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Purdue University**INDIANA PEPPERMINT GROWERS' TOP MANAGEMENT PRACTICES****Controlling Verticillium Wilt**

This publication investigates Indiana farmers' integrated pest management (IPM) strategies to control Verticillium wilt in commercial peppermint (*Mentha piperita* L. Black Mitcham) production. Verticillium wilt was first reported in commercial mint production in the Midwestern U.S. in the 1920s, and by the 1950s, it had spread to mint-producing regions of the Pacific Northwest (Dung, 2020). Verticillium wilt in mint is caused by *Verticillium dahlia*, where the fungi enter xylem elements, disrupt the flow of water in plants, and cause vascular wilt (Johnson & Dung, 2010). Verticillium wilt is currently one of the most important and destructive mint diseases in the United States (Dung, 2020).

*Mentha* is a genus belonging to the family *Lamiaceae* that includes about 30 species and hybrid species distributed around the world. These aromatic plants are widely used for human needs (e.g., oils, herbs, spices) and pharmaceutical needs. The cultivation of mint for oil

production has a long story in the United States. Mint production shifted in the early 20th century into the muck soils of Michigan and Indiana and further west into the Pacific Northwest.

Indiana is the fourth-largest peppermint-producing state after Idaho (ID), Oregon (OR), and Washington (WA). In 2021, Indiana peppermint production operations reached 5,500 acres harvested with a yield of 52 pounds/acre, resulting in a total of 286,000 pounds harvested. According to the latest US Census of Agriculture, the selling price was estimated at \$22.80 per pound, with a total value estimated at \$6,521,000.

**Data**

Data for this article was collected through an online survey of Indiana peppermint growers. The survey was created on Qualtrics and reviewed by a group of peppermint experts. A total

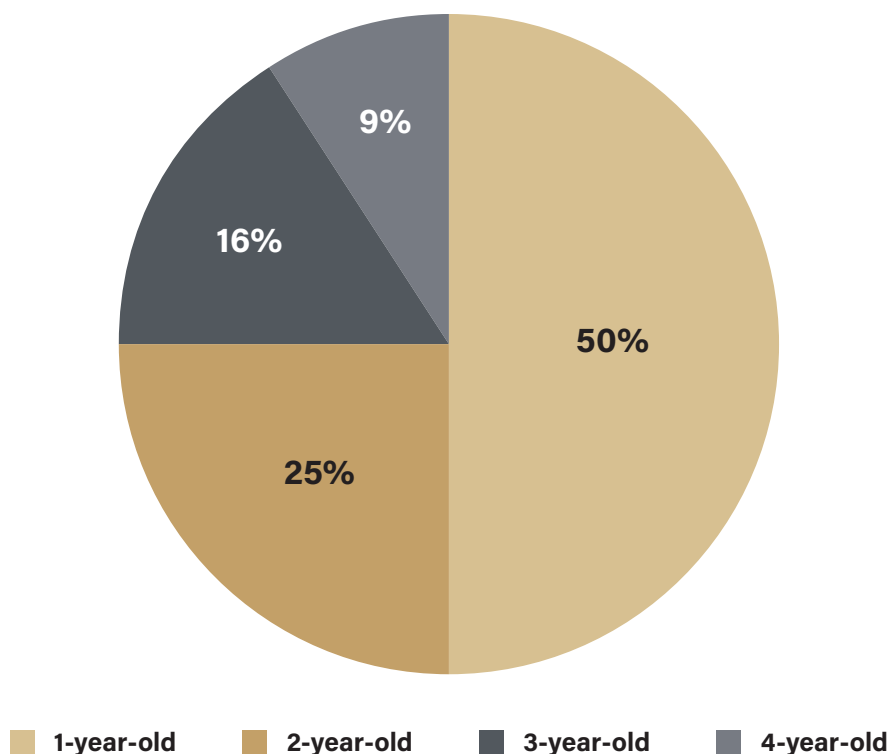
of four responses were obtained. Over the past five years, the number of mint growers in Indiana has declined to between six and eight. Fewer peppermint growers emerged from the COVID-19 pandemic and related supply chain issues that resulted in higher input costs, while the price of mint oil has not increased. The survey asked the growers about their growing practices, management practices, pests and pathogens, distilling practices, sales, and their perceptions of agriculture and operations.

### Findings on Peppermint Production

Peppermint species commonly found in Indiana include Black Mitcham, Murray's Mitcham, Robbert's Mitcham, and Todd's Mitcham. The average peppermint production reported by the five surveyed operations was 171.1 acres, with 99.3% of the area planted with Black Mitcham (170 acres). Only one grower reported growing 4 acres of Murray's Mitcham. All growers reported cutting their peppermint once a year. Three of the four growers reported using sustainable farming practices on their total acreage; the remaining grower followed conventional farming practices on 100% of their land.

We asked growers to rank their preferred crop to grow in the year before mint is planted. Mustard species, onion, and corn were the top three crops preferred to be planted the year before mint. Other crops included soybeans, pickling cucumber, sorghum, cover crops, pumpkin, cereal rye, potato, and tomato. We also asked growers for the age of all cultivated acres of peppermint production (see Figure 1). Half of the total acreage was planted with baby/row mint (1 year), followed by 2-year plantings (25%), and 3 and 4 years, with 16% and 9%, respectively. None of the growers surveyed reported having peppermint plants older than 4 years. Figure 2 illustrates the average mint oil yield by age of planting. The highest yield was reported for 2-year-old mint (55 lb/acre), followed by 1-year-old mint (45.3 lb/acre), 3-year-old mint (42.7 lb/acre), and a 4-year-old mint (42.0 lb/acre).

Figure 3 illustrates the different types of farming practices used by Indiana peppermint growers. The top three practices are the use of disease-free genetic material (25%), the application of spent mint hay on the fields (25%), and planting in fields that have never been planted with mint (25%). Irrigation and cover cropping were reported by 17% and 8% of respondents, respectively.



**Figure 1.** Age of peppermint fields as a percentage of acreage planted.

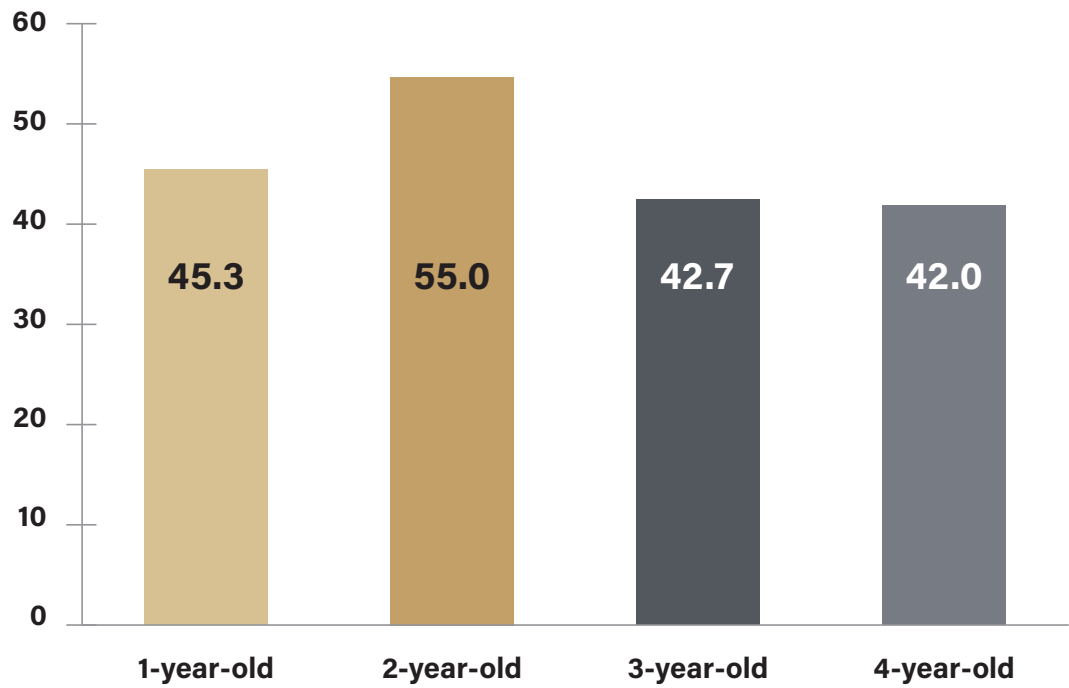


Figure 2. Oil yield by age of peppermint field.

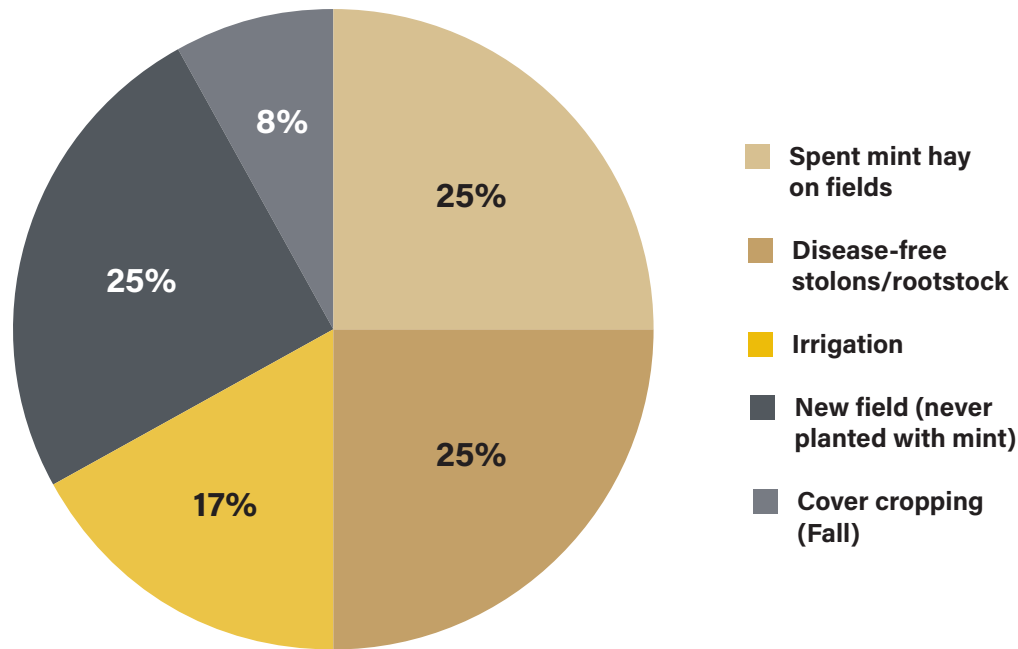


Figure 3. Farming practices for peppermint production.

We asked Indiana peppermint growers the planting distance between peppermint rows (in inches). The average planting distance among all growers was 30 inches between rows, with a maximum of 36 inches and a minimum of 24 inches. Three out of four growers propagate their own peppermint stolons. Lastly, growers typically dig and plant their peppermint stolons between March and April.

Three out of four farmers in our sample reported doing soil tests to assess the level of nutrients. Most of the fertilizer applications were granular (100% of farmers) or liquid (25% of farmers). Interestingly, only 50% of peppermint growers in our sample reported testing for Verticillium wilt, while 25% are considering testing. In addition, none of the respondents reported disinfecting their tillage equipment when moving from one field to another. All respondents reported applying mint hay to either peppermint fields or other mint fields.

On average, 86% of mint production among all respondents was sold under contract in 2021. In addition, an average 14.8% of all farm income came from mint oil production.

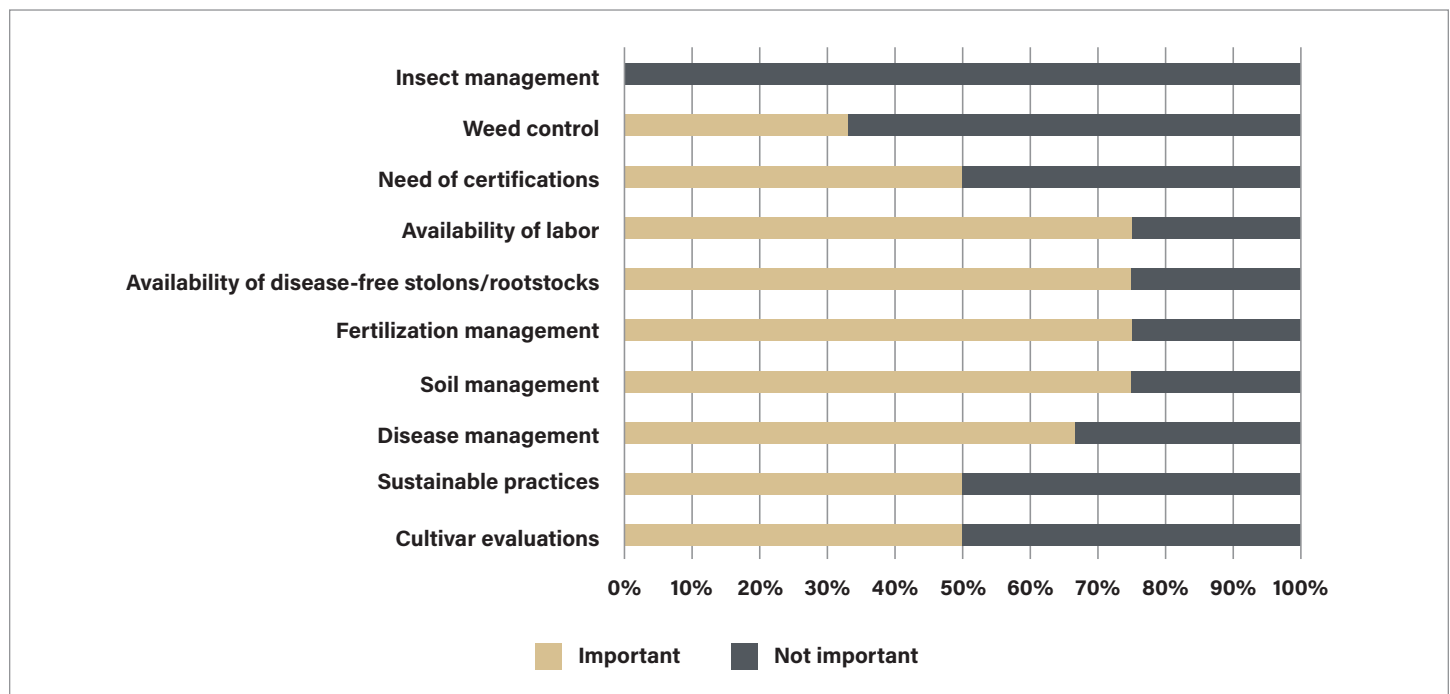
## Findings on Pest Management Control in Peppermint

We asked growers about the practices used to control Verticillium wilt in peppermint, which included

chemical fumigation before planting, application of biological control products, and crop rotation. All farmers reported using crop rotation, and only one reported doing chemical fumigation before peppermint planting. Nematodes can be an important pest in mint, causing stunted and dying plants and eventually leading to root death. Among the techniques used to control nematodes affecting mint, 75% of peppermint growers in our sample used crop rotation, while only one used chemical fumigation in addition to crop rotation.

The survey asked farmers' perceptions of the most severe annual weeds in peppermint production. Pigweed was considered the most severe pest, followed by ragweed and lambsquarter. Most growers considered nightshade and velvetleaf not severe. All farmers in our sample reported using chemical herbicides to control weed populations; only one reported using hand weeding.

The survey also asked growers about their perception of the severity of mint pests. In growers' experience, mint rust, mint bud mite, and Verticillium wilt were considered extremely serious. On the other hand, Asian garden beetle, nematodes (stem, spiral, pin, dagger, common needle, northern root, and false root), two-spotted spider mites, and mint flea beetle were considered as low- to medium-severity pests. Finally, cutworms, peppermint aphids, and Japanese beetle were considered non-severe.



**Figure 4.** Importance of agricultural practices for the success of peppermint operations.



## Findings on Distilling Practices

Steam distilling is used to extract the oil from the mint leaves. On average, growers produced 57.5 pounds of oil per acre in 2021. Half of the growers let the mint remain in the windrow for 2 days before distillation; the remaining 50% of growers let the mint remain in the windrow for 1 or 3 days, equally. On average, peppermint distillation occurs when leaves are steamed at 220°F for ≈92 minutes per batch.

## Findings on Agricultural Practices

Growers were asked about the importance of certain practices for the success of their farms (Figure 4). Labor availability, disease-free runners, fertilization management, and soil management were the most important practices in peppermint production, followed by disease management, sustainable practices, cultivar evaluations, and need of certifications. The practices with lowest importance for growers were insect management and weed control.

## Findings on Farm Characteristics

The survey asked peppermint growers how much land they rent or own. The survey results show that in 2021, an average peppermint grower had 160 acres used for peppermint production. This amount of land is divided into rented land (59% of the total – 93.75 acres) and owned land (41% of the total – 66.25 acres.) All growers responded that they did not receive any financial assistance to carry out their peppermint production. In 2021, all growers paid property insurance, 75% paid crop insurance and farm equipment insurance, and only 25% paid product liability, income protection, and worker compensation.

For an average farmer in Indiana, peppermint has been grown and distilled for 27 years, and the peppermint operation has been running for 2.25 generations. The survey results show that 75% of the growers farmed their peppermint full-time, and only one farmer worked on his farm part-time in 2021.

Labor plays an important role in carrying out the different operations for peppermint production. We asked peppermint growers about family (including themselves) and nonfamily labor. The nonfamily labor was categorized into permanent employees, temporary or seasonal employees, and foreign migrant

employees. An average peppermint grower had 6.25 workers distributed into 2.75 family members, 2 permanent employees, 1.5 temporary or seasonal employees, and no foreign migrant employees. Half of the respondents are limited liability companies (LLCs), and the other 50% are sole proprietorships.

Half of the respondents were in the age range of 25 to 44 years old. The ranges for the other half – 18 to 24 years old and 65 to 74 years old, were split equally. All respondents were male, and 75% of them reported a high school diploma. The education level of the other 25% was some college/vocational technical work.

## Conclusion

Findings from the survey highlight the main practices in peppermint production among farmers in Indiana. The survey focused on management and cultural practices adopted to control Verticillium wilt, one of the most important and destructive mint diseases in the United States. Main findings include the age of peppermint field, yield of oil production (in lb/acre), and planting strategies to prevent mint yield reductions due to pests.

## Resources

Dung J.K.S., 2020. Verticillium Wilt of Mint in the United States of America. *Plants* (Basel). 2020 Nov 18;9(11):1602. DOI: 10.3390/plants9111602

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