

SCIENTIFIC SECTION

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OBSERVATIONS ON THE MENTHOL CONTENT OF OIL OF JAPANESE MINT UNDER CONTINUOUS CULTIVATION IN ONE LOCALITY.

BY A. F. SIEVERS AND M. S. LOWMAN.¹

About 15 years ago the Division of Drug and Related Plants of the Bureau of Plant Industry became interested in the possibilities of the Japanese mint (*Mentha arvensis*, var. *piperascens* Malinvaud) as a commercial crop in the United States. The world supply of natural menthol, which is obtained exclusively from this species of mint grown in Japan, had been subject for some time to extreme fluctuations resulting some years in exceedingly high prices and uncertainty among the important consumers of this commodity as to an available supply from year to year. The fact that the cultural requirements of this mint are, on the whole, very similar to those of the American mint suggested that its introduction in some localities in the United States would not be difficult and that it might be at least as profitable as American mint if the higher prices of imported menthol that prevailed at that time were maintained. No detailed reports of experiments with this mint in the United States could be found. Therefore, this division undertook an investigation of this problem in 1922 which continued until 1931. Four main questions were considered: (1) The adaptiveness of this mint to various sections of the country and to various soil types; (2) the cultural practices required and the yields of oil that might be expected; (3) the menthol content of the oil, free and combined, and (4) the effects of continuous culture in any one locality on the menthol content and therefore on the usefulness of the oil for menthol production. The results of these investigations were published by the writers in 1933 as *Technical Bulletin* 378, U. S. Department of Agriculture, "Commercial Possibilities of Japanese Mint in the United States as a Source of Natural Menthol." With regard to questions 3 and 4 above, the summary in this bulletin states that "oil of satisfactory quality can be produced in this country" and that "continuous cultivation over a period of years indicates that seasonal conditions cause fluctuations in the menthol content of the oil but there is no general tendency for the menthol content to decline gradually as a result of the prevailing conditions in any one locality."

The foregoing conclusions are based on data from many sections but particular attention was called to the quality of the oil obtained year by year from a small bed of the mint on heavy clay loam soil at Arlington Farm, Rosslyn, Va. Data on the oil from six consecutive years were available from this bed in which the only cultivation during the period consisted of a light stirring of the soil in the spring and hand weeding during the season as necessary. The complete data are included in the table presented herewith which also includes data subsequently obtained.

¹ Bureau of Plant Industry, U. S. Department of Agriculture.

TABLE I.—THE YIELD, SOME PHYSICAL CONSTANTS AND MENTHOL CONTENT OF OIL FROM JAPANESE MINT OBTAINED UNDER CONTINUOUS CULTURE ON THE SAME GROUND FOR A PERIOD OF YEARS.

| Year. | Date of Cutting. | Stage of Maturity. | Yield of Oil from Fresh Herb, Per Cent. | Color. | Physical Constituents of Oil. | | | Menthol in Oil. | | |
|-------|------------------|--------------------|---|-----------------|-------------------------------|-------------------------|--------------------|---------------------|-----------------|------------------|
| | | | | | Specific Gravity 20° C. | Index Refraction 20° C. | Angle of Rotation. | Combined, Per Cent. | Free, Per Cent. | Total, Per Cent. |
| 1923 | Aug. 20 | Early | | | | | | | | |
| | | blooming | 0.39 | | 0.8966 | 1.4560 | —43.0 | 9.19 | 72.34 | 81.53 |
| 1924 | Sept. 5 | Full bloom | 0.21 | | 0.8973 | 1.4550 | —43.5 | 9.75 | 68.10 | 77.85 |
| 1925 | Sept. 17 | Past | | | | | | | | |
| | | blooming | 0.30 | | | | | 7.24 | 76.37 | 83.61 |
| 1926 | Sept. 20 | Full bloom | 0.29 | Very pale straw | 0.9001 | 1.4580 | | 9.34 | 71.37 | 80.71 |
| 1927 | Sept. 12 | " " | 0.22 | Greenish yellow | 0.9006 | 1.4590 | | 11.03 | 71.25 | 82.28 |
| 1928 | Sept. 14 | " " | 0.28 | Slightly yellow | 0.9001 | 1.4592 | | 10.03 | 67.40 | 77.43 |
| 1929 | Sept. 16 | " " | 0.35 | | 0.8999 | 1.4560 | | 8.23 | 70.68 | 78.91 |
| 1931 | Sept. 17 | " " | 0.33 | | 0.9001 | 1.4589 | | 8.01 | 70.02 | 78.03 |
| 1932 | Sept. 20 | " " | 0.30 | | 0.8998 | 1.4588 | | 7.78 | 72.02 | 79.80 |
| 1933 | Sept. 11 | " " | 0.36 | | | | | 12.54 | 72.14 | 84.68 |
| 1935* | Sept. 9 | " " | 0.28* | Very pale straw | 0.9040 | 1.4580 | | 17.41 | 69.15 | 86.56 |
| 1936 | Sept. 14 | " " | 0.48 | Very pale straw | 0.9017 | 1.4577 | | 13.93 | 71.36 | 85.29 |

* Distilled Sept. 14, 1936. Yield calculated on basis of 75 per cent moisture in fresh herb.

In view of the fact that there were only seasonal fluctuations in the menthol content of the oil from this bed and no permanent decline in this respect could be discerned, the planting was continued after 1928, the last year for which data were reported in the bulletin.

There was no change in the cultural handling as described until the fall of 1932 when, due to the difficulty of further controlling weeds, the bed was spaded, the roots removed, manure added and the roots replanted in rows. This procedure resulted in a much improved growth in 1933 and a much larger total yield of oil. In the spring of 1934 a new bed near the old one and with the same type of soil was set with plants from the old bed. This was a year of extreme drought and insufficient growth was obtained to make a distillation. For a similar reason data are also lacking from the old bed in 1930. It is possible, therefore, to report at this time on the results obtained from the same original planting stock on the same soil type in a single locality for the period 1922 to 1936, except for the two years mentioned.

It will be noted from the tabulated data that from 1928 to 1932, inclusive, the total menthol content remained about the same, being slightly below 80 per cent. During the five years prior to 1928 a content below 80 per cent was obtained only in 1924. In 1933, after the bed had been spaded, fertilized and reset the total menthol content was much higher and the same results have been obtained in the last two seasons.

The percentage of combined menthol increased in 1927 and 1928, then declined until 1933 and since then has been higher than in any previous year. The extent

to which the increase in the ratio of combined to free menthol is due to the replanting in the old bed or to the transfer of the stock to the new bed the following year is an open question. The fact that the herb cut in 1935 was not distilled until the fall of 1936, as indicated in the table, may be responsible in part for the unusually high percentage of combined menthol in the oil of that year.

From a practical standpoint a high percentage of free menthol rather than of total menthol is desired. When menthol is high in price, saponification of the oil may be resorted to in order to recover the menthol not present in the free state but under other conditions only the free menthol content determines the value of the oil as an economical source of that product.

Commercial mint fields are seldom maintained longer than four or five years even under the best conditions and the results reported in the bulletin showed quite conclusively that no serious decline in the quality of the oil is indicated during the normal life of a mint field. The question remained, however, whether the establishing of new fields with plants or roots from old fields in the same locality could be continued indefinitely without decline in the percentage yield or quality of the oil or even in the yield of the herb. If such a decline occurs and is due to continuous growing of the same stock in a specific locality it would be necessary for the grower to secure new planting stock from other regions. This would add to his production costs and introduce some uncertainty. The data obtained subsequent to 1928 appear to show, however, that such is not the case and that by planting new fields at such intervals as may be required under the prevailing conditions the securing of planting stock from other regions is not necessary. American peppermint oil has been produced in this country for many years and no general change in its quality has taken place where local planting stock is used for replacements indefinitely. It could not be reasoned from this, however, that the Japanese mint would behave similarly. The menthol content of its oil is much higher than that of the American mint oil and this characteristic might conceivably be modified by climatic and cultural conditions, not immediately perhaps, but possibly gradually. Moreover, it was the view of some that oils of high menthol content cannot be produced with consistency in this country, especially in the south, a view that was certainly not based on known facts when these investigations were begun. That it is an erroneous view with respect to the region where these experiments were conducted has been clearly shown.

THE BARK OF AMERICAN LARCH.*

BY K. E. LARSEN AND E. V. LYNN.¹

Together with other parts of the tree, the bark of American larch, *Larix americana* (Muench) Michx., has been employed as a remedy since earliest times. Several of the Indian tribes held it in high esteem as treatment for chronic bronchitis, inflammation of the urinary passages and in phases of hemorrhage. They considered it "equal to one man and a medicine in itself, without the addition of any

* Scientific Section, A. PH. A., Dallas meeting, 1936.

¹ Massachusetts College of Pharmacy, Boston, June 20, 1936.