Precision Agriculture Technologies: 
*Integrating Agriculture and Geo-Sciences*

**Hi Tech Conference July 19, 2017**

**Presenters:**

Cathryn S. Balas Consultant Evaluator
Gordon F. Snyder, Consultant Evaluator

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*The career you want. The degree you need.*
Precision Agriculture

What is it?
Monitor and Manage Conditions
Managing assets by the $\text{in}^2$

• One acre
  • Area = 209’ X 209’
    • 43,560 ft$^2$
    • Or 6,272,640 in$^2$

• Precision Agriculture tools allow management decisions for each square inch rather than each field
No plant left behind
Managing “Uniqueness”

• Grid Soil Sampling

The career you want. The degree you need.
Managing “Uniqueness”

• Crop Yield Map

Relative Yield Map

The relative yield map shows the spatial variability of yield relative to the average yield of the field. Zones in the colors red-brown to yellow yielded below average. Zones in the colors green to dark blue yielded above average.

Example of calibrated yield scale after harvest. Average yield was 200 bu/acre.

CropMaps, LLC - 1251 S. Huron St., Unit C - Denver, CO 80223
Ph: 303 777-7092 - www.croppmaps.com - e-mail: info@cropmaps.com

The career you want. The degree you need.
Develop Planting “Prescriptions”
Treat Only “Problem” Areas

The career you want. The degree you need.
Creates options for organic/reduced chemicals

Autonomous weeder

High Speed Electric In-Row Weeding

https://www.youtube.com/watch?v=912XK-U_6ZE

Precision Agriculture Principles are also applicable to:

- Animal Production
- Natural Resources
- Landscape Design
- Golf Course Operations
- Nursery Operations
- Turf and Landscape Operations
Advantages

• Treats a Specific Problem
• Environmentally Friendly
• Saves Money
• Saves Time
• Fewer Problems with Residual Effects
Monitor Current Conditions

• UAV Fixed Wing or Rotary Wing
Monitor Current Conditions

UAV Fixed Wing or Rotary Wing
State of the Art Equipment

- GPS with repeatable accuracy of < 0.4”
- Sensors (and lots of them)
- Actuators and Control Devices
- Complete integration with other units
State of the Art Equipment
State of the Art Equipment

Coming soon
Precision Agriculture – What is it?

• Aims to optimize field-level management with regard to:
  • **crop science**: by matching farming practices more closely to crop needs (e.g. fertilizer inputs)
  • **environmental protection**: by reducing environmental risks and footprint of farming (e.g. limiting leaching of nitrogen)
  • **economics**: by boosting competitiveness through more efficient practices (e.g. improved management of fertilizer usage and other inputs)

• Provides farmers with a wealth of information to:
  • built up a record of their farm
  • improve decision-making
  • foster greater traceability
  • enhance marketing of farm products
  • improve lease arrangements and relationships with landlords
  • enhance the inherent quality of farm products (e.g. protein level in bread-flour wheat)

Source: https://en.wikipedia.org/wiki/Precision_agriculture
National Science Foundation Advanced Technological Education (ATE) Grant

• $402,000 -- 3 year project--July 1, 2016 to June 30, 2019

• Goals
  • Develop Precision Ag Technician Degree
  • Develop Summer Workshops
    • High School Teachers and Students
  • Develop Curriculum With
    • Parkland College – Champaign, Illinois
    • Ellsworth College – Iowa Falls, Iowa
National Science Foundation ATE Grant

- **Employment Outlook:**
  - Positions include: Precision Agriculture Technician, Crop Specialist, Nutrient Management Specialist, Precision Agriculture Department Manager, Precision Agronomist, Precision Farming Coordinator
  - Spring 2014 *Ag Leader Insights* article projected employment opportunities in all precision agriculture-related careers to increase by more than 29 percent and create more than 100,000 new jobs by 2020
  - The Association of American Geographers projects an 8% to 14% growth for Precision Agriculture Technicians, with a median annual salary of $43,000
National Science Foundation ATE Grant—Year 1 outcomes

• Created new degree option and new courses
### FALL 1st YEAR

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
<th>Prerequisite(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGR 1100</td>
<td>Ag Survey and Professional Developmen</td>
<td>4.00</td>
<td>CPE 0100, CPE 0300</td>
</tr>
<tr>
<td>AGR 1300</td>
<td>Soil Science</td>
<td>4.00</td>
<td>CPE 0100, CPE 0300</td>
</tr>
<tr>
<td>AGR 1750</td>
<td>Precision Agriculture</td>
<td>3.00</td>
<td>CPE 0200, CPE 0500</td>
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<tr>
<td>ENG 1111</td>
<td>English I</td>
<td>3.00</td>
<td>CPE 0300 B or CPE 0400 C; Pre/Co: CPE 0200</td>
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**Total Credit Hours Fall 1st Year** 14.00

### SPRING 1st YEAR

<table>
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<tr>
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<tr>
<td>AGR 1350</td>
<td>Soil Fertility</td>
<td>4.00</td>
<td>AGR 1300</td>
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<tr>
<td>ENG 1112</td>
<td>English II</td>
<td>4.00</td>
<td>ENG 1111 C or ENG 1111 or OAD 1105</td>
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<tr>
<td>or ENG 2211</td>
<td>Business Communication</td>
<td>3.00</td>
<td></td>
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<tr>
<td>INT 1201</td>
<td>Hydraulics and Pneumatics I</td>
<td>3.00</td>
<td>AGR 1200 or ENT 1000</td>
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<tr>
<td>INT 1300</td>
<td>Electrical Systems</td>
<td>3.00</td>
<td>AGR 1200 or ENT 1000</td>
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<tr>
<td>MTH 1200</td>
<td>Technical Math for Agriculture</td>
<td>3.00</td>
<td>CPE 0100 and CPE 0500</td>
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**Total Credit Hours Spring 1st Year** 16.00

### SUMMER SEMESTER

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<th>Credits</th>
<th>Prerequisite(s)</th>
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</thead>
<tbody>
<tr>
<td>AGR 200C</td>
<td>Co-Op Experience in Precision Ag Tech</td>
<td>2.00</td>
<td>AGR 1100 C plus a minimum of 10 technical hours</td>
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**Total Credit Hours Summer Semester** 2.00

### FALL 2nd YEAR

<table>
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<tr>
<td>AGR 2200</td>
<td>Crop Production</td>
<td>3.00</td>
<td>ENG 1111</td>
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<tr>
<td>AGR 2600</td>
<td>Plant Pests</td>
<td>4.00</td>
<td>CPE 0100 and CPE 0300</td>
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<td>AGR 2700</td>
<td>Ag Business Management</td>
<td>4.00</td>
<td>Pre/Co: ENG 1111</td>
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<td>AGR 2725</td>
<td>Applied Precision Ag Technology</td>
<td>4.00</td>
<td>AGR 1750</td>
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**Total Credit Hours Fall 2nd Year** 15.00

### SPRING 2nd YEAR

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<tr>
<td>AGR 2650</td>
<td>Integrated Pest Management</td>
<td>4.00</td>
<td>AGR 2600</td>
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<tr>
<td>AGR 2850</td>
<td>Agricultural Capstone Seminar</td>
<td>3.00</td>
<td>AGR 1550 and AGR 2700 and AGR co-op</td>
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<td></td>
<td>Arts &amp; Humanities Elective*</td>
<td>3.00</td>
<td></td>
</tr>
<tr>
<td>MKT 2450</td>
<td>Sales and Sales Management</td>
<td>3.00</td>
<td>MKT 2000 or MGT 1120 or Pre/Co: AGR 2700</td>
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<tr>
<td></td>
<td>Social &amp; Behavioral Science Elective*</td>
<td>3.00</td>
<td></td>
</tr>
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</table>

**Total Credit Hours Spring 2nd Year** 16.00

### TOTAL CREDIT HOURS

**63.00**

At least one must be a global awareness (GA) course. Select from social/behavioral sciences or arts/humanities courses identified in the Catalog as General Education for technical programs. AGR elective may be any AGR course not required above. AGR 1700, 1750, 1800, 2300, 2450 are recommended. Other course work may be approved by the division.

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The career you want. The degree you need.
• 13 high school teachers from 10 school districts in Ohio participated in a workshop designed to prepare them to provide information to high school students about Precision Agriculture career opportunities and to enable them to teach introductory precision ag modules.
Evaluation Results

• Teachers show significant gains in knowledge and ability to explain Precision Ag careers

• Knowledge ratings before workshop ranged from 1.46 to 2.46 (out of 4):
Evaluation Results

• Teachers show significant gains in knowledge and ability to explain Precision Ag careers
• Knowledge ratings after workshop ranged from 2.69 to 3.54 (out of 4):
### Responses

**Seeing all the parts work together, from setting up boundaries for a field, creating points for soil sampling, and uploading lab data to those sample points, and getting to see what the maps looked like. The hands-on/outdoor activities were great.**

**Materials given in a ready to use format, and actual practice in doing the lessons.**

**Resources and collaboration**

- Hands on applications and activities, vast amount of resources to take to students
- The instructor interaction as well as the actual "hands on" activities that we performed.
- Networking with colleagues, post-secondary instructors, and ag professionals to gather ideas that I can implement in my classroom.
- The hands on activities and interaction with other teachers and programs. Great exposure to Clark State opportunities
- Hands-on learning Excellent instructors Lessons that I can apply directly in my classroom
- Hands on technology usage by the participants.
- GPS, and Soil sampling data
- The hands on use of software and equipment
- The hands on based activities. Lessons I can take and utilize directly in my class.
- Hands on activities.
Real World Education

Precision Ag students must also complete a co-op or internship experience.
Partners: Parkland College in Illinois and Ellsworth Community College in Iowa
Evaluation challenges turned into excitement about opportunities

- Anticipated some evaluation challenges since Ag we lack technical expertise in the field
- Have found instead that there are exciting connections to Geo-spatial; Computing; IT; Cybersecurity; Engineering; and other technologies
- Believe that students from other disciplines will have the same reaction
Thank You!

• Questions?

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Bonus slide: John Deere “farm forward” video

• https://www.youtube.com/watch?v=t08nOEkrX-I
Out-takes: Hi-Tec Utah 2017