Mint landscape

From Field to Flavor

The mint industry's latest trends, challenges and outlook

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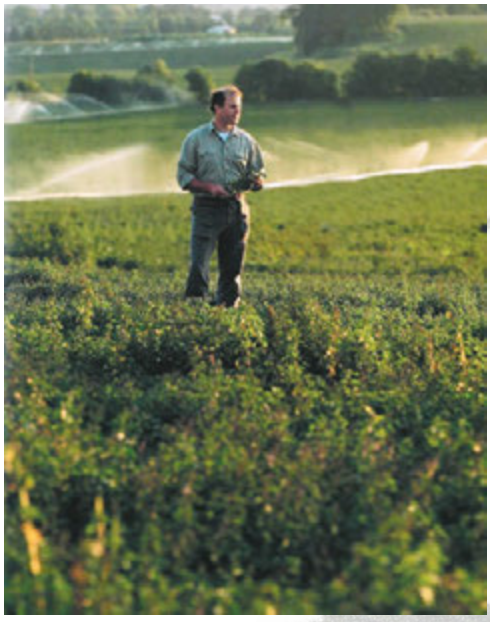
Mint's popularity is undeniable; lately, however, producers have faced increasing pressure to reduce raw material costs. Here Mark Morris and Eric Robbins provide an update on the world of mint — the issues and challenges — from both the agronomist's and the flavorist's perspective.

Agronomy

Mark Morris discusses the five key areas of peppermint agronomy

The mint family (Labiatae or Lamiaceae) is composed of many species — including basil, lavender, rosemary, peppermint and spearmint — grown commercially for their essential oils or leaves. This article focuses on agricultural practices employed in the production of peppermint (*Mentha x piperita*). Because the global peppermint oil market has become increasingly competitive, agricultural practices that maintain oil quality while managing production costs are more crucial today than ever before.



Mark Morris

The Root of the Problem

The trend in US peppermint acreage since 1996 offers a glimpse into this situation. Between the 1960s and 1987 total US peppermint plantations fluctuated between 60,000 and 107,000 acres, and increased to 149,000 acres in 1995. Erosion began with an economic downturn in foreign markets, primarily the Pacific Rim; today, US peppermint acreage is below 80,000 acres. Meanwhile, peppermint acreage in India, where land, labor and other production costs are significantly lower, has more than doubled.

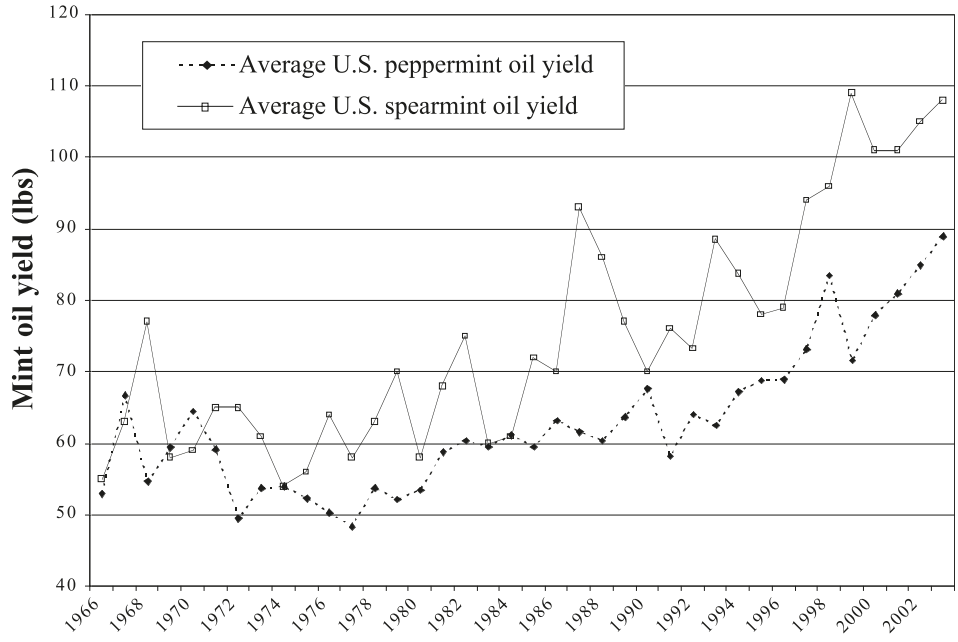
With US peppermint growers facing increased competition from foreign producers, domestic acreage has shifted from the high-cost growing regions of central and western Oregon to south-central Washington and western Idaho where yields are higher. This regional shift, paired with the US mint industry's substantial commitment to agricultural research has resulted in US mint acreage declines with simultaneous yield increases (from an average of about 60 lb of oil per acre in the 1960s to more than 100 lb of oil per acre at present) (F-1).

Despite these advances, global cost competition and trends toward high-intensity mint flavors exert ongoing pressure on mint farmers. In such an environment, companies must continue to place a high priority on agricultural innovation, working closely with growers in five key areas of peppermint agronomy: site selection, variety development, rootstock management, pest management and harvest timing.

Site Selection

Peppermint and spearmint can survive a wide range of climatic and soil conditions, but the ultimate question is whether they can be grown profitably. Most peppermint production occurs at latitudes above the 40th parallel where oil quality is considered optimal, but peppermint can also be grown near the 28th parallel in places like India where lower production costs justify lower oil yields and differences in oil quality.

US peppermint and spearmint oil yield trends from 1966 through 2003 **F-1**



Prior to 1996, when the estimated demand for peppermint oil was thought to exceed the capacity of established US growing regions, our company evaluated the suitability of other areas within and outside the United States. While LaGrande, OR, and northern California have proven viable peppermint producing regions, climatic extremes made other areas unsuitable. On the plains of Nebraska, mintcrops could be established during spring and summer, but they perished during severe winters. In Texas and parts of the southeast, summer rainfall interferes with mint harvest and oil distillation.

New plantations in south-central Washington and western Idaho have thrived because soils there are not infested with *Verticillium* wilt, a disease caused by the soil fungus *Verticillium dahliae* that is often considered the major limiting factor to peppermint production in the United States. However, unique and severe pest outbreaks were frequently encountered outside the traditional western and mid-western US growing regions. Arizona and Texas suffered from severe whitefly outbreaks, while peppermint grown in Argentina was extremely susceptible to root-aphid.

Variety Development

Once an appropriate location is identified, the grower must decide which peppermint variety to grow, weighing such factors as climate, soils, and levels of disease infestation.

Over the years, A.M. Todd has developed new peppermint varieties for commercial flavor and fragrance applications via our Green Plant program. Merritt Murray, an A.M. Todd plant geneticist from the 1940s to the late 1970s, made an important early contribution by developing two varieties resistant to *Verticillium* wilt. These varieties have allowed thriving commercial peppermint production in regions where the plant would otherwise have been wiped out. Having a private germplasm "library" of mint types is valuable for evaluating varieties for specific plantation locales and searching for peppermints with unique flavor profiles. In addition, organizations can protect intellectual property by genetically fingerprinting different mint species and varieties.

Rootstock Programs

Because peppermint is functionally sterile, new mint fields are established by planting rooted tip cuttings or by digging stolons from existing fields and planting them into new fields. Stolons are underground stems, also referred to as rhizomes, runners or rootstock.

When establishing a new field, it is extremely important to plant with clean, vigorous rootstock to avoid the spread of harmful pests, diseases and weeds that can reduce the vigor of a young stand. The importance of planting pest- and disease-free rootstock is well understood by the mint growing community, but pest-infested rootstock continues to be a major concern. One reason: limited availability of clean rootstock when it's needed most. Most peppermint growers scale back production during

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times of oversupply and low oil prices, and rootstock growers are no exception. When oil supplies dwindle and more production is needed to satisfy increasing demand, clean rootstock is often unavailable. This problem can be even greater in India where peppermint is grown as an annual crop and must be re-planted each year.

In new growing regions such as La-Grande, OR, and northern California, our company's agronomists met regularly with growers to discuss the advantages of planting clean rootstock and following a shorter crop rotation. A.M. Todd also worked closely with the State Departments of Agriculture and Extension Services to implement certified rootstock programs. Through such efforts, peppermint growers in these regions have prevented Verticillium wilt and other soil pests and diseases from reaching damaging levels. Since peppermint is an annual crop in India, soil pests are less of a problem because pests have less time to colonize the crop.

Once a healthy peppermint field is established, it must be monitored regularly to catch signs of crop stress before oil yields or quality are compromised. Proper crop monitoring is one of the most important ways to manage production costs, enabling growers to correctly determine fertilizer, irrigation and pest management needs.

Integrated Pest Management

Certain arthropods, diseases, mollusks, nematodes and weeds can cause economic damage to peppermint. If a plantation becomes infested, rotating to a non-host crop and replanting with clean rootstock can effectively break the pest lifecycle. But wholesale replanting is not the grower's only recourse.

The US mint industry has invested heavily in the development of an integrated pest management (IPM) approach to pest control, defined as the selection of cost-effective pest control tactics that are least harmful to non-target species and the outside environment. In addition to supporting university-based IPM programs in the United States and India, A.M. Todd conducts ongoing research to develop new biological and chemical pest control methods. In some growing regions, agronomists run active crop monitoring and pest management programs; in other areas we work to educate growers about the benefits and techniques of optimal pest management and help farmers establish their own IPM programs.

Mint IPM includes the application of biological controls and the selective use of pesticides. Biological control depends on natural enemies to reduce or maintain pest populations below damaging levels. Unlike other crops where cosmetic appearance is important, mint grown for its oil can tolerate higher pest levels provided economic damage does not occur.

Many kinds of natural enemies can serve as biological control agents in mint, including bacteria, fungi, insects, mites, nematodes and viruses. Some of these agents are commercially available as biological insecticides. Spider mites can drastically reduce both peppermint oil yield and quality. Fortunately, predator mites, primarily the species *Neoseiulus fallacis*, are very effective at controlling their voracious cousins. (Years ago, quality sources of *N. fallacis* were unavailable; commercial packages often contained the wrong species or even the wrong family of predators. In response, our company began growing its own armies of predator mites and supplying them to growers for release onto mint fields that needed them. Today, quality predators are available from specialty companies, and we are no longer in the mite business.)

Farming practices that encourage a healthy population of predator mites and other beneficial insects are essential; here, the careful use of pesticides is key. Because cultural and biological controls may provide only partial control in some situations, pesticides continue to be an indispensable part of mint IPM. One advantage pesticides have over natural enemies is that they can rapidly reduce pest populations. Natural enemies usually work more slowly, and may be unable to control rapidly increasing pest populations before economic damage occurs. If a pesticide treatment is required, we advise growers on selecting pesticides that are more toxic to the pest than to its natural enemies or other non-target species.

Harvest Timing

When to harvest a peppermint crop is one of the most important decisions for growers. Many factors influence harvest timing, including desired oil yield and quality, stand age, crop maturity, climate, length of the growing season, and whether the crop is to be harvested once or twice during the season (often referred to as "single-cut" or "double-cut").

The ideal time to harvest mint is when oil yield and oil quality are at their peak. Because these two criteria rarely coincide, compromise is necessary. This is especially true for peppermint, whose oil quality varies considerably more than spearmint as harvest time approaches. For peppermint, desirable oil quality typically includes total alcohol and menthol levels above 50 percent, and menthofuran and pulegone levels below 4 percent and 2 percent, respectively.

Depending on temperature, wind speed, soil moisture, and other factors, irrigation is stopped one to five days prior to harvest. If the crop is overly dry prior to swathing, crop vigor and oil quality may suffer, so this timing is important. Mint is first swathed into windrows and then allowed to cure for one to three days. After curing, windrows are chopped into two pieces with a forage chopper. The windrow should not be too moist or too dry prior to chopping, otherwise poor oil extraction or leaf shatter may occur.

Because maturation is delayed during the first year of production, new peppermint fields are often harvested in late August or early September for optimal yield. In new stands, harvesting at this relatively late date does not affect oil quality, as is the case for mature single-cut stands. Mature peppermint stands to be harvested once are cut at about 10 percent bloom, which occurs in early to mid-August. Although oil yields tend to increase as flower bloom reaches 50 percent or more, menthofuran also increases. Abundant flower bloom usually does not reduce spearmint oil quality, but peppermint harvested in late September or October is considered over-mature. At this time, menthol levels approach 60 percent, menthofuran has decreased and oil yields drop dramatically. We love over-mature peppermint quality, but it is expensive to produce because oil yields are very low.

Mint fields harvested too late in the season also can suffer significant yield losses through oil catabolism and the effects of fall rains. Late harvest also may lead to reduced oil quality because heavy dew accumulating on windrows imparts a musty odor to the oil. Finally, reduced winter survival may result from late harvest because root reserves are not replenished.

Although spearmint has long been harvested twice a season in regions with long growing seasons such as south-central Washington, more peppermint fields are now double-cut to reduce cost. This practice generally produces larger total yields and has modified the concept of what constitutes desirable peppermint oil.

Timing of the first harvest in peppermint fields to be double-cut is key. Studies by A.M. Todd agronomist Richard Schneider have shown that harvesting the first cut in early July instead of mid-July produces higher oil yields from the second cut. In this scenario, the first-cut yield is smaller and has lower alcohol levels; the larger second harvest compensates for the immature oil qualities of the first cut since second cuts usually have higher levels of menthol, menthyl acetate, menthofuran and limonene, and lower levels of menthone and cineole. But the second harvest may compensate somewhat for the immature oil qualities of the first cut.

Growers must weigh several factors when deciding whether to harvest peppermint twice during growing season. If mid-July temperatures approach or exceed 100°F,

excessive heat stress can reduce re-growth following the first harvest, resulting in lower oil yields from the second harvest. Soils and climate also must be considered; winter survival can be more precarious for a double-cut crop, especially when grown on sandy soils in colder growing regions.

Because the best time to harvest peppermint often cannot be predicted solely on visual characteristics of the crop, agronomists can assist growers with harvest timing using more advanced technical means. Employing small-scale distillation equipment followed by chemical analysis of the oil, both peppermint oil yield and quality can be accurately predicted.

Conclusion

While peppermint remains one of the flavor industry's most perennially popular ingredients, businesses that traditionally rely on peppermint oils are under pressure to reduce raw material costs. This urgency requires that both US and foreign producers of peppermint develop agricultural practices that provide a high quality product at a competitive price. Through the combined efforts of mint farmers, the mint industry and companies such as our own, we are successfully meeting these challenges, ensuring that peppermint will continue to be one of the world's most sought-after flavors.

Flavor

Eric Robbins provides a flavorist's perspective on the mint industry

Mint is not just mint any more. Today's mint flavor profiles are no longer derived from simple commodity mint oils. Regardless of the end product application or its overall function — toothpaste, chewing gum, gel cap, film strip, pressed tablet, lozenge or pharmaceutical — mint flavor profiles have become more complex, incorporating more intense flavor loads, new flavor combinations, and the merging of both natural and artificial flavors.

The consumer is the primary force driving these new mint flavor concepts. As consumers become worldlier in their experiences, they also become increasingly sophisticated in their preferences and desires in regard to taste. They want products that are truly unique or extraordinary, that perform or present them with new experiences and sensations. Product developers are responding with innovative new offerings to meet consumer demand. And flavorists are responding to product developers' needs with flavors and flavor applications that are unique, creative, and sometimes rather unusual.

In the world of mint, flavor fusions are increasingly popular, and we may experiment with various formulations, combining mint with differentiating components to contribute notes that are reminiscent of pineapple or some other fruity character for lift/top-note impact and coconut-green-cheesy-smoky notes to increase body.

The flavor possibilities are endless, the applications innovative and exciting; the challenge is to apply our imagination, knowledge and skill to the changing realities of the mint/flavor markets.

The Bottom-Line Challenge: Price

These new flavor applications translate into an increasing number of issues for flavorists. Formulations must be compatible with the various bases and matrices of our customers' products. Flavor solutions must be able to withstand necessary processing conditions. They must be manufactured consistently from batch to batch to ensure product and brand integrity. And flavorists must develop and deliver desirable and effective flavors to meet customers' needs within a given timeframe.

On top of all these requirements, one of the biggest challenges flavor companies face today is from a pricing perspective. Everyone wants a high quality product at the lowest possible price.

There are several reasons for this increased emphasis on costs, but one quickly growing trend is squeezing everyone in the supplier chain: the huge growth of the private label sector. Almost every store has its own private label. These "me too" organizations have realized that they can compete successfully with the large consumer product giants in almost every product segment. They have discovered that if one can offer a product that is appealing, adequately distributed, reasonably priced, and is somewhat equivalent to a national brand, chances are high that product will sell. For many of these private-label customers, price is of utmost importance. These customers may not have the marketing, distribution, and brand recognition of their competitors, so they need some other competitive edge.

In this case, the following concept holds true: "A product is only successful if it is accepted and embraced by the consumer." In the world of flavors — as one of my mentors, Carl Holmgren, reiterates — the phrase is more along the lines of "the only good flavor is one that sells!" In other words, in today's competitive marketplace a low-cost flavor will almost always win over a higher-cost flavor, as long as it meets the needs of the project/product, no matter how great tasting the higher-cost flavor may be.

Challenge = Opportunity

These challenges offer opportunities for companies that can reliably provide mint oils and formulations that deliver customers' desired flavor characteristics at a competitive price point. Obviously, with improved

analytical instrumentation and techniques, science plays a critical role in this scenario. However, there is a point where science ends and creativity must prevail.

In-depth understanding of mint must start in the field, where agronomists work to advance mint production from both a quantity/cost and quality/flavor perspective. Working toward potential variety growing and oil producing scenarios takes place four to five years out. As agronomists produce test plots of new varieties and evaluate the resulting crops for yields, flavorists can work in tandem to determine what flavor potential specific varieties may possess.

By creating a feedback loop connecting the flavor lab with the grower network, farming partners can focus on propagating proprietary mint varieties that yield the desired oils for specific feedstock purposes. For instance, one plant variety may produce a base oil that can be used as a building block, while another may produce an oil from which specific isolates or fractions can be extracted. Flavorists can use these individual components to create cost-effective formulations with unique characteristics and nuances that provide products with the differentiation desired by today's customers.

In addition to cost considerations, one of the first and foremost challenges involved with mint and mint-based formulations is the fact that the base product is derived from nature and is therefore quite variable. This makes quality control crucial at every step.

Comprised of more than 300 compounds, mint is also quite complex. Although there are a few primary components that can be combined to yield a somewhat basic characterizing organoleptic impression, there is considerable opportunity to create unique and complex mint blends. As with many other essential oils, a few major compounds are present in mint at higher concentrations, and many times more occur at very low levels — some present only at trace levels of detection. And not all the compounds contained actually contribute to the overall profile.

It is the flavorist's responsibility to determine which are most critical for a given project. An experienced flavorist applies what he or she has learned over the years to decide which components will function synergistically with one another to yield a given effect. By selecting the proper components to exaggerate necessary nuances and/or mute others, the flavorist can create a specific impression that satisfies the customer's desired flavor profile.

Mint Goes Global

Another challenge directly related to both cost and quality is the growing trend of global sourcing. Today, more mint production (growing and distilling) occurs outside the United States in regions where energy and resource costs are much lower. Many brokers and suppliers are turning to areas like India for this lower cost material.

The prices of these oils may appear quite attractive to those responsible for procurement of these materials. However, along with lower prices come potential areas for concern. Mint-growing regions around the world have distinct climates, soils, growing practices, etc., and yield oils with inherently different organoleptic characteristics compared to oils produced in the traditional growing areas of the US.

Familiarity with the properties of locally grown mint can help ensure that material meets defined acceptable standards, alleviating potential processing issues later. In places like India, where there are many small producers with oils on the market, flavorists must closely monitor material for any lot-to-lot variation, which can result in out-of-spec or unacceptable products and pose other adverse consequences for flavor manufacturers.

Creativity

In general, when presented with a project brief, it is in the laboratory where the flavorist conducts the heart of his or her work. Regardless of the flavor type or project, a flavorist must draw upon all available resources and piece together a wealth of information to create a flavor solution that meets the customer's need. There really is no magic involved. With an adequate supply of high-quality oils and flavor compounds, the flavorist then applies logic and experience, with a lot of creativity thrown in. A flavorist with a vast knowledge of raw materials, an endless imagination, proper supplies and equipment, and a conducive working environment has nearly all the tools necessary to develop cost-effective and winning formulations.

No matter what your specialization or how extensive your practical background, there is always something new to learn. New raw materials are being developed, new separation and analytical technologies advanced, and the demands of the market are constantly shifting.

A flavorist only improves with time, experience, and exposure. Evaluations and analyses become easier to perform. A target product's organoleptic intricacies, subtle nuances, and trace components become more recognizable, or at the very least reproducible. Every trial and error in the process becomes a learning experience, and one becomes better at formulating in an efficient and effective manner. As individual style develops, formulating techniques become instinctual; intuition is one of the flavorist's most beneficial and fascinating gifts.

The flavor industry is dynamic and ever-changing. The challenges and formulation potential of mint offers enthusiastic flavorists endless opportunities to apply their talents to the development of creative new flavors and product applications.

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