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Economic Evaluation of Fumigants in Florida Bell Pepper Production: A Multi-Season Perspective

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Introduction

Florida is the second largest producer of bell peppers in the United States (USDA, 2016). Production of bell pepper is of great economic significance to the state's vegetable industry. In 2016, Florida accounted for 28.5 percent ($209.7 million) of the total U.S. value ($735.7 million) of bell peppers. For the sustainable growth of bell peppers, Florida farmers have been dependent on methyl bromide (MBr) to control and regulate soil-borne pests and diseases. Fresh bell pepper production accounted for 23% of total MBr pre-plant usage in the United States in 1997 (NASS, 2002). However, the phase-out of MBr has created tremendous challenges for pest and disease management that is critical for Florida due to its warm and humid production conditions. The bell pepper production in Florida has been experiencing a steady decline over the past decade in part due to the loss of methyl bromide.

Since the phase-out of MBr, many alternative fumigants have been identified that can be used in combinations, or in sequence, but it is generally acknowledged that these alternatives tend to provide inconsistent pest control. Since fumigation efficacy varies over time, an economic evaluation of fumigants based on single-year trials is not reliable. Several studies have examined economic effects of fumigant alternatives on vegetable production in the U.S. The recommended fumigant alternatives are not necessarily economically sustainable and viable due to efficacy inconsistency, which calls for an economic assessment from a multi-season perspective.

Objective

The objectives of this study are twofold.

First, we analyzed the cost-effectiveness of fumigants using a multi-season field trial data. Using a long-term experimental data for the whole-farm budget analysis to estimate the profitability is expected to generate more robust and reliable results since it considers efficacy variation over time.

Second, the economic analysis will further incorporate risk factors to account for the variability of yield or net benefit for this practice, which will give farmers additional information on how stable or volatile the results are.

Data

The bell pepper field trial used was conducted by the University of Florida Gulf Coast Research and Education Center (GCREC) over 2008-2010. Fumigant treatments included:

- a non-fumigated control;
- MBr:Pic -- MBr plus chloropicrin (MBr:Pic 67:33) at 196 kg·ha-1;
- DMDS:Pic -- dimethyl disulfide plus Pic (DMDS:Pic 79:21) at 595 kg·ha-1;
- Two-way System -- 1,3-dichloropronpene (1,3-D) at 112 L·ha-1 plus Pic (1,3-D:Pic) at 168 kg·ha-1, which is also the current industry standard;
- Three-way System -- the two-way system followed by metam potassium (Kpam) at 561L·ha-1 (1,3-D:Pic:Kpam).

Results and Discussion

Treatment	Revenue	Total Costs	Profit
MBr:Pic	31,949	31,348	601
DMDS:Pic	22,775	29,803	-7,028
Two-way	27,859	30,330	-2,471
Three-way	33,148	33,030	119
Non-fum.	21,675	26,475	-4,800

Table 1: Net economic effects ($/ha) of treatments

Whole Farm Budgeting Analysis

Taken together with all three years, three-way treatment was found to be the most costly treatment at $33,030 per ha, followed by MBr:Pic ($31,348/ha) (Table 1). Also, three-way treatment gave the highest revenue ($33,148/ha) followed by MBr:Pic ($31,949/ha) and the current industry standard ($27,859/ha). Combined, the results suggest that MBr:Pic was the best choice because the profit from using MBr:Pic was positive and highest among all treatments. Three-way treatment was found to be the next best. Although two-way treatment performed better than DMDS:Pic and non-fumigated treatments, it generated an average negative profit.

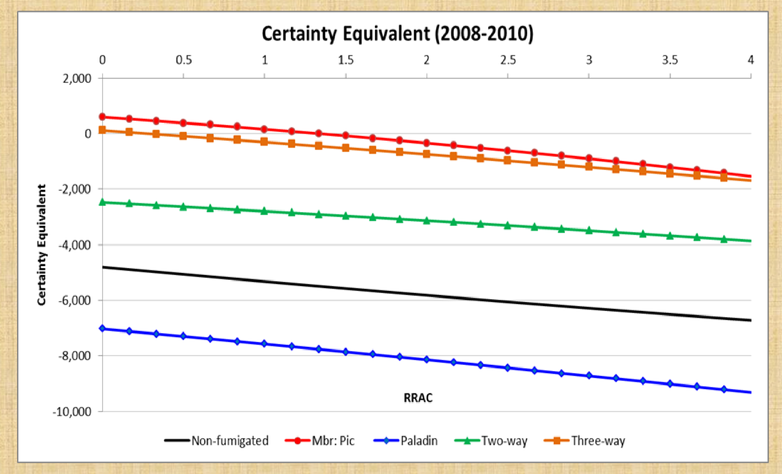

Figure 1. Comparison of the CE values of treatments' profits for all the three experimental years

Certainty Equivalent Analysis

The results of certainty equivalent (CE) analysis (Hardaker et al., 2004) suggest that for a Florida bell pepper farmer with any degree of risk aversion, MBr:Pic always dominates any other treatments (Figure 1). Three-way treatment is the second best. Two-way treatment is preferred to non-fumigated treatment while DMDS:Pic always was the least preferred choice.

Conclusion

- The results from risk-efficiency analysis are consistent with the findings from the cost-effective analysis.
- MBr:Pic was found to be the most consistent and least risky fumigation for a risk averse decision maker followed by the three-way system.
- No better alternative to MBr in Florida bell pepper production exists that can substitute MBr in terms of cost effectiveness and risk efficiency.
- Switching from MBr to the current industry standard resulted in a loss of $3,072/ha in profit, while the loss would reduce to $483/ha when adopting three-way treatment.

References

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