A Social Science Perspective on Weed Management Practices

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May 10, 2012
Background

• Pervasive reduction in the diversity of weed control tactics from mid-1990s to mid-2000s

• Significant room for improvement in Best Management Practice adoption for resistance management (RM), particularly using herbicides with diverse mechanisms of action

• As of mid-2000s, many growers had perceptions that tend to discourage BMP adoption
Grower adoption of RM Best Management Practices (BMPs)

• Most growers are applying most practices most of the time, but …

• This is not sufficient for RM, and …

• Many growers are not practicing some of the most important BMPs
BMP adoption varies more across practices than crops

Source: Frisvold, Hurley, Mitchell, 2009
Growers often or always adopting BMPs by total number of BMPs adopted

Source: Frisvold, Hurley, Mitchell, 2009
Growers often or always adopting BMPs by total number of BMPs adopted

Most growers adopting 7 or more BMPs often or always

Source: Frisvold, Hurley, Mitchell, 2009
Grower perceptions that can discourage BMP adoption

• Attributing spread of resistant weeds to natural forces & neighbors’ behavior

• Belief individual action has little effect on resistance

• Belief resistance is inevitable

• Low awareness of how practices affect weed resistance

• Low awareness of importance of rotating herbicides with different modes of action

• Low concern about resistance

• Confidence new products will become available
Grower perceptions: research needs

- As of mid-2000s, evidence growers had – to varying degrees – perceptions that discourage BMP adoption

- It would be useful to know
  - How pervasive are these different perceptions?
  - Have they changed since early-to-mid 2000s?
  - How do perceptions affect resistance management today?
Looking beyond expected profit maximization framework

• Grower decisions more complex than expected profit maximization

• Useful extensions
  – Household modeling framework
  – Addressing uncertainty
Household modeling framework

- Decisions depend on effects on household income, not just per-acre, plot-level returns

- Studies have found non-pecuniary benefits to matter

- Pecuniary effects more complex than plot-level returns

- Implies need to consider household utility rather than plot-level returns in assessing incentives
Farm household considerations for weed management

- Ease & flexibility of management program
- Management time requirements
- Regulations & incentives on highly erodible land
- Asset fixity: changes in equipment
- Change in knowledge base after widespread not-till / HR seed adoption
- Life-cycle, legacy issues (discount rate)
  - Tenancy
  - Development pressure
Role of uncertainty

• Costs of resistance management (RM) relatively certain, but benefits are uncertain

• Need to shift from expected profit maximization to expected utility or behavioral economics framework

• Uncertainty about how other growers will behave implies a collective action problem
Lessons from the Green Revolution

• Demonstrated limits of simple expected profit maximization framework

• Farmer non-adoption often tied to real economic constraints

• Adding uncertainty to analysis
  – Increased explanatory power of economic models
  – Demonstrated importance
    • Farm size
    • Credit constraints
    • Infrastructure constraints
    • Learning and information provision
Role of information provision

• Where are growers getting their information?

• How does information source affect behavior?

• Are growers getting a consistent message?
Lessons from voluntary environmental programs

• Track record of voluntary approach is mixed, but there have been successes

• Some evidence that voluntary programs perform better if there is a regulatory option in the background

• Possible strategy: survey growers about preferences of different voluntary and regulatory approaches
Miransowski & Carlson Revisited


• Analysis ahead of its time

• Posed question, what is the proper division between public and private sector in resistance management?

• Applying their framework, one could have predicted different RM approaches for Bt and HR crops
Miransowski & Carlson implications

• Cannot just look at farm-level problem

• Need to examine market structure and pricing of input supply industries

• Need to consider externalities and their implications for regulatory authority

• Price as a signal of scarcity – were effective pesticides becoming scarce?
Herbicide prices rising more slowly than most other production inputs

*Prices Paid for Herbicides Compared to Other Production Items*

Index of Priced Paid (1990-2)

Herbicides
Fertilizer
All Production Items
Fuels

Source: USDA, NASS

A National Summit on Strategies to Manage Herbicide-Resistant Weeds
May 10, 2012
Seed prices rising more quickly than most other production inputs

Prices Paid for Herbicides and Seed Compared to All Production Items

USDA, NASS
Relevant players

- Growers
  - Large-scale
  - Small-scale

- Seed/biotech/ag chemical suppliers

- Grower associations
  - National
  - State
  - Local

- Scientific associations

- Weed management consultants / custom applicators

- Other custom operations

- USDA

- EPA
Economics is about incentives

• What incentives do different players have?

• How are incentives for resistance management compatible or incompatible?

• What are the economic trade-offs for different players?
Neglected players

• Weed management consultants / custom chemical applicators

• Custom harvest and other custom operations

• Smaller-scale producers

• Are there big problems here?

• If yes, what can be done?
Herbicide susceptibility a "weakest link public good"

- A good whose provision requires effort / compliance by those least able and with least incentives

- Smaller scale producers more likely to have significant off-farm activity

- May have less capacity and less at stake in managing resistance

- At this point, we simply do not know; surveys have focused on larger producers
Role of smaller scale producers

The largest attitude, perception, and behavior surveys have excluded growers with <250 acres of targeted crop, but …

- 30% of corn growers had <250 acres of corn, accounting for 15% of US corn acres

- 23% of cotton growers had <250 acres of cotton, accounting for 6% of US cotton acres

- 32% of soybean growers had <250 acres of soybeans, accounting for 18% of US soybean acres
Data on resistance management is becoming dated

• Relatively large amounts of data circa 2005-7

• Much has happened since then
  – Resistance problems
  – Resistance awareness

• USDA, ARMS data for cotton and corn
  – Growers surveyed in 2010
  – Potential to test hypotheses about factors encouraging or discouraging adoption
From product-based to systems and science-based solutions

• Old paradigm (oversimplification)
  – Growers as “customers” buying products “off the shelf”
  – Simplification of weed management reduces knowledge requirements
  – New products will solve problems
  – Strategy: keep new products coming
From product-based to systems and science-based solutions

• New Paradigm
  – Greater knowledge of agro-ecological systems needed
    • Growers from passive recipients of products to partners in knowledge generation
    • Information needs to flow from the bottom up as well
    • Contradictions in (overly)simplified weed management
  – Greater knowledge of entire agricultural supply chain, especially structure, conduct, and performance of input industries
Challenges of knowledge sharing

• Information & knowledge will have to substitute for chemical compounds

• Paradox of information sharing
  – Grower participation & input will be critical to success
  – Growers less likely to provide information if they perceive it only leads to regulatory tightening
  – Growers won’t participate unless they recognize benefits
Quick Questions?

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