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A Comparison of Various Aphid and Disease Management Practices in Soybeans – Are Management Decisions Based on Economics?

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Driven to Discover℠
Different managements & motivations?

- **Time of infestation?**
  - Early or mid-season the population dynamics (how populations change) of soybean aphids don’t change…
    - Reproduction rate influenced by temperature in the same way
    - Thresholds hold across plant stages (dataset used to develop the original threshold calculations incorporated different plants stages)

- **Higher commodity value?**
  - At the threshold of 250/plant, there is NO damage occurring
    - Take ~4500-6000 Cumulative Aphid Days (CAD) to reach a point where economic injury ours but at lower levels the plant compensates for loss
  - Lowering the threshold make no biological sense, and therefore no economic sense

- **Simplify production?**
  - Tank mixing below threshold increases potential for later infestations
Lots of strategies…

• As value of commodity rises, so does risk aversion
  – Adoption of more intensive management
  – Addition of inputs

• But, how much is enough?
  – Is there really a payout?
Evaluation of inputs

• Have to evaluate the return on different sometimes multiple treatments for different reasons/targets (i.e. how to evaluate insecticides + fungicides apart ad together)
  – Design a set of treatments that evaluate each individual contribution and compare economic returns…
  – Ran our expt over 2008 & 2009 across MN
Treatments

1. Untreated Control
2. Cruiser Max
3. Warrior II – V3
4. Headline – R3
5. Warrior II & Headline – R3
6. Warrior II – R3
7. Cruiser Max & Headline – AP & R3
8. Cruiser Max, Warrior II, & Headline – AP & R3 (Kitchen Sink)
9. Cruiser Max & Warrior II – AP & R3
10. Scouting & Applying @ threshold (IPM)
Design

- 3 locations NWROC (Crookston), SWROC (Lamberton), SE MN (Rochester) (in 2008 Rochester site was modified to get some late season treatment data so comparisons were not possible)
- Replicated 4 times at each location in Randomized Complete Block & analyzed results using ANOVA
- IPM plots scouted once during early vegetative stages, and subsequent scouting based on previous populations, (never required more than 1/week)
- Soybean aphid CADs & yield components recorded
- Soybean disease symptoms assessed & recorded
A comparison of soybean pest management strategies
Lamberton site 2008
MacRae, Brietenbach, Holen, Ostlie & Potter

Bushels/acre

Control 26.3
Cruiser/Warden 32.2
Insecticide I3 27.9
Fungicide R3 31.9
Fungicide + Insecticide R3 43.1
Insecticide R3 40.4
Insecticide + Fungicide + Insecticide R3 34.5
Cruiser/Warden + Fungicide + Insecticide R3 44.2
Cruiser/Warden + Insecticide R3 43.0
IPM (insecticide@F7) 41.0

Croplan 2020 RR
Fungicide Headliner @6 oz
Insecticide - Warrior II @ 1.6 oz
A comparison of soybean pest management strategies

Lamberton site 2008
MacRae, Brietenbach, Holen, Ostlie & Potter

R3 treatments applied 7/29
ET treatment applied 8/02
A comparison of soybean pest management strategies
Crookston site 2008
MacRae, Brietenbach, Holen, Ostlie, & Potter

Bushels/acre

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<th>Treatment</th>
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Lamberton Yields - 2009

- Control
- Cruiser Max (AP)
- Insecticide V3
- Fungicide R3
- Fungicide & Insecticide R3
- Insecticide R3
- Cruiser Max (AP) & Fungicide R3
- Cruiser Max (AP) & Fungicide R3 & Insecticide R3
- Cruiser Max & Insecticide R3
- IPM

Yield: 41.2, 46.4, 40.9, 44.7, 45.9, 49.2, 45.0, 44.1, 51.6, 48.3
Cumulative Aphid Days

- Control
- Cruiser Max (AP)
- Insecticide V3
- Fungicide R3
- Fungicide & Insecticide R3
- Insecticide R3
- Cruiser Max (AP) & Fungicide R3
- Cruiser Max (AP) & Fungicide R3 & Insecticide R3
- Cruiser Max & Insecticide R3
- IPM

Max CAD < 1800
EIL ~4500-6000 CAD

Crookston CAD - 2009
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Crookston site 2008
MacRae, Brietenbach, Holen, Ostlie, & Potter

Bushels/acre

- untreated
- Cruiser Max
- Insecticide V3
- Fungicide R3
- Fungicide + Insecticide R3
- Insecticide R3
- Cruiser + Fungicide R3
- Cruiser + Fungicide + Insecticide R3
- IPM (Insecticide @ ET)

21.6 32.7 29.1 29.0 42.5 41.2 31.5 43.8 42.7 44.7
Economics

• Intensive treatment ~$30 - $35
  – Cruiser ~$10 - $12
  – Fungicide@R3 ~$14
  – Insecticide @ R3 ~$10

• IPM Treatment
  – Scouting ~$6 - $7
  – 1 treatment $10

• So, ~$15 difference at least
Soybean acreage

• According to USDA National Ag Statistics Service (2002-2008)
  – in NW MN counties, the average soybean producers has 550 ac of soybeans
  – At $15/ac, difference between intensive treatment and treating at threshold

$8250/producer or
$105,000,000 in MN
Other trials


Simplifying production

- Tank mixing may be more convenient but it comes at a significant disadvantage/cost
  - Tank mixing means that the timing is off for one or the other pesticides
  - Application technologies not the same/best fit
  - Removes natural enemies so colonizing aphids more successful (increases probability (i.e. risk) or re-infestation
  - Untreated new growth ideal for incoming aphids
  - False sense of security??
Late Season and/or low populations

- Most trials show that later season (esp late R5 or R6) and/or low level applications do not show an economic return.
- Good example from Iowa State U trial from last year.

Low population impacts?

• Numerous trials indicate low populations of soybean aphids in commercial fields do not cause economic yield loss

• E.g. NWROC data

Figure 3. Yield data from plots at UMN-NWROC in Crookston, 2004. Difference between lowest and highest yield <1.2 bu/ac. Plots had aphids over a 30-35 day period, plots with 1000-2000 aphid days averaged ~50 aphids/plant.
Risk aversion

• Increased risk aversion when commodity prices rise
  – Is this logical?

• Concept of risk implies probability of hazard
  – Does higher commodity decrease insecticide efficacy? Perhaps chemically metabolize pesticide?
  – Does higher commodity value impact aphid’s susceptibility to insecticides (superbean)?

• Control tactics remain as effective at high crop values as they are at low crop values
Influence of high commodity value on management decisions

• There may be a greater return on input costs, BUT this has to supported by an increase in efficacy and/or return

• At the current recommended threshold, there is no measurable economic yield loss
  – So what is the rationale for adjusting the threshold (math vs reality)
Risk aversion

• A number of economic models backed by agronomic data indicate that response to threshold provides a better return than later or earlier applications:
  – E.g. Rossen, Deamon & Hendrix. 1994, Framework to support decisions on chemical pest control under uncertainty, applied to aphids and brown rust in winter wheat. *Crop Protection*

• Perceived risk vs real risk may be responsible for adoption of less sustainable control tactics

• Even in systems where prophylactic applications are necessary, information can assist in making application decisions and improve economic return
Foliar treatments

• Efficacy
  – Most of the products currently used generally still providing good control
    • Some reports of rate creep in some products (maybe resistance?) but early enough to manage (e.g. rotate modes of action)
  • Response applications may be much more effective than prophylactic treatments
    – Early season prophylactics (e.g. seed treatments) may not be as effective at controlling aphids later in the season than are foliar treatments
Foliar treatments

• Cost
  – Foliar applications (chem and application costs) for most products still below cost of seed treatments
  – Prophylactic treatments may or may not be needed
    – if a foliar (rescue) treatment is required, this is always a necessary input cost
Basis of decision / recommendation

• Our data indicates counting and responding with foliar treatments maximizes economic return over time
  – As or more effective as prophylactic applications, not always required so decreases input costs over seasons, lower input cost when necessary

• So what should be the basis for treatment decisions and recommendations??