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Assessing New Methods of Integrated Pest Management for Apple Orchards in the Midwest

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Abstract
Producing apples in the Midwest requires intensive, chemically based pest management systems in order to bring high-quality, fresh market apples to consumers. A combination of rising costs, pest resistance, and new legislation has caused existing systems of apple pest management to become ineffective or to fall out of favor with growers. Because of this, new methods of pest control were developed to combat the ever present problems in apple production. These new methods must meet a number of criteria: sufficient pest control must be achieved; the innovative tactics must be safer for applicators, the environment, and consumers; and also must be economically feasible or they are not likely to be adopted by growers.

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Introduction

Producing apples in the Midwest requires intensive, chemically based pest management systems in order to bring high-quality, fresh market apples to consumers. A combination of rising costs, pest resistance, and new legislation has caused existing systems of apple pest management to become ineffective or to fall out of favor with growers. Because of this, new methods of pest control were developed to combat the ever present problems in apple production. These new methods must meet a number of criteria: sufficient pest control must be achieved; the innovative tactics must be safer for applicators, the environment, and consumers; and also must be economically feasible or they are not likely to be adopted by growers.

Materials and Methods

A conventional apple pest management system was compared with a current integrated pest management (IPM) and two new IPM systems employing a combination of pest control tactics. These included three apple scab-resistant cultivars (Redfree, Liberty, and Gold Rush on M9 rootstock), weather based disease warning systems, and alternative pesticides.

Four apple pest management treatments were compared in a 4-year-old orchard at the ISU Horticulture Research Station. All treatments included apple cultivars that are highly resistant to apple scab; some also possess resistance to cedar rust and/or tolerance to fire blight. The plot was arranged in a stratified randomized complete block with five blocks for each treatment–cultivar combination and five trees per subplot.

1) ***Calendar-based*** using conventional pesticides.
2) ***Current IPM*** using delayed and degree day based pesticide sprays.
3) ***New IPM A*** using a leaf wetness based disease warning system, and alternative, calendar-based, pest specific insecticide applications.
4) ***New IPM B*** using a relative humidity based disease warning system and several alternative insecticides whose applications were based on degree days and insect trap captures.

At harvest, 30 fruit per tree were sampled and the number of fruit with sooty blotch and flyspeck (SBFS), apple scab, codling moth, and damage due to other insects and disease was recorded. All fruit from the three center trees of every subplot were harvested and marketable and cull apples were counted and weighed.

Results and Discussion

There were few differences in marketable or cull number and weight of apples among treatments, and few differences among treatments for insect and disease incidence (Table 1). No apple scab was observed. No SBFS signs appeared on early cultivar Redfree and few signs were observed on later harvested cultivars. Treatments using SBFS warning systems had slightly more SBFS signs than conventional treatments, but still had $\leq$ 1% incidence on fruit. Very little codling moth damage occurred (Table 1).

Treatment 4 required the fewest pesticide sprays to manage pests and diseases (Table 2). Treatment 3 required weekly Cyd-X applications throughout the growing season and spray numbers were higher than any other treatment. Several of the new IPM options explored in this study controlled apple pests as well as conventional strategies and showed potential for reducing orchard management costs while minimizing pesticide exposure to humans and the environment.

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Table 1. Summary of mean fruit yield per tree and mean incidence of disease/pest damage means by cultivar and treatment in 2009.

	Weight (lb) per tree		Mean fruit number per tree		Disease/pest incidence (% of sampled fruit)			
Treatment	Marketable	Cull	Marketable	Cull	Codling Moth	SBFS	Other insect	Apple scab
Redfree								
1	18.6 a	0.4 a	54.1 a	2.2 a	0.2 a	0.0	0.5 a	0.0
2	18.7 a	0.8a	55.7 a	3.5 a	0.2 a	0.0	1.0 a	0.0
3	19.0 a	0.3a	56.7 a	2.1 a	0.0 a	0.0	0.5 a	0.0
4	23.7 a	0.5a	65.5 a	2.5 a	0.1 a	0.0	0.7 a	0.0
Liberty								
1	21.6 a	0.4 b	66.5 a	1.7 b	0.1 a	0.5 a	0.1 b	0.0
2	19.5 a	0.8 ab	64.5 a	2.6 b	0.1 a	0.1 a	0.1 b	0.0
3	23.4 a	0.6 b	68.1 a	3.0 ab	0.1 a	0.5 a	0.1 b	0.0
4	22.3 a	1.1 a	66.5 a	4.3 a	0.1 a	0.5 a	1.6 a	0.0
Goldrush								
1	35.7 a	1.2 b	99.9 ab	4.4 b	0.1 a	0.0 b	0.1 ab	0.0
2	31.1 a	1.7 ab	102.1 ab	11.1 ab	0.3 a	0.0 b	0.2 ab	0.0
3	31.2 a	1.1 b	86.9 b	5.1 b	0.1 a	0.9 a	0.3 a	0.0
4	36.8 a	2.6 a	113.8 a	12.9 a	0.1 a	0.6 ab	0.0 b	0.0

[z]For each cultivar means followed by the same letters are not different (P = 0.05).

Table 2. Summary of number of pesticide sprays by cultivar and treatment, 2009.

	Treatment			
Cultivar	1	2	3	4
Redfree	Number of sprays			
Insecticide	10	6	15	7
Fungicide	10	9	6	6
Total number of sprays	20	15	21	13
Total number of trips[z]	12	12	16	10
Liberty				
Insecticide	13	7	19	8
Fungicide	12	11	9	8
Total number of sprays	25	18	28	16
Total number of trips	15	14	20	13
Goldrush				
Insecticide	13	7	19	8
Fungicide	12	11	9	8
Total number of sprays	25	18	28	16
Total number of trips	15	14	20	13

[z]Combines insecticide and fungicide sprays that were applied at the same time as a tank mix.