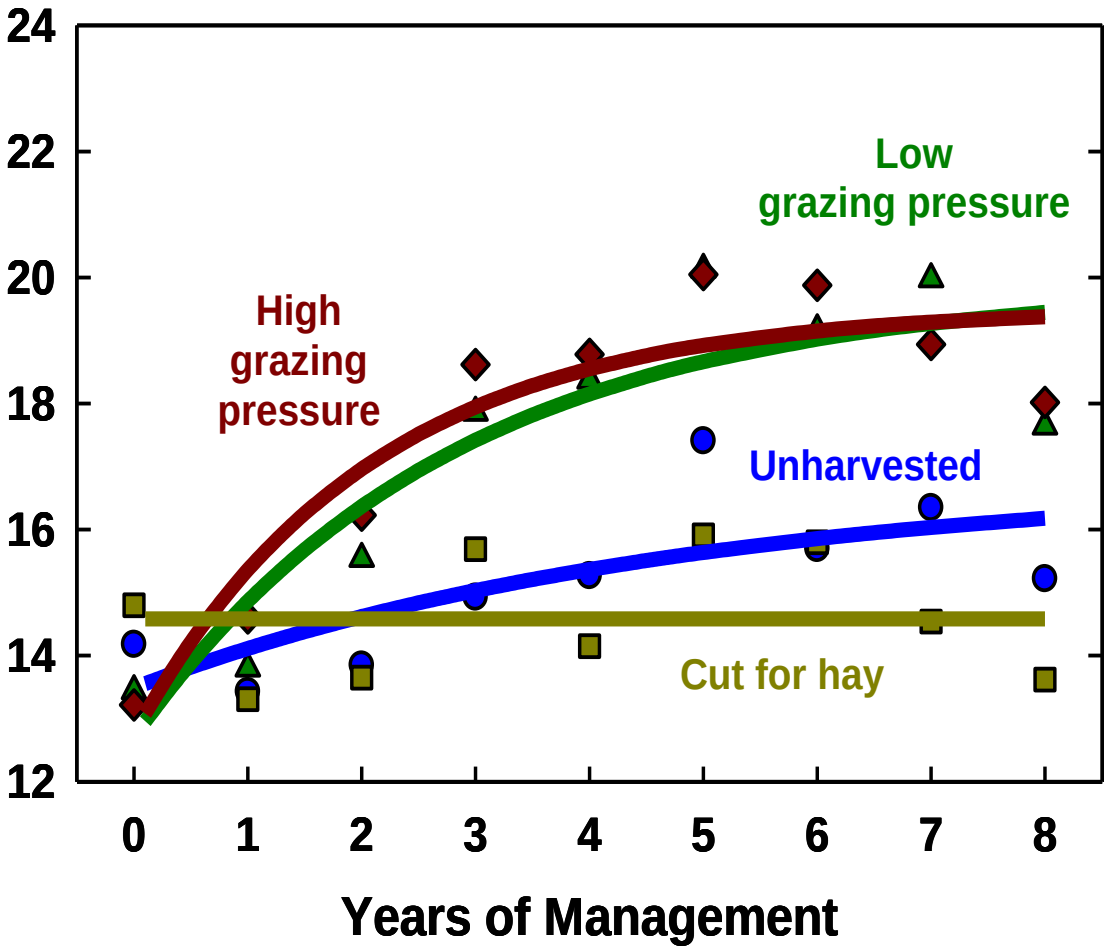
INIA
Instituto Nacional de Investigación Agropecuaria
URUGUAY

Soil Carbon Sequestration

Calculation by change with time

Establishment of bermudagrass pasture following long-term cropping in Georgia USA (16 °C, 1250 mm)

Soil Organic Carbon ($Mg \cdot ha^{-1}$)



Soil C sequestration ($Mg\ ha^{-1}\ yr^{-1}$) (0-5 yr):

Hayed	0.30
Unharvested	0.65
Grazed	1.40

Franzluebbers et al. (2001) Soil Sci. Soc. Am. J. 65:834-841 and unpublished data

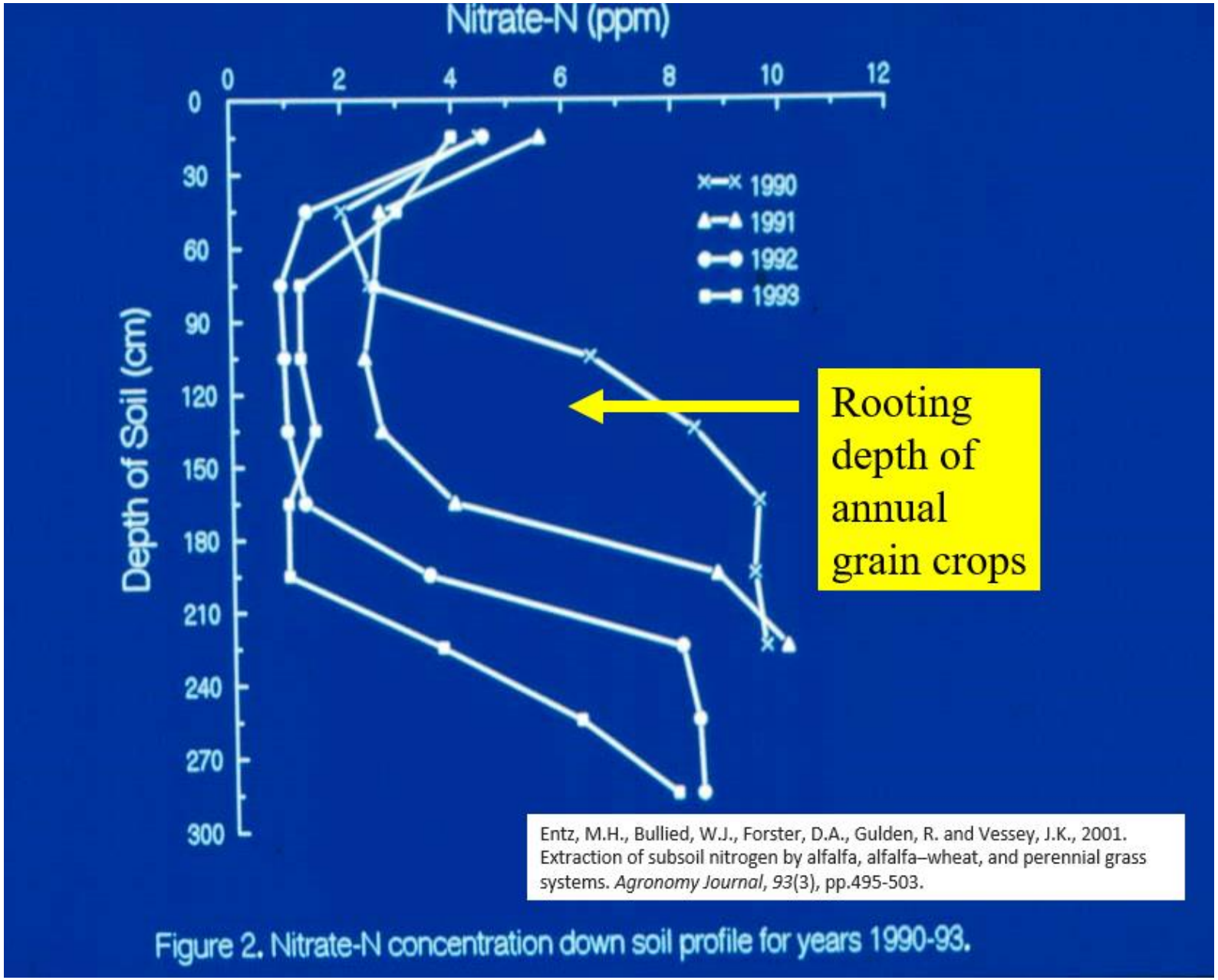


Figure 2. Nitrate-N concentration down soil profile for years 1990-93.

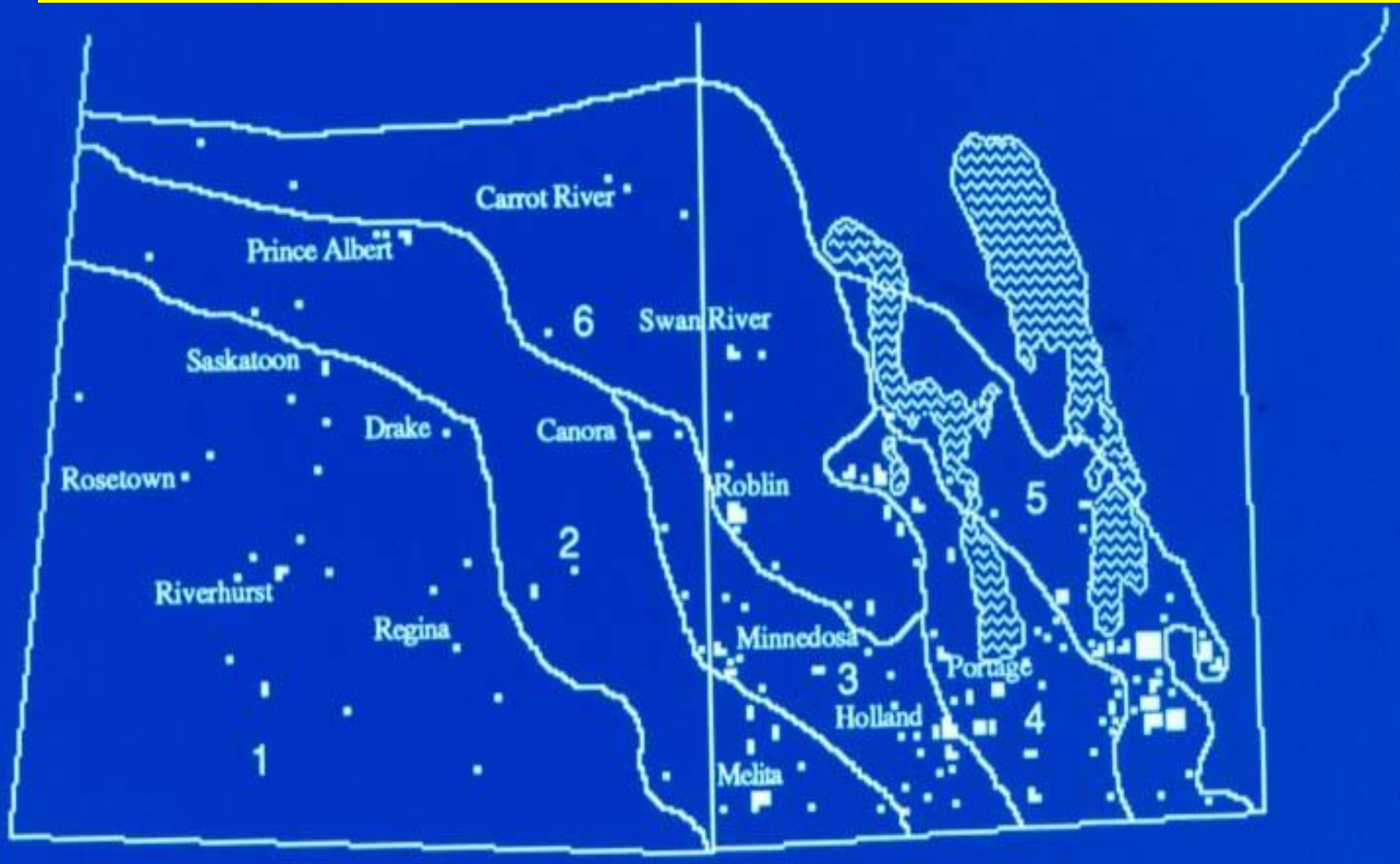

Forages and wet soil conditions

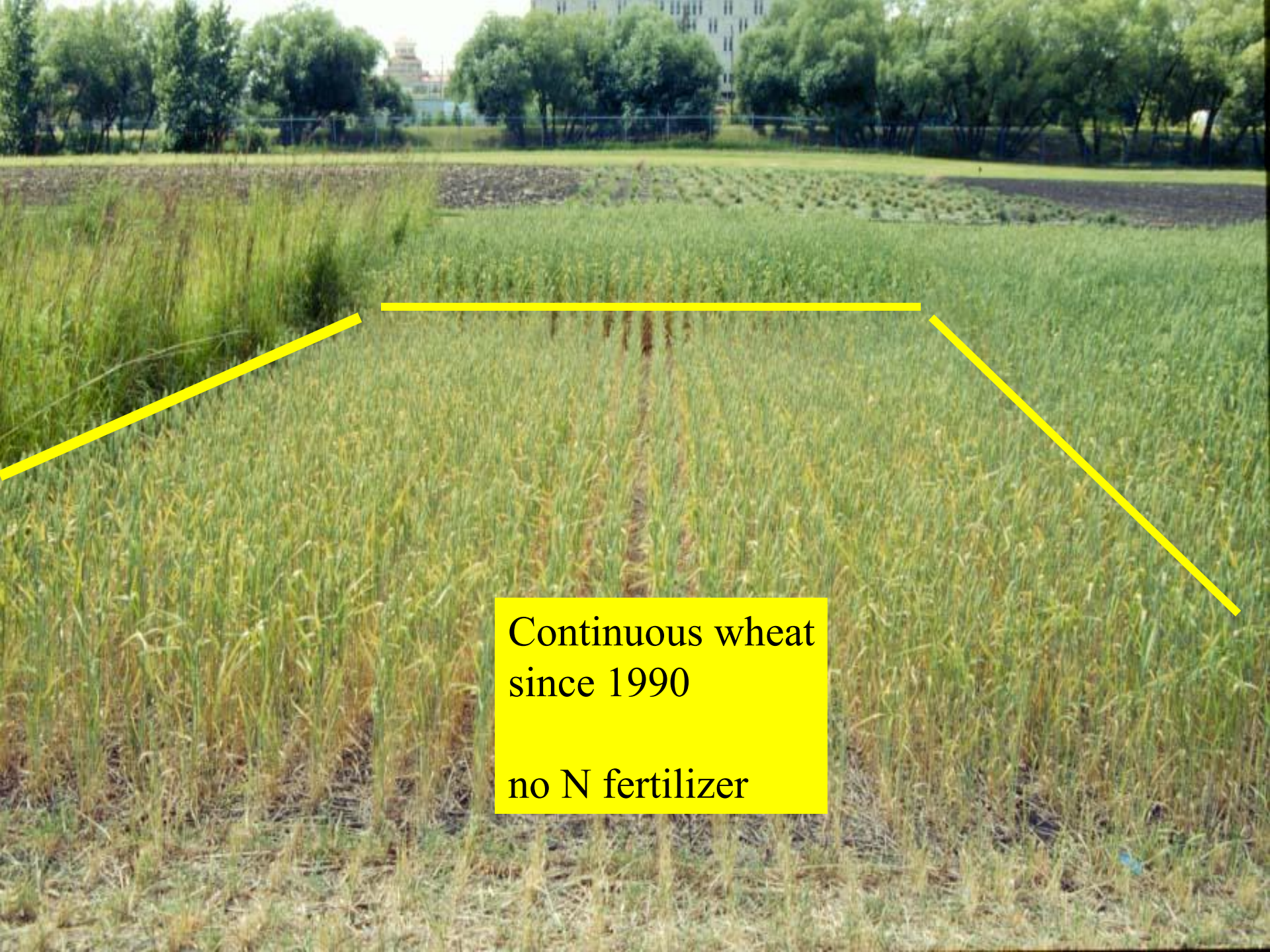

FORAGE VARIETY
PLOT
(SALINE SITE)
CO-OPERATOR: KEN WALL,
NEVILLE

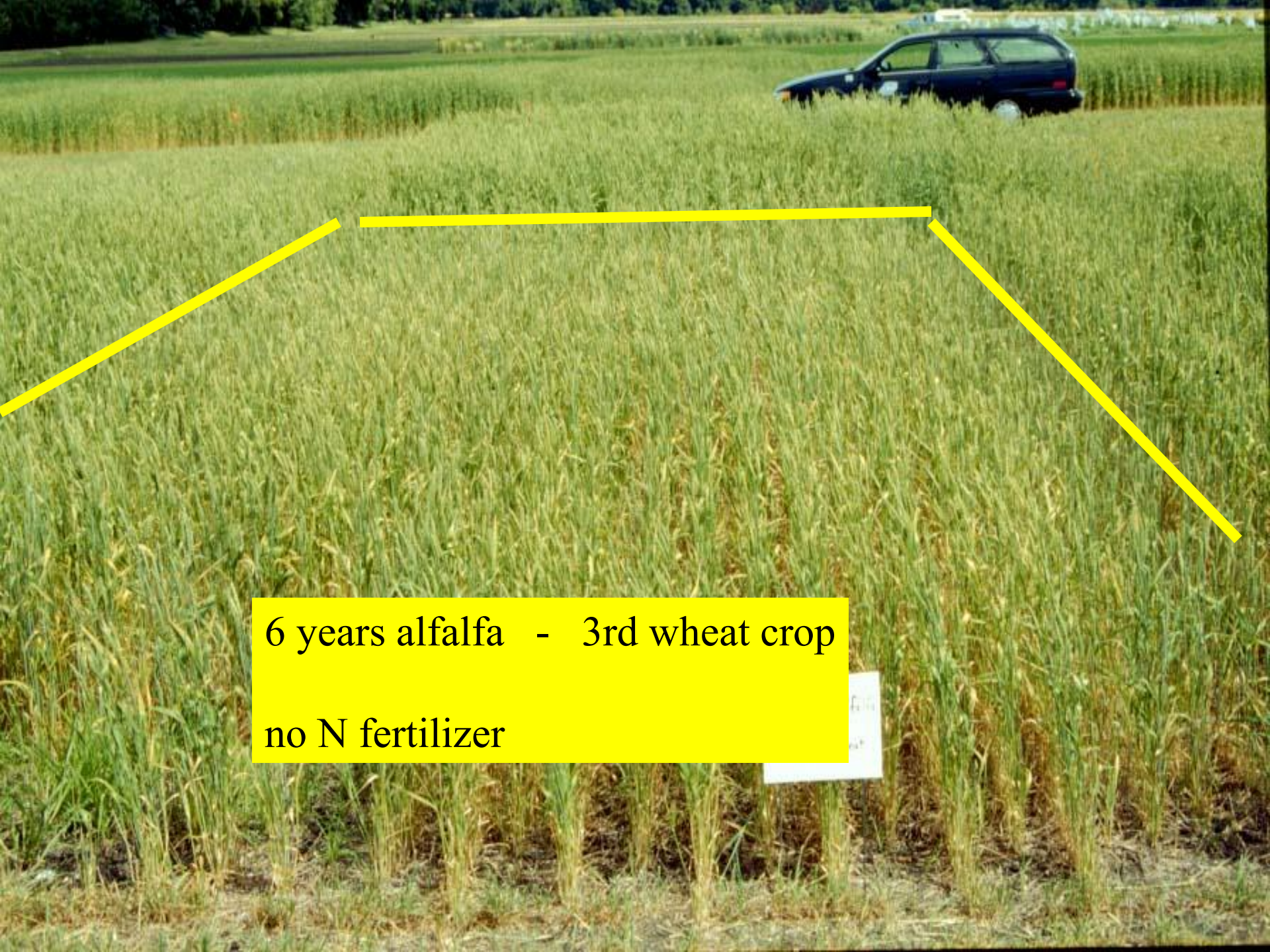

"fix" saline patches with forages

Forages And Crop Yield

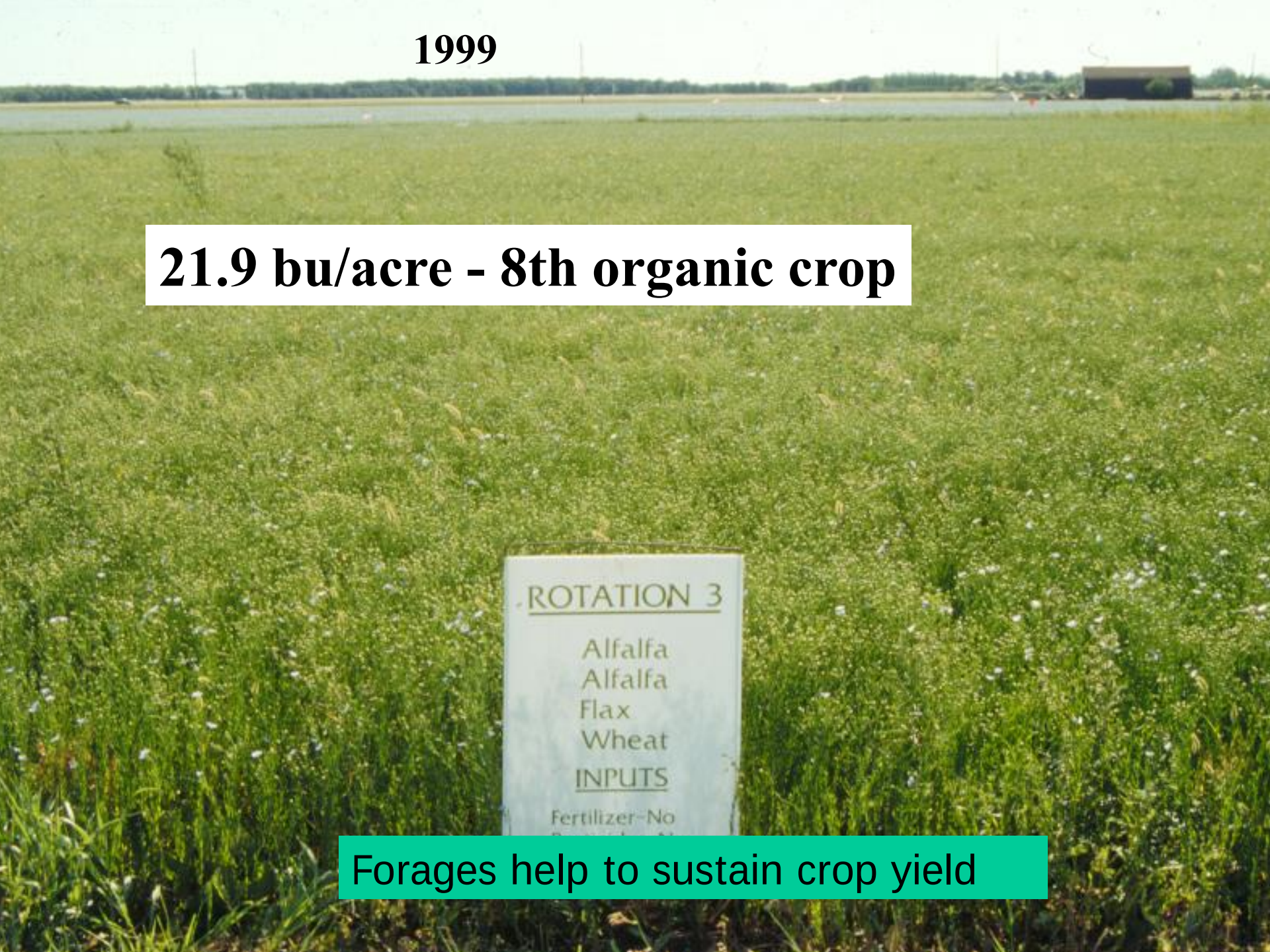
1992 Forage Survey - 67% said yield benefit after forages




Continuous wheat
since 1990
no N fertilizer

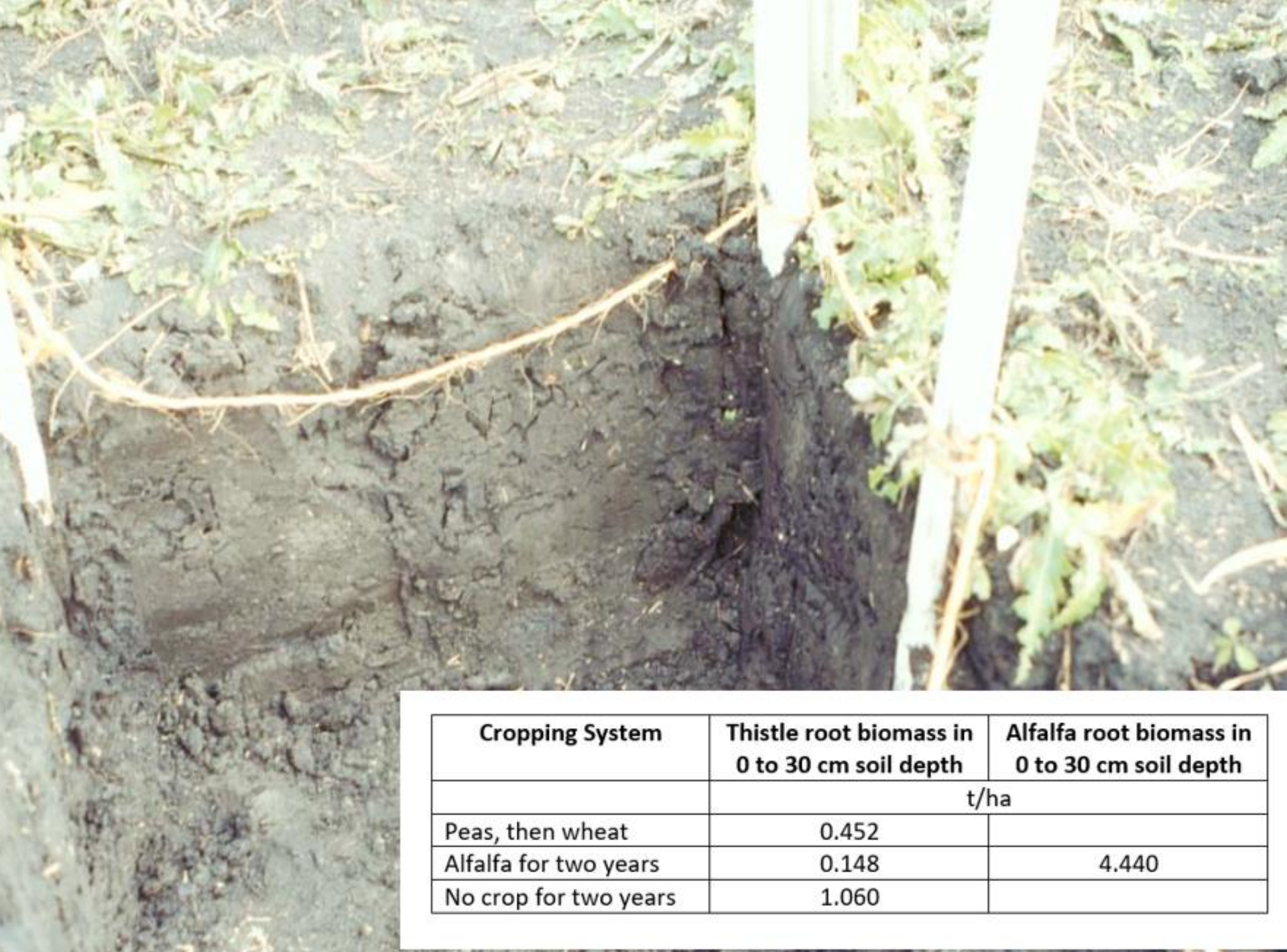

6 years alfalfa - 3rd wheat crop
no N fertilizer


1999
21.9 bu/acre - +pesticide
+fertilizer
ROTATION 1
Wheat
Pea
Wheat
Flax
INPUTS


1999
21.9 bu/acre - 8th organic crop
ROTATION 3
Alfalfa
Alfalfa
Flax
Wheat
INPUTS
Fertilizer-No
Forages help to sustain crop yield

Forages and weeds

Thistle in alfalfa spindly and investing energy into growing taller – to capture light



Cropping System	Thistle root biomass in 0 to 30 cm soil depth	Alfalfa root biomass in 0 to 30 cm soil depth
	t/ha	
Peas, then wheat	0.452	
Alfalfa for two years	0.148	4.440
No crop for two years	1.060	

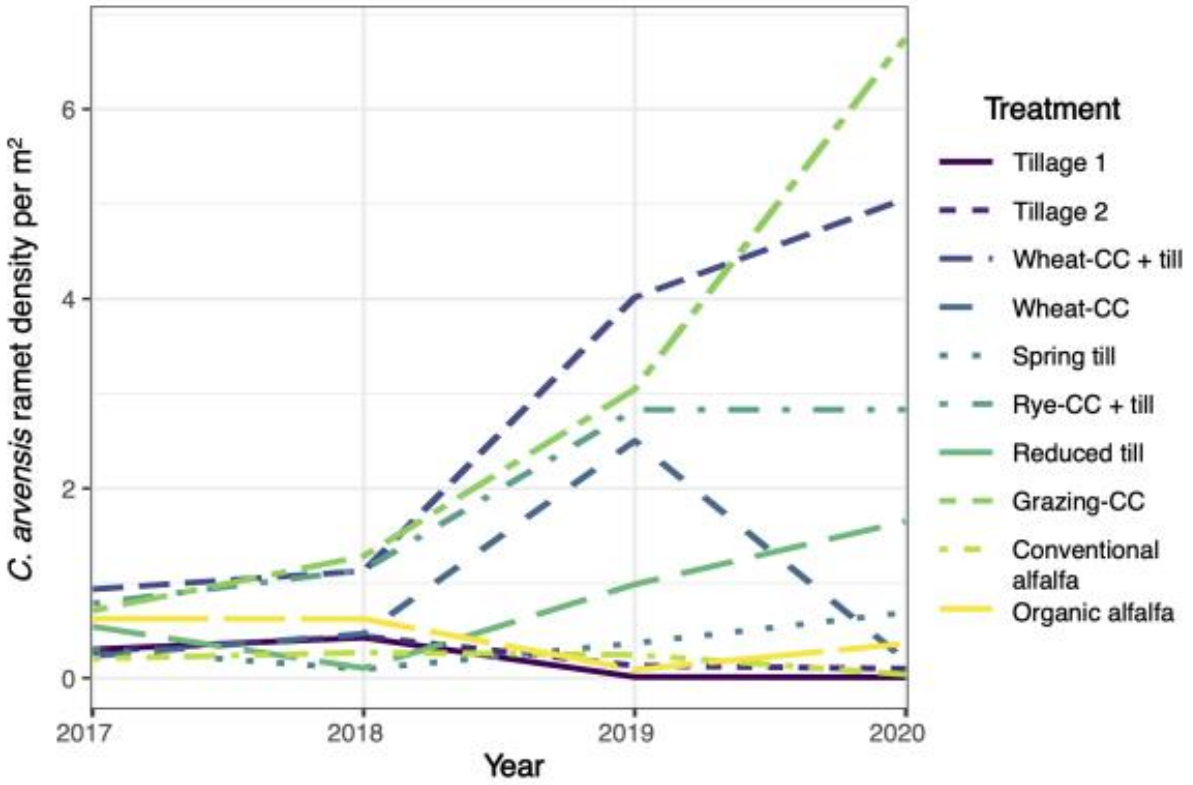
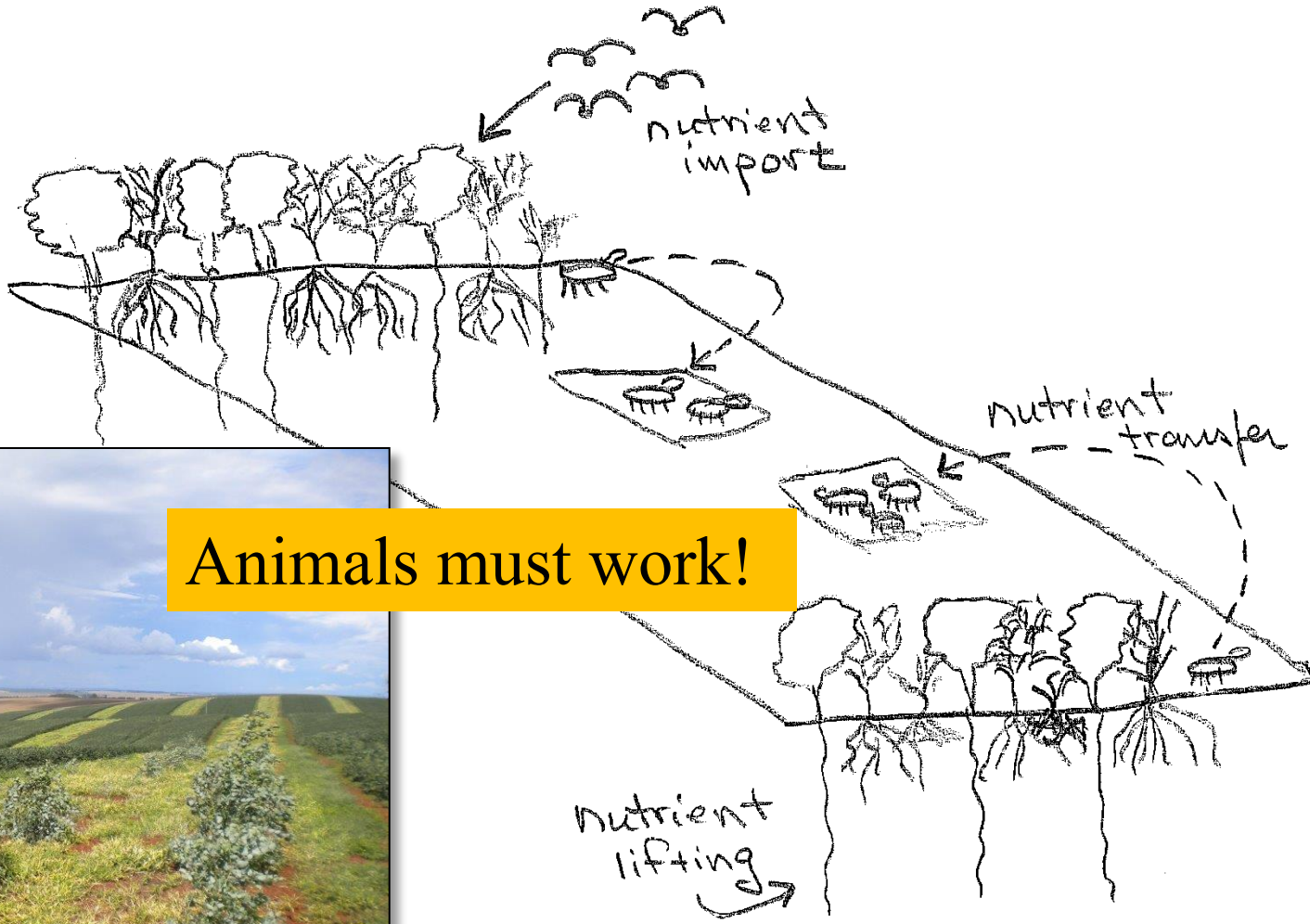


FIGURE 1
Estimated means of ramet density of *Convolvulus arvensis* per m^2 among ten cropping system treatments over a four-year period (2017-2020).

New crop-livestock integration approaches

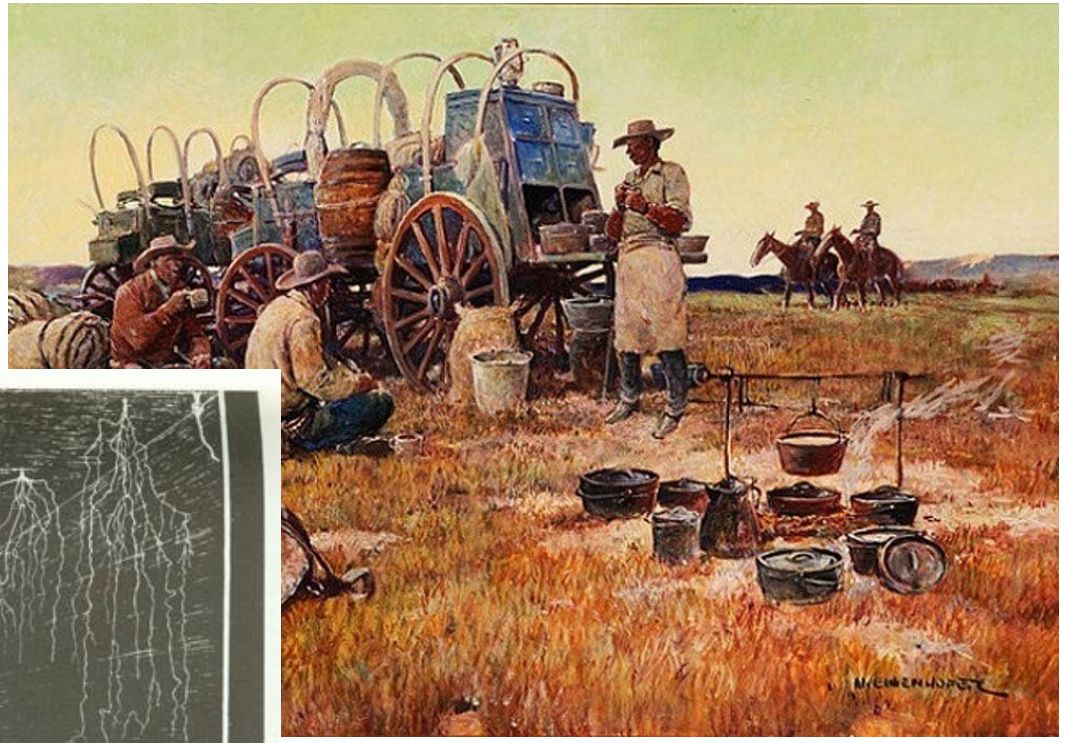


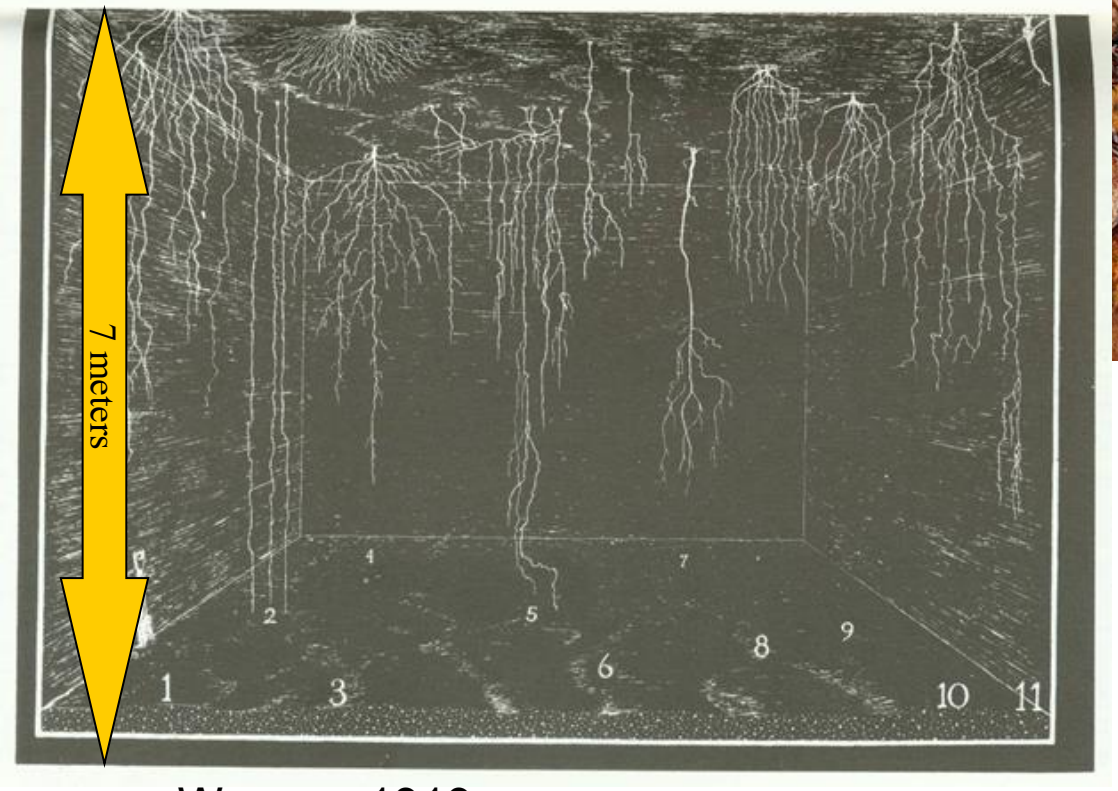
Animals must work!

Integrated Farming System - India

NETFLIX

Season opener: This ole Prairie





Weaver, 1919

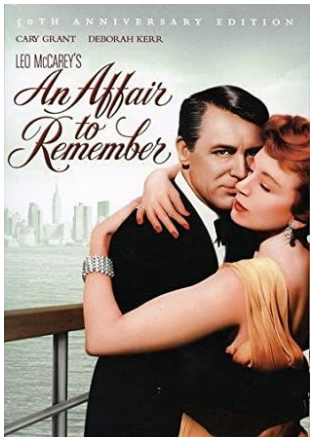
Over 60% of case study beef farms in perennial forage production, greater than the 30% at similar crop-beef operations in Canada (Alemu et al. 2016). 100% in case of dairy farms.

Gentile, R.M., Martino, D.L. and Entz, M.H., 2005. Influence of perennial forages on subsoil organic carbon in a long-term rotation study in Uruguay. *Agriculture, ecosystems & environment*, *105*(1-2), pp.419-423.

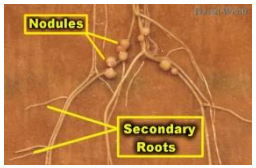
Feeding regime	Omega 6:3 ratio	β-carotene µg/g	Vitamin E µg/g
Grass-fed	1.53	0.45	2.1 to 7.7
Grain-fed	7.65	0.06	0.7 to 2.9

Daley. C.A., et al., 2010. A review of fatty acid profiles and antioxidant content in grass-fed and grain-fed beef. Nutri J. 9: doi:10.1186/1475-2891-9-10

Shift from grains to forage for ruminant production -human and environmental health benefits profound



Episode 2: The atmosphere-rhizobium affair



Got to reduce my organic N costs

Thiessen Martens, J. and Entz, M., 2011. Integrating green manure and grazing systems: A review. *Canadian Journal of Plant Science*, *91*(5), pp.811-824.

Stop checking the internet - We got this!

Cicek, H., Martens, J.R.T., Bamford, K.C. and Entz, M.H., 2014. Effects of grazing two green manure crop types in organic farming systems: N supply and productivity of following grain crops. *Agriculture, ecosystems & environment*, *190*, pp.27-36.

Episode 3: Pigs in space

Sorry, I’m
in my space

Selecting potato genotypes to follow pig pastures, Southern Manitoba

Entz, M.H., Kirk, A.P., Carkner, M., Vaisman, I. and Fox, S.L., 2018. Evaluation of lines from a farmer participatory organic wheat breeding program. *Crop Science*, *58*(6), pp.2433-2443.

Episode 4: Diesel or me?

Hoeppner, J.W., Entz, M.H., McConkey, B.G., Zentner, R.P. and Nagy, C.N., 2006. Energy use and efficiency in two Canadian organic and conventional crop production systems. *Renewable Agriculture and Food Systems*, pp.60-67.

Episode 5: Great bags of fire

Photo credits: Laura Sims

Food waste
↓
Insect Frass

Food waste
↓
Digestate

Of the electricity produced at Lethbridge Biogas, 5-10% is used for the parasitic load of the plant, with the balance feeding directly into the Alberta electrical grid.

Since 2013

Electricity from poop

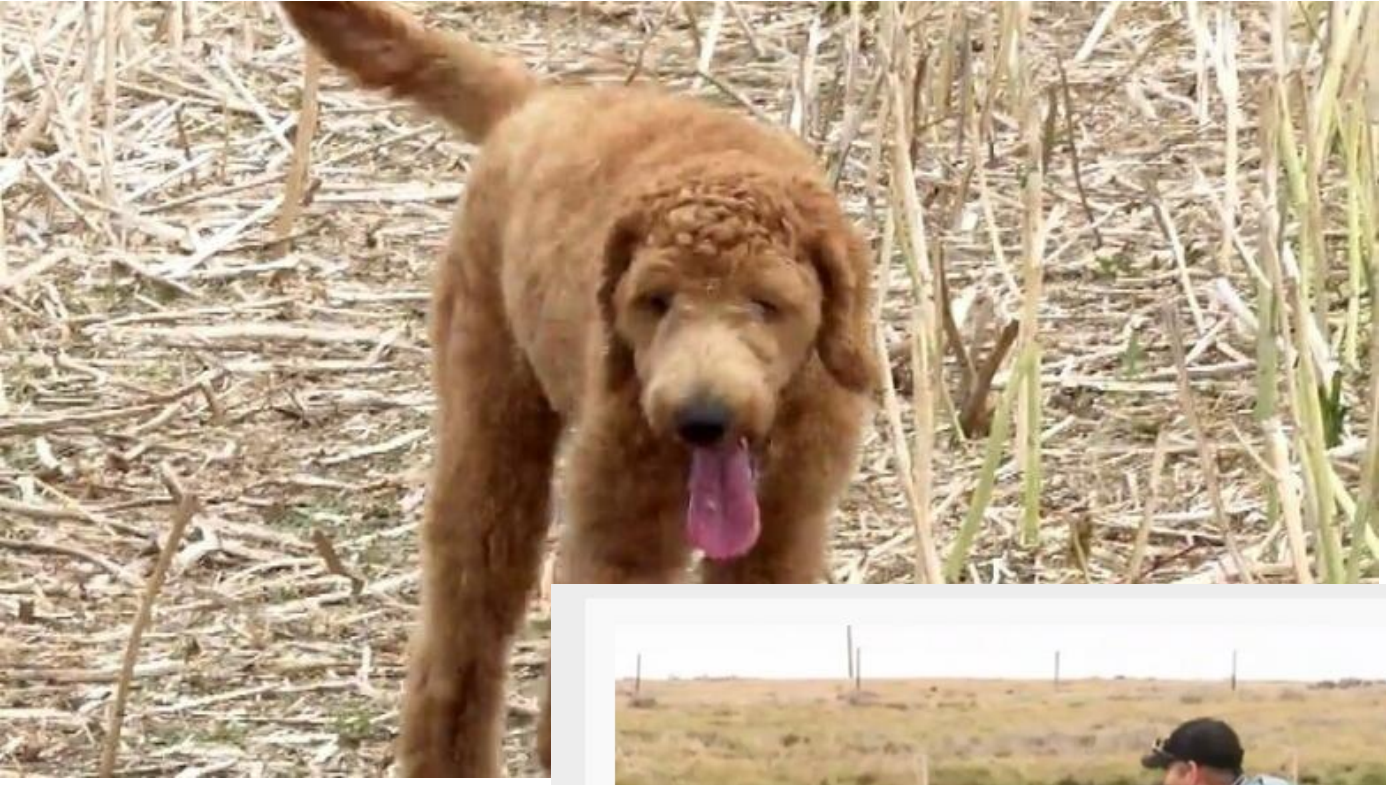
http://www.lethbridgebiogas.ca/wp-content/uploads/2018/08/LETHBRIDGE-BIOGAS-SUCCESS-STORY.pdf

Nicksy, J. 2021. Circular Nutrients for Supplying Phosphorus and Closing Urban to Rural Nutrient Cycles in Organically Managed Cropping Systems, MSc thesis, UM Soil Science.

Episode 6: A dog's (aspirational) life


Anyone up for kicking some mealy bug butt?
You butt!
HONIG
Vineyard & Winery

https://www.honigwine.com/Honig-Story/Sniffer-Dogs



https://www.theguardian.com/technology/2018/nov/04/five-diseases-that-dogs-can-detect

This German shepherd was one of the two dogs brought to Alberta for field trials. (Rural Roots Canada video report- YouTube)

Dedicated to all who do agriculture…

Thanks for your attention!!

University of Manitoba

PODF
PRAIRIE ORGANIC DEVELOPMENT FUND

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- Builds resilience in the sector by investing in
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www.organicdevelopmentfund.org

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www.organicdevelopmentfund.org

For more organic production resources visit:
www.pivotandgrow.com