The college garden as a laboratory for sustainable agriculture

J. Michael Campbell
Professor of Biology

Do not try this, unless…

1) You have a President that embraces the idea of sustainable agriculture;

2) You have a creative and sociable garden/farm manager, who is rewarded by the livelihood of producing food;

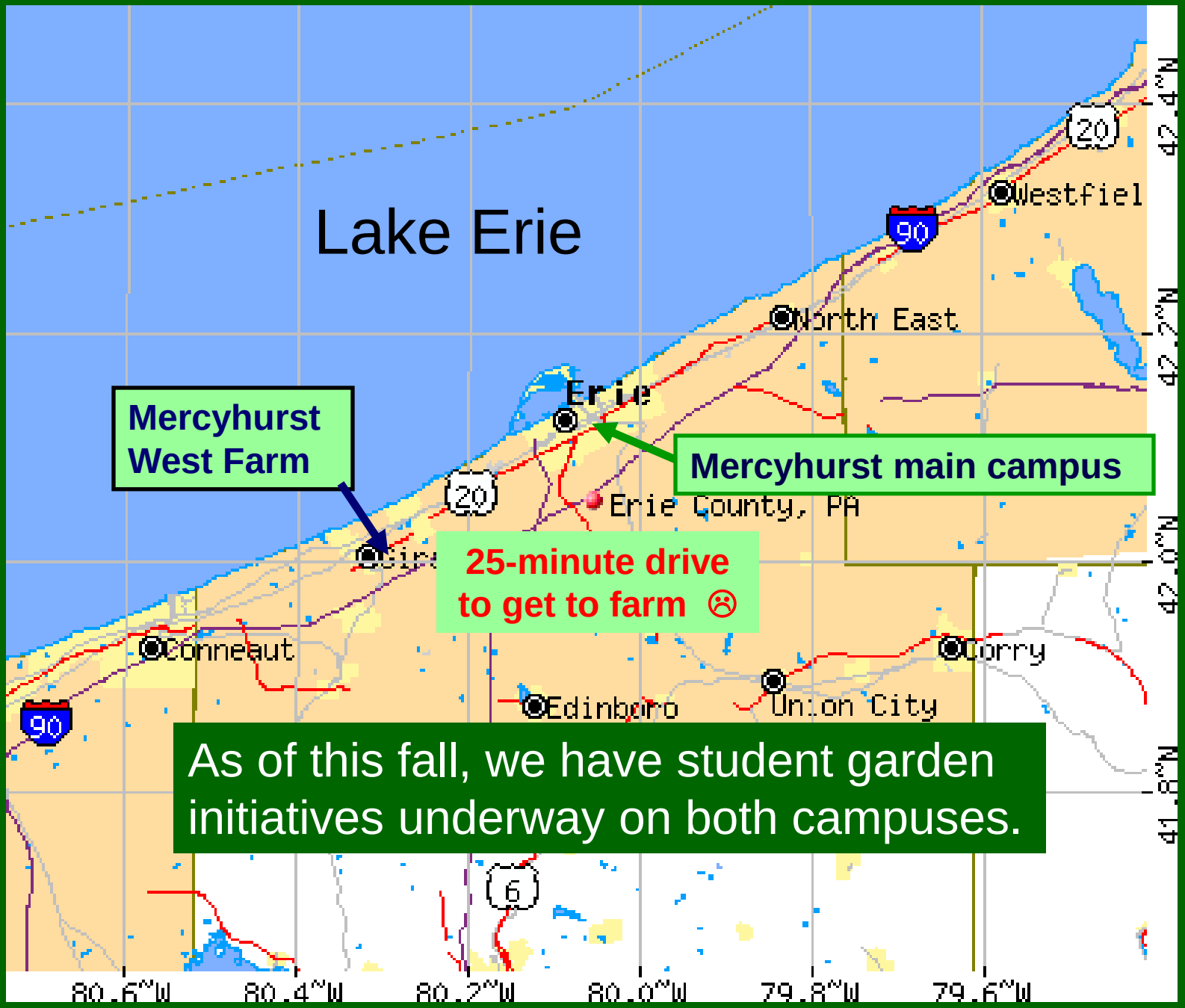
3) You are good at managing paperwork, or have someone on staff that is;

4) You have committed and interested colleagues and students that share your vision;

5) You are single or have a spouse that understands your work obsession; and

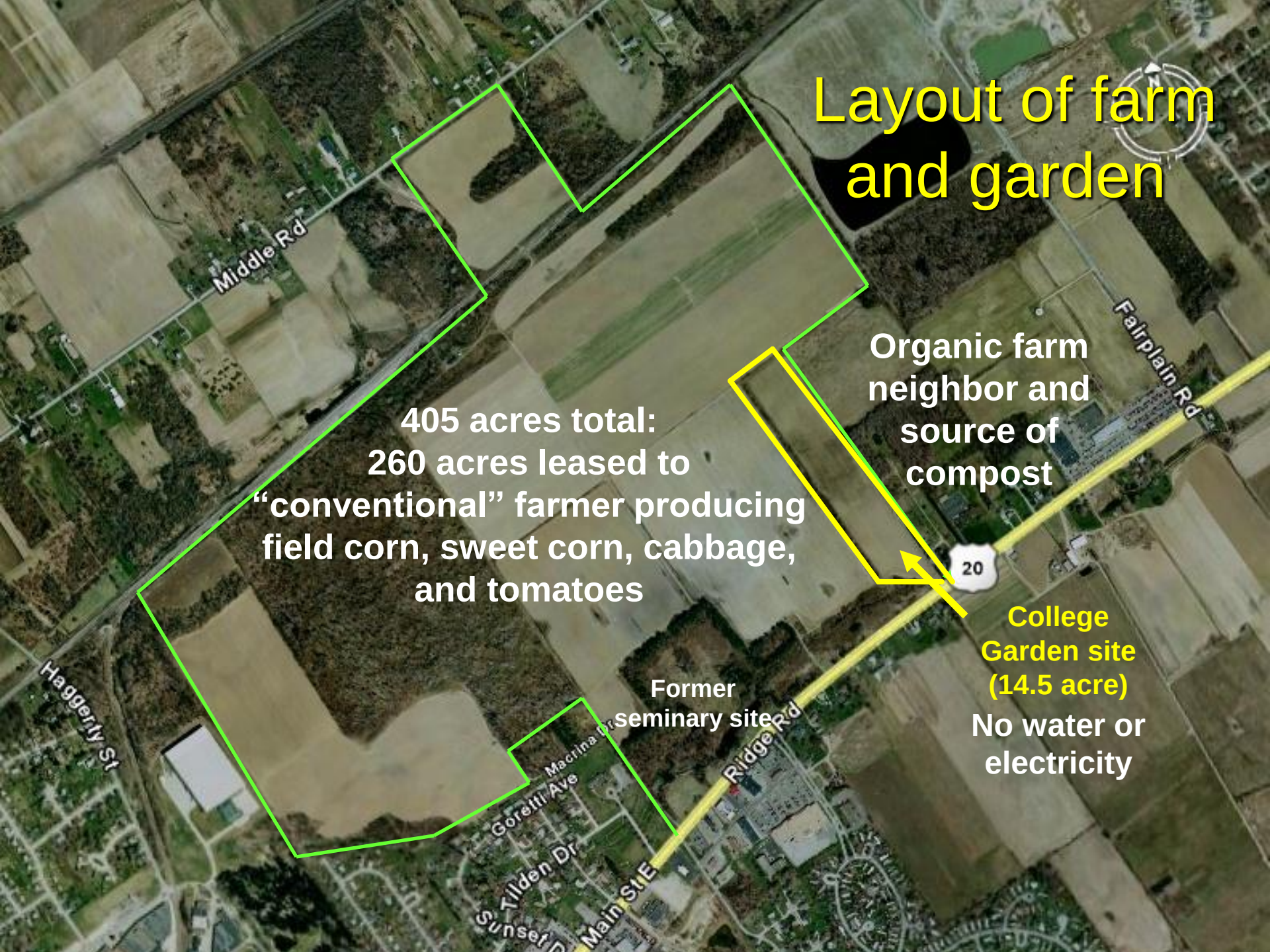
6) You are already tenured and have achieved full rank.

Our situation


Lake Erie
Mercyhurst West Farm
Mercyhurst main campus
25-minute drive to get to farm ☹
As of this fall, we have student garden initiatives underway on both campuses.
Erie
Erie County, PA
North East
Westfiel
Conneaut
Corry
Edinboro
Union City
20
90
6
42.4°N
42.2°N
42.0°N
41.8°N
80.6°W
80.4°W
80.2°W
80.0°W
79.8°W
79.6°W

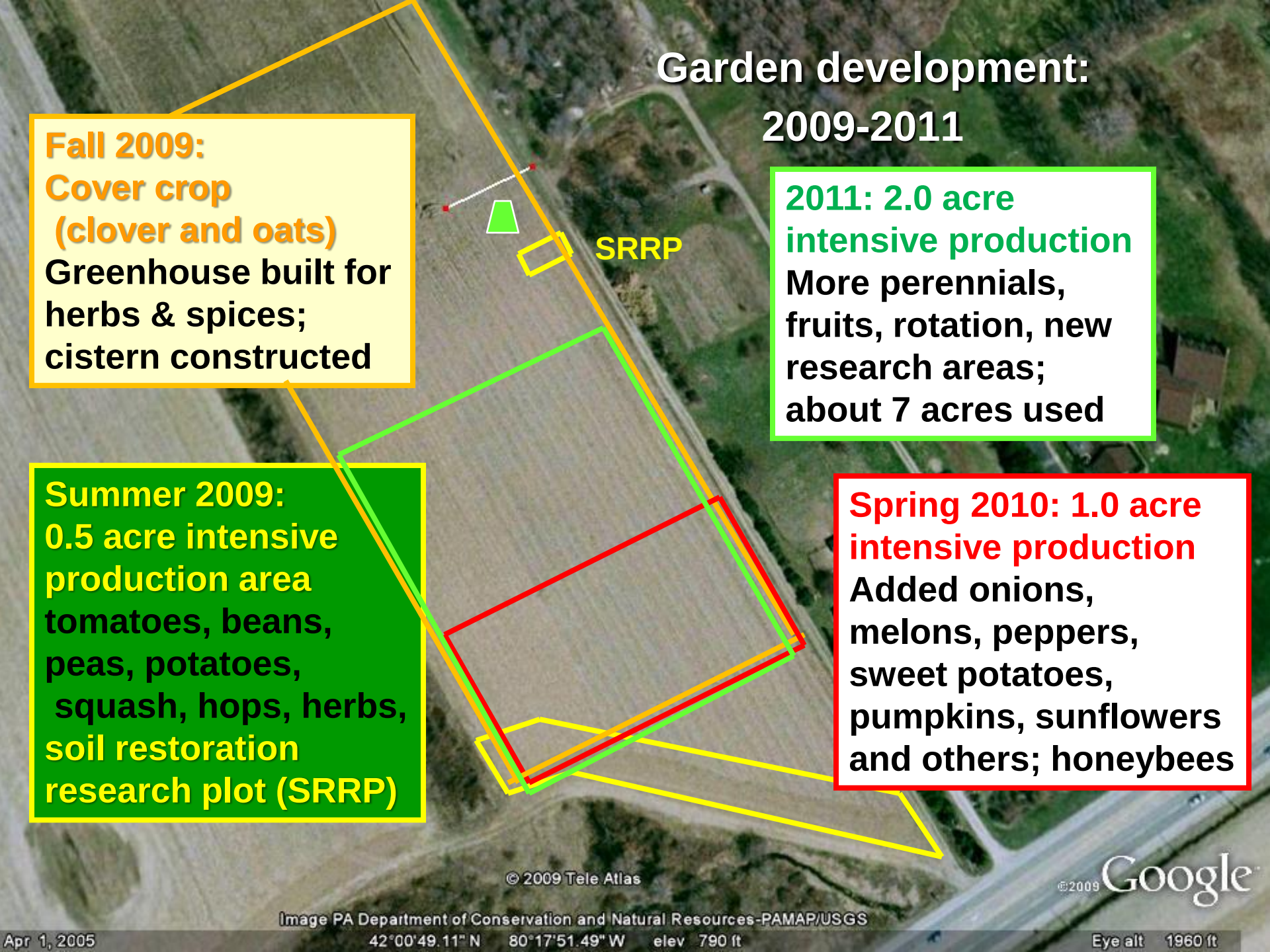
Objectives:

- Demonstrate sustainable land use principles: year-round food production for local use on college-owned properties
- Utilize gardening and food production facilities to strengthen current programs and cultivate new academic opportunities
- Utilize gardening activities to broaden connections into community


Layout of farm and garden
Middle Rd
405 acres total:
260 acres leased to
“conventional” farmer producing
field corn, sweet corn, cabbage,
and tomatoes
Organic farm
neighbor and
source of
compost
Fairplain Rd
20
College
Garden site
(14.5 acre)
No water or
electricity
Former
seminary site
Ridge Rd
Haggerty St
Goretti Ave
Tilden Dr
Main St E
Sunset

Year 1 – 2009
Made lots of mistakes
but also had some successes

Planted directly into compost


Garden development:
2009-2011
Fall 2009:
Cover crop
(clover and oats)
Greenhouse built for herbs & spices; cistern constructed
SRRP
2011: 2.0 acre intensive production
More perennials, fruits, rotation, new research areas; about 7 acres used
Summer 2009:
0.5 acre intensive production area
tomatoes, beans, peas, potatoes, squash, hops, herbs,
soil restoration research plot (SRRP)
Spring 2010: 1.0 acre intensive production
Added onions, melons, peppers, sweet potatoes, pumpkins, sunflowers and others; honeybees
© 2009 Tele Atlas
©2009 Google
Image PA Department of Conservation and Natural Resources-PAMAP/USGS
Apr 1, 2005
42°00'49.11" N 80°17'51.49" W elev 790 ft
Eye alt 1960 ft

Garden Manager: Timothy Boucher

Companion planting

Mastermind of sustainable garden innovations

Peas, cucumbers and lettuce grown together

Rainwater and snow-melt collection system for greenhouse

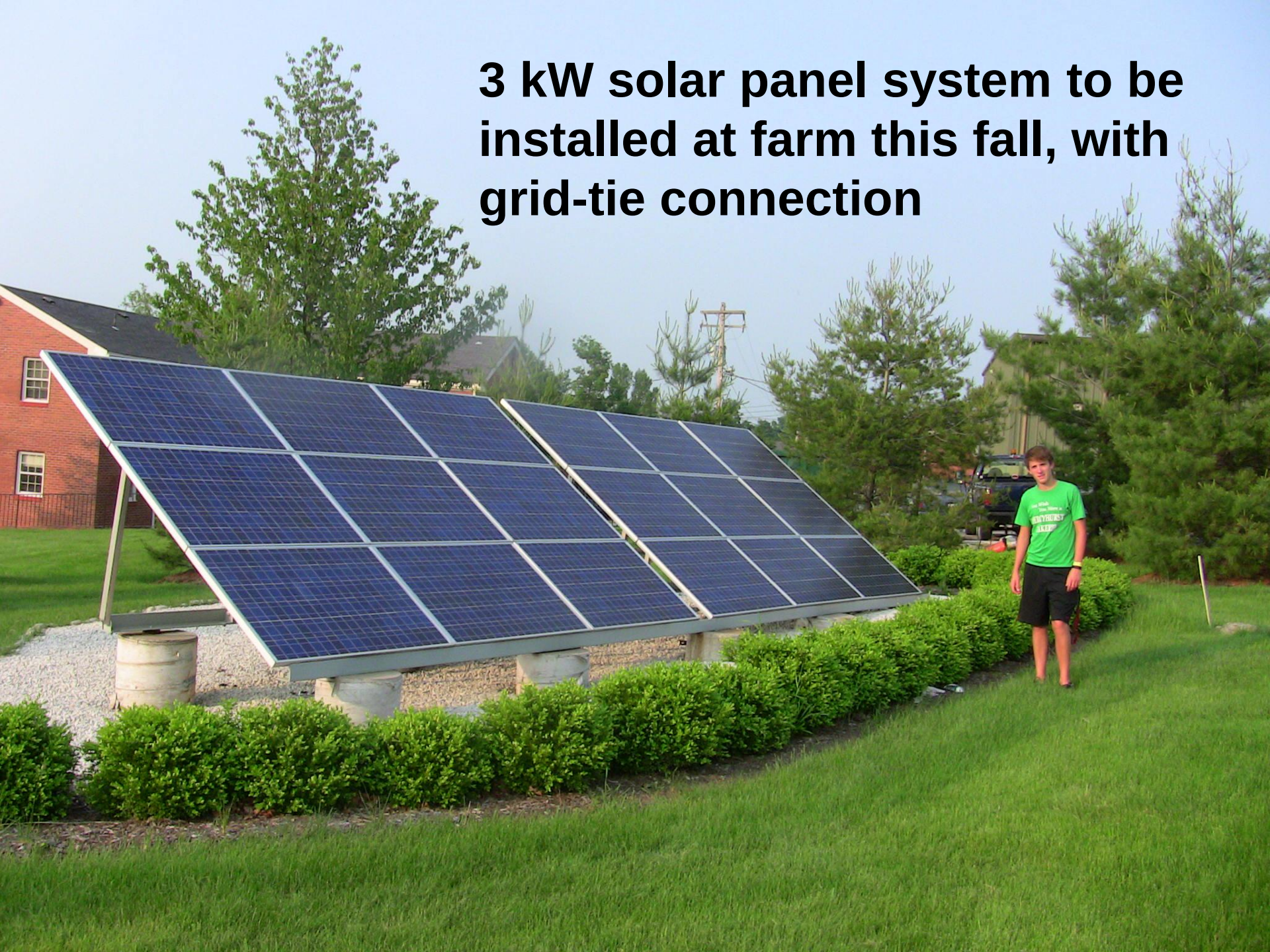
Main campus grass clippings to suppress weeds between the rows

2500-gallon cistern for greenhouse watering

Low-input winter food production

Herbs, spinach, collards, radishes, carrots

Cold frame built on main campus for early spring and fall start-ups

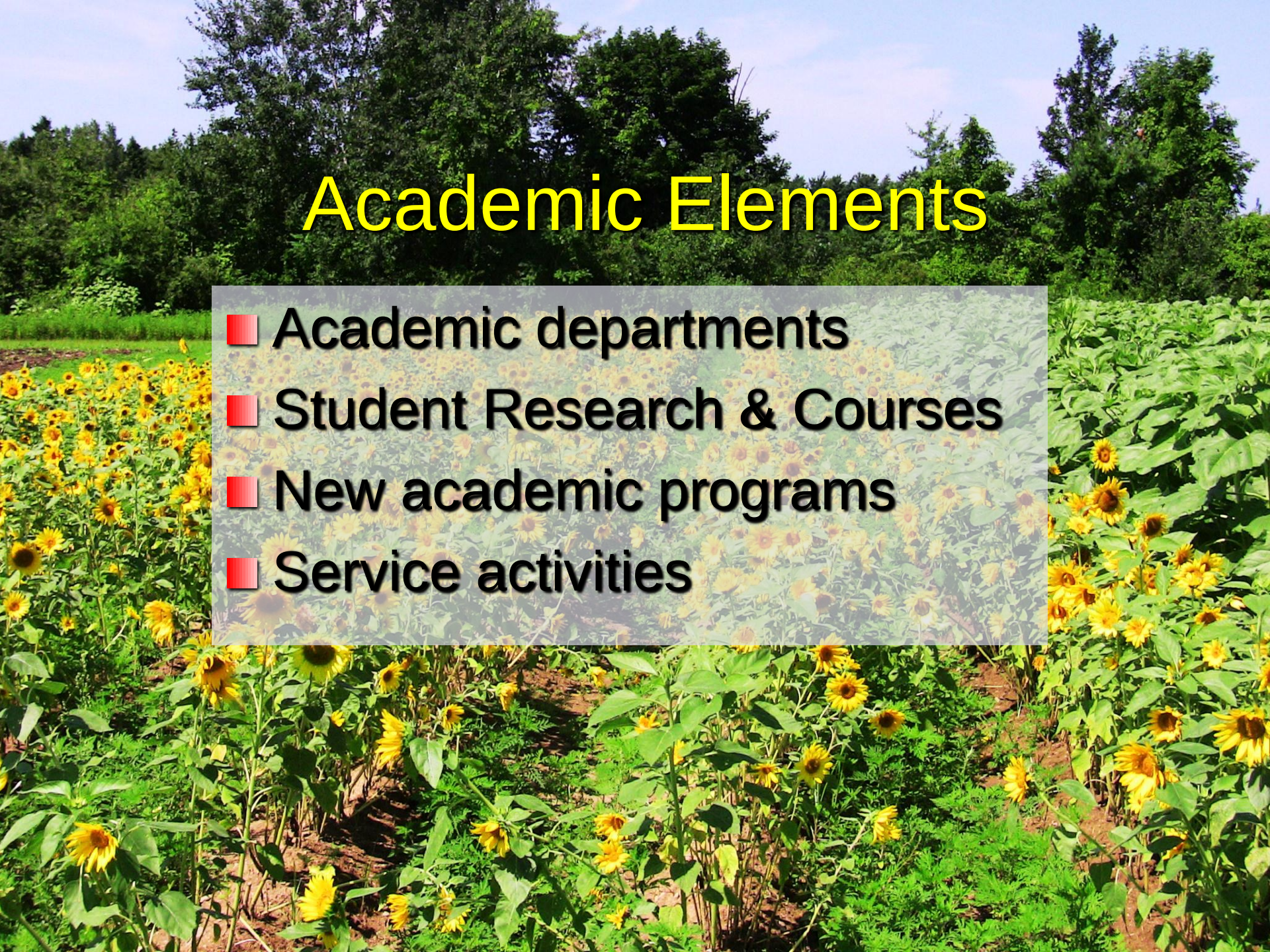

3 kW solar panel system to be installed at farm this fall, with grid-tie connection

Food production and marketing

- Deliver produce to campus food service
- Two local farmers markets
- Direct sales to local restaurants
- Donation of unsold produce to food bank (nearly 5 tons in 2011)

People make this all happen.


TRACK



Academic Elements

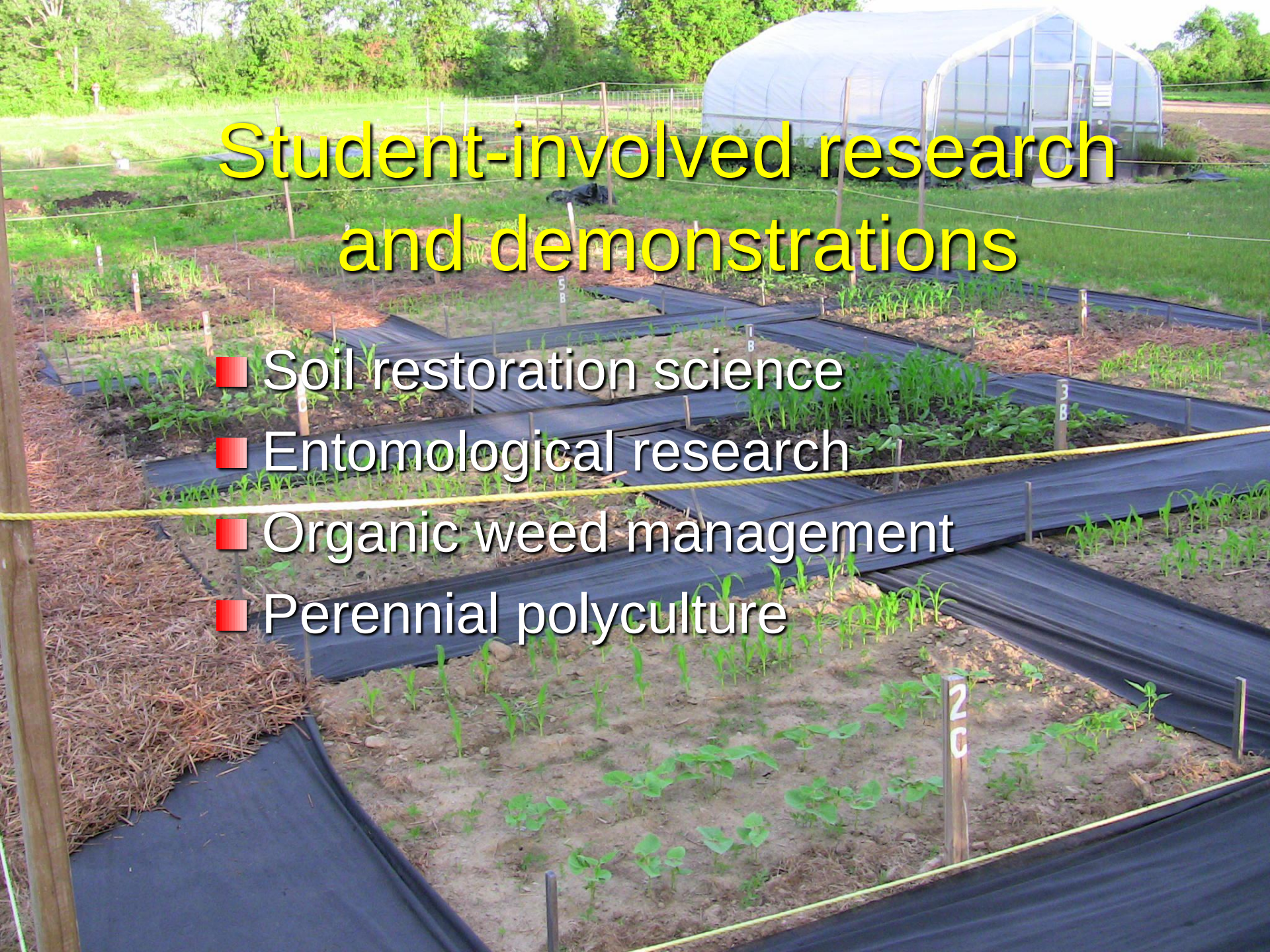
- Academic departments
- Student Research & Courses
- New academic programs
- Service activities

Academic Departments

Introduction to Sustainability Studies course
50-150 students per year: service hour work site

Studio Art course:
3-D design

Three sisters sculpture and garden


Student-involved research and demonstrations
Soil restoration science
Entomological research
Organic weed management
Perennial polyculture

Soil Restoration Science: Effects of soil amendments on C-sequestration and microbial communities

Botany and Plant Propagation classes of Dr. Marlene Cross

Soil bacteria

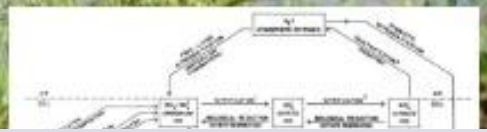
Mycorrhizal fungi

Extraction and Purification of DNA from Nitrogen-Fixing Bacteria in Organic and Chemical Soils Using Real-Time Polymerase Chain Reaction

Cerissa Lynch (Marlene Cross) Mercyhurst College, Zurn School of Natural Science and Mathematics - Biology

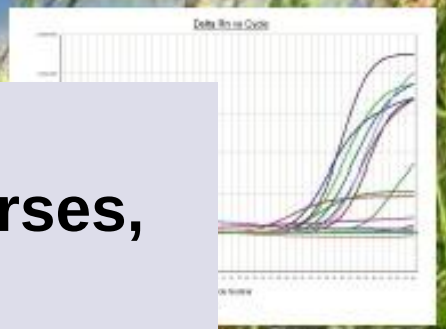
ABSTRACT

Chemical fertilizers have been the choice of many farmers for a long time but now with a growing global awareness of the problems associated with chemical fertilizers, more farmers are turning towards organic options. Soil with a healthy microbial population, which includes nitrogen-fixing bacteria, may sup crop growth without the input of nitrogen fertilizers. The pu of this study was to quantify the nitrogen-fixing bacteria fou organically treated soil as compared to chemically treated so Eighteen plots were treated with six different fertilizer treatm arranged in a randomized complete block design. DNA was extracted from each plot after the growing season. Nitrogen fixing bacteria were quantified by amplification of the nitrogenase gene with real-time polymerase chain reaction. was predicted that the soil from chemically fertilized plots w contain fewer nitrogen-fixing bacteria. In the process of try quantify the nitrogenase gene, a simple method of extracting quantifying DNA from soil was developed. This method ma provide future scientists a more efficient technique to extract purify DNA from environmental samples.



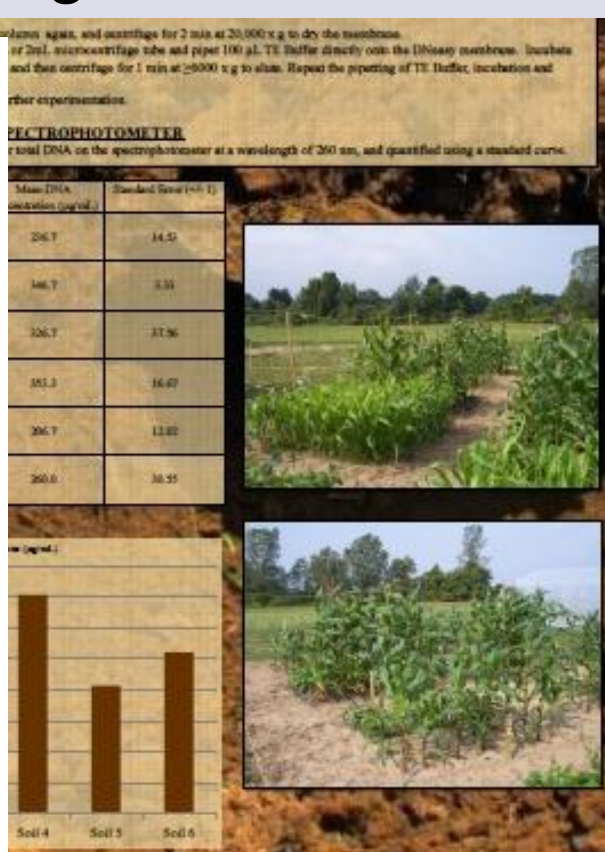
NITROGEN CYCLE SPECIFIC TO NITROGEN-FIXATION

RESULTS



Marlene Cross:
Cell Biology and Genetics courses, undergraduate research

New research on garlic



Through the use of Real Time-PCR, we were able to amplify the nitrogenase gene within our R.rubrum samples when they were 100x and 1000x dilute. When checked using electrophoresis, we can clearly see two bands around the 457 b.p. range (nif gene) in lanes 6 & 7, thus proving a successful extraction and amplification of the nif (nitrogenase) gene.

CONCLUSIONS

Through statistical analysis of spectrophotometer data:
- Soils 1 & 5 are different from 2 and 4 (not 3,6 or each other)
- Soils 2 & 4 are different from 1 and 5 (not 3,6 or each other)
- Soils 3 & 6 are not significantly different from any other soil samples.

This initial discovery is very positive as our purpose to the study is to find out if the quantity of nitrogen-fixing bacteria is affected by chemical fertilizers or organic fertilizers. This data shows the total soil DNA (bacteria, fungi, etc.) is lower in untreated soil and algae treated soil.

Our simple, developed method for extraction of DNA from R.rubrum and soil samples has proven to be successful. We have also successfully amplified the nif (nitrogenase) gene from R.rubrum with PCR and confirmed its base pair size with gel electrophoresis.

FUTURE RESEARCH

We still need to work on successfully amplifying the nif (nitrogenase) gene within our soil samples using PCR and confirm through gel electrophoresis. Ultimately, we would like to quantify the changes in the amount of nitrogen-fixing bacteria in the research plots as we move from chemical to organic fertilizers.

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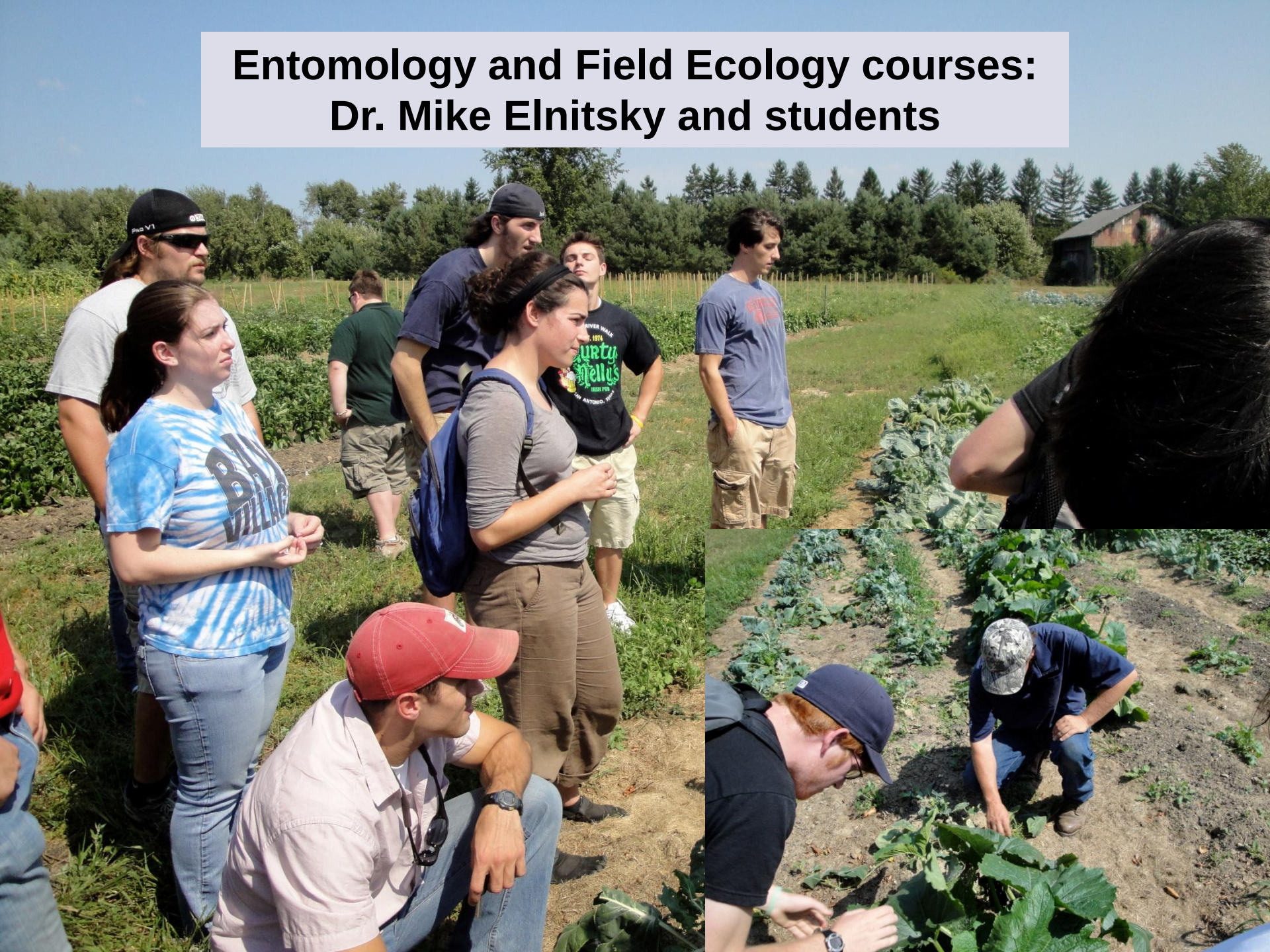
Poly, Franck, Lionel Ranjard, Sylvie Nazaret, Francois Gourbiere, and Lucile L Monrozier. "Comparison of nifH Gene Pools in Soils and Soil Microenvironments with Contrasting Properties." Applied and Environmental Microbiology 67.1 (2001): 2255-2262.

Reed, Christopher, Alexander Mergel, and Hermann Bothe. 2002. Biodiversity of Denitrifying and Dinitrogen-Fixing Bacteria in an Acid Forest Soil. Applied and Environmental Microbiology. 68:3318 - 3326.

Widmer, F., R. F. Shaffer, L. A. Porteous, and R. J. Seidler. "Analysis of nifH Gene Pool Complexity in Soil and Litter at a Douglas-fir Forest Site in the Oregon Cascade Mountain Range." Applied and Environmental Microbiology 65.2 (1999): 374-80.

Entomology and Field Ecology courses: Dr. Mike Elnitsky and students




TRACK


Weed management research
The case of the ragweed-overrun onion field


OMRI LISTED
For use in organic production
St. Gabriel ORGANICS
BurnOut II
Fast Acting Weed & Grass Killer
CONCENTRATE
For Non-Selective Control of Herbaceous Broadleaf and Grass Weeds.
MADE FROM PLANT OILS
Active Ingredients:
Citric Acid 24.0%
Clove Oil 8.0%
Other Ingredients: 68%
Total 100%
DANGER
KEEP OUT OF REACH OF CHILDREN
WARNING: See back panel for additional precautionary statements.
PET APPROVED BRAND
NET CONTENTS: 1 US GALLON (3.8 L)
For Control of Grasses and Broadleaf Weeds (both Annual and Perennial) In Crop and Non-Crop Areas
GreenMatch
Burndown Herbicide
FOR ORGANIC PRODUCTION
OMRI LISTED
ACTIVE INGREDIENT: d-limonene 55%
INERT INGREDIENTS 45%
Total 100%
KEEP OUT OF REACH OF CHILDREN
CAUTION
Distributed by
Marrone Bio Innovations
Net Contents: 1 Gallon
EPA Reg. No. 82052-4
EPA Est. No. 82052-GA-1

Barley does a great job of suppressing ragweed.

Experiment in perennial polyculture

Elderberry
Plus
Groundnut

Academic programs launched

Sustainability Studies Concentrations in
Chemistry and Biology
Sustainability Studies Minor & Major
Post-Bac Certificate in Sustainability Studies

Community Outreach

City of Erie School District
April 2010
Jefferson Elementary


EarthForce
June 18, 2010
60 children

Our greatest challenges?

1) Transportation frustration 25-min drive ☹

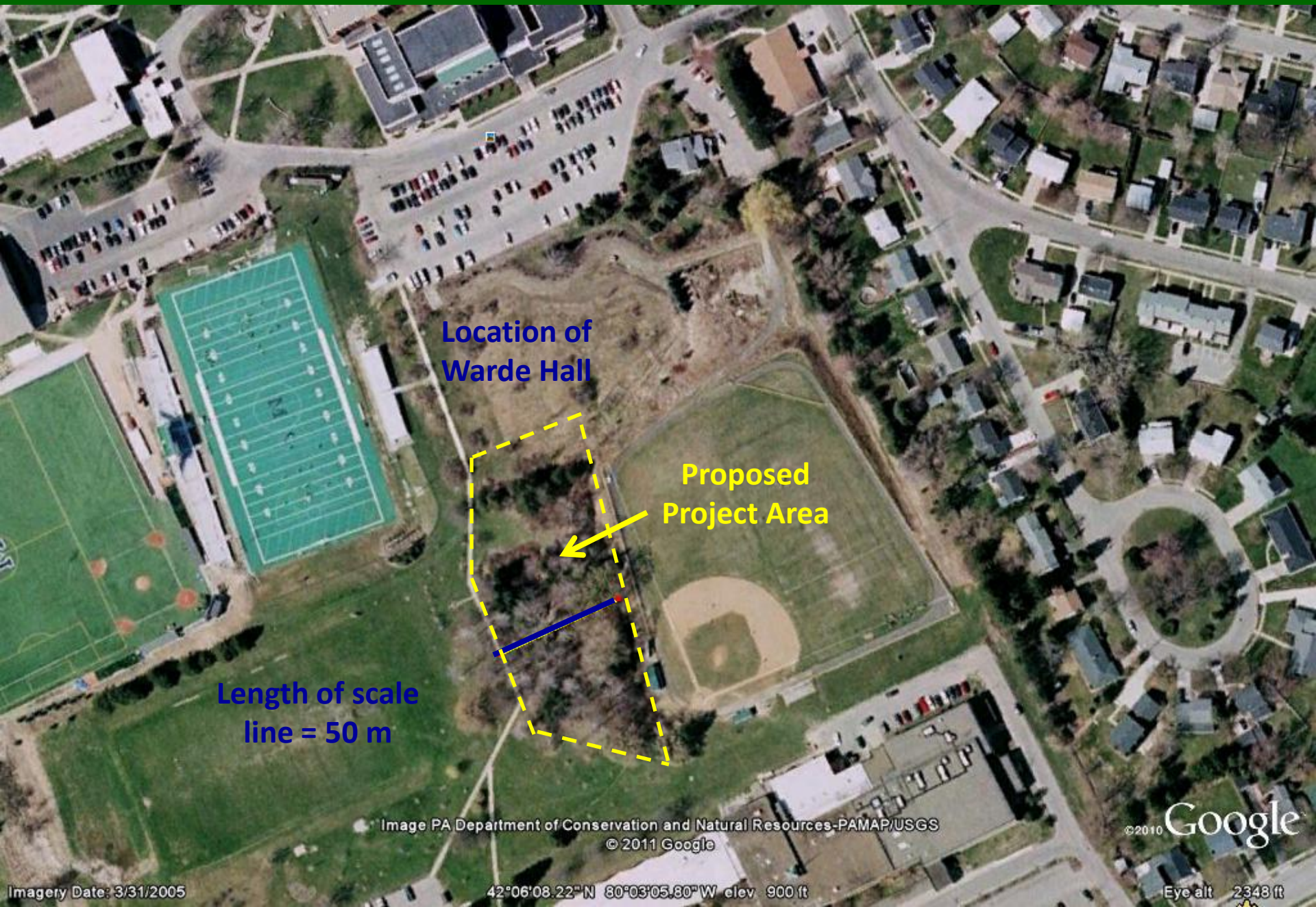
2) Achieving economic sustainability, such that farm-associated income equals or exceeds monetary costs, in the absence of “subsidies”

academic programs are needed that attract and retain more tuition-paying students

3) Figuring out what to do with the rest of the farm!!!

advancement of larger-scale educational initiatives in sustainable agriculture

Challenge 1: Main Campus Edible Forest Garden Project



Challenge 2: New academic programs on the drawing board

Community classes (for credit or non-credit)

Organic gardening series

Certificate programs

Sustainable horticulture and landscaping

Renewable energy technology

Coming in July to Girard…..
at Mercyhurst West

Sustainable Organic Gardening

Instructor Team: Dr. Mike Campbell, Dr. Marlene Cross, Dr. Mike Elnitsky, and Tim Boucher

This experiment in community instruction did not succeed in 2011 ☹

Offering Community Summer classes
Thursday evenings and Saturday mornings
July 7 to August 20

Thurdsays 6:30 – 8:30 PM
Saturdays 9AM - Noon

Garden art installation "Three Sisters"

.vailable non-credit ($75)
or college credit ($446)

For Teachers: Act 48 credit available

For more information
call 774-0704
or e-mail
jcampbell@mercyhurst.edu

Partnership possibilities with Renewable Energy Technology Program

Ernst BIOMASS

AMERICAN FEDERATION OF LABOR & CONGRESS OF INDUSTRIAL ORGANIZATIONS & CANADIAN LABOUR CONGRESS · AFFILIATED WITH ·
INTERNATIONAL BROTHERHOOD OF ELECTRICAL WORKERS
ORGANIZED NOV. 28, 1891
REG. U. S. PAT. OFF.

HERO BX™ FUEL FOR HUMANITY


Challenge 3: Future development of the farm
When our conventional farmer partner retires, what will we do the remaining 390 acres?
College Garden site (14.5 acre)
Former seminary site
Middle Rd
Fairplain Rd
Haggerty St
Ridge Rd
Main St E
Tilden Dr
Goretti Ave
20

Perennial Polyculture Farming

Seeds of Another Agricultural Revolution?

James A. Dewar

Mark Shepherd's 106 acre permaculture farm in Viola, Wisconsin

Agriculture as a Mimic of Natural Ecosystems

Workshop Report for the
RIRDC/LWRRDC/FWPRDC Joint Venture Agroforestry Program

Williams, Western Australia
2 - 9 September 1997

By E C Lefroy and R J Hobbs

Edible Forest Gardens: an Invitation to Adventure *

David Jacke with Eric Toensmeier

Invitation to Adventure:

Join me on a 1-week travel tour of perennial polyculture projects in New York, Ohio, Michigan, Wisconsin, Minnesota, Iowa, Missouri, and Kansas

Mid-July 2001
Restoration Ecology and Perennial Polyculture

Contact jcampbell@mercyhurst.edu for more details