

# Economic feasibility of pest management strategies in high tunnels to increase the resiliency of local food systems

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**Winter spinach production with organic practices in 2,100 sq.ft. under HT in Indianapolis. Total HT area is 15,848 sq. ft. producing +12 types of vegetables.**

## INTRODUCTION

Demand for local foods is a major driver of specialty crops production, especially for smaller operations in urban and peri-urban areas. Yet, pest management tends to impact yield and marketability of foods.

We investigated the economic feasibility of using biocontrol strategies to address pest management in High Tunnel (HT) systems.

We are using this information to build an online tool to assist farmers in making investment decisions for biological control and other technologies.

## OBJECTIVE

To deploy online decision-making tools to support the adoption of biocontrol strategies in HT production.

## DATA/METHODS

We are using a Qualtrics survey to collect data on:

- **Revenues.**
- **Costs:** variable, fixed, overhead.
- **Other inputs:** markets, etc.

We are modeling spinach under HT production.

Tool reports include:

- Projected profitability.
- Cost structure.
- Sensitivity analysis.
- Breakeven analyses: price, yield.

## ASSUMPTIONS

Seasons: winter, spring and fall planting.

Spinach tends to share HT space with others crops.

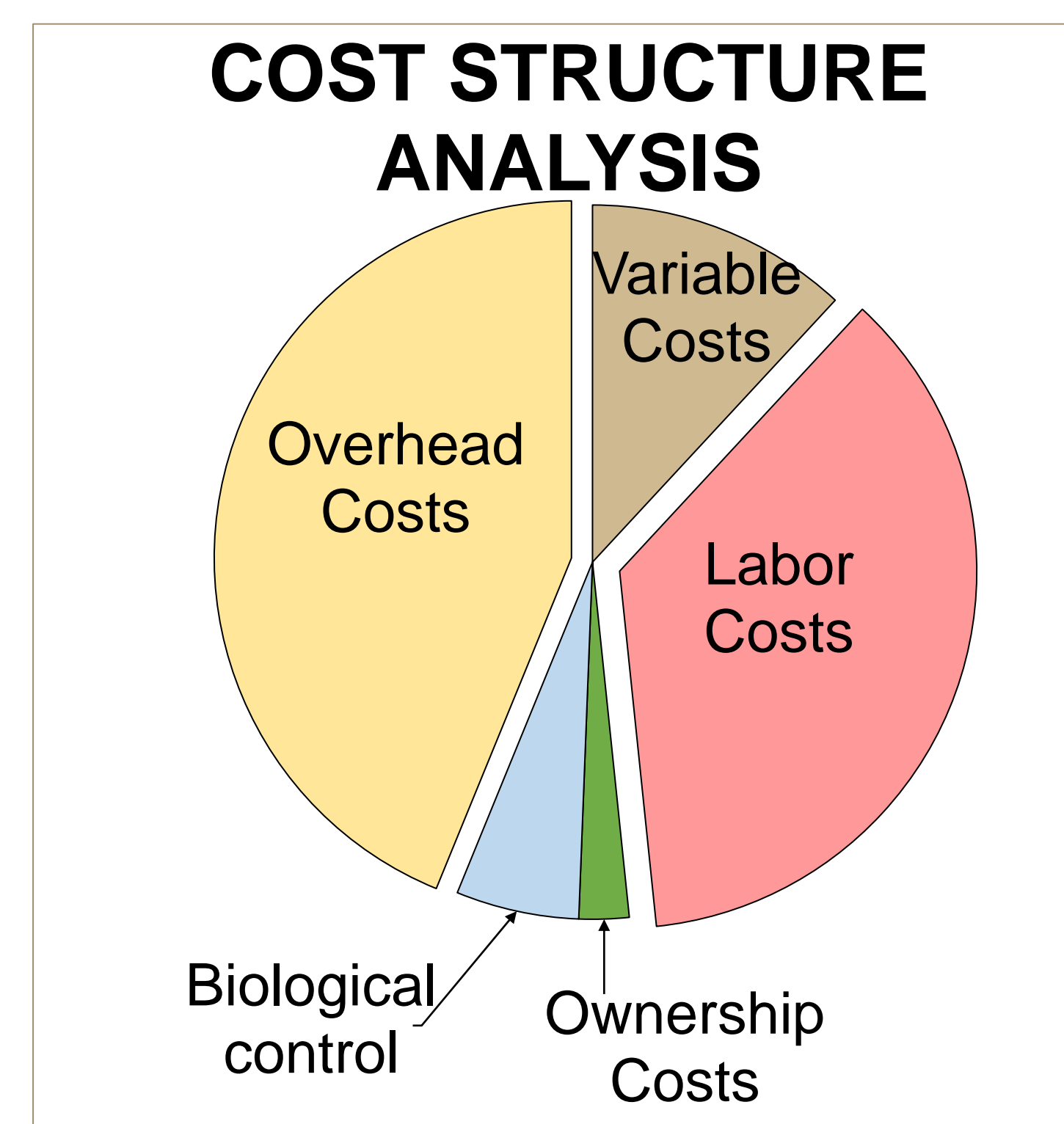
Farmers' practices vary widely: agronomic, pest management, sales.

Pest and beneficial insect communities tend to remain relatively stable across space and time.

Natural enemies provide pest suppression and are compatible with HTs systems.

| NET PROFIT ANALYSIS        |                   |                           |
|----------------------------|-------------------|---------------------------|
| Financial Results          | Crop Values       | Values (ft <sup>2</sup> ) |
| Direct Sales               | \$2,040.00        | \$0.97                    |
| Sales to Wholesalers       | \$1,980.00        | \$0.94                    |
| Other Sales                | \$1,980.00        | \$0.94                    |
| <b>Total Gross Revenue</b> | <b>\$6,000.00</b> | <b>\$2.86</b>             |
| Total Variable Costs       | \$429.00          | \$0.20                    |
| Total Labor Costs          | \$1,315.05        | \$0.63                    |
| Total Ownership Costs      | \$81.51           | \$0.04                    |
| Total Biological Costs     | \$200.73          | \$0.10                    |
| Total Overhead Costs       | \$1,580.53        | \$0.75                    |
| <b>Total Costs</b>         | <b>\$3,606.82</b> | <b>\$1.72</b>             |
| <b>NET PROFITS</b>         | <b>\$2,393.18</b> | <b>\$1.14</b>             |

2100 ft<sup>2</sup> seems to yield a net profit of \$ 2393.18



| SENSITIVITY ANALYSIS  |     |          |          |          |            |          |          |          |
|---|-----|----------|----------|----------|------------|----------|----------|----------|
| This tool calculates how net profits (\$ 2393.18 in 2100 ft <sup>2</sup> ) change when the average price (\$10 per lb) and yield (600 lb per 2100 ft <sup>2</sup> ) change. |     |          |          |          |            |          |          |          |
|   |     | -30%     | -20%     | -10%     | Unit Price | 10%      | 20%      | 30%      |
|   |     | \$       |          |          |            |          |          |          |
|   |     | \$ 7.00  | \$ 8.00  | 9.00     | \$ 10.00   | \$ 11.00 | \$ 12.00 | \$ 13.00 |
| -30%  | 420 | \$ -667  | \$ -247  | \$ 173   | \$ 593     | \$ 1,013 | \$ 1,433 | \$ 1,853 |
| -20%  | 480 | \$ -247  | \$ 233   | \$ 713   | \$ 1,193   | \$ 1,673 | \$ 2,153 | \$ 2,633 |
| -10%  | 540 | \$ 173   | \$ 713   | \$ 1,253 | \$ 1,793   | \$ 2,333 | \$ 2,873 | \$ 3,413 |
| Yield   | 600 | \$ 593   | \$ 1,193 | \$ 1,793 | \$ 2,393   | \$ 2,993 | \$ 3,593 | \$ 4,193 |
| 10%   | 660 | \$ 1,013 | \$ 1,673 | \$ 2,333 | \$ 2,993   | \$ 3,653 | \$ 4,313 | \$ 4,973 |
| 20%   | 720 | \$ 1,433 | \$ 2,153 | \$ 2,873 | \$ 3,593   | \$ 4,313 | \$ 5,033 | \$ 5,753 |
| 30%   | 780 | \$ 1,853 | \$ 2,633 | \$ 3,413 | \$ 4,193   | \$ 4,973 | \$ 5,753 | \$ 6,533 |

| BREAKEVEN YIELD ANALYSIS  |          |         |         |      |            |          |          |          |
|---|----------|---------|---------|------|------------|----------|----------|----------|
| This tool calculates the breakeven yield for your crop. The table shows what should be the yield of 2100 ft <sup>2</sup> in order to cover all your costs (at \$3606.82). |          |         |         |      |            |          |          |          |
|   |          | -30%    | -20%    | -10% | Unit Price | 10%      | 20%      | 30%      |
|   |          | \$      |         |      |            |          |          |          |
|   |          | \$ 7.00 | \$ 8.00 | 9.00 | \$ 10.00   | \$ 11.00 | \$ 12.00 | \$ 13.00 |
| -30%  | \$ 2,525 | 361     | 316     | 281  | 252        | 230      | 210      | 194      |
| -20%  | \$ 2,885 | 412     | 361     | 321  | 289        | 262      | 240      | 222      |
| -10%  | \$ 3,246 | 464     | 406     | 361  | 325        | 295      | 271      | 250      |
| Cost  | \$ 3,607 | 515     | 451     | 401  | <b>361</b> | 328      | 301      | 277      |
| 10%   | \$ 3,968 | 567     | 496     | 441  | 397        | 361      | 331      | 305      |
| 20%   | \$ 4,328 | 618     | 541     | 481  | 433        | 393      | 361      | 333      |
| 30%   | \$ 4,689 | 670     | 586     | 521  | 469        | 426      | 391      | 361      |

| BREAKEVEN PRICE ANALYSIS   |          |                             |         |         |                |         |         |         |
|--|----------|-----------------------------|---------|---------|----------------|---------|---------|---------|
| This tool calculates the breakeven price for your crop. The table shows what should be the average price per lb at which you should sell your yield of 600 lb. in 15848 ft <sup>2</sup> in order to cover all your costs (at \$3606.82). |          |                             |         |         |                |         |         |         |
|  |          | -30%                        | -20%    | -10%    | Yield          | 10%     | 20%     | 30%     |
|  |          | 420 480 540 600 660 720 780 |         |         |                |         |         |         |
| -30%   | \$ 2,525 | \$ 6.01                     | \$ 5.26 | \$ 4.68 | \$ 4.21        | \$ 3.83 | \$ 3.51 | \$ 3.24 |
| -20%   | \$ 2,885 | \$ 6.87                     | \$ 6.01 | \$ 5.34 | \$ 4.81        | \$ 4.37 | \$ 4.01 | \$ 3.70 |
| -10%   | \$ 3,246 | \$ 7.73                     | \$ 6.76 | \$ 6.01 | \$ 5.41        | \$ 4.92 | \$ 4.51 | \$ 4.16 |
| Cost   | \$ 3,607 | \$ 8.59                     | \$ 7.51 | \$ 6.68 | <b>\$ 6.01</b> | \$ 5.46 | \$ 5.01 | \$ 4.62 |
| 10%  | \$ 3,968 | \$ 9.45                     | \$ 8.27 | \$ 7.35 | \$ 6.61        | \$ 6.01 | \$ 5.51 | \$ 5.09 |
| 20%  | \$ 4,328 | \$ 10.31                    | \$ 9.02 | \$ 8.02 | \$ 7.21        | \$ 6.56 | \$ 6.01 | \$ 5.55 |
| 30%  | \$ 4,689 | \$ 11.16                    | \$ 9.77 | \$ 8.68 | \$ 7.81        | \$ 7.10 | \$ 6.51 | \$ 6.01 |

## RESULTS

Yield losses could be 30% if aphids are not controlled (Foss & Jones, 2000).

In a 15-year lettuce experiment treated with imidacloprid summary, Palumbo (2019) found that yield losses due to aphids can be, on average, 13%, and Gianessi (2009) found that a treatment with imidacloprid could reduce as 3 aphids/plant in spinach.

Sarwar (2014) found in Canola, 35.5 aphids/plant when applying *C. carnea* larvae (yield: 3,133 kg ha<sup>-1</sup>) and 74 aphids/plant in control treatment (2,013 kg ha<sup>-1</sup>). Similarly, Usman et al. (2012) found that tomato treated with Trichogramma eggs, Chrysoperla and neem extract had 11.04% of weight loss, while the control loss was 20.45%.

The total gross revenue was \$6,000, total cost was \$3,606.82, and profit was \$2,393.18.

Overhead costs (44%) were the largest expense category, followed by labor costs (36%), variable costs (12%), biological costs (6%) and ownership costs (2%).

The breakeven yield was calculated at 361 lb. of spinach sold, which is the level of yield needed to cover all costs and breakeven price was calculated at \$6.01/lb.

## TAKE-HOME

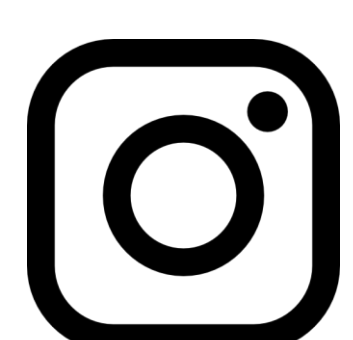
This tool can help farmers understand the economic impact of using biocontrol strategies.

Farmer markets, restaurants, online sales, and other high-value markets seem to be the best channels to sell spinach with price premiums.

We are currently collecting data on biocontrol inputs and outputs.

## ACKNOWLEDGMENTS

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