2010
Norman Borlaug Lectureship
Jo Luck / David Beckmann
Poster Presentation
Photos
Tillage and composting strategies to maximize potentially mineralizable nitrogen in maize-based cropping systems

Background:
Tillage and composting can affect soil microbial activity and potentially mineralizable nitrogen (PMN). In a previous study, it was observed that tillage and composting can increase the availability of nitrogen in maize-based cropping systems.

Objectives:
1. To compare the effects of different tillage and composting practices on PMN.
2. To determine the impact of different management practices on the stability of PMN.

Methods:
A field experiment was conducted in a randomized complete block design with four replicates. Treatments included no-till (NT), conventional tillage (CT), compost (C), and compost + tillage (CT+C). Soil samples were collected before planting and after harvest.

Results:
1. Compared to NT, CT and C treatments increased PMN by 20% and 30%, respectively.
2. CT+C treatment showed the highest PMN (40%), indicating the synergistic effect of tillage and composting.

Conclusions:
1. Tillage and composting can significantly increase PMN.
2. CT+C treatment is the most effective in increasing PMN.

Acknowledgments:
This work was supported by the USDA National Institute of Food and Agriculture.
Impacts of lipids on digestive rate and physicochemical properties of starch

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ABSTRACT
This experiment was an in vitro study to investigate the effects of different lipids on digestive rates and physicochemical properties of starch. The aim was to determine whether lipids, chemical property, and physicochemical property of modified starches, such as starch, acid, and alkali treatments, could be affected by the type of lipid used. The results show that lipids, both in the form of free acids and as emulsifier, significantly affect the physicochemical properties of modified starches. A nongelled solution of lipids, such as those used in this experiment, may be more effective in reducing the physicochemical properties of modified starches than gelled lipids.

MATERIALS & METHODS

Materials

Starch: native, modified, or other

Methods

The starch was prepared by modifying it with 1% w/v of the lipids, and the samples were analyzed as follows:

Analytical Procedure

1. Digestion of starch with amylase
2. Measurement of carbohydrate content
3. Determination of lipids

RESULTS

Table 1: Physicochemical properties of native and lipids-modified starch.

<table>
<thead>
<tr>
<th>Sample</th>
<th>pH</th>
<th>DS</th>
<th>ADF</th>
<th>LTV</th>
<th>DTG</th>
<th>KSV</th>
<th>LTL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>4.5</td>
<td>0.2</td>
<td>0.1</td>
<td>0.06</td>
<td>1.5</td>
<td>0.5</td>
<td>25.5</td>
</tr>
<tr>
<td>Lipids 1</td>
<td>5.5</td>
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<td>0.2</td>
<td>0.09</td>
<td>2.0</td>
<td>0.7</td>
<td>29.5</td>
</tr>
<tr>
<td>Lipids 2</td>
<td>6.5</td>
<td>0.4</td>
<td>0.3</td>
<td>0.12</td>
<td>2.5</td>
<td>1.0</td>
<td>31.5</td>
</tr>
</tbody>
</table>

Table 2: Digestion and chemical properties of native and lipids-modified starch.

<table>
<thead>
<tr>
<th>Sample</th>
<th>pH</th>
<th>DS</th>
<th>ADF</th>
<th>LTV</th>
<th>DTG</th>
<th>KSV</th>
<th>LTL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>0.5</td>
<td>0.0</td>
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<td>0.0</td>
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</tr>
<tr>
<td>Lipids 1</td>
<td>0.5</td>
<td>0.1</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
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<tr>
<td>Lipids 2</td>
<td>1.0</td>
<td>0.2</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
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</tbody>
</table>

Table 3: Changes in chemical and physical properties of native and lipids-modified starch.

<table>
<thead>
<tr>
<th>Sample</th>
<th>pH</th>
<th>DS</th>
<th>ADF</th>
<th>LTV</th>
<th>DTG</th>
<th>KSV</th>
<th>LTL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
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<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Lipids 1</td>
<td>0.5</td>
<td>0.1</td>
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<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Lipids 2</td>
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<td>0.2</td>
<td>0.0</td>
<td>0.0</td>
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<td>0.0</td>
<td>0.0</td>
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</table>

CONCLUSIONS

This study suggests that lipids can significantly affect the physicochemical properties of starch. Further research is needed to understand the mechanisms by which lipids affect these properties.

ACKNOWLEDGMENTS

This research was supported by a grant from the National Science Foundation.
EFFECTS OF DRYING CONDITIONS ON ENDOSTEROUS ENZYME ACTIVITY AND STARCH PROPERTIES OF CORN

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Department of Chemical Engineering, Iowa State University, Ames, IA, 50011
Department of Agricultural & Biosystems Engineering, Iowa State University, Ames, IA 50011

Introduction

Dryness is an important post-harvesting process for crops because it helps to improve quality and ensures safe post-harvest storage of kernels. Drying of corn at elevated drying temperatures reduces drying time, but often causes deterioration of kernel physical properties.

Objectives

1. Identifying how drying of corn at different temperatures affects: endogenous amylase activity of kernels.
2. Starch properties, such as thermal and swelling properties, and enzyme digestibility of starch.

Results obtained from these studies can provide useful information to animal feed and food industries for optimizing drying conditions of corn to obtain better quality and yield of products.

Materials and Methods

Data from three corn hybrids grown in Northern Iowa in 1997 and 1998 were harvested, dried, and stored at 24% moisture for different temperatures.

Activity of endogenous amylase activity: Ground corn kernels were suspended in a sodium cyanide buffer (pH 7.0) and incubated at 40°C for 1 hour. Aliquots were collected at different times of the reaction, filtered, and assayed at 400 μg/100 ml for 30 minutes to determine the degree of degradative sugar. The reducing sugar content in the supernatant was determined using the phenol-sulfuric acid method.

Activity gel analysis of amylase enzyme: Starch gels were prepared following the methods of Anjali et al. (2000).

Thermal Properties were determined using differential scanning calorimetry following the method of Ward et al. (1995).

Solubility and Swelling Power were determined using the method of Bird et al. (2005).

In vitro Digestibility of starch using Pancreatic Amylase:

Amylase activity was determined following the procedure of Bird et al. (2005).

Figure 1. Enzyme activity at different temperatures of three corn hybrids.

Table 1. Thermal properties of starch isolated from corn at different temperatures. Average value of three corn hybrids.

<table>
<thead>
<tr>
<th>Temperature (°C)</th>
<th>Amylase activity</th>
<th>Solubility</th>
<th>Swelling power</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>7.5 ± 0.7</td>
<td>11.6 ± 0.2</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>7.3 ± 0.8</td>
<td>13.6 ± 0.3</td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>7.1 ± 0.9</td>
<td>16.8 ± 0.3</td>
<td></td>
</tr>
</tbody>
</table>

Conclusions

1. No significant change in the endogenous amylase activity was observed in corn dried at 70°C, compared with its control sample dried at 30°C (Figure 1). Drying of corn at 80°C, however, caused a decrease in reducing sugar and after 20°C incubation.

2. The activity gel analysis of amylase enzyme showed that the activity of a specific enzyme was different at different temperatures. The activity of a specific enzyme was different at different temperatures (Figure 1).

3. Starch content decreased between 40°C and 80°C, but not significantly. The swelling power of starch was increased at 40°C and 60°C, but decreased at 80°C (Table 1). The swelling power of starch is determining the quality of the product. However, the gelatinization temperature and swelling power of starch were not significantly affected by the enzyme activity (Figure 1).

References


Figure 2. Enzyme activity at different temperatures of three corn hybrids.
Poultry House Structure 2010

- Poultry House was constructed.
- 12 hens were vaccinated and bred, 10 hens are at the school.
- Workshop was conducted to establish poultry club and included student leaders, teachers, and staff.
- Local NAIAS supplied poultry feed up to the 21st week when subsequent income from selling eggs provided funds for continued inputs and feed.
- Majority of eggs are incorporated in mane 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 will sustain the hens.
- Disease control: Vaccinated for:
  - Marek's disease
  - Newcastle disease
  - Gumboro disease
  - Influenza
- 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 composted and used in the school gardens.

Conclusion

- The following are the activities that will ensure continued sustainability of the project:
  - Ensuring food security and nutrition for students through the school and community
  - Ensuring the development of personal skills through the poultry project
  - Establishing a poultry club and involving teachers and students in other related activities
  - Creating an environment in which students can learn to care for poultry
  - Ensuring the sustainability of the poultry project

Acknowledgements

The authors gratefully acknowledge the contributions of the following: University of Iowa, Makerere University, and the support of海南大学.
Integrating Rainfall Measurement into the School Garden Curriculum at Namasagali Primary School, Uganda

Ellen Franzenburg1, Sean Lund1, Katie Taylor1, Samuel Ikendi2, Silver Tumwa2

1Undergraduate student, Iowa State University; 2Undergraduate student, Makerere University

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

Results
- A rain gauge was designed and constructed at Namasagali Primary School.
- A workshop was held with the teachers to instruct them on 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.

Conclusions
- An inexpensive rain gauge provides a learning tool for students in agriculture, science, and math.
- With a precipitation database, the system requirements of the 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 Development 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.

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 nearby river to irrigate vegetable gardens, especially when there are lower rainfall 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.

Conversion formula:

\[ h_2 = \frac{d_2^2}{d_1^2} \cdot h_1 \]

- \( h_2 \) = rainfall depth
- \( d_2 \) = diameter of funnel
- \( d_1 \) = diameter of measurement can
- \( h_1 \) = depth of water in measurement can

Example of conversion chart:

<table>
<thead>
<tr>
<th>Conversion chart</th>
<th>Rainfall (mm)</th>
<th>Rainfall (mm)</th>
<th>Rainfall (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10 cm diam. can</td>
<td>9 cm diam. can</td>
<td>8 cm diam. can</td>
</tr>
<tr>
<td>0.35</td>
<td>0.7</td>
<td>0.6</td>
<td>0.5</td>
</tr>
<tr>
<td>1.6</td>
<td>3.2</td>
<td>2.7</td>
<td>2.4</td>
</tr>
<tr>
<td>1.5</td>
<td>3.0</td>
<td>2.6</td>
<td>2.2</td>
</tr>
<tr>
<td>1.4</td>
<td>2.8</td>
<td>2.4</td>
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</tr>
<tr>
<td>1.3</td>
<td>2.6</td>
<td>2.2</td>
<td>1.9</td>
</tr>
</tbody>
</table>

Rain gauge logbook, with conversion chart and instructions in the front.
The Mediterranean Diet in Italy: The Role of Leafy Greens

Vivian Bernau1, Sam Bird2, Emma Flemming1 and Emily Zimmerman2

Iowa State University

Biodiversity International
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
As 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/m² of corn, reduced soybean yield by 56%. (Bensch et al. 2003).

Characteristics that make common waterhemp a great challenge in food production:
- Weighed reproductive and prolonged germination period results in a continuous contribution to soil seed bank (Steckel and Sprague 2004).
- Noxious nature: high genetic variability and more likely to evolve resistance, particularly in glyphosate-based crop systems.

Hypothesis
Timing of common waterhemp emergence (cohort effect) has a critical trait affecting life history and reproductive success of common waterhemp, which results in greater negative impact on food production.

Materials & Methods
Location:
Data study was 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 x 5m in 2009, 3m x 3m in 2010) at each location.

Data collected:
- Weather conditions: daily precipitation, air and soil temperature
- Flowering pattern: Plants with recognizable fluorescence were marked at two day intervals
- Seed production: Seeds were collected from five randomly chosen female plants, weighed and counted.

Findings
Emergence pattern: closely correlate with rain events

Flowering pattern: Early cohorts have more prolonged flowering pattern

Reproductive success: High fecundity throughout the growing season

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.

References
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 potato 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. Deficiencies in iron, zinc, vitamin C, and other metals in low-income populations worldwide helped characterize ascorbic acid (vitamin C) deficiencies in various potato cultivars with an acid-specific dye in acetone extracts of potato solutions were subjected to spectrophotometry at higher ascorbic acid levels using CIP researchers using this method. Ascorbic acid levels up to 65% ascorbic acid in boiled potatoes, or 20% of the recommended allowance for adults (Bugnone et al. 2008).

Morphology analysis
Reliably characterizing tuber morphology and its subjective and time-consuming process. Analysts often done without the aid of computers based on ear measurements and color-matching them. To train accuracy in characterization, I investigated ease of use of computer programs such as ToppAnalyzer 2.2.0.0 (van der Knaap 2002). This method was discontinued after being determined too slow for large populations. Furthermore, the lack of available potato-specific classification software meant that much unusable data was generated.

Consumer preference
The success of a new cultivar depends on consumer perception. With this in mind, CIP is working to release colored-flesh cultivars with defined anthocyanin and carotenoid levels to provide nutritional antioxidants (Figure 2). I helped conduct a “taste test” of previously colored-flesh cultivars. The potatoes were boiled until removed cleanly, and were judged based on texture, and post-cooking color charge.

Acknowledgments
A million thanks to Michael Strong and Walter Ammerman of the International Potato Center for hosting me and for their guidance. Elliot Miller Bins and Delaine Brill of the Plant Science Institute for making this experience possible.

Figure 1. Potato fruit with true seed for advancement in a virus resistance program.

Figure 2. Potential colored-flesh potato cultivars.

Literature cited
Beekeeping as an Alternative Agriculture Enterprise to Enhance Food Security

Violet Akello\textsuperscript{1}, Brian Castro\textsuperscript{2}, Jacob Ntulir\textsuperscript{3}, Peninah Ngobol\textsuperscript{4}, Kevin Ntakunda\textsuperscript{5}, Amber Seitz\textsuperscript{1}, and Muhammed Walugembe\textsuperscript{1}

Faculty Advisors: Drs. Tom Brumm\textsuperscript{6}, Donald A. Kugonza\textsuperscript{7}, Dorothy Masinde\textsuperscript{1}, Gail Nonnecke\textsuperscript{1}, and Richard Schultz\textsuperscript{2}

\textsuperscript{1}Makerere University, Uganda and \textsuperscript{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 nutritious honey 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 for acquiring agricultural skills, including those needed in beekeeping.

Objectives

The 2009 pilot beekeeping project aims to:

- Improve productivity at the school to provide an income generation opportunity
- Train teachers, and parents in acquiring basic farming knowledge
- Establish beekeeping clubs and management of apiary and beekeeping

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

- First meeting to select beekeeping club leaders

Results

- Assessment surveys conducted in 2010 showed that pupils at Namawojjoli Primary School (NPS) have transferred the knowledge gained from the project in 2009 by establishing hives in 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
- Continuously assess the project
- Forge relationships with local beekeepers for the sharing of expertise

The team acknowledges Iowa State University, Makerere University, Walugembe Efforts for Development Center's Organization (DECO) and the Center for Sustainable and Rural Livelihoods (CSRL) for their contributions to the project. Ms. Ameerah NTulir for her wisdom and guidance.
Validation of an Indirect ELISA ferritin assay protocol for screening high iron bioavailability in Phaseolus vulgaris

Introduction
Iron is essential for life, playing a vital role in many physiological processes. However, iron deficiency is a significant global health problem, particularly common in children and pregnant women. Phaseolus vulgaris, commonly known as beans, is an important food crop in many regions of the world, including Uganda. Beans are a rich source of iron, but traditional methods for determining iron bioavailability can be laborious and time-consuming.

Methods
A new protocol based on an indirect ELISA ferritin assay was developed to assess iron bioavailability. The protocol involves extraction of ferritin from the bean variety, purification of the ferritin, and measurement of its bioavailability using an ELISA assay.

Results
The results showed that the ferritin extract from the bean variety could be successfully purified using a sequential protocol involving precipitation, dialysis, and DEAE chromatography. The purified ferritin was then tested for iron bioavailability using an iron-depleted cell culture assay.

Conclusion
The new protocol provides a rapid and efficient method for assessing iron bioavailability in beans, which can be used to identify high-iron bean varieties suitable for populations at risk of iron deficiency.
Improving nutrition and income of rural farmers in Kamuli, Uganda: training and facilitation in animal production

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Department of Animal Science, Center for Sustainable Rural Livelihoods, Iowa State University, Ames IA 50011

Introduction

Impact of training on income and production

Materials and Methods

Table 1: Comparison of income and production between trained and untrained farmers

Table 2: Changes in animal numbers after training

Table 3: Farmers' perceptions of training

Table 4: Reasons for training

Conclusion

Training improves income and production of rural farmers in Kamuli, Uganda.