2010
Norman Borlaug Lectureship

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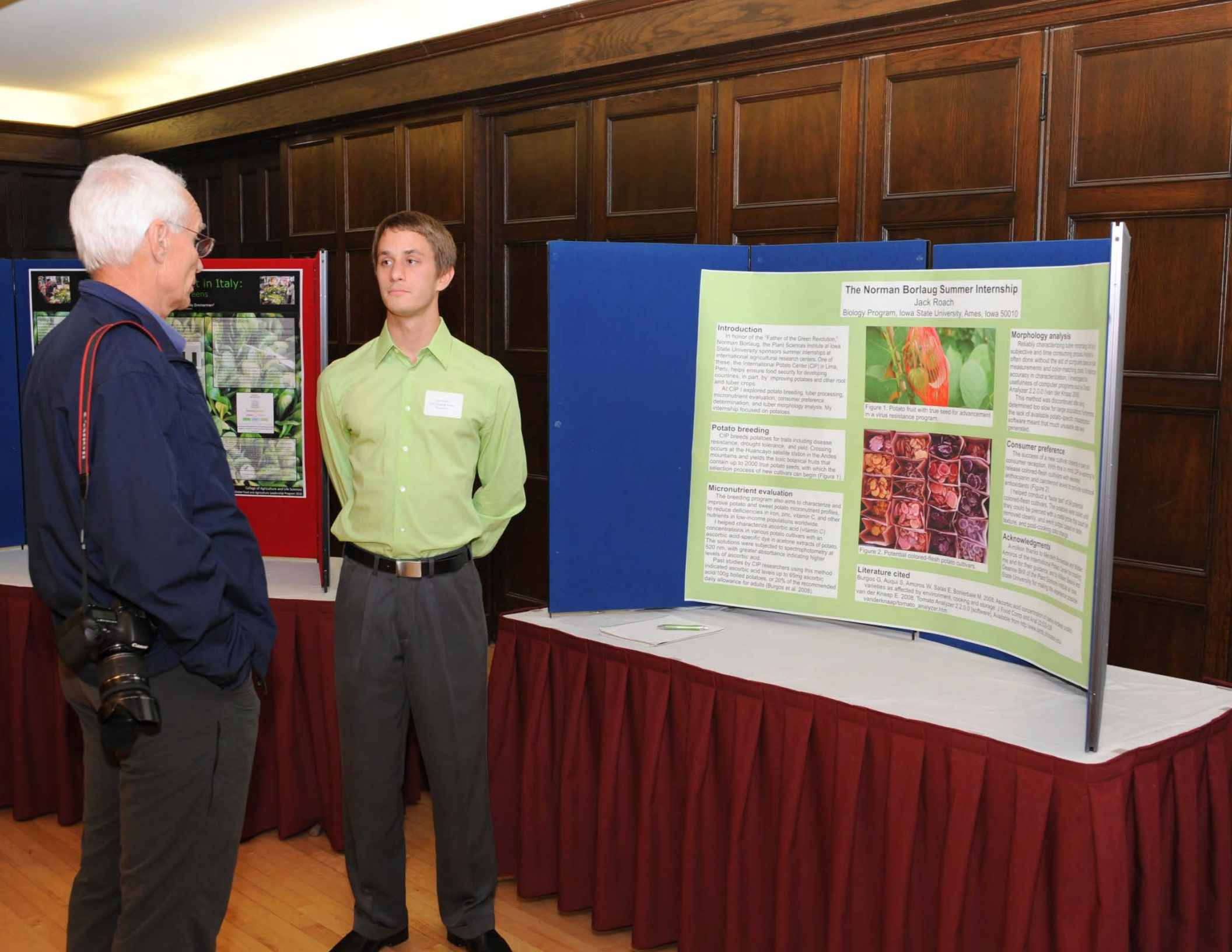
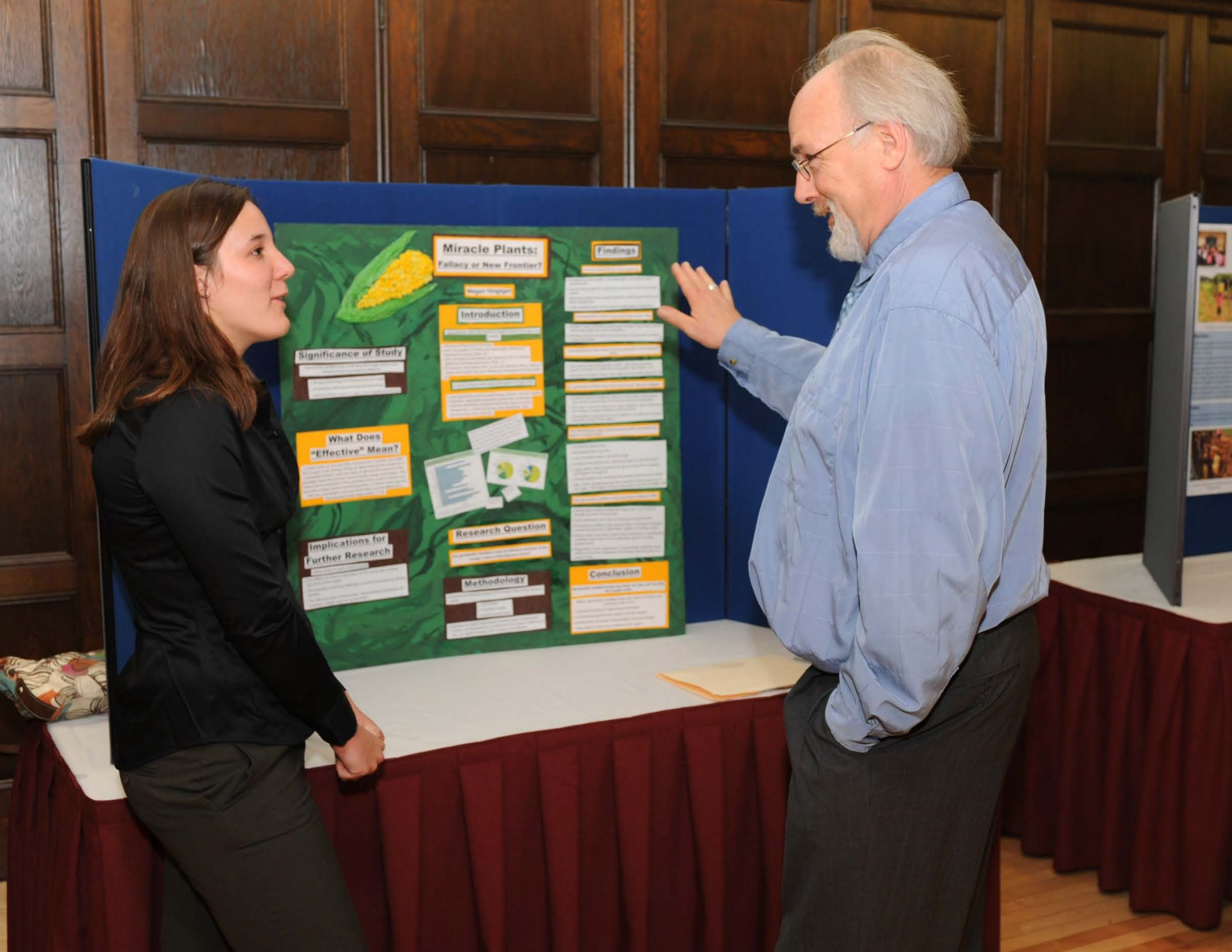
Poster Presentation Photos


The Norman Borlaug Summer Internship
Jack Roach
Biology Program, Iowa State University, Ames, Iowa 50010
Introduction
Potato breeding
Micronutrient evaluation
Figure 1. Potato fruit with true seed for advancement in a virus resistance program.
Figure 2. Potential colored-flesh potato cultivars.
Morphology analysis
Consumer preference
Acknowledgments
Literature cited


Miracle Plants:
Fallacy or New Frontier?
Introduction
Significance of Study
What Does "Effective" Mean?
Implications for Further Research
Research Question
Methodology
Findings
Conclusion


Miracle Plants:
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Megan Hinglger
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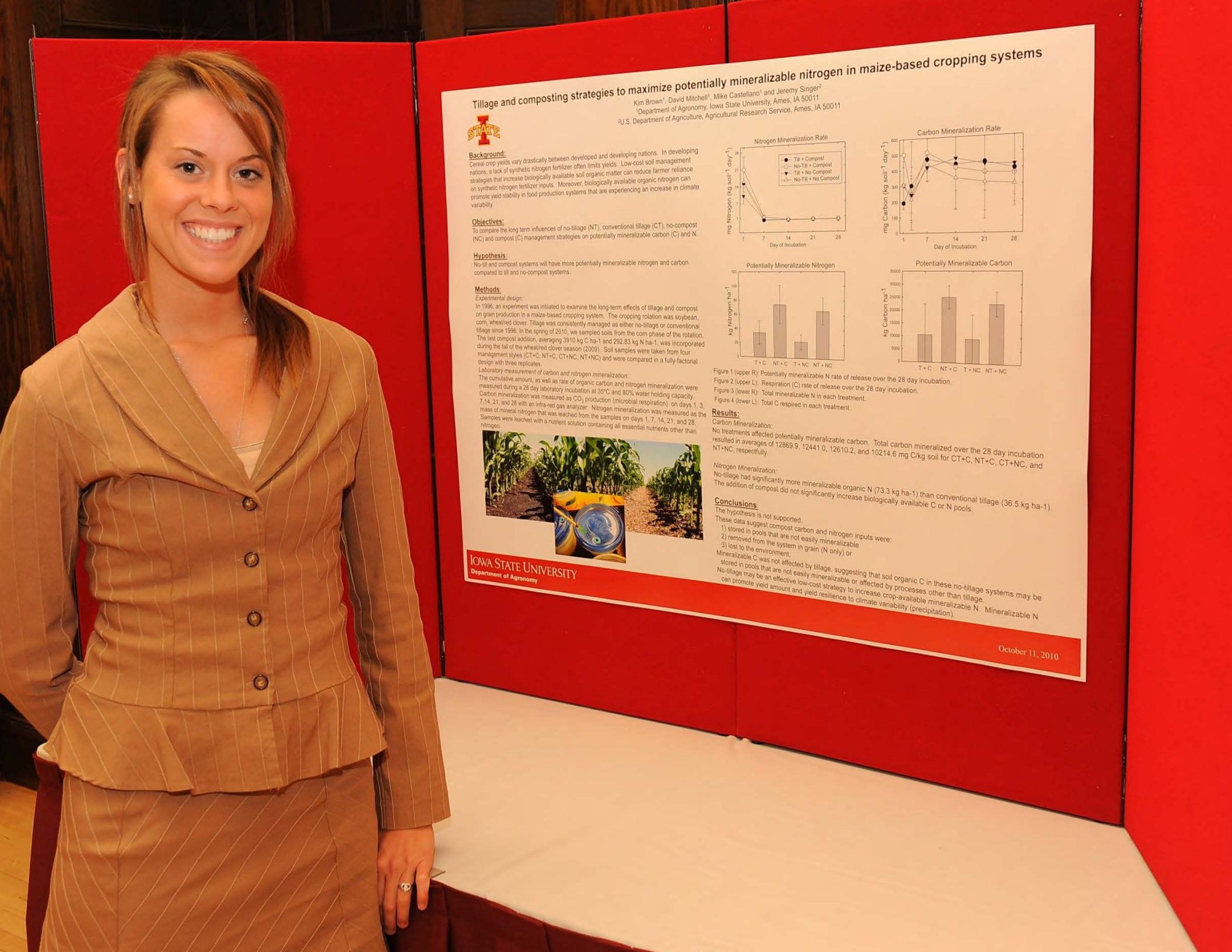
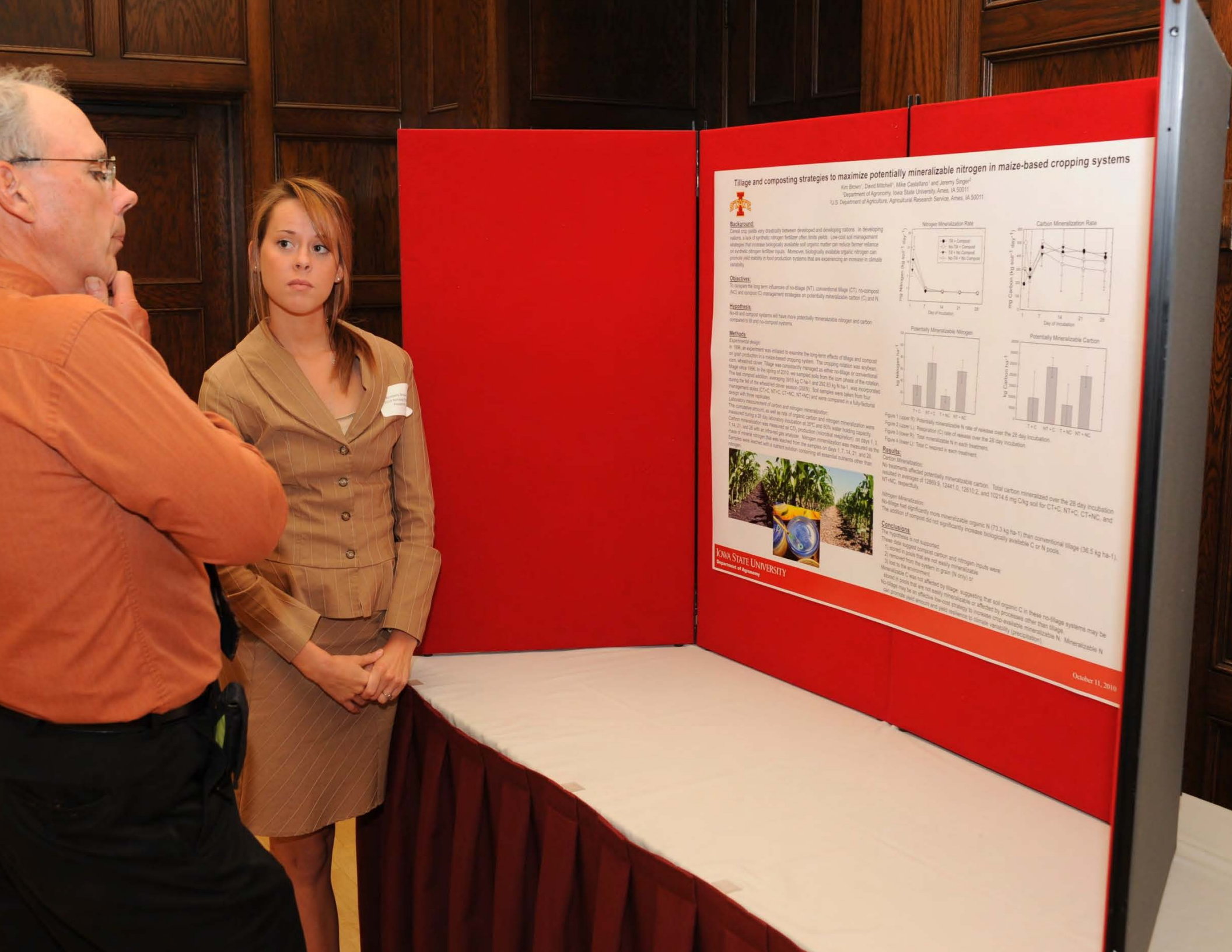

Tillage and composting strategies to maximize potentially mineralizable nitrogen in maize-based cropping systems
Kim Brown[1], David Mitchell[1], Mike Castellano[1] and Jeremy Singer[2]
[1]Department of Agronomy, Iowa State University, Ames, IA 50011
[2]U.S. Department of Agriculture, Agricultural Research Service, Ames, IA 50011
Background:
Cereal crop yields vary drastically between developed and developing nations. In developing nations, a lack of synthetic nitrogen fertilizer often limits yields. Low-cost soil management strategies that increase biologically available soil organic matter can reduce farmer reliance on synthetic nitrogen fertilizer inputs. Moreover, biologically available organic nitrogen can promote yield stability in food production systems that are experiencing an increase in climate variability.
Objectives:
To compare the long term influences of no-tillage (NT), conventional tillage (CT), no-compost (NC) and compost (C) management strategies on potentially mineralizable carbon (C) and N.
Hypothesis:
No-till and compost systems will have more potentially mineralizable nitrogen and carbon compared to till and no-compost systems.
Methods:
Experimental design:
In 1996, an experiment was intiated to examine the long-term effects of tillage and compost on grain production in a maize-based cropping system. The cropping rotation was soybean, corn, wheat/red clover. Tillage was consistently managed as either no-tillage or conventional tillage since 1996. In the spring of 2010, we sampled soils from the corn phase of the rotation. The last compost addition, averaging 3910 kg C ha-1 and 292.83 kg N ha-1, was incorporated during the fall of the wheat/red clover season (2009). Soil samples were taken from four management styles (CT+C, NT+C, CT+NC, NT+NC) and were compared in a fully-factorial design with three replicates.
Laboratory measurement of carbon and nitrogen mineralization:
The cumulative amount, as well as rate of organic carbon and nitrogen mineralization were measured during a 28 day laboratory incubation at 35°C and 80% water holding capacity. Carbon mineralization was measured as CO_2 production (microbial respiration) on days 1, 3, 7,14, 21, and 28 with an infra-red gas analyzer. Nitrogen mineralization was measured as the mass of mineral nitrogen that was leached from the samples on days 1, 7, 14, 21, and 28. Samples were leached with a nutrient solution containing all essential nutrients other than nitrogen.
Nitrogen Mineralization Rate
mg Nitrogen (kg soil^{-1} day^{-1})
Day of Incubation
Till + Compost
No-Till + Compost
Till + No Compost
No-Till + No Compost
Carbon Mineralization Rate
mg Carbon (kg soil^{-1} day^{-1})
Day of Incubation
Potentially Mineralizable Nitrogen
kg Nitrogen ha^{-1}
Potentially Mineralizable Carbon
kg Carbon ha^{-1}
T + C
NT + C
T + NC
NT + NC
Figure 1 (upper R): Potentially mineralizable N rate of release over the 28 day incubation.
Figure 2 (upper L): Respiration (C) rate of release over the 28 day incubation.
Figure 3 (lower R): Total mineralizable N in each treatment.
Figure 4 (lower L): Total C respired in each treatment.
Results:
Carbon Mineralization:
No treatments affected potentially mineralizable carbon. Total carbon mineralized over the 28 day incubation resulted in averages of 12869.9, 12441.0, 12610.2, and 10214.6 mg C/kg soil for CT+C, NT+C, CT+NC, and NT+NC, respectfully.
Nitrogen Mineralization:
No-tillage had significantly more mineralizable organic N (73.3 kg ha-1) than conventional tillage (36.5 kg ha-1). The addition of compost did not significantly increase biologically available C or N pools.
Conclusions:
The hypothesis is not supported.
These data suggest compost carbon and nitrogen inputs were:
1) stored in pools that are not easily mineralizable
2) removed from the system in grain (N only) or
3) lost to the environment.
Mineralizable C was not affected by tillage, suggesting that soil organic C in these no-tillage systems may be stored in pools that are not easily mineralizable or affected by processes other than tillage.
No-tillage may be an effective low-cost strategy to increase crop-available mineralizable N. Mineralizable N can promote yield amount and yield resilience to climate variability (precipitation).
IOWA STATE UNIVERSITY
Department of Agronomy
October 11, 2010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Nitrogen Mineralization Rate
Carbon Mineralization Rate
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Potentially Mineralizable Carbon
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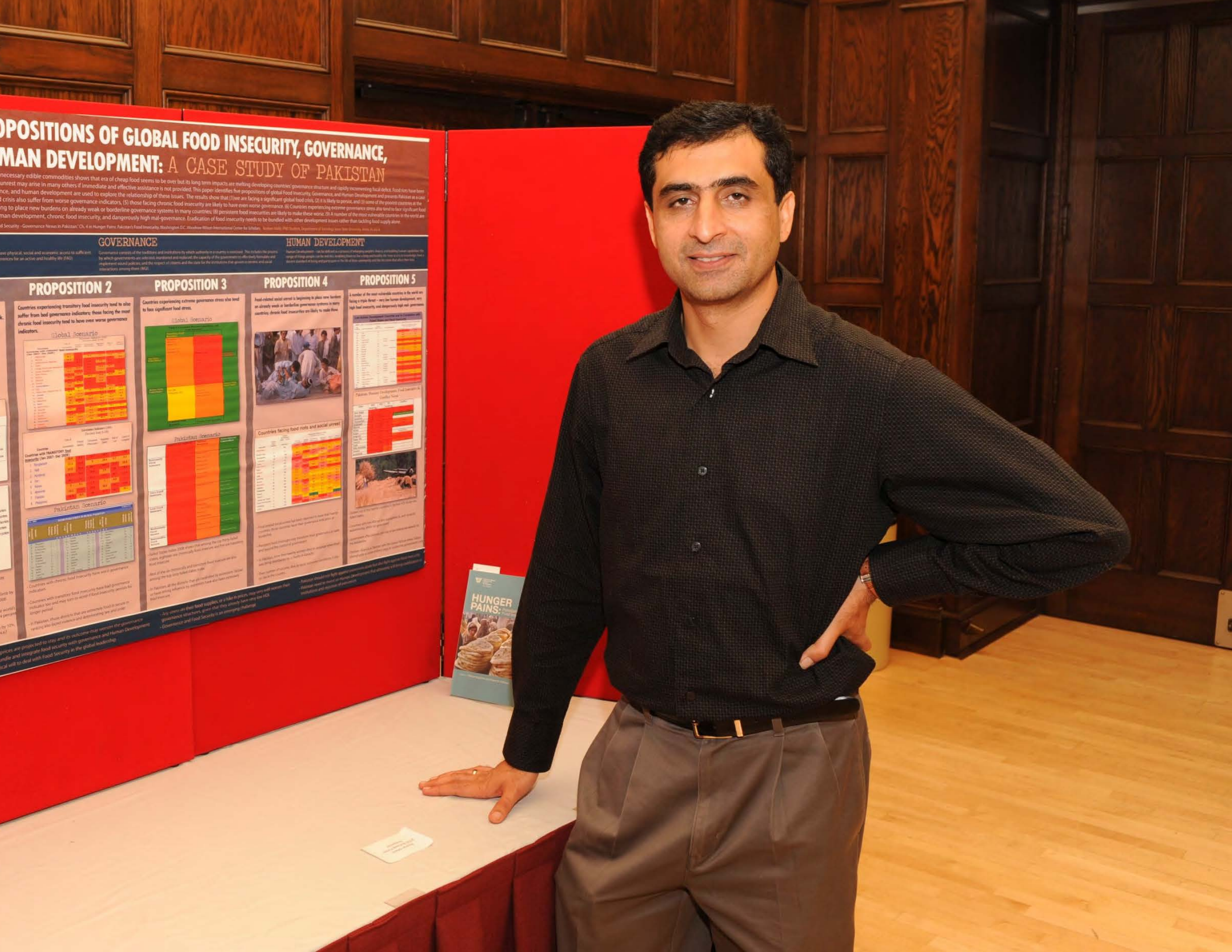
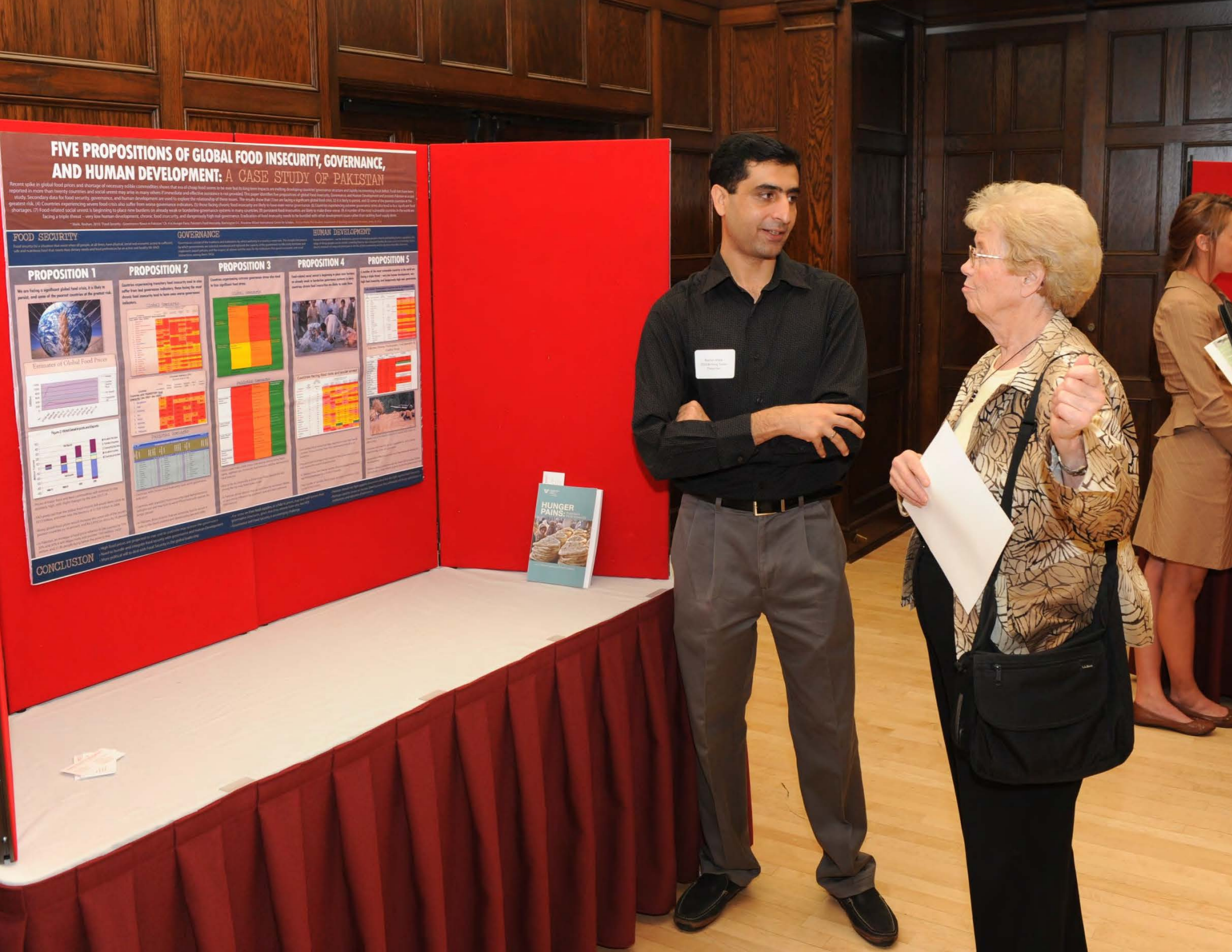

OPOSITIONS OF GLOBAL FOOD INSECURITY, GOVERNANCE,
MAN DEVELOPMENT: A CASE STUDY OF PAKISTAN
GOVERNANCE
HUMAN DEVELOPMENT
PROPOSITION 2
PROPOSITION 3
PROPOSITION 4
PROPOSITION 5
Global Scenario
Pakistan Scenario
Countries facing food riots and social unrest
HUNGER PAINS


FIVE PROPOSITIONS OF GLOBAL FOOD INSECURITY, GOVERNANCE, AND HUMAN DEVELOPMENT: A CASE STUDY OF PAKISTAN
FOOD SECURITY
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PROPOSITION 1
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PROPOSITION 4
PROPOSITION 5
Estimates of Global Food Prices
CONCLUSION
HUNGER PAINS

Impacts of lipids on digestive rate and physicochemical properties of starch

Yongfeng Ai, Stephen Setiawan, and Jay-lin Jane

Center for Crops Utilization Research, Department of Food Science and Human Nutrition, Iowa State University

ABSTRACT

The objective of the first part of the study was to compare effects of different lipids on digestive rates and physicochemical properties of starches with different structures. The enzymatic hydrolysis, thermal property, and pasting property of selected starches, normal, waxy, and high-amylose cornstarch and tapioca starch, and that with added lipids were analyzed and compared. Amylodextrin (DP 25) with and without lipids were analyzed using ^{13}C-nuclear magnetic resonance (NMR) to reveal the interaction between starch molecules and lipids. Results showed that all the tested lipids formed helical complex with amylose but to different extents. The amylose-corn oil and amylose-soy lecithin mixtures had little complex formation and did not show a melting peak in the thermogram of differential scanning calorimetry (DSC). The second part of the study was to understand *in vivo* digestibility of high-amylose cornstarch-stearic acid complex in rats, comparing with high-amylose cornstarch and normal cornstarch. Results showed a substantially larger amount high-amylose cornstarch-stearic acid complex was not digested by rats and was discharged in feces.

MATERIALS & METHODS

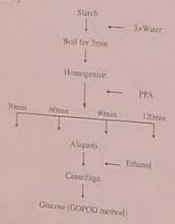
Materials:

- **Starch**: normal, waxy, and high-amylose cornstarch and tapioca starch.
- **Lipid**: corn oil, soy lecithin, palmitic acid, oleic acid, and linoleic acid.
- High-amylose cornstarch-stearic acid complex used for *in vivo* study was prepared following the method of Hasjim et al. (2010).

Methods:

The starch was properly mixed with 10% (w/w, dsb) each of the lipids, and the sample was subjected for the following analyses:

- **Enzymatic digestibility**



- **Thermal property** — use a DSC. Percentage retrogradation of starch was done using the gelatinized starch samples after storing at 4°C for 7days.
- **Pasting property** — use a Rapid Visco-Analyzer with 8% (w/w, dsb) starch suspension.
- **^{13}C-NMR**-amylodextrin (DP 25) aqueous solution (50mg/mL) with 25% (w/w, dry amylodextrin basis) lipids following the method of Jane & Robyt (1985).
- **Diet for *in vivo* study** — normal cornstarch diet, high-amylose cornstarch diet, and high-amylose cornstarch-stearic acid complex diet were prepared following the recipe of AIN-93 Rodent Diets with cooked starch (Reeves, 1997).
- **Resistant starch content of the diet** — analyzed following the AOAC Method 991.43 (2003).
- **Lipid content of rat feces** — analyzed following the method of Folch et al. (1956).
- **Total starch content of rat feces** — analyzed using Total Starch Assay Kit following the AACC method 76-13 (2000).
- **Thin layer chromatography (TLC) of lipids** — lipids were extracted from rat feces following the AOAC Method 996.06 (2005) and separated using TLC following the method of Wang & Wang (2008).

RESULTS

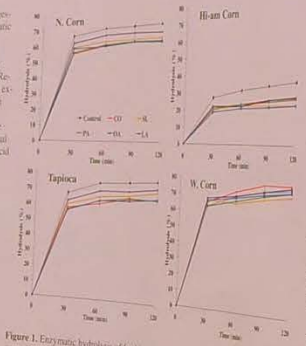


Figure 1. Enzymatic hydrolysis of freshly-cooked starch and that with 10% (w/w, dsb) added corn oil (CO), soy lecithin (SL), palmitic acid (PA), oleic acid (OA), and linoleic acid (LA).

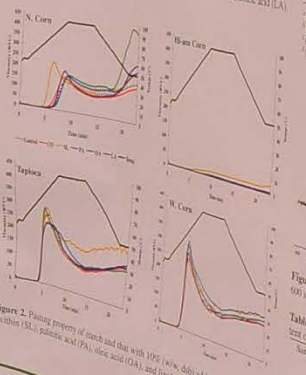


Figure 2. Pasting property of starch and that with 10% (w/w, dsb) added corn oil (CO), soy lecithin (SL), palmitic acid (PA), oleic acid (OA), and linoleic acid (LA).

Table 1. Percentage retrogradation of starch and that with 10% (w/w, dsb) added lipids

Sample	Retrogradation (%) [a]				
	Control	CO [c]	SL [c]	OA [c]	LA [c]
NCS [b]	53.0	46.4	42.1	47.1	47.2
TPS [b]	13.4	13.9	11.9	17.2	19.6
WCS [b]	7.8	11.0	17.2	25.8	31.7

Table 2. Enthalpy change of amylose-lipid complex of starch and that with 10% (w/w, dsb) added lipids

Sample	ΔH (J/g)					
	Control	CO [c]	SL [c]	PA [c]	OA [c]	LA [c]
NCS [b]	0.9±0.0	0.9±0.1	0.1±0.0	1.8±0.1	1.9±0.1	1.7±0.1
TPS [b]	N.D. [d]	N.D. [d]	N.D. [d]	0.6±0.4	0.6±0.1	0.4±0.1
WCS [b]	N.D. [d]	N.D. [d]	N.D. [d]	N.D. [d]	N.D. [d]	N.D. [d]

Table 3. Changes in chemical shifts of amylodextrin (DP 25) in aqueous solutions with the presence of 25% (w/w, db) lipids

Sample	Change of Chemical shift (p.p.m.)					
	C1	C4	C3	C2	C5	C6
CO [c]	+0.01	+0.02	0.00	0.00	0.00	0.00
SL [c]	+0.03	+0.06	0.00	0.00	0.00	0.00
OA [c]	+0.03	+0.05	0.00	0.00	0.00	0.00

[a] Retrogradation=ΔH of the melting of retrograded starch / ΔH of starch gelatinization×100.
[b] NCS = normal cornstarch, TPS = tapioca starch, WCS = waxy cornstarch.
[c] CO = corn oil, SL = soy lecithin, PA= palmitic acid, OA = oleic acid, LA = linoleic acid.
[d] Not detected.

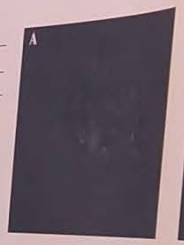


Figure 4. Light micrographs of starch isolated from rat feces: A: high-amylose cornstarch diet, and B: high-amylose cornstarch-stearic acid complex diet.

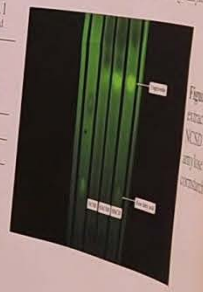


Figure 5. Thin layer chromatography of lipid extracts from rat feces: NCSD = normal cornstarch diet, HACSD = high-amylose cornstarch diet, HSCD= high-amylose cornstarch-stearic acid complex diet.

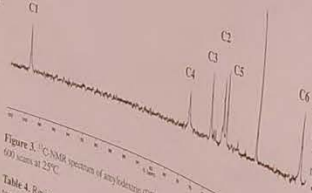


Figure 3. ^{13}C-NMR spectrum of amylodextrin (DP 25) in aqueous solutions (50mg/mL), obtained from 600 scans at 25°C.

Table 4. Resistant starch content of rat diets, and weight, total starch content, and lipid content of feces collected from rats fed with different diets

Sample	Resistant starch of diet (%)	Feces weight (g)		Total starch content of feces (%)	Lipid content of feces (%)
		As is	Dry		
NCSD [a]	2.5±0.2	0.23±0.07	0.26±0.08	0.9±0.6	0.6±0.4
HACSD [b]	12.5±0.8	0.55±0.31	0.26±0.14	16.8±1.0	16.6±0.4
HSCD [c]	30.1±1.0	2.04±0.76	1.65±0.42	44.9±0.0	11.7±0.3

[a] NCSD = normal cornstarch diet, HACSD = high-amylose cornstarch diet, HSCD= high-amylose cornstarch-stearic acid complex diet.

CONCLUSIONS

- Lipids suppressed the retrogradation of normal cornstarch but not high-amylose cornstarch (**Table 1**).
- Lipids showed different impacts on the pasting properties of normal cornstarch and tapioca starch (**Figure 2**).
- Lipids had little effects on the digestive rate and pasting properties of high-amylose cornstarch (**Figure 2**), indicating no interaction.
- Free fatty acids reduced digestive rates of normal corn, high-amylose cornstarch, and tapioca starch (**Figure 1**).
- Corn oil and soy lecithin also formed complex with amylose, but to different extents. The formation of amylose-fatty acid complex was not detected, as no change in the melting peak of amylose-lipid complex was not detected (**Table 2, Figure 1**).
- High-amylose cornstarch was partially resistant to enzymatic hydrolysis in the digestive tract of rats, which was discharged in feces (**Table 4, Figure 4**). The high-amylose cornstarch-stearic acid complex was highly resistant to enzymatic hydrolysis in the digestive tract of rats, and was discharged in feces in large quantity (**Table 4, Figures 4, 5**).

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ACKNOWLEDGEMENT

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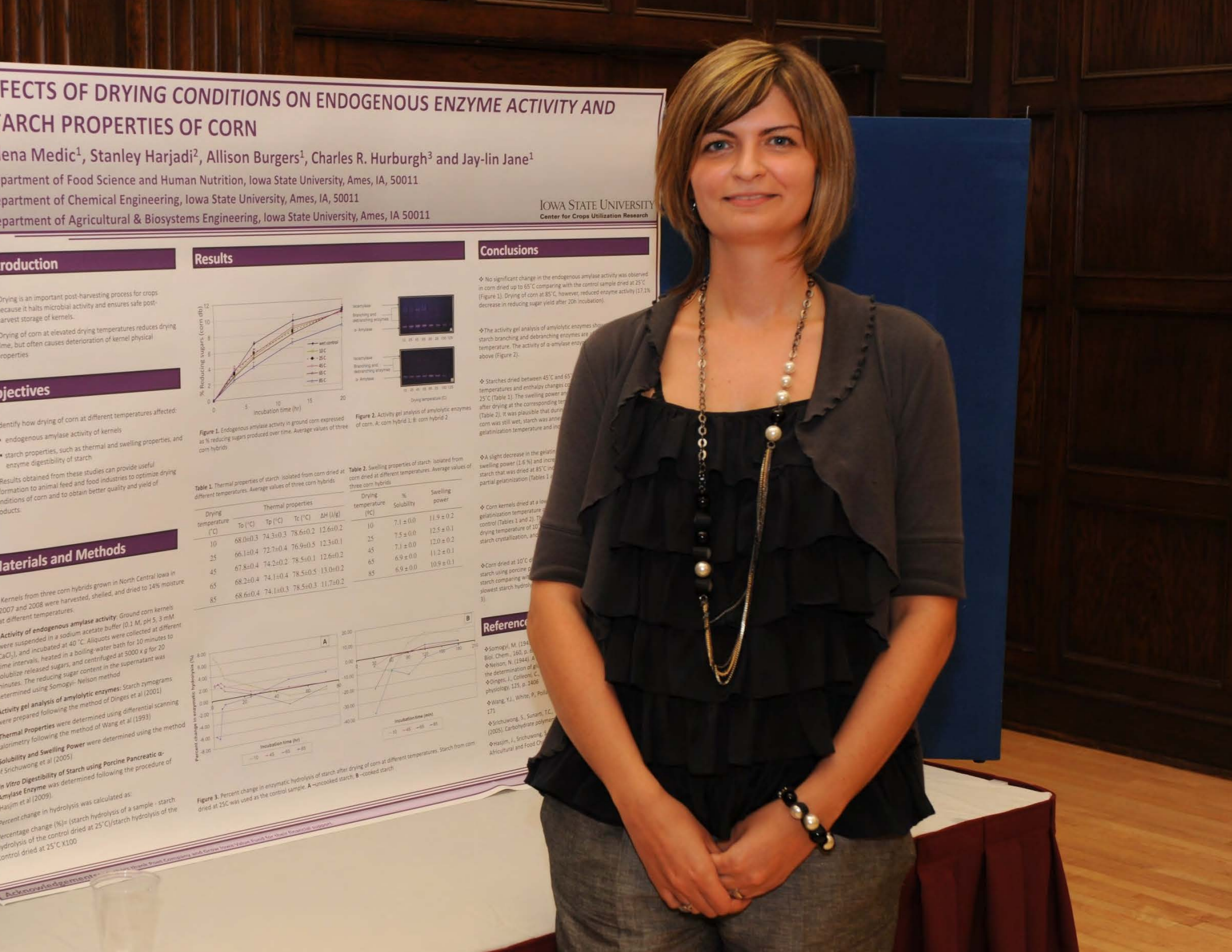
FECTS OF DRYING CONDITIONS ON ENDOGENOUS ENZYME ACTIVITY AND
ARCH PROPERTIES OF CORN
ena Medic[1], Stanley Harjadi[2], Allison Burgers[1], Charles R. Hurburgh[3] and Jay-lin Jane[1]
partment of Food Science and Human Nutrition, Iowa State University, Ames, IA, 50011
partment of Chemical Engineering, Iowa State University, Ames, IA, 50011
partment of Agricultural & Biosystems Engineering, Iowa State University, Ames, IA 50011
IOWA STATE UNIVERSITY
Center for Crops Utilization Research
roduction
Drying is an important post-harvesting process for crops ecause it halts microbial activity and ensures safe post-arvest storage of kernels.
Drying of corn at elevated drying temperatures reduces drying me, but often causes deterioration of kernel physical roperties
jectives
Identify how drying of corn at different temperatures affected:
endogenous amylase activity of kernels
starch properties, such as thermal and swelling properties, and enzyme digestibility of starch
Results obtained from these studies can provide useful formation to animal feed and food industries to optimize drying nditions of corn and to obtain better quality and yield of oducts.
laterials and Methods
Kernels from three corn hybrids grown in North Central Iowa in 2007 and 2008 were harvested, shelled, and dried to 14% moisture at different temperatures.
Activity of endogenous amylase activity: Ground corn kernels were suspended in a sodium acetate buffer (0.1 M, pH 5, 3 mM CaCl2), and incubated at 40 °C. Aliquots were collected at different ime intervals, heated in a boiling-water bath for 10 minutes to olublize released sugars, and centrifuged at 5000 x g for 20 inutes. The reducing sugar content in the supernatant was etermined using Somogyi- Nelson method
Activity gel analysis of amylolytic enzymes: Starch zymograms ere prepared following the method of Dinges et al (2001)
Thermal Properties were determined using differential scanning alorimetry following the method of Wang et al (1993)
Solubility and Swelling Power were determined using the method f Srichuwong et al (2005)
In Vitro Digestibility of Starch using Porcine Pancreatic α-Amylase Enzyme was determined following the procedure of Hasjim et al (2009).
Percent change in hydrolysis was calculated as:
Percentage change (%)= (starch hydrolysis of a sample - starch hydrolysis of the control dried at 25°C)/starch hydrolysis of the control dried at 25°C X100
Results
% Reducing sugars (corn db)
Incubation time (hr)
wet control
10 C
25 C
45 C
65 C
85 C
Figure 1. Endogenous amylase activity in ground corn expressed as % reducing sugars produced over time. Average values of three corn hybrids.
Figure 2. Activity gel analysis of amylolytic enzymes of corn. A: corn hybrid 1; B: corn hybrid 2
Table 1. Thermal properties of starch isolated from corn dried at different temperatures. Average values of three corn hybrids
Table 2. Swelling properties of starch isolated from corn dried at different temperatures. Average values of three corn hybrids
Drying temperature (°C) | % Solubility | Swelling power
10 | 7.1 ± 0.0 | 11.9 ± 0.2
25 | 7.5 ± 0.0 | 12.5 ± 0.1
45 | 7.1 ± 0.0 | 12.0 ± 0.2
65 | 6.9 ± 0.0 | 11.2 ± 0.1
85 | 6.9 ± 0.0 | 10.9 ± 0.1
Percent change in enzymatic hydrolysis (%)
Incubation time (hr)
Incubation time (min)
Figure 3. Percent change in enzymatic hydrolysis of starch after drying of corn at different temperatures. Starch from corn dried at 25C was used as the control sample. A –uncooked starch; B –cooked starch
Conclusions
No significant change in the endogenous amylase activity was observed in corn dried up to 65°C comparing with the control sample dried at 25°C (Figure 1). Drying of corn at 85°C, however, reduced enzyme activity (17.1% decrease in reducing sugar yield after 20h incubation).
The activity gel analysis of amylolytic enzymes sho starch branching and debranching enzymes are temperature. The activity of α-amylase enzy above (Figure 2).
Starches dried between 45°C and 65 temperatures and enthalpy changes co 25°C (Table 1). The swelling power an after drying at the corresponding te (Table 2). It was plausible that durin corn was still wet, starch was anne gelatinization temperature and inc
A slight decrease in the gelatin swelling power (1.6 %) and incre starch that was dried at 85°C inc partial gelatinization (Tables 1 a
Corn kernels dried at a low gelatinization temperature g control (Tables 1 and 2). Th drying temperature of 10 starch crystallization, and
Corn dried at 10°C d starch using porcine p starch comparing wi slowest starch hydrol 3).
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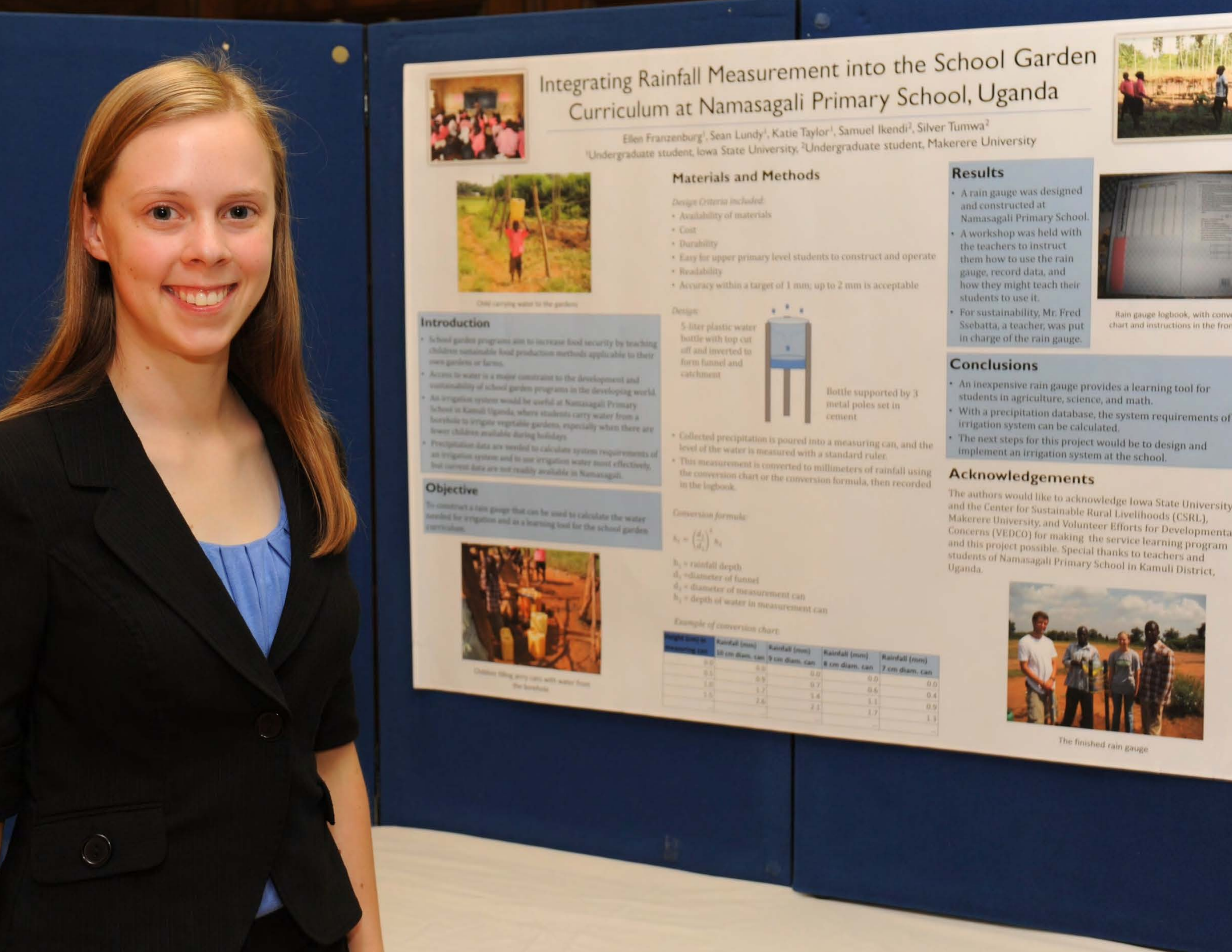
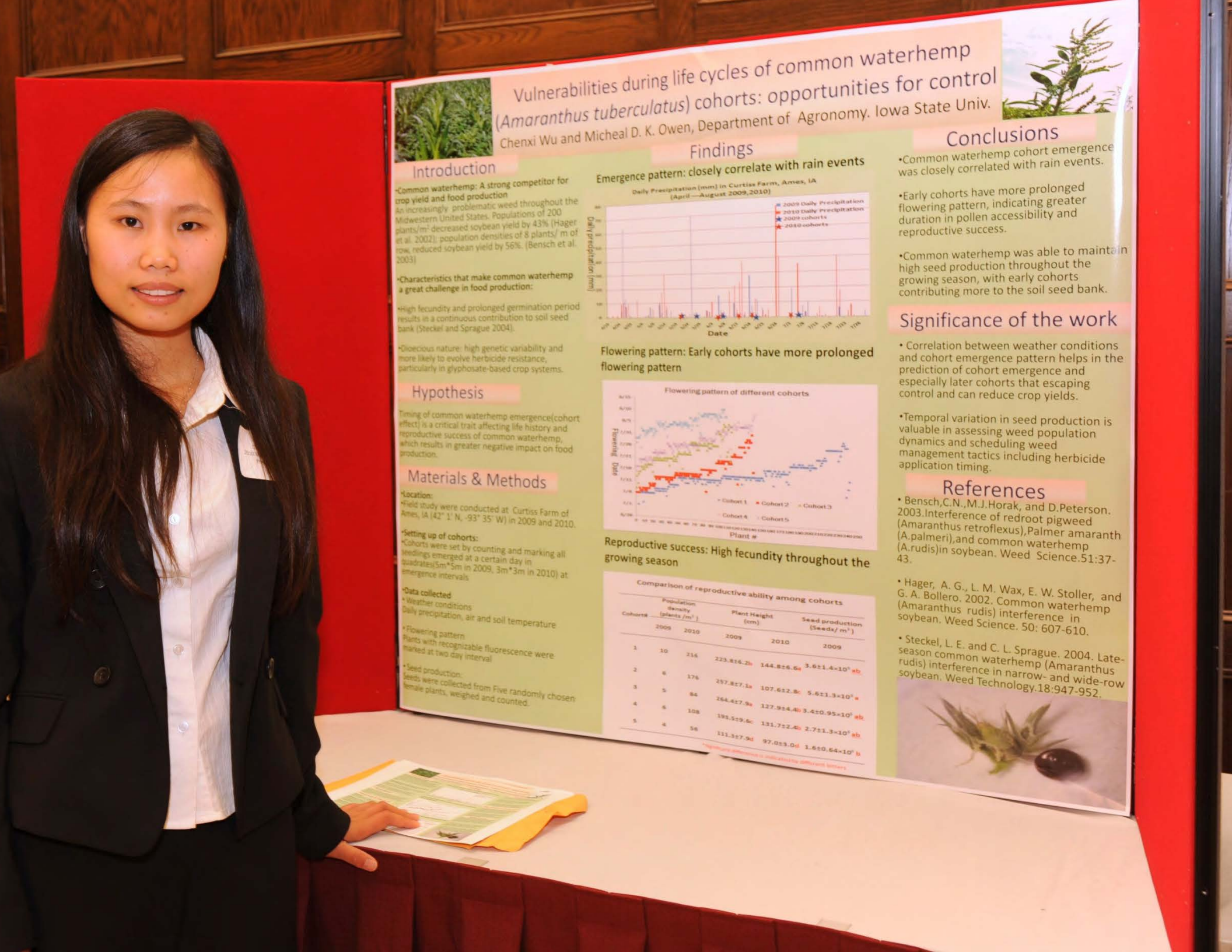
Hasjim, J., Srichuwong, S. Africultural and Food Ch
Acknowledgement


y Production: Using Knowledge Transfer to Alleviate Protein Deficiencies
ls and Provide an Income Source for Namasagali Primary School, Uganda
Iowa State University[1] Makerere University[2]
Castro[1], Andrew Stammer[1], Akech Violet[2], Ibore Martha[2], Natukunda Kevin[2], Tumwa Silver[2]
Donald Kugonza[2], Dorothy Masinde[1], Gail Nonnecke[1], Tom Brumm[1], and Richard Schultz[1]
Poultry House Structure 2010
The Poultry house was built on an angle to break wind and create shadow at mid-day for cooling.
Building dimensions and equipment:
• 6m x 5m x 2m; Area: 30m²
• Gabled roof requiring ~14 tin sheets
• Highest peak in house will reach to 3m
• Wind break established
• Nesting boxes and roosts
• Feeders(3) and drinkers(5)
Results
• Poultry House was constructed.
• 126 chicks were vaccinated and brooded, 101 layers are at the school.
• Workshop was conducted to establish a poultry club.
• A management plan was created for the poultry club and included student leaders, teachers and staff.
• Local NGO supplied poultry feed up to the 21st week when subsequent income from partial egg sales provided funds for continued inputs and feed.
• Majority of eggs are incorporated in maize porridge used for school lunch program.
• Children have knowledge to practice poultry keeping at their homes and community on a small scale.
Poultry Management Practices
Housing- Chickens will live in a deep litter system where wood shavings, coffee husks, and other organic materials are used as litter. The house also has a run where the birds can forage and exercise. The walls are brick with mesh openings to help stabilize the indoor temperature.
Feeding- An age-specific balanced diet of prepackaged feed with garden residues and agroforestry products will sustain the birds.
Disease control/prevention- Vaccinated for:
• Mareks disease
• Newcastle disease
• Gumboro disease
• Infectious bronchitis
• Fowl typhoid diseases
Egg collection- Eggs collected twice daily, cleaned with damp cloth, and stored in egg trays in a cool, dry place.
Litter management- Litter is checked weekly and dug using a rake. Used litter can be composed and used in the school garden.
Conclusion
Acknowledgements


Health Education and Resources for Primary School
Boys and Girls in the Kamuli District
Ellen Franzenburg[1], Jacob Hunter[1], Martha Ibore[2], Sean Lundy[1], Amber Seitz[1], Sharon Tusiime[2], Muhammed Walugembe[2]
[1]Iowa State University & [2]Makerere University
Introduction
Results
Conclusion
This sanitation project showed there is a high level of interest in health education at the rural primary schools of the Kamuli district and has created an opportunity for continued sanitation improvement.
Future work includes:
• Evaluating the effectiveness of the resource clubs
• More education about reusable pads
• Using vegetable gardens as a source of income for the clubs
• Involve parents in health education seminars.
To left: With the help of two students, Sean Lundy builds a hand washing station. (Photo by: Jacob Hunter)
To right: Two girls show their re-usable cloth sanitary pads they sewed. (Photo by: Darrin Vanderplas)
To right: Amber Seitz interviews a student about her menstruation and health. (Photo by: Jacob Hunter)


Integrating Rainfall Measurement into the School Garden Curriculum at Namasagali Primary School, Uganda
Ellen Franzenburg[1], Sean Lundy[1], Katie Taylor[1], Samuel Ikendi[2], Silver Tumwa[2]
[1]Undergraduate student, Iowa State University, [2]Undergraduate student, Makerere University
Child carrying water to the gardens
Introduction
School garden programs aim to increase food security by teaching children sustainable food production methods applicable to their own gardens or farms.
Access to water is a major constraint to the development and sustainability of school garden programs in the developing world.
An irrigation system would be useful at Namasagali Primary School in Kamuli Uganda, where students carry water from a borehole to irrigate vegetable gardens, especially when there are fewer children available during holidays.
Precipitation data are needed to calculate system requirements of an irrigation system and to use irrigation water most effectively, but current data are not readily available in Namasagali.
Objective
To construct a rain gauge that can be used to calculate the water needed for irrigation and as a learning tool for the school garden curriculum.
Children filling jerry cans with water from the borehole
Materials and Methods
Design Criteria included:
Availability of materials
Cost
Durability
Easy for upper primary level students to construct and operate
Readability
Accuracy within a target of 1 mm; up to 2 mm is acceptable
Design:
5-liter plastic water bottle with top cut off and inverted to form funnel and catchment
Bottle supported by 3 metal poles set in cement
Collected precipitation is poured into a measuring can, and the level of the water is measured with a standard ruler.
This measurement is converted to millimeters of rainfall using the conversion chart or the conversion formula, then recorded in the logbook.
Conversion formula:
$h_2 = \left(\frac{d_1}{d_2}\right)^2 h_1$
h_2 = rainfall depth
d_1 = diameter of funnel
d_2 = diameter of measurement can
h_1 = depth of water in measurement can
Example of conversion chart:
Height (cm) in measuring can
Rainfall (mm) 10 cm diam. can
Rainfall (mm) 9 cm diam. can
Rainfall (mm) 8 cm diam. can
Rainfall (mm) 7 cm diam. can
0.0 0.0 0.0 0.0 0.0
0.5 0.9 0.7 0.6 0.4
1.0 1.7 1.4 1.1 0.9
1.5 2.6 2.1 1.7 1.3
Results
A rain gauge was designed and constructed at Namasagali Primary School.
A workshop was held with the teachers to instruct them how to use the rain gauge, record data, and how they might teach their students to use it.
For sustainability, Mr. Fred Ssebatta, a teacher, was put in charge of the rain gauge.
Rain gauge logbook, with conve chart and instructions in the fron
Conclusions
An inexpensive rain gauge provides a learning tool for students in agriculture, science, and math.
With a precipitation database, the system requirements of irrigation system can be calculated.
The next steps for this project would be to design and implement an irrigation system at the school.
Acknowledgements
The authors would like to acknowledge Iowa State University and the Center for Sustainable Rural Livelihoods (CSRL), Makerere University, and Volunteer Efforts for Developmenta Concerns (VEDCO) for making the service learning program and this project possible. Special thanks to teachers and students of Namasagali Primary School in Kamuli District, Uganda.
The finished rain gauge


The Mediterranean Diet in Italy:
The Role of Leafy Greens
Vivian Bernau[1], Sam Bird[2], Emma Flemmig[1] and Emily Zimmerman[2]
Results
Recommendations
Bioversity International
WA STATE UNIVERSITY


Vulnerabilities during life cycles of common waterhemp (Amaranthus tuberculatus) cohorts: opportunities for control
Chenxi Wu and Micheal D. K. Owen, Department of Agronomy. Iowa State Univ.
Introduction
•Common waterhemp: A strong competitor for crop yield and food production
An increasingly problematic weed throughout the Midwestern United States. Populations of 200 plants/m² decreased soybean yield by 43% (Hager et al. 2002); population densities of 8 plants/ m of row, reduced soybean yield by 56%. (Bensch et al. 2003)
•Characteristics that make common waterhemp a great challenge in food production:
•High fecundity and prolonged germination period results in a continuous contribution to soil seed bank (Steckel and Sprague 2004).
•Dioecious nature: high genetic variability and more likely to evolve herbicide resistance, particularly in glyphosate-based crop systems.
Hypothesis
Timing of common waterhemp emergence(cohort effect) is a critical trait affecting life history and reproductive success of common waterhemp, which results in greater negative impact on food production.
Materials & Methods
•Location:
•Field study were conducted at Curtiss Farm of Ames, IA (42° 1' N, -93° 35' W) in 2009 and 2010.
•Setting up of cohorts:
•Cohorts were set by counting and marking all seedlings emerged at a certain day in quadrates(5m*5m in 2009, 3m*3m in 2010) at emergence intervals
•Data collected
• Weather conditions
Daily precipitation, air and soil temperature
• Flowering pattern
Plants with recognizable fluorescence were marked at two day interval
• Seed production:
Seeds were collected from Five randomly chosen female plants, weighed and counted.
Findings
Emergence pattern: closely correlate with rain events
Daily Precipitation (mm) in Curtiss Farm, Ames, IA (April —August 2009,2010)
2009 Daily Precipitation
2010 Daily Precipitation
2009 cohorts
2010 cohorts
Daily precipitation (mm)
Date
Flowering pattern: Early cohorts have more prolonged flowering pattern
Flowering pattern of different cohorts
Flowering Date
Cohort 1
Cohort 2
Cohort 3
Cohort 4
Cohort 5
Plant #
Reproductive success: High fecundity throughout the growing season
Comparison of reproductive ability among cohorts
Cohort#
Population density (plants /m²)
2009
2010
Plant Height (cm)
2009
2010
Seed production (Seeds/ m²)
2009
1 10 216 223.8±6.2b 144.8±6.6a 3.6±1.4×10⁵ ab
2 6 176 257.8±7.1a 107.6±2.8c 5.6±1.3×10⁵ a
3 5 84 264.4±7.9a 127.9±4.4b 3.4±0.95×10⁵ ab
4 6 108 193.5±9.6c 131.7±2.4b 2.7±1.3×10⁵ ab
5 4 56 111.3±7.9d 97.0±3.0d 1.6±0.64×10⁵ b
*Significant difference is indicated by different letters
Conclusions
•Common waterhemp cohort emergence was closely correlated with rain events.
•Early cohorts have more prolonged flowering pattern, indicating greater duration in pollen accessibility and reproductive success.
•Common waterhemp was able to maintain high seed production throughout the growing season, with early cohorts contributing more to the soil seed bank.
Significance of the work
• Correlation between weather conditions and cohort emergence pattern helps in the prediction of cohort emergence and especially later cohorts that escaping control and can reduce crop yields.
•Temporal variation in seed production is valuable in assessing weed population dynamics and scheduling weed management tactics including herbicide application timing.
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The Norman Borlaug Summer Internship
Jack Roach
Biology Program, Iowa State University, Ames, Iowa 50010
Introduction
In honor of the "Father of the Green Revolution," Norman Borlaug, the Plant Sciences Institute at Iowa State University sponsors summer internships at international agricultural research centers. One of these, the International Potato Center (CIP) in Lima, Peru, helps ensure food security for developing countries, in part, by improving potatoes and other root and tuber crops.
At CIP I explored potato breeding, tuber processing, micronutrient evaluation, consumer preference determination, and tuber morphology analysis. My internship focused on potatoes.
Potato breeding
CIP breeds potatoes for traits including disease resistance, drought tolerance, and yield. Crossing occurs at the Huancayo satellite station in the Andes mountains and yields the toxic botanical fruits that contain up to 2000 true potato seeds, with which the selection process of new cultivars can begin (Figure 1).
Micronutrient evaluation
The breeding program also aims to characterize and prove potato and sweet potato micronutrient profiles, reduce deficiencies in iron, zinc, vitamin C, and other rients in low-income populations worldwide.
helped characterize ascorbic acid (vitamin C) ntrations in various potato cultivars with an bic acid-specific dye in acetone extracts of potato. olutions were subjected to spectrophotometry at m, with greater absorbance indicating higher of ascorbic acid.
studies by CIP researchers using this method ascorbic acid levels up to 65mg ascorbic boiled potatoes, or 20% of the recommended nce for adults (Burgos et al. 2008).
Figure 1. Potato fruit with true seed for advancement in a virus resistance program.
Figure 2. Potential colored-flesh potato cultivars.
Morphology analysis
Reliably characterizing tuber morphology can be a subjective and time consuming process. Analysis is often done without the aid of computers based on ruler measurements and color-matching charts. To maximize accuracy in characterization, I investigated the usefulness of computer programs such as Tomato Analyzer 2.2.0.0 (van der Knaap 2008).
This method was discontinued after being determined too slow for large populations. Furthermore, the lack of available potato-specific characterization software meant that much unusable data were generated.
Consumer preference
The success of a new cultivar depends in part on consumer reception. With this in mind, CIP is working to release colored-flesh cultivars with elevated anthocyanin and carotenoid levels to provide nutritional antioxidants (Figure 2).
I helped conduct a "taste test" of 54 potential colored-flesh cultivars. The potatoes were boiled until they could be pierced with a metal probe that could be removed cleanly, and were judged based on taste, texture, and post-cooking color change.
Acknowledgments
A million thanks to Meridith Bonierbale and Walter Amoros of the International Potato Center for hosting me and for their guidance, and to William Beavis and Deanne Brill of the Plant Sciences Institute at Iowa State University for making this experience possible.
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Impacts of lipids on digestive rate and physicochemical properties of starch

Yongfeng Ai, Stephen Setiawan, and Jay-lin Jane

Center for Crops Utilization Research, Department of Food Science and Human Nutrition, Iowa State University

METHODS

RESULTS

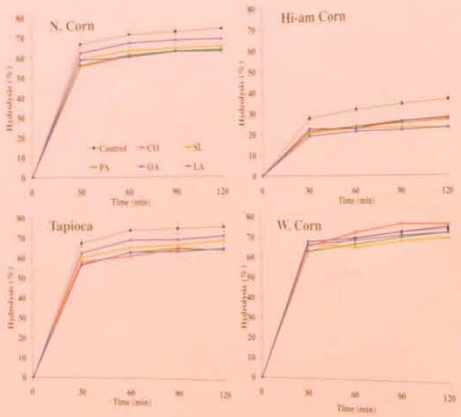

Figure 1. Enzymatic hydrolysis of freshly-cooked starch and that with 10% (w/w, dsb) added corn oil (CO), soy lecithin (SL), palmitic acid (PA), oleic acid (OA), and linoleic acid (LA).

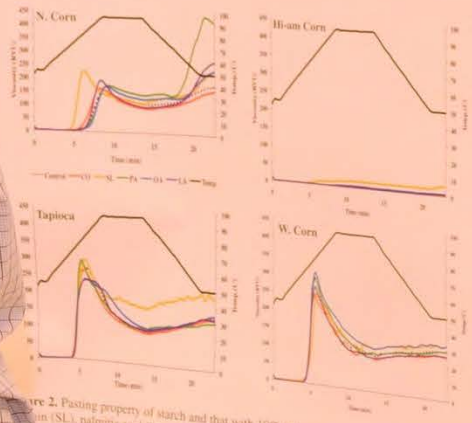

Figure 2. Pasting property of starch and that with 10% (w/w, dsb) added corn oil (CO), soy lecithin (SL), palmitic acid (PA), oleic acid (OA), and linoleic acid (LA).

Table 1. Percentage retrogradation of starch and that with 10% (w/w, dsb) added lipids

Sample	Retrogradation (%) [a]				
	Control	CO [c]	SL [c]	OA [c]	LA [c]
NCS [b]	53.0	46.4	42.1	47.1	47.2
TPS [b]	13.4	13.9	11.9	17.2	19.6
WCS [b]	7.8	11.0	17.2	25.8	31.7

Table 2. Enthalpy change of amylose-lipid complex of starch and that with 10% (w/w, dsb) added lipids

Sample	ΔH (J/g)					
	Control	CO [c]	SL [c]	PA [c]	OA [c]	LA [c]
NCS [b]	0.9±0.0	0.9±0.1	0.1±0.0	1.8±0.1	1.9±0.1	1.7±0.1
TPS [b]	N.D. [d]	N.D. [d]	N.D. [d]	0.6±0.4	0.6±0.1	0.4±0.1
WCS [b]	N.D. [d]	N.D. [d]	N.D. [d]	N.D. [d]	N.D. [d]	N.D. [d]

Table 3. Changes in chemical shifts of amylodextrin (DP 25) in aqueous solutions with the presence of 25% (w/w, db) lipids

Sample	Change of Chemical shift (p.p.m.)					
	C1	C4	C3	C2	C5	C6
CO [c]	+0.01	+0.02	0.00	0.00	0.00	0.00
SL [c]	+0.03	+0.06	0.00	0.00	0.00	0.00
OA [c]	+0.03	+0.05	0.00	0.00	0.00	0.00

[a] Retrogradation% = ΔH of the melting of retrograded starch / ΔH of starch gelatinization×100.
[b] NCS = normal cornstarch, TPS = tapioca starch, WCS = waxy cornstarch.
[c] CO = corn oil, SL = soy lecithin, PA= palmitic acid, OA = oleic acid, LA = linoleic acid.
[d] Not detected.

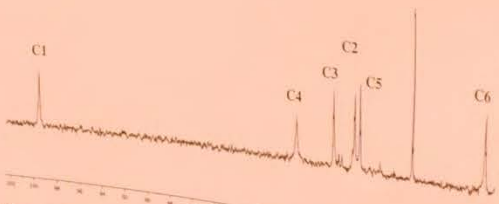

Figure 3. ^{13}C-NMR spectrum of amylodextrin (DP 25) in aqueous solutions (50mg/mL) obtained from 600 scans at 25°C

Table 4. Resistant starch content of rat diets, and weight, total starch content, and lipid content of feces collected from rats fed with different diets

Sample	Resistant starch of diet (%)	Feces weight (g)		Total starch content of feces (%)	Lipid content of feces (%)
		As is	Dry		
NCSD [a]	2.5±0.2	0.23±0.07	0.20±0.06	0.0±0.0	16.8±0.4
HACSD [a]	12.5±0.8	0.55±0.31	0.45±0.25	16.8±1.0	11.7±0.3
HSCD [a]	30.1±1.0	2.04±0.76	1.65±0.62	44.0±0.0	22.0±2.2

[a] NCSD = normal cornstarch diet, HACSD = high-amylose cornstarch diet, HSCD= high-amylose cornstarch-stearic acid complex diet.

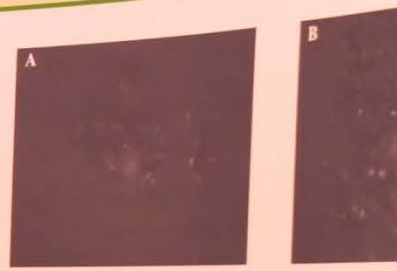

Figure 4. Light micrographs of starch isolated from rat feces observed high-amylose cornstarch diet, and B: high-amylose cornstarch-stearic a

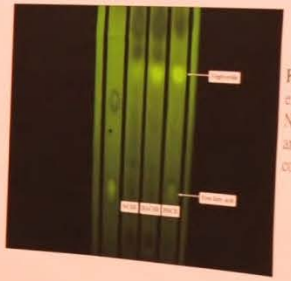

Figure 5. Thin layer chr extracted from rat feces NCSD = normal cornsta amylose cornstarch diet, cornstarch-stearic acid c

CONCLUSIONS

- Lipids suppressed the retrogradation of normal cornstarch but accelerated starch (**Table 1**).
- Lipids showed different impacts on the pasting properties of normal and h and tapioca starch (**Figure 2**).
- Lipids had little effects on the digestive rate and pasting properties of wax 2), indicating no interaction.
- Free fatty acids reduced digestive rates of normal corn, high-amylose corn, the formation of amylose-fatty acid complex (**Table 2, Figure 1**).
- Corn oil and soy lecithin also formed complex with amylose to lesser exten melting peak of amylose-lipid complex was not detected using DSC (**Table 2**
- High-amylose cornstarch was partially resistant to enzymatic hydrolysis in rats, which was discharged in feces (**Table 4, Figure 4**). The high-amylose co complex was highly resistant to enzymatic hydrolysis both in vivo and in vitro discharged in feces in large quantity (**Table 4, Figure 4, 5**).

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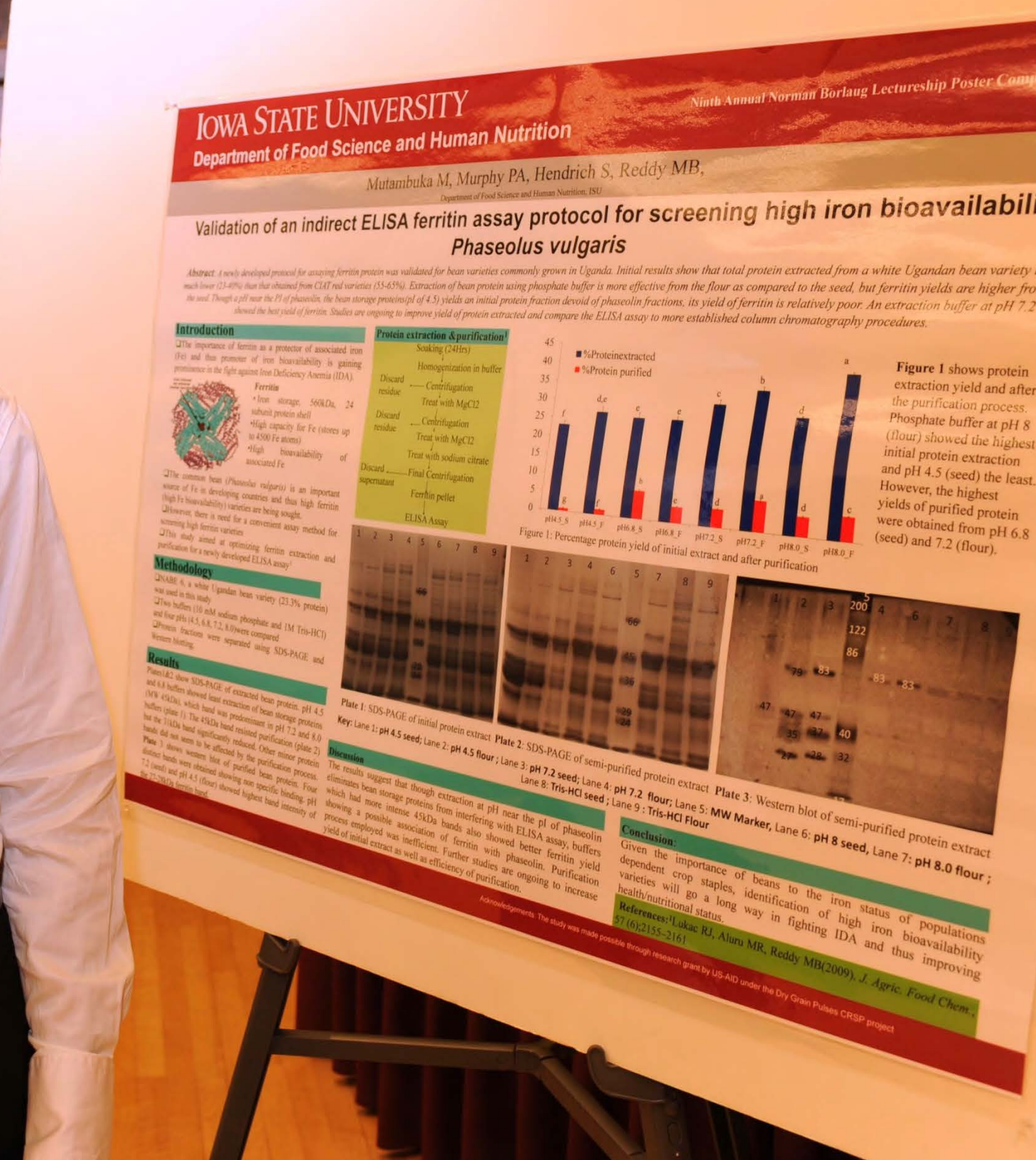
Beekeeping as an Alternative Agriculture Enterprise to Enhance Food Security
Violet Akech[1], Brian Castro[2], Jacob Hunter[2], Peninah Nangobi[1], Kevin Natukunda[1], Amber Seitz[2], and Muhammed Walugembe[1]
Faculty Advisors: Drs. Tom Brumm[2], Donald R. Kugonza[1], Dorothy Masinde[2],
Gail Nonnecke[2], and Richard Schultz[2]
[1] Makerere University, Uganda and [2] Iowa State University, USA
Introduction
Over 80% of Uganda's population relies on subsistence farming for their existence. Due to the seasonal availability of local crops, children suffer from chronic malnutrition. The ability to utilize the nutrient-rich foods within the marketplace is largely dependent upon their income. Indigenous honey is highly valued in local markets and provides an agricultural enterprise for income generation, which can be used to purchase food, supplies or pay school fees.
The school garden provides an outdoor learning laboratory pupils to acquire agricultural skills, including those needed beekeeping.
Objectives
he 2009 pilot beekeeping project
oney production at the school to provide an for income generation
s, teachers, and parents in acquiring basic knowledge
per management of apiary and beekeeping
First meeting to elect beekeeping club leaders
Methods
Conducted assessment surveys regarding beekeeping knowledge and activities
Evaluated the current condition of hives and made repairs and relocated as necessary
Established a bee club and elected leaders for the club
Delivered multiple workshops
Created a map and numbered hives for identification
Compiled a simplified manual for NPS children
Workshops
Results
Assessment surveys conducted in 2010 showed that pupils at Namasagali Primary School (NPS) have transferred the knowledge gained from the project in 2009 by establishing hives at their homes and within the community.
A week long workshop taught multiple topics, including how to manage a beekeeping club, properly bait, site, and maintain hives, record keeping, and the importance of beekeeping.
A simplified manual entitled "Lifelong Learning in Honey Collection, Beekeeping & Apiary for Uganda" was compiled for the NPS children. The summary will assist the pupils, teachers, and parents acquire basic beekeeping knowledge.
Recommendations for Future Beekeeping Project
Involve community members in workshops carried out at the schools
Expand the apiary
Introduce marketing skills to the pupils so that they are able to market the honey harvested
Continually assess the project
Forge relationships with local beekeepers for the sharing of expertise
The team acknowledges Iowa State University, Makerere University, Volunteer Efforts for Development Concerns Organization (VEDCO) and the Center for Sustainable and Rural Livelihoods (CRSL) for their contributions to the project. We express gratitude to Dorothy Masinde for her wisdom and guidance.



IOWA STATE UNIVERSITY

Department of Food Science and Human Nutrition

Ninth Annual Norman Borlaug Lectureship Poster Comp

Mutambuka M, Murphy PA, Hendrich S, Reddy MB,

Department of Food Science and Human Nutrition, ISU

Validation of an indirect ELISA ferritin assay protocol for screening high iron bioavailabil

Phaseolus vulgaris

Abstract: A newly developed protocol for assaying ferritin protein was validated for bean varieties commonly grown in Uganda. Initial results show that total protein extracted from a white Ugandan bean variety *much lower (23-40%) than that obtained from CIAT red varieties (55-65%). Extraction of bean protein using phosphate buffer is more effective from the flour as compared to the seed, but ferritin yields are higher fro* *the seed. Though a pH near the PI of phaseolin, the bean storage proteins(pI of 4.5) yields an initial protein fraction devoid of phaseolin fractions, its yield of ferritin is relatively poor. An extraction buffer at pH 7.2* *showed the best yield of ferritin. Studies are ongoing to improve yield of protein extracted and compare the ELISA assay to more established column chromatography procedures.*

Introduction

- The importance of ferritin as a protector of associated iron (Fe) and thus promoter of iron bioavailability is gaining prominence in the fight against Iron Deficiency Anemia (IDA).

Ferritin

- Iron storage, 560kDa, 24 subunit protein shell
- High capacity for Fe (stores up to 4500 Fe atoms)
- High bioavailability of associated Fe

- The common bean (*Phaseolus vulgaris*) is an important source of Fe in developing countries and thus high ferritin (high Fe bioavailability) varieties are being sought.
- However, there is need for a convenient assay method for screening high ferritin varieties
- This study aimed at optimizing ferritin extraction and purification for a newly developed ELISA assay[1]

Methodology

- NABE 6, a white Ugandan bean variety (23.3% protein) was used in this study
- Two buffers (16 mM sodium phosphate and 1M Tris-HCl) and four pHs (4.5, 6.8, 7.2, 8.0)were compared
- Protein fractions were separated using SDS-PAGE and Western blotting.

Results

Plates1&2: show SDS-PAGE of extracted bean protein. pH 4.5 and 6.8 buffers showed least extraction of bean storage proteins (MW 45kDa), which band was predominant in pH 7.2 and 8.0 buffers (plate 1). The 45kDa band resisted purification (plate 2) but the 31kDa band significantly reduced. Other minor protein bands did not seem to be affected by the purification process. Plate 3 shows western blot of purified bean protein. Four distinct bands were obtained showing non specific binding. pH 7.2 (seed) and pH 4.5 (flour) showed highest band intensity of the 22-28kDa ferritin band.

Protein extraction &purification[1]

Soaking (24Hrs)
↓
Homogenization in buffer
↓
Discard residue ← Centrifugation
↓
Treat with MgCl2
↓
Discard residue ← Centrifugation
↓
Treat with MgCl2
↓
Treat with sodium citrate
↓
Discard supernatant ← Final Centrifugation
↓
Ferritin pellet
↓
ELISA Assay

Figure 1: Percentage protein yield of initial extract and after purification

Figure 1 shows protein extraction yield and after the purification process. Phosphate buffer at pH 8 (flour) showed the highest initial protein extraction and pH 4.5 (seed) the least. However, the highest yields of purified protein were obtained from pH 6.8 (seed) and 7.2 (flour).

Plate 1: SDS-PAGE of initial protein extract **Plate 2**: SDS-PAGE of semi-purified protein extract **Plate 3**: Western blot of semi-purified protein extract

Key: Lane 1: **pH 4.5 seed;** Lane 2: **pH 4.5 flour ;** Lane 3: **pH 7.2 seed;** Lane 4: **pH 7.2 flour;** Lane 5: **MW Marker,** Lane 6: **pH 8 seed,** Lane 7: **pH 8.0 flour ;** Lane 8: **Tris-HCl seed ;** Lane 9 : **Tris-HCl Flour**

Discussion

The results suggest that though extraction at pH near the pI of phaseolin eliminates bean storage proteins from interfering with ELISA assay, buffers which had more intense 45kDa bands also showed better ferritin yield showing a possible association of ferritin with phaseolin. Purification process employed was inefficient. Further studies are ongoing to increase yield of initial extract as well as efficiency of purification.

Conclusion:

Given the importance of beans to the iron status of populations dependent crop staples, identification of high iron bioavailability varieties will go a long way in fighting IDA and thus improving health/nutritional status.

References:[1]Lukac RJ, Aluru MR, Reddy MB(2009). *J. Agric. Food Chem.*, 57 (6):2155–2161

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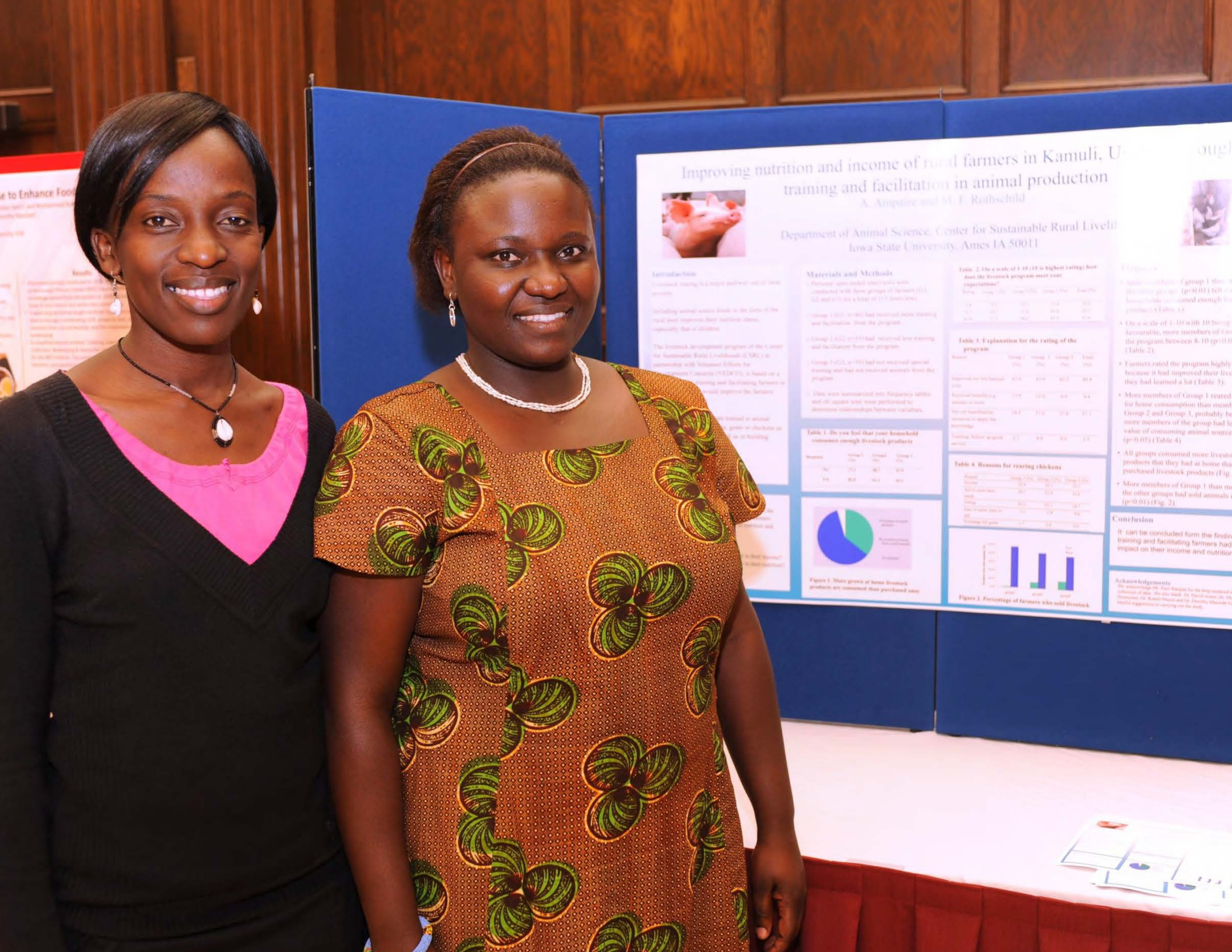
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Materials and Methods
Conclusion