

The Phytopathology of *Mentha piperita* L.

RALPH J. GREEN, Jr., Purdue University

Peppermint oil is one of the most valuable of the volatile oils and one of the few such oils produced commercially in the United States. This oil is used extensively in pharmaceutical preparations, dentifrices, confections and chewing gum. There is also a limited quantity of peppermint oil exported.

The cultivation and production of peppermint, *Mentha piperita* L., and peppermint oil has reached a very advanced stage in specialization of methods and equipment used in its production on a commercial scale.

References to peppermint oil can be found in such early writings as those of Synesius of Alexandria in 410 A.D. However, the peppermint plant of the present day, *Mentha piperita*, was first mentioned by John Ray, in England in 1696 (5). The exact origin of commercially-grown peppermint is obscure, but most botanists agree that it arose as the result of natural hybridizations that occurred many years ago (1).

Peppermint plant stock was imported to this country from England in about 1812. The first plantings were made at Ashfield, Massachusetts. From this early beginning, the crop was established in Wayne County, New York, and this area soon became the leading producer of peppermint oil in this early era.

Gradually, the industry migrated westward to Ohio and then to southern Michigan. The muck and peat soils of St. Joseph County were so well adapted for the cultivation of mint that total acreages increased many fold in a short period. Since northern Indiana has extensive areas of the same muck type of soil, peppermint was introduced into this state and many growers soon were cultivating this plant as a major crop. At the present time, the centers of mint production are found near the cities of South Bend, North Judson, Rensselaer, Bremen, Nappanee, and Columbia City, Indiana (5).

The midwestern mint-producing areas held a virtual monopoly in the production of peppermint oil until comparatively recently. In the past few years the Pacific coast states of Washington, Oregon, and California have expanded mint plantings which were made in these areas as early as 1919.

TABLE I. Peppermint Acreages and Yields

State	1938-48 Ave	1950	Yield/Acre	
			1939-48 Ave. lb./Acre	1950
Indiana	14,920	16,500	29.0	26.0
Michigan	14,780	10,000	23.2	33.0
Ohio	110	34.0
California	570	35.9
Oregon	6,240	14,400	43.4	49.0
Washington	3,190	5,100	46.4	60.0
Total	39,810	46,000	30.4	35.4

As Table I indicates, the total acreage devoted to peppermint production in Indiana is 16,500 acres, with an average yield of 26 lb./acre. This is approximately 600 acres more than the 10 year average of 14,920 acres for 1939-48, but the average yield is two pounds less per acre. The price of peppermint oil at the present time is between \$3.50 to \$5.00 per pound, so the gross income to Indiana growers is some \$1,700,000 annually.

The acreage devoted to the cultivation of peppermint in Michigan this year shows a decrease of 4,780 acres over the ten year average. However, the average yield per acre is some ten pounds higher for 1950 than the average yield for 1939-1948. This may be explained by the fact that the production of peppermint is now in the hands of a relatively few growers in that state. These producers have extensive plantings and operate much more efficiently than the small producers are able to operate. These small growers are being forced to abandon this crop for reasons which shall be brought forth later.

This table also indicates the rapid ascendancy of the western states in mint oil production. Special note should be made of the high yields per acre which are realized, especially in the states of Washington and Oregon. These differences in yield may be partially explained by noting the different methods of cultivation employed in the two areas. Practically all of the mint grown in the western states is planted in small acreages and in rows. This is to facilitate irrigation, which is necessary in these areas. Such practices also enhance cultivation and weeding.

In the midwestern region, mint is only grown in rows for the first year and cultivated. The following year it is allowed to spread into meadows. Some overhead irrigation is practiced but, for the most part, controlled water tables are relied upon to furnish adequate moisture for growth.

Although these cultural practices certainly have some bearing upon yields, the major cause for this difference is the incidence of disease.

The three principal diseases of *Mentha piperita* L. in the Indiana-Michigan area are *Verticillium*-wilt, anthracnose, and mint rust.

Verticillium-wilt is the most serious disease of mint in southern Michigan and northern Indiana at the present time. The total acreage devoted to mint production has decreased rapidly in Michigan since 1939 and the full effect of this disease is now being felt in Indiana.

This disease is caused by one of the Fungi Imperfecti *Verticillium albo-atrum*, R. & B. It was first reported by Nelson (6) near Kalamazoo, Michigan, in 1926. The disease spread rapidly throughout the state and was reported in Indiana for the first time by Baines in 1941 (2).

To illustrate the severity of this disease, Ellis and Stevenson (4) noted that the total acreage devoted to mint decreased in Clinton County, Michigan, from 19,000 acres in 1935 to only 2,300 acres in 1946. They attribute this decline wholly to the incidence of *Verticillium*-wilt.

Plants infected with this disease show marked stunting and lack of vigor. The apical leaf whorls map show bronzing and asymmetrical

development of some of the leaves. The symptoms encountered later in the growing season are general chlorosis of the leaves of infected plants and progressive necrosis from the base of the stem upward. This is due to a hadromycosis of the vascular tissues, particularly the xylem.

Young plantings may be killed by this attack and older fields are markedly reduced in stand and vigor. Once infected, plants never recover from this disease. In addition to the direct effect of the disease, infected plants are much more susceptible to winter kill than are normal plants.

Although the life cycle of the casual organism is not fully understood, it is fairly well established that infection takes place through the roots and stolons in the soil. Symptoms of the disease may be suppressed until the advent of hot weather when the plugged vascular tissues fail to compensate for moisture lost during the day. Infected plants seldom "wilt" in the true sense of the term, however; so the common name of this disease is not particularly appropriate.

Since this is evidently a soil borne disease, the problem of control is quite complex. There are few means of combatting pathogens of this type directly. Crop rotation programs have been instigated and it was shown that a three-year rotation program is not of sufficient length to reduce the population of the causal agent in the soil so that mint can be grown successfully on infested soils. Longer rotation trials are now in progress.

Attempts have also been made to breed resistant varieties of *Mentha piperita* L. This program has been hampered by the fact that this species of *Mentha* produces male sterile flowers. Resistant crosses have been developed, using pollen from some other species of the genus *Mentha*, but the quality of the oil produced is not acceptable.

Certain cultural measures, such as controlled water tables in the drained muck soils and overhead irrigation, have permitted profitable yields but offer no permanent promise of control.

If the chain of events in Michigan can be used to predict the future of the mint industry in Indiana, the outlook is not favorable. Acreages will decrease as the small, marginal growers are forced to other crops because they can no longer raise mint profitably. The larger, more efficient operators, through improved cultural methods, will still be able to grow mint on a profitable scale but eventually the soils will become so infested with the casual agent of *Verticillium* wilt that the crop will be abandoned. It is not pessimistic to say that the future of the peppermint oil industry in the midwestern region depends upon a feasible control of the disease *Verticillium*-wilt.

Verticillium-wilt is not known to be present in the mint plantings found on the west coast at the present time.

The anthracnose disease of mint ranks second in importance in this area. This disease has been destructive at times in Indiana but is not often of epiphytotic proportions.

The symptoms of this disease on the leaves are small, brown, depressed lesions which gradually enlarge and become oval in shape. The centers of these lesions become ash-grey in color and may coalesce.

Necrotic areas may develop in the leaf tissues and drop out, causing a typical "shot hole" effect.

The stem lesions enlarge rapidly and cause extensive cankers in the cortical tissues. These lesions are usually brown to reddish-brown in color.

The causal organism of mint anthracnose was first described by Baines in 1933 (3) and later identified as *Sphaceloma menthae* by Jenkins (6) in 1937.

The casual agent produces conidiospores abundantly in the leaf and stem lesions and these spores are disseminated by wind and splashing rain. The fungus overwinters on old mint refuse in the field but evidently not in the soil proper.

The most effective means of control has been to carefully plow under all mint in the fall. Trash shields are recommended to insure that all the plant debris is covered (8). If all plants are buried adequately new growth in the spring is seldom affected even though the previous crop may have shown a high incidence of this disease. Since this cultural practice is also recommended to protect overwintering plants against cold injury, it is followed extensively in the Indiana mint growing regions.

Such measures as frequent dusting with 20-80 copper-lime dust or spraying with 6-6-100 Bordeaux mixture are also effective and may be utilized in localized outbreaks of this disease.

Puccinia menthae, Persoon, the causal agent of the rust found on *Mentha piperita*, L. is autoecious, with all the spore stages occurring on this host. It is not a serious disease under Indiana conditions but is severe on the West coast.

The first symptoms appear in the spring or early summer. These are yellow to brown, eruptant lesions which are accompanied by considerable hypertrophy of the host tissue. Later in the season, the uredial sori develop and these are followed by the telial or over-wintering spore stage. At this time the lesions are dark brown in color and heavily infected leaves may curl and die. This loss of foliage reduces the oil yield since the oil glands are concentrated mainly on the leaves.

Mint rust is evidently held in check in the midwestern region by the practice of late fall plowing previously mentioned. In the western states, where this not done, mint rust is a serious problem.

Other control measures include the application of dusting sulphur at intervals of seven to ten days or spraying with 8-8-100 Bordeaux mixture at similar times.

Summary and Conclusions

As has been indicated, Indiana holds a prominent place in the production of peppermint oil in the United States. The quality of the oil produced in this state is such that buyers prefer it above oils distilled in other areas. There is grave concern, however, over the future of this industry in Indiana and many institutions are devoting considerable

effort to the problems of disease control, plant breeding, methods of harvesting and processing, etc.

In this paper we have been concerned primarily with the prominent disease of peppermint and a brief discussion of the origin and distribution of the crop. *Verticillium*-wilt is the most serious disease in the midwestern region and may well be the cause of the failure of this industry, commercially. In southern Michigan, where this disease is even more serious, much of the land formerly devoted to mint production is being abandoned and growers are seeking new disease-free soil.

Both anthracnose and mint rust are of secondary importance in this area but may cause serious losses locally at certain times. Both of these diseases can be controlled efficiently.

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