Integrated Cropping Systems: A Capstone Course Designed to Enhance Critical Thinking

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Abstract

CSS 488 Agricultural Cropping Systems: Integration and Problem Solving is a capstone course designed to enhance critical thinking skills in seniors completing a B.S. in Crop and Soil Sciences or an Agronomy Minor. Assignments include two semester long projects and one, two week assignment that require group work and collaboration. Groups are assigned based on academic majors, personal background, and student evaluation of their competence areas. For the Farm Report, students work in small groups to develop a farm report outline after reviewing three published case studies of farms. Students then write their own farm report throughout the semester. Grading is based on content of the farm report and inclusion of the reasoning behind various farm management practices. For the Crop Rotation exercise, student groups are given six crops in an envelope and initially decide a crop rotation. Throughout the semester, the agronomic and input cost information to design the cropping system including tillage operations, planting dates, seeding rates and row spacing, soil fertility programs, and pest management is added. Soil organic matter is calculated throughout the six year rotation. For the final project, groups are required to convert a county to organic production. Current crop acreage and livestock numbers are provided and students may not export or import feed or manure. Critical thinking skills in nutrient and manure management are enhanced, as well as skills in managing cover crops. These assignments require students to take course content based material and apply it to integrated cropping systems projects, enhancing information gathering, data synthesis, communication, and team-building skills.

Objectives

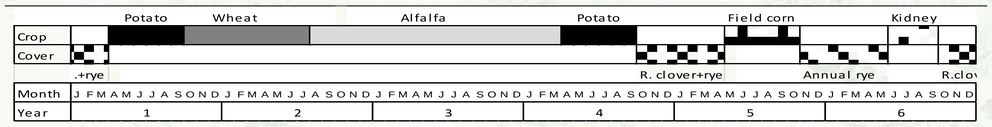
- Design and teach a capstone course to agronomy majors and minors that builds on previous coursework, personal background and internship experiences
- Design and assign student group projects that enhance information gathering, data synthesis and analysis, communication, and team-building skills

Syllabus (abbreviated)

Date	Topics in Class	Assignments	Due Today:
Weeks 1-3	Integrated (and *not* integrated) Cropping Systems: Midwest; Cotton Benefits of rotations MI AgBus Assoc. meeting:	Crop rotation readings Diverse Crop Rotations IWMFT pp. 1-22 Soil Quality, Carbon and Food Webs MFCE pp.14-27, MPE pp. 25-34	*Worksheet and short opinion paper "Can you beat the rotation effect?"*
Weeks 4-5	Fertilization: N, P, K Sources and systems	N fertilization and carbon sequestration reading Cover Crops -reading Manure and Compost IWMFT pp. 47-60	*N fertilization and carbon sequestration worksheet WS*
Week 6	Sustainability of Cropping Systems: Economic, Environment and Social	Attend Climate Change Academy	*Farm Case Study analysis*
Week 7	Climate Change Convergence of Ag and Energy	Biofuels: Switchgrass or Corn Stover	*Biofuels conversion WS*
Week 8	Live: MI Farmers Report Midterm Exam		
Weeks 9-12	Agroecology, IPM and Cropping Systems Weed, Insect, Disease and Nematode decision management	MPE pp. 21-94 MFCE pp. 40-59 IWM – both pubs, 6 chapters	*Pest WS (optional) available on line*
Week 13	Multiple land use issues	Minto Island and San Diego County	*Land Use WS* *Farm Reports due*
Week 14	Farm Reports: Group discussion and analysis Crop Rotation Exercise: Discussion and synthesis		*Crop Rotation Exercise due*
Week 15	Organic Agriculture: Rotations, GMO, Nutrition Sustainable Food Systems Final Exam	*Organic Only Assigned*	*Organic Only due*

Crop Rotation Exercise: rotation; planting and harvest dates; SOM changes over time*

Crop Rotation - Interstate Group Soil : Loamy-sand pH = 6.2 SOM = 1.5%



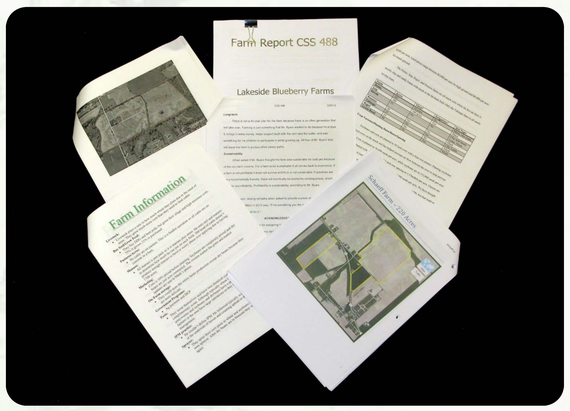
Crop	Date on	Date off	Planting	Seeding rate	Cost/acre
Potato	April 25-June 5	Aug-Sept	Hill	2,000lb/acre	250
Wheat	Sept 15-Oct 20	June 15-July	Drill	1.6 mil. seeds/acre	50
Alfalfa	July	April-May (yr4)	Drill	15-20	50
Potato *R. clover+Rye*	April 25-June 5 *Fall drill rye, frost seed clover*	Aug-Sept *Glyphosate kill*	Hill *see left*	2,000lb/acre 8lb (R. clover) + 10lb (rye)	250 24+6 = 30
Field Corn *Annual rye*	April 15-May	Oct *Glyphosate kill*	No-till Drill	32-35 20lb/acre	100 12
Kidney Beans *R. clover+Rye*	June 1 *Fall drill rye, frost seed clover*	Sept. 15 *Glyphosate kill*	No-till *see left*	70-75 8lb (R. clover) + 10lb (rye)	50 24+6 = 30

SOM Crop	lbs. Residue	C:N	Dry lbs. C x.4	lbs. C retained x.35	Added SOM x2	Total SOM lbs. **	% SOM
Potato	2000	20	800	280	560	29960	**1.498**
Wheat	4000	80	1600	560	1120	30480.8	**1.524**
Alfalfa†	4000	13	1600	560	1120	31308.2	**1.565**
Potato	2000	20	800	280	560	31242	**1.562**
R. clover+Rye *^	3000	40	1200	420	840		
Field Corn	8000	60	3200	1120	2240	32857.2	**1.643**
Annual rye	3000	40	1200	420	840		
Kidney Beans	2200	30	880	308	616	32816	**1.641**
*R. clover+Rye^^*	3000	30	1200	420	840	32999.7	**1.650**

†Based on 2500 gallons/acre @ 6% dry matter = 150 gal of solids, 25% of that as added SOM. 38 gal x 8.34 lb/gal = 317 lbs. * estimate 1500 rye + 1500 clover.
^mixture of C:N, young clover (1:20) and rye (1:40) = 1:30. ** ~2% SOM lost each year due soil respiration. ^^ only 1% removed since only half a year

* A portion of the Crop Rotation Exercise assignment

Farm Reports



Instructions:

1. Students have read examples of four farm case studies in class.
2. Students have discussed briefly the content of these farm case studies.
3. Students have listened to 'live' young Michigan farmer reports.
3. Students formulated a list of what should be included in a farm report.
4. Students will visit with a farmer. It is *strongly suggested* that the student visit the farm at least twice; once to meet with the farmer and ask questions about the farm, soil types, rotations, crop row spacing, varieties, populations, tillage system, etc. from the first seven weeks of class (late February) and then meet with the farmer again in late March to ask questions about pest management, future farming plans, etc.
5. It is important that the student not just ask "what" but also ask "**Why?**" This will provide the student insight into why these cropping system decisions were made. **The goal of the farm report is to understand the integrated farming system operation.**

Converting a County to Organic Production Only

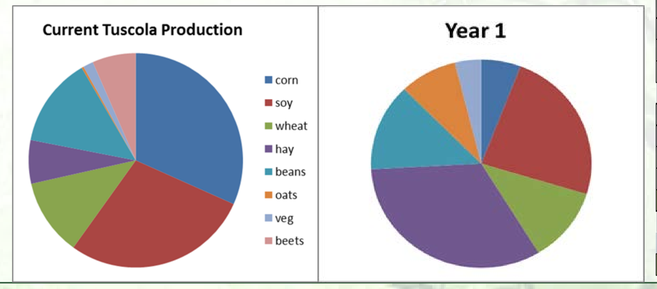
3. **Feed Needed for Livestock in the County**
Milk cow- 5,500 X 106 bushels corn = **583,000 bushels corn**
Milk cow- 5,500 X 5.7 tons forage dry matter = **31,350 tons dry forage**

Hogs- 9,000 X 4.5 lbs feed X 365 days = 14,782,500 lbs feed/year X .75 corn = 11,086,875 lbs corn / 56 lbs/bushel = **197,979 bushels corn**

Cattle/calves-
19,000 X 40 bushels corn
= **760,000 bushels corn**
19,000 X 6 tons forage dry matter
= **114,000 tons dry forage**

Major change in acreage allocation: reduce corn acreage to still yield with available manure N

Organic Production



4. Manure produced and NPK requirements for Organic Corn and Wheat

Tuscola Co. Manure NPK Availability Per Year			
Livestock	N (lbs)	P (lbs)	K (lbs)
Beef (19000 head/year)	4306635	4785150	22330700
Dairy (500 head/year)	590205	421575	1124200
Swine (9000 head/year)	873810	344925	942795
Total 3 Year Available NPK (lbs):	**17311950**	**16654950**	**73193085**

NPK Requirements Per Acre			
Crop	N (lbs)	P (lbs)	K (lbs)
Corn	175	65	70
Wheat	75	45	30

Total Tuscola Co. NPK Requirements			
Crop	N (lbs)	P (lbs)	K (lbs)
Corn (55000 acres/ 3 year rotation)	9625000	3575000	3850000
Wheat (105000 acres/ 3 year rotation)	7875000	4725000	3150000
Total 3 Year Rotation NPK Requirements (lbs)	**17500000**	**8300000**	**7000000**
	N	**P**	**K**
% of NPK Requirements Manure Fulfills:	**98.93%**	**200.66%**	**1045.62%**

Student Comments from SIRS forms - anonymous

"The group projects helped me understand the dynamics behind actual farming operations and apply what I had learned in the past and in this class."

"At first I didn't like the crop rotation exercise but as it went on I realized I expanded my knowledge beyond corn and soybean and that is important to me."

"I don't have an ag background and the farm report probably helped me learn the most about farming". "The farm report might have been a pain but I felt it helped me understand what goes into a farming operation."