Risk and the Value of Additional Insecticide Applications for European Corn Borer Control in Processing Sweet Corn

Paul D. Mitchell
William D. Hutchison
Terrance M. Hurley

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Overview of Presentation

- Goal: use insecticide field trial data to estimate the value and risk effect of an additional insecticide application for ECB control in processing sweet corn

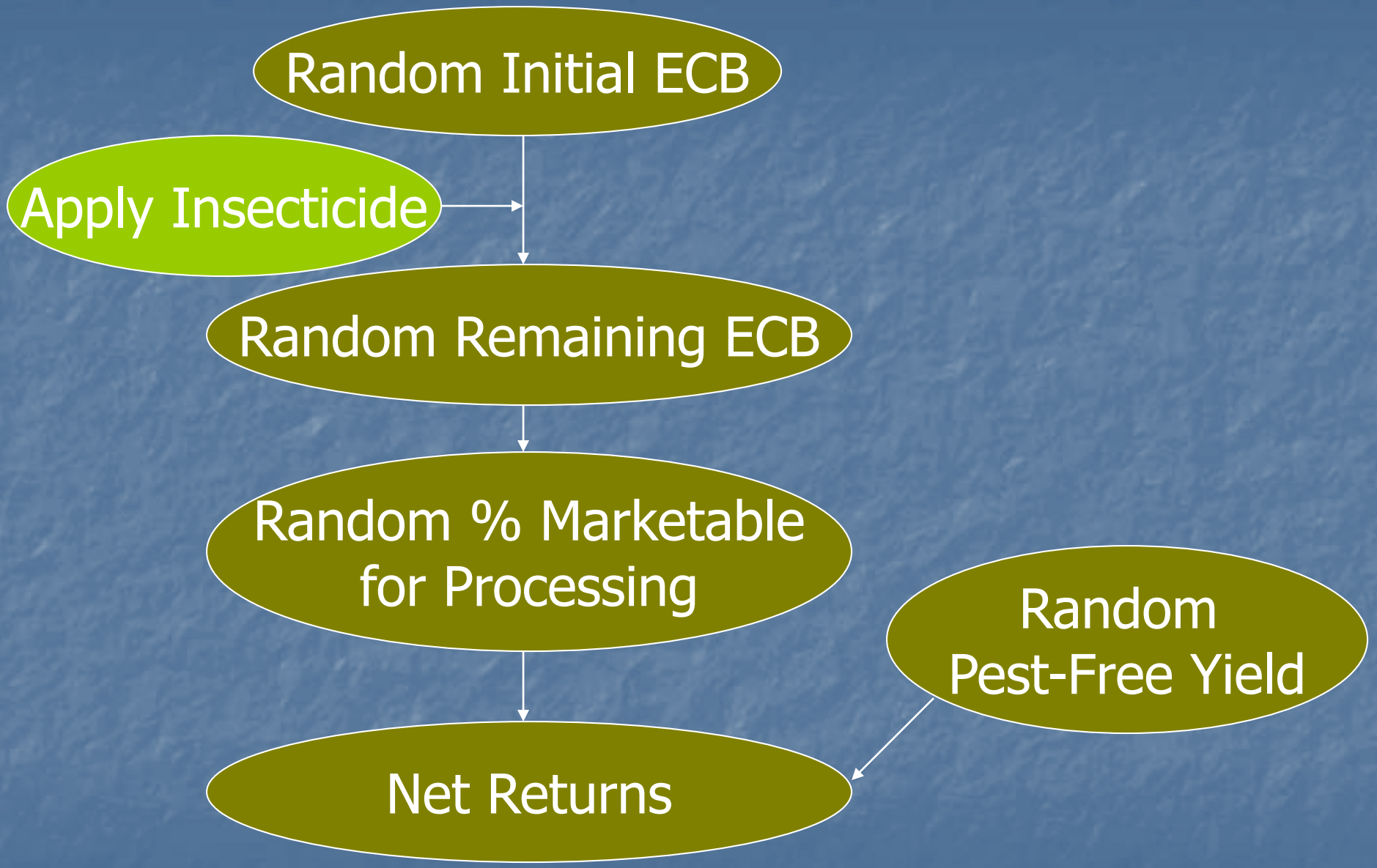
- Work in progress as part of NC IPM grant
- Preliminary empirical results today

Data

- Efficacy data from pyrethroid trials (~ 50)
- Capture, Warrior, Baythroid, Mustang, Pounce
- Most data from: MN, WI, IN and *AMT*
- Data include:
  - Mean ECB larvae/ear for treated and untreated control plots
  - % yield marketable for processing
  - Number of sprays and application rate

Empirical Model

- Keep key variables random to capture the risk/uncertainty in pest control
- Develop hierarchical model of linked conditional probability densities
- Estimate non-normal conditional densities
- Mean and variance depend on other variables that may be random



Net Returns = P_{sc} x Yld x %MktProc – P_i x AI_i - #Sprys x CostApp - COP

Initial/Untreated ECB density

- Lognormal density with constant mean and standard deviation
- WI DATCP fall surveys of 2nd generation ECB larvae in field corn (1964-2004)
  - Mean 0.70
  - Standard Deviation 0.92
  - CV 130%

Remaining/Treated ECB density

- Lognormal density
- Mean and standard deviation functions of initial ECB and amount of applied AI, with insecticide specific effects
- More initial ECB, on average more treated ECB
- More AI applied, on average fewer treated ECB
- Insecticide Specific Effects: at max approved rate, efficacy ranking (best to worst) is:

  Capture/Warrior-Baythroid, Mustang, Pounce

% Marketable for Processing

- Beta density between 0 and 1
- Mean function of the ECB larval population density (exponential decrease)
- More ECB, on average lower percentage marketable for processing
- Constant variance/standard deviation

Pest-Free Yield

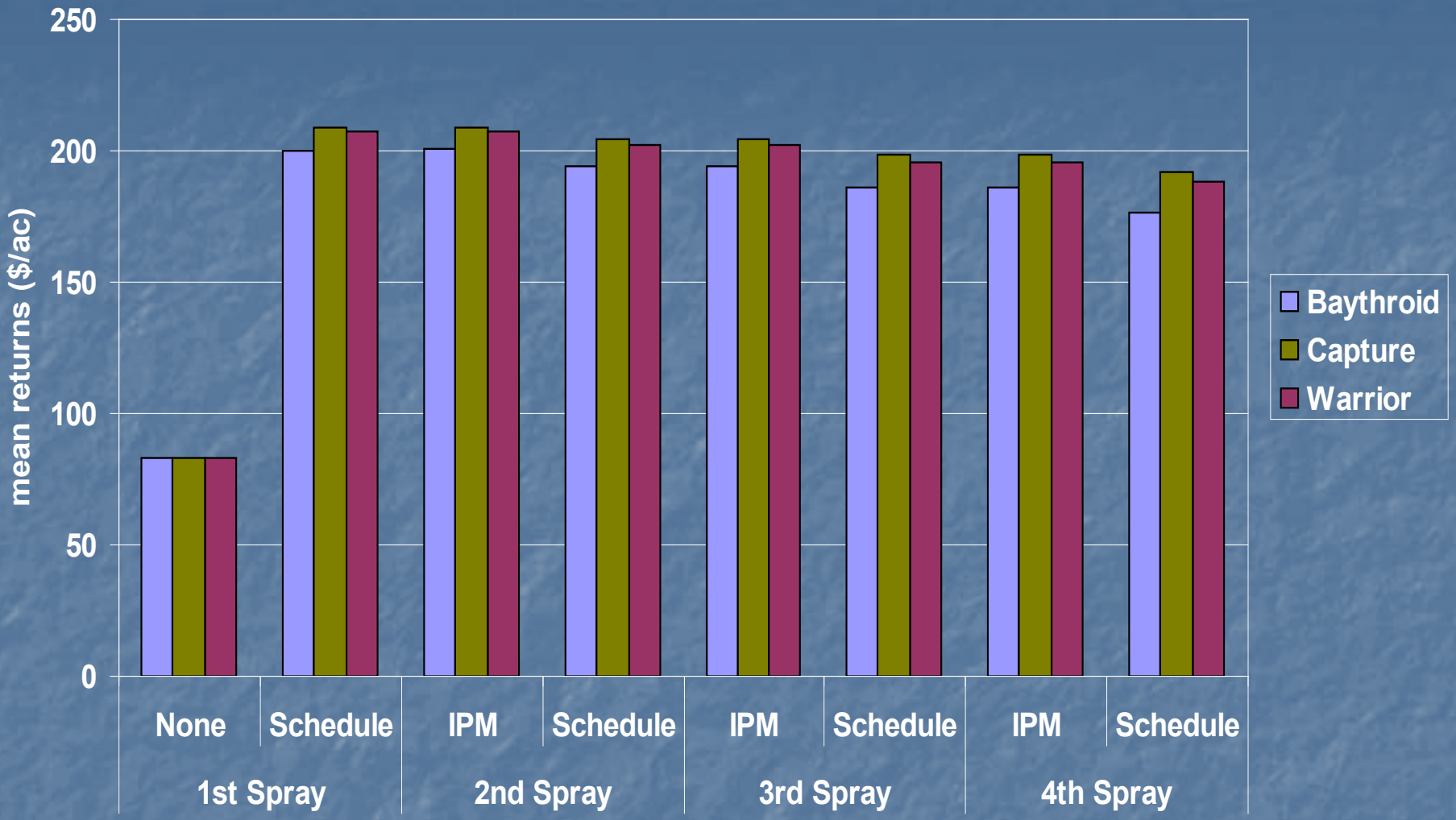
- Harvested yield without ECB damage
- Beta density (common for crop yields)
- Mean: 6.6 tons/ac (WI NASS 3-yr avg.)
- CV: 25% (increase WI NASS state CV)
- Minimum: 0 tons/ac
- Maximum: 9.9 tons/ac (mean + 2 st. dev.)

Prices and Costs

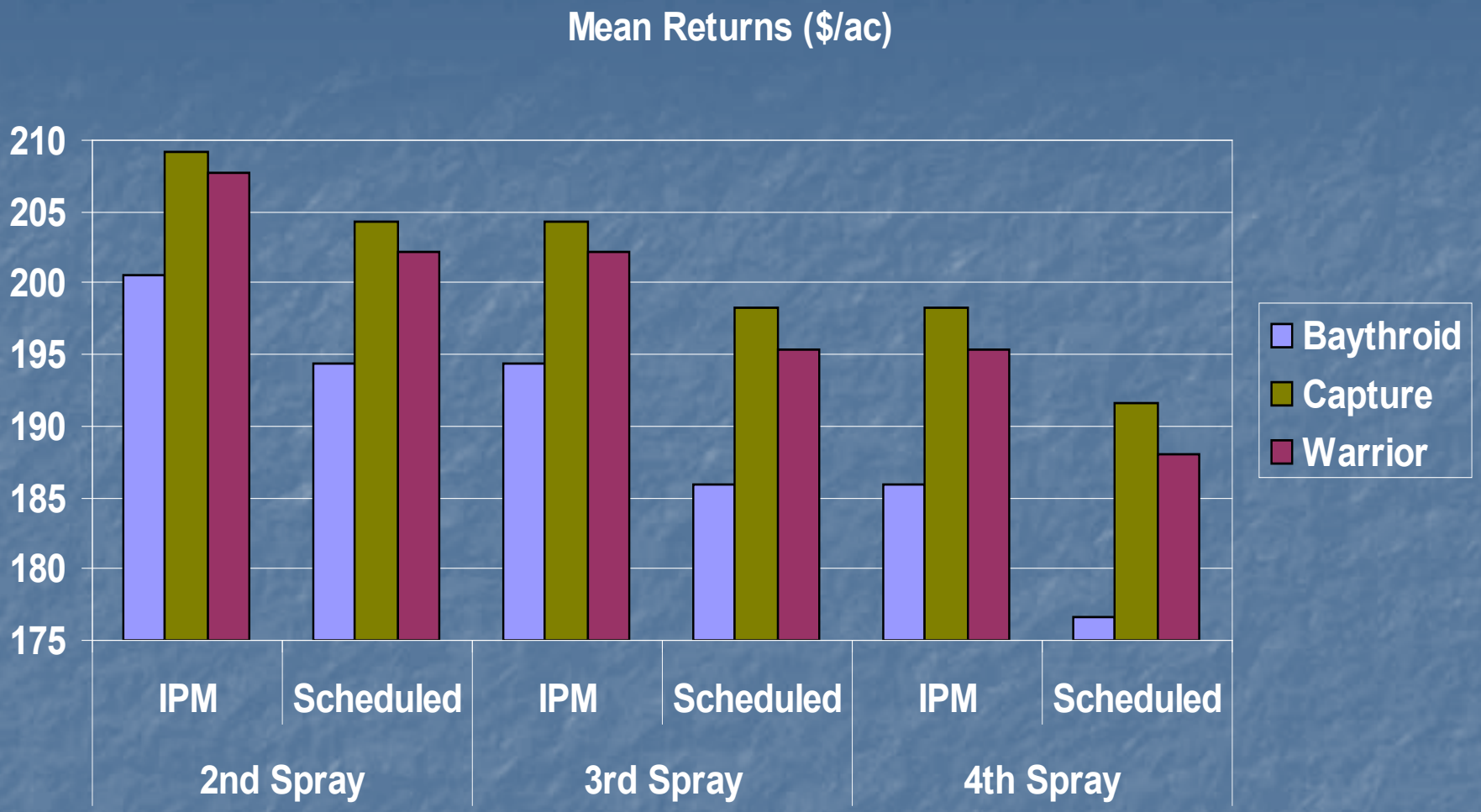
- Sweet Corn: $67.60/ton
- Insecticides ($/ac-treatment)
- Capture Warrior Baythroid
  $2.82/ac $3.49/ac $6.09/ac
- Mustang Pounce
  $2.80/ac $3.76/ac
- Aerial Application: $4.85/ac-treatment
- Other Costs of Production: $200/ac
- No Cost for ECB Scouting, Farmer Management Time, or Land

Model Summary

- Stochastic variables: yield, ECB population, insecticide efficacy, % marketable for processing, net returns
- Monte Carlo simulations for the hierarchical model
- Value with Stochastic Net Returns
  - Mean/Average/Expected Value Net Returns
- Risk with Stochastic Net Returns
  - Standard Deviation of Net Returns

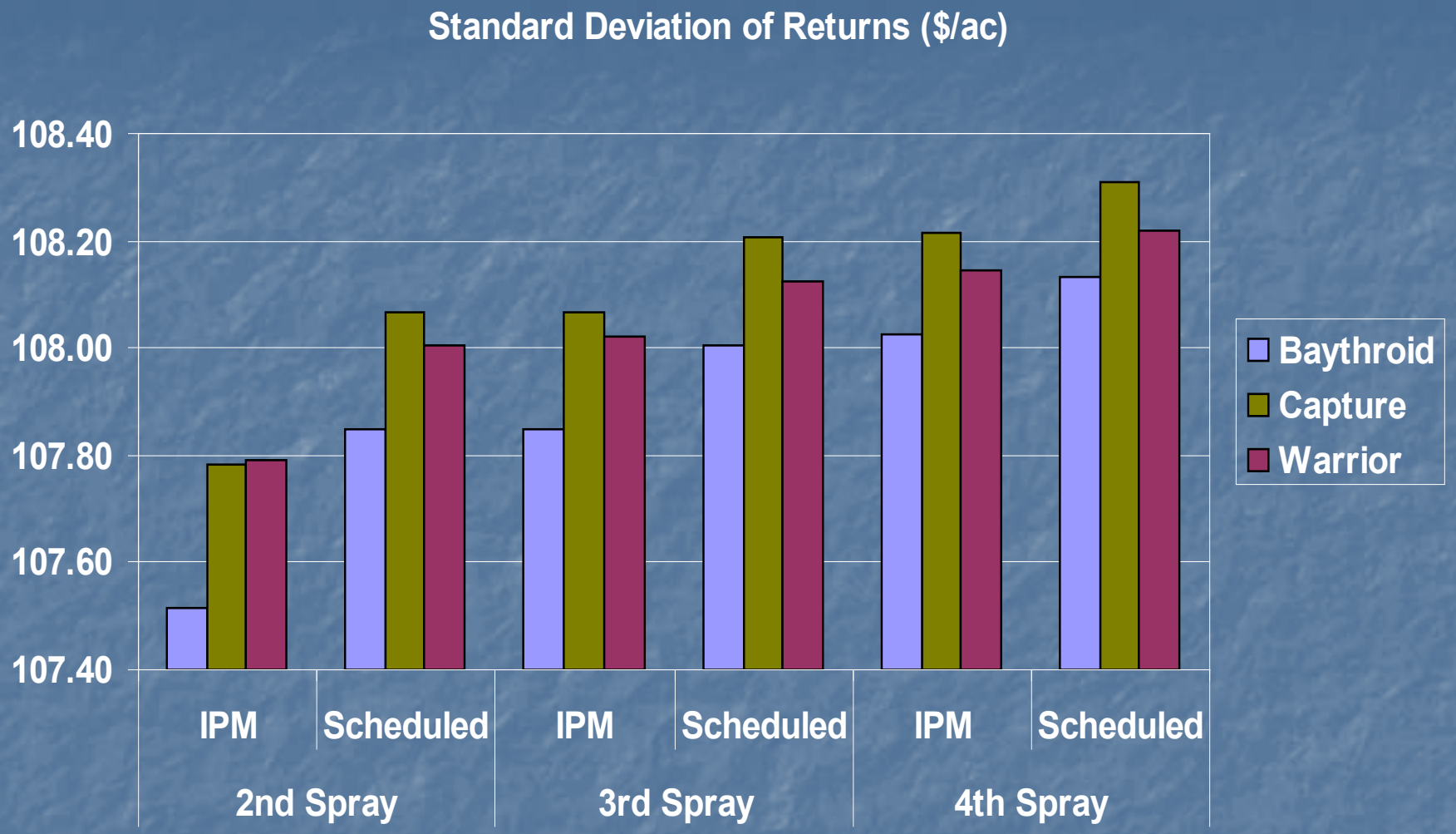


- Value of 1st spray: $115-125/ac
- 1 Scheduled Spray and use of IPM for 2nd spray maximizes farmer returns

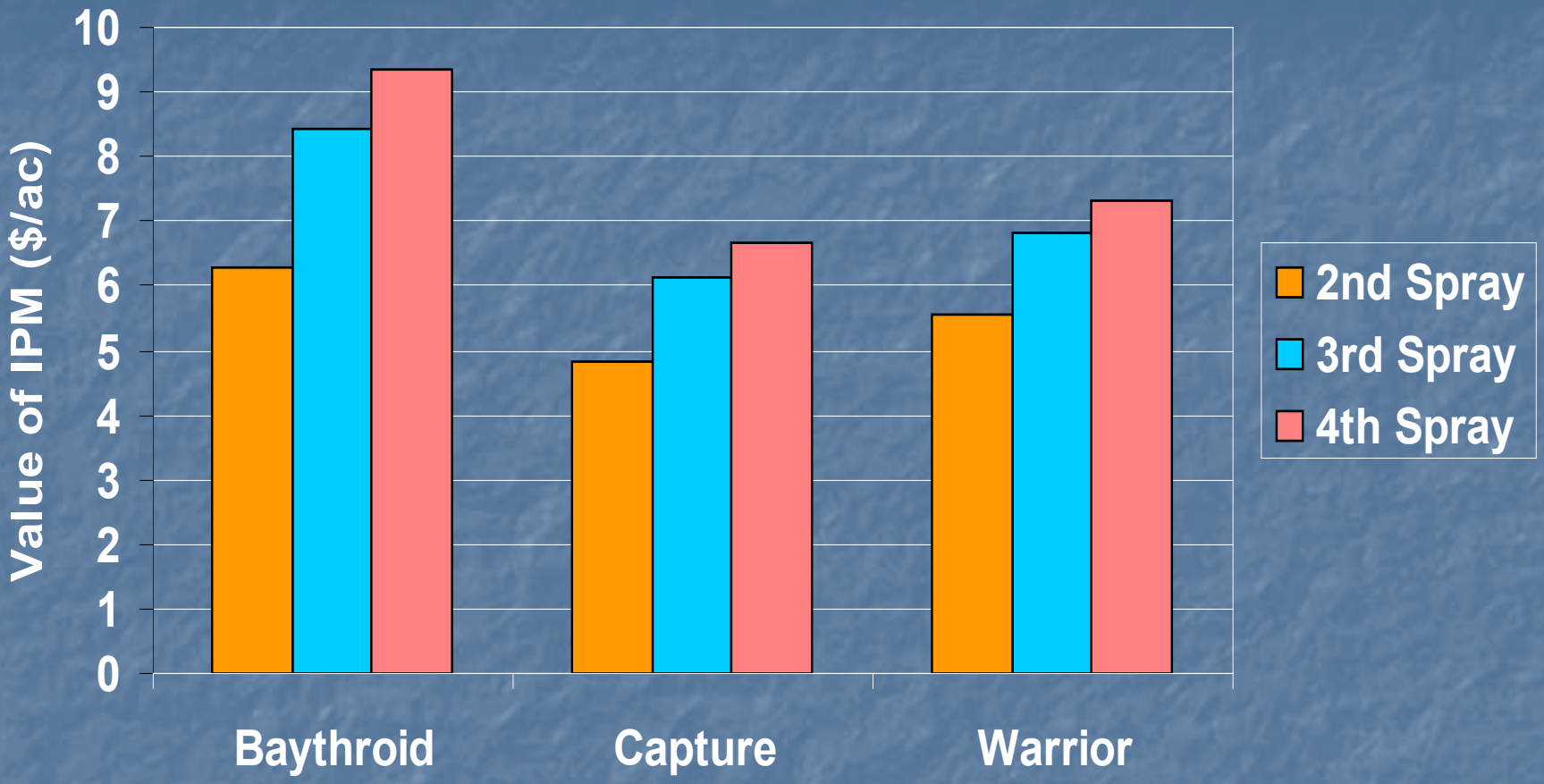


Economic Thresholds (ECB larvae/ear)

2nd spray: 0.15 3rd spray: 0.20 4th spray: 0.25

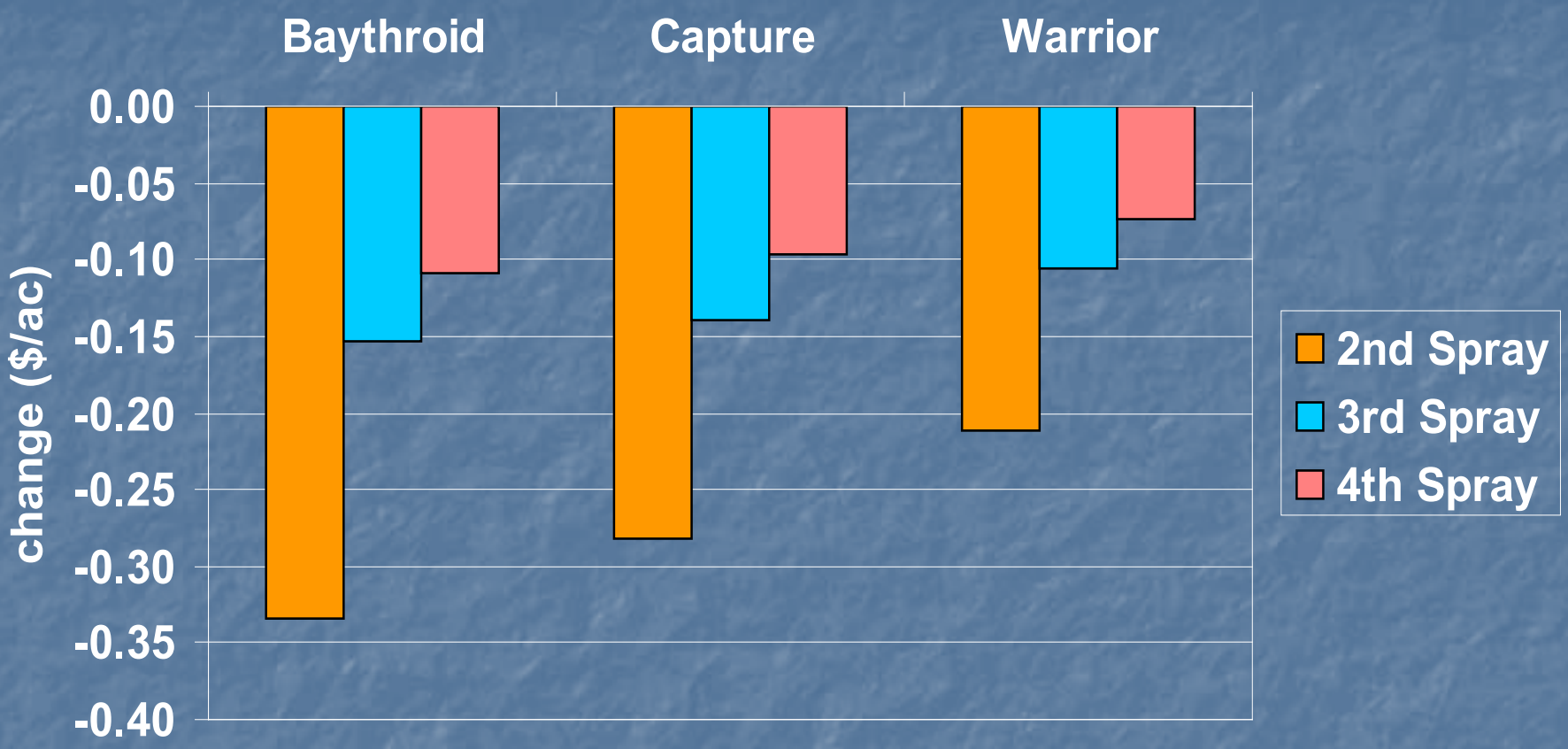

Standard Deviation of Returns ($/ac)
108.40
108.20
108.00
107.80
107.60
107.40
IPM
Scheduled
IPM
Scheduled
IPM
Scheduled
2nd Spray
3rd Spray
4th Spray
Baythroid
Capture
Warrior

Value of IPM/Change in Mean Returns ($/ac)



- Source of IPM value is preventing unneeded sprays
- Baythroid and Warrior more costly, so IPM more valuable
- After more applications, fewer scheduled sprays needed

IPM Risk Effect/Standard Deviation Change ($/ac)



Summary/Conclusion

- First scheduled spray worth $115-$125/ac
- 1 scheduled spray and use of IPM for the 2nd spray maximizes farmer returns
- Value of IPM vs scheduled additional spray ranges $5-9/ac, not including scouting cost
- IPM brings modest reductions in risk

- Improvements to make
- Specify the processing company's objective
- More representative ECB population data

Table 4. Expected net returns ($/ac) for each insecticide use strategy

Strategy	---------- Insecticide ----------				
Insecticide Use	Pounce	Mustang	Baythroid	Capture	Warrior
No Sprays	83.16	83.16	83.16	83.16	83.16
Schedule 1 Spray	137.68	176.65	199.86	208.78	207.45
Schedule 1 Spray, IPM for 2nd Spray	181.41	183.71	200.60	209.11	207.69
Schedule 2 Sprays	185.80	182.53	194.33	204.28	202.12
Schedule 2 Sprays, IPM for 3rd Spray	189.99	183.74	194.40	204.32	202.13
Schedule 3 Sprays	192.11	179.01	185.97	198.20	195.31
Schedule 3 Sprays, IPM for 4th Spray	192.56	179.30	185.96	198.20	195.30
Schedule 4 Sprays	189.54	172.54	176.62	191.55	187.96

Table 5. Net returns standard deviation ($/ac) for each insecticide use strategy

Strategy	---------- Insecticide ----------				
Insecticide Use	Pounce	Mustang	Baythroid	Capture	Warrior
No Sprays	128.50	128.50	128.50	128.50	128.50
Schedule 1 Spray	116.00	109.34	107.71	107.86	107.83
Schedule 1 Spray, IPM for 2nd Spray	105.52	106.92	107.51	107.78	107.79
Schedule 2 Sprays	107.90	107.88	107.85	108.07	108.00
Schedule 2 Sprays, IPM for 3rd Spray	106.16	107.29	107.85	108.07	108.02
Schedule 3 Sprays	107.94	107.71	108.00	108.21	108.13
Schedule 3 Sprays, IPM for 3rd Spray	107.72	107.55	108.02	108.21	108.14
Schedule 4 Sprays	108.52	107.77	108.13	108.31	108.22