Research Planning Meeting - USDA Specialty Crops Research Initiative

Midwest Food Processors Association
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Building Market Foundations for Sustainable Vegetable Production and Processing: A Consumer and Metrics-Based Approach


Goal. “Enhanced potential for improved efficiency, productivity, and profitability for the vegetable production and processing industry based on an improved understanding of the role of consumer markets”

Approach. “Beginning with the market, work with growers, processors, and distributors to explore how to generate market rewards through science-based sustainability that is measurable and profitable”
## Total Impact of Specialty Crop Production and Processing

*(Economic activity in $ millions per year)*

<table>
<thead>
<tr>
<th>Specialty Crop Production and Processing</th>
<th>Total Economic Activity</th>
<th>Total Jobs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetable &amp; Fruit Production</td>
<td>$1,092</td>
<td>9,900</td>
</tr>
<tr>
<td>Potatoes</td>
<td>$349</td>
<td>2,770</td>
</tr>
<tr>
<td>Cranberries</td>
<td>$300</td>
<td>3,400</td>
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<tr>
<td>Sweet Corn</td>
<td>$83</td>
<td>660</td>
</tr>
<tr>
<td>Green Beans</td>
<td>$63</td>
<td>490</td>
</tr>
<tr>
<td>Green Peas</td>
<td>$26</td>
<td>200</td>
</tr>
<tr>
<td>Carrots, Cucumbers &amp; Onions</td>
<td>$28</td>
<td>220</td>
</tr>
<tr>
<td>Ginseng</td>
<td>$16</td>
<td>130</td>
</tr>
<tr>
<td><strong>Specialty Crop Processing</strong></td>
<td><strong>$5,268</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Total Impact</strong></td>
<td><strong>$6,360</strong></td>
<td>34,700</td>
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</tbody>
</table>

1. Production estimates based on 2006-2008 average farmgate values; processing estimates based on 2007 Economic Census values. Note: Sum of impacts may not equal total impact due to rounding.

Keene and Mitchell, 2010
Project Objectives

Objective 1. Identify consumer preferences and willingness to pay for sustainably produced and processed vegetables and quantify market segments.

Objective 2: Create and test sustainability assessment tools and sustainability metrics for commercial vegetable growers.

Objective 3: Validate and improve the relationship between practice-based sustainability assessments and environmental and economic outcomes at the farm scale in each region.

Implement sustainable practices to identify opportunities for improved water, nitrogen, and pesticide use efficiency at the field and farm level (Bland, Colquhoun, Mitchell, Ruark).

Refine sustainable production practices to reduce environmental and economic risk (Bland, Colquhuon, Hutchison, Nault, Ruark).

Objective 4: Build critical mass of support for sustainably grown and processed vegetables.
Factors Influencing Nutrient and Water Management

- **Water availability, Water quality**
  - Multiple users of the water resource
  - Agriculture, Industry, Communities/Municipalities, Recreation

- **Is the resource sustainable?**
  - Climate, Irrigation, other factors

- **Complex solutions**
  - Involvement of all interested parties
  - Growers, processors, communities, citizens, Govt. Agencies
Improved water and nitrogen use efficiency
(Bland & Ruark)

- Develop and evaluate fertilization strategies that are based on dynamic estimation of the:
  - current amount of available N in root zone
  - required uptake remaining by crop for desired yield

- Designed to:
  - incorporate effects of leaching loss following heavy rains
  - include nutrient release through time by various fertilizer materials

- Outcomes:
  - align supply with crop need
  - minimize soil nitrate in root zone susceptible to leaching loss
Factors Influencing Insect Pest Management

‘Environmental Concerns’

– With increasing affluence reaching the developing world, there will be increasing concerns about pesticide usage and perceived environmental effects.

– This will accelerate the shift to “softer” products and technologies.
Large scale field trials (Dillard and Gevens)

- Compare current conventional disease management practices in snap beans vs. a novel Best Management Practice (BMP) approach on large commercial scale (≥20 acre) cooperating farms
  - NY & WI
  - Disease incidence and environmental conditions will be monitored in fields
  - Fungicide applications will be made with commercial equipment
  - Marketable yield, quality, and economics associated with control programs will be assessed in collaboration with processor cooperators

- Investigations will be specific to production region
  - NY: White mold (*Sclerotinia sclerotiorum*) and gray mold (*Botrytis cinerea*) control
    
    **Standard:** Application of Topsin M (thiophanate methyl) at 10-30% bloom and 100% bloom
    
    **Novel:** Application of Endura (boscalid) or Propulse (fluopyram+prothioconazole) at 10-30% bloom and 100% bloom

  - WI: White mold (*Sclerotinia sclerotiorum*) and root rot (Pythium, Rhizoctonia, Fusarium spp.) control
    
    **Standard:** Application of Topsin M (thiophanate methyl) at 30% bloom and 100% bloom (or 7 days after 1st spray)
    
    **Novel:** Soil incorporation of Contans prior to planting. Application of Endura at 10% bloom and 7 days later. Selection of cultivar with moderate to high root rot resistance.
Investigation of novel inputs to further optimize a BMP ('high bar’ sustainable) system. Such practices would include further investigation of biorational/biological pesticides, seed treatments vs foliar applications, and cultivar evaluation and integration.

**NY:**
- i) evaluate efficacy and appropriate timing of new fungicides (ie. systemics) for white mold and gray mold control
- ii) identify barriers to white mold control success of Contans (Coniothyrium minitans) in small plots

**WI:**
- i) evaluate efficacy and timing of application of newly registered fungicides for white mold control
  - Endura (boscalid)
  - Fontelis (penthionyrad)
  - Omega 500F (fluazinam)
  - Priaxor (fluxapyroxad+pyraclostrobin)
- ii) Optimize use pattern of Contans to enhance long term white mold management program
- iii) Evaluate influences of cultivar, N fertility, and irrigation on white mold and root rot incidence and severity in small plots
Refine sustainable production practices to reduce environmental and economic risk (Dillard & Gevens)

- Refined white and gray mold disease management
  - standard program of control versus novel active ingredients
  - replacement of Topsin® M (benzamidazole resistant isolates) with Endura® (boscalid), Propulse® (fluopyram, prothioconazole), or Contans® (C. minitans)

- Designed to:
  - incorporate novel biopesticides into control programs
  - integrate pathogen biology into the timing of pest control
  - identify abiotic / biotic barriers to successful implementation of RR-programs
Refine sustainable production practices to reduce environmental and economic risk (Colquhoun & Kikkert)

- Define a sequence of ‘best management practices’ for weed control
  - standard program (pre-emergence or at-plant) consisting of Treflan, Dual Magnum, Sandea, Prowl, Reflex, Eptam, Command…
  - refined program: novel herbicides resulting from,
    (1) Snap beans: 2 cultivations (blind harrowing and row-crop), followed by POST herbicides only if scouting indicates need
    (2) Sweet corn: in-row banded PRE herbicides combined with single cultivation, POST herbicides only if scouting indicates need
    (3) Potential for pre-season and in-season cover crop mixes in sweet corn or pre-season and post-harvest cover crop mixes in snap bean
    (4) Herbicide choices based on resistance management and recent use in rotational crops

- Extension of residual weed control: impregnation into polymer matrix
  - loading rates of polymer (polyacrylate), particle sizes and herbicide rates
Pesticide - Polyacrylate Impregnation

Polymers Inc.

Sand Suppression Polymers

Hydro-seeding polymers

Horticultural Polyacrylate
Herbicide - Polyacrylate Impregnation Trials: HAES, 2010 - 2011

Herbicide Impregnated Polyacrylate (vacuum-dried)

Vacuum Oven
Herbicide - Polyacrylate Impregnation Trials HAES, 2010 - 2011

In-furrow Application
Vacuum Dried

Impregnated Polyacrylamide (in-furrow)
Factors Influencing Insect Pest Management

‘Food Safety’

– Major food retailers are setting acceptable residue levels below those set by government regulatory agencies.

“No detectable residues” will be a competitive advantage for food retailers.

– Older insecticides that do not meet these requirements are not being re-registered, resulting in increased use of novel insecticides (reduced-risk & bio-pesticides).
Wisconsin Vegetable Pest Management

Options for Insect Pest Management – *More than ever before!*

- Cultural controls
- Natural enemies
- Baits and baiting systems
- Host plant resistance
- Population disruption
- Transgenic plants IR traits
- Reduced-Risk Chemical Insecticides
- Entomopathogens

Vegetable IPM
Evaluate a novel attractant for corn earworm management in sweet corn, Push-Pull IPM system (Hutchison & Burkness)

- Implement a Push-Pull IPM strategy for management of CEW
  - standard program plus the addition of the insect attractant, Magnet

1) Bt sweet corn untreated
2) Bt sweet corn treated with a pyrethroid (e.g., Warrior II, Brigade) based on pest pressure and environmental conditions (typically 3-4 applications in fresh market production in MN)
3) Non-Bt sweet corn untreated
4) Non-Bt sweet corn treated with a pyrethroid (e.g., Warrior II, Brigade)
5) Non-Bt sweet corn treated with a nuclear polyhedrosis virus (NPV) (e.g., Gemstar)

- Designed to:
  - increase the efficiency of novel biopesticides into control program
To evaluate the efficacy of chlorantraniliprole and cyantraniliprole when applied as a seed treatment, in furrow spray and foliar spray for managing seed corn maggot, potato leafhopper and European corn borer (large scale, field trials)

Investigating timing of foliar anthranillic diamide applications to coincide with fungicide applications at flowering (small-scale experiments)
Processing Snap Bean: ECB Pest Phenology

ECB Phenology

- Early
- Middle
- Late

Date

Flowering

Insecticide app
Refine sustainable production practices to reduce environmental and economic risk (Nault & Groves)

- Refined insect management in snap beans
  - timing of standard foliar applications (bloom & pin bean) vs fungicide tank mix

![Diagram showing planting and application dates]

- Need to protect green bean crop during vulnerable stages
- Insecticide X Fungicide application(s)
- Fungicide application(s)
- Late Planting
- Mid Planting
- Early Planting

Timeline:
- 15-Mar
- 14-Apr
- 14-May
- 13-Jun
- 13-Jul
- 12-Aug
- 11-Sep
- 11-Oct
Refine sustainable production practices to reduce environmental and economic risk (Nault & Groves)

- Refined insect management in snap beans
  - at plant, in-furrow applications and fertilizer side-dress applications

### Diagram:

- **Early Planting**
- **Mid Planting**
- **Late Planting**

**Need to protect green bean crop during vulnerable stages**

- Side-dress application(s)
- At-plant application(s)
Percent Snap Bean Pods Damaged by European corn borer

Arlington, WI 2011

Mean % damaged pods

Seed treatments

N=4

In-furrow  Foliar

Treatments

Groves & Chapman, 2011
Eco-informatics

1. Use of pre-existing data
2. Integration of data from multiple sources
3. Use of observational data
4. Large spatial and temporal scales
5. Large amounts of data
6. New tools for data management and analysis

Future directions: Field-level, processor data
State-wide survey data

Recent examples: (1) predicting soybean aphid phenology
(2) defining the risk window in carrots
Opportunity for Eco informatics in IPM:

Large amounts of pre-existing data are available, from farmers and pest control consultants: processors

• Labor-intensive job of monitoring pest densities and crop performance is decentralized → large data sets

• But, these data are observational, rather than experimental . . .
# Strengths of Observational Methods

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Experimental approaches</th>
<th>Ecoinformatics-based approaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study’s spatial and temporal scale</td>
<td>Smaller; often much smaller than the scale of farming</td>
<td>Larger; matching the actual scale of farming</td>
</tr>
<tr>
<td>Applicability to the broad range of farming conditions</td>
<td>Lower; results may only apply to conditions under which the experiment was conducted (“internal validity”)</td>
<td>Higher; with suitable planning, data sets can embrace a large range of real farming conditions (“external validity”)</td>
</tr>
<tr>
<td>Ability to evaluate many variables simultaneously</td>
<td>Lower; experiments are operationally difficult and costly for more than 4-5 variables at once</td>
<td>Higher; may be particularly valuable when many variables must be screened</td>
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<tr>
<td>Ease of translating research results into farmer recommendations</td>
<td>Lower; researchers often use different sampling methods than farmers</td>
<td>Higher: using data from farmers means that research results translate naturally into recommendations</td>
</tr>
<tr>
<td>Ability to study farmer behavior</td>
<td>Lower; farmers are typically excluded from the experimental research setting</td>
<td>Higher</td>
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Summary – Eco informatics

1. IPM researchers rely heavily on experimentation
2. Experimentation has some notable strengths
3. Experimentation also has some weaknesses

With processor data, we have the motivation to explore complementary approaches to IPM research
Modeling Aphid Phenology: Wisconsin GAMM’s (2005-11)
Seasonal Trends: ALH abundance

Determining the “Risk Window” for Aster Yellows

Solve for $S = 0$

$X_1: 155$ (June 3)

$X_2: 216$ (August 3)

$X_3: 265$

Above average ALH catches between $X_1$ and $X_2$
Summary – Research Plan

- What research emphasis has been omitted??
- Experimental procedures not well defined??
- How to best generate rewards through science-based sustainability??

“Contributions from the producer / processor community”

Questions and Suggestions ??