# Cultivation of Japanese Mentha in Kerala

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*The optimum conditions favouring the cultivation of Japanese mint in Kerala are discussed. Indigenous Indian production is at present nil and Rs. 80 lakhs offoreign exchange an year has to be saved by its cultivation. It thrives in the climate of Kerala better than in Japan and can form a valuable cash crop.*

By the cultivation of a variety of Mentha arvensis which yields more oil with a higher content of menthol than all other varieties of mint, the Japanese were able to supply 50% of the world market by the first world war and 70% by the beginning of the second world war. The Japanese industry was almost destroyed during the war and after the war, the Americans introduced it into several countries, especially in North and South America,

Due to the phenomenal growth of the pharmaceutical industry during recent years in India, the import of menthol and mentha oil which was estimated to be worth about Rs, 15 lakhs an year in 1955 has risen sharply and now forms the costliest single essential oil .import into India.

| *Product* | *Approximate present annual import (value)* | *Indigenous production* |
|---|---|---|
| Menthol and peppermint oil | Rs. SO.OO lakhs | |

## World production of mentha oils and crystalline menthol

The annual production of mint oil (Mentha piperita Linn) was an English monopoly and was estimated to be about 1000 kg in the 18th century and about 5000 kg by 1850, A Japanese priest Enzan is said to have introduced Chinese

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mint into Japan in the 3rd century. In recent times, the Japanese achieved almost a monopoly in this oil (M. arvensis) and their export, first begun in 1883, was about 3 lakhs of kilos of crystalline menthol and 5 lakhs of kilos of dementholised oil by 1935. Destroyed during the war, their industry is being vigorously regenerated at present. Annual American -production in 1940 was 4 lakhs of kilos. The Chinese grew mentha arvensis, var. glabrata Holmes, from olden times. Japanese mentha cultivation was introduced into China at the beginning of this century and they also are large producers of the oil and menthol. Japanese settlers introduced it to Brazil in 1936 and in their peak year of 1945, when Japanese production was lowest, they sold 1 million kg of oil and 4 lakhs of kg of crystals.

The oil of mentha piperita contains between 45—65% total menthol and while being the basis of the British and American pharmacoepial standards, does not easily lend itself to the production of crystals. Japaneses mentha, of a total menthol content between 65—90%, is well suited to the production of crystalline menthol and even the demetholised oil is above B. P. Standard in total menthol.

None of the six mentha species indigenous to North India gives oil of B. P. or Indian standard.

**Cultivation in Kerala**

Trial cultivation in the Kerala University grounds has shown that Japanese mentha thrives in the climatic conditions of Kerala and can yield as good quality oil as in Japan, Cultivation in the Lemon grass Research Station at Odakkali gave similar results. It can form a very valuable cash crop for Kerala.

The Agricultural College and Research Institute, Vellayani, is now conducting field trials with Japanese mentha, using planting material supplied by the Department of Applied Chemistry, University of Kerala.

*Name: Mentha arvensis Linn. Subsp. haplocalyx Briquet Var. Piperascens Holmes,* It is called *'akamaru''* in Japanese and is a perennial with pink violet stems and light blue flowers and grows 1—3 feet in **height.**

Propogation is carried out from root suckers, or stem cuttings, while seeds need not breed true to type.

**Soil and climatic requirements**

Literature on the growth of Japanese mentha in several places the world over, shows that it grows best in tropical or subtropical countries, in fertile, well drained sandy soil on lowlying fields permitting of easy root penetration or on hill sides of low elevations in soils of sandy loam, rich in humus. Optimum growth and yield of oil is obtained from soils of pH 5.5 to 8 ; the pH of the soil does not appear to be of much significance. Trials in Kashmir have shown that at high elevations above 2000 ft., growth and yield are less with increasing

elevation, *la* Japan, districts with a high mean average temperature have been found to give high oil and menthol content. **Mikhalov(1930)** found that from the same plantations, the summer harvest in July gave 2% oil (on the dry herb) while the October harvest gave only 0.6%.

The plantations should be in open ground and not under the shade of trees as plenty of sunshine leads to high methol content. The plant cannot withstand continued dry days. The ideal climate for **mentha** cultivation is one which provides sufficient rains during the period of growth and only little rain during the harvesting season.

In Brazil, lowlying forests are burnt down, ploughed over and mentha planted. Similar places in Kerala may prove very suitable for the plantations of Japanese mentha.

It has to b2 emphasized that in Kerala only fields of sandy loams containing plenty of organic matter and having cheap irrigation facilities should be used for the cultivation of mentha. Where there is too much of clay or laterite, plenty of sand has to be incorporated in the soil, especially around the root of the plant.

Proportion **and planting**

Root suckers taken by digging up healthy old vigorous plants are cut into bits of about 6 cms *(2* inches) long and placed about 4 cms (1 1/2 inch) below the soil surface, almost end to end, and kept moist. Shoots and roots begin to appear from the nodes within a week and continue to be formed for 2-3 weeks. Stem cuttings of about 8 cms (3") also take about the same time to root well. The plants are removed and planted in well-cultivated and manured fields from which weeds and roots Jpve been carefully removed and planted in rows about 50 cms (1 1/2—2 ft) apart and about 10 — 15 cms (4 — 6 inches) between each **plant.**

Alternately, the root suckers can be rooted in specially prepared sandy soil, rich in humus and retentive of moisture, in a part of the field, kept well moist (as for growing paddy) and after rooting planted out in the field preferably about the beginning of the monsoon.

**Propogation studies in seed pots**

The percentage of rooted plants obtained from cuttings of the stems as welt as of root suckers planted in seed pots in sandy loam is given in Table I.

Further experiments gave about the same number of plants- The progogation from root suckers planted in open fields is much less.

After the monsoons, a very large number of root suckers will be found growing just above the surface, which can be removed for furtherpropogation. During the beginning of the next growth period after harvesting, a number of new plants sprout in the rows which will have to be thinned considerably. Both these **abun**

TABLE I

| Cuttings | June 1959 rooted plants | February 1960 |
|---|---|---|
| 8 cm (3 1/2) stems | 94% | — |
| 2.5 cm (1") root sucker | 94% | 98% |
| 5 cm (2") root sucker | 134% | 130% |
| 10.5 cm (3") root sucker | 210% | 194% |

dant sources of supply of new plants can be used to increase the acreage of the plantation in short time.

In Kerala, the time of planting should be so adjusted before the monsoons in June-July and September-October which are the best growth periods. The plant was found to withstand the sudden down pours of our monsoons without being crushed down. After the monsoons the plants are to be harvested when in full bloom.

**Manuring and Irrigation**

Rotted leaf, farmyard manure or compost, about 25,000 kg to the hectare (10 tons to the acre) is used to supply most of the nitrogen requirements. Rich humus is necessary. It is advisable to use chemical fertilisers also, about 750kg to the hectare, (500 — 700 **lbs** per acre) of a manure of high potash content. A mixture of super-phosphate, potassium sulphate and ammonium sulphate has been found to give good yields in Kashmir. We found ammonium sulphate, superphosphate, wood ash for potassium and green manuring very beneficial. Part of the farm yard manure and all the chemical fertilisers can be added in small lots from time to time throughout the year, followed by profuse watering.

Japanese mentha requires a lot of water and in summer, daily watering or overhead irrigation is very necessary as the plants cannot stand any drought or drying about the roots. Weeding **will** have to be regularly carried out, at least once a fortnight. Luxuriant leaf growth should be the chief aim, as nearly 90% of the oil and menthol are in the leaves, only about 10 — 12% are found in the stems.

In the tropical climate of Kerala with its two monsoons, intensive cultivation with plants growing fairly thickly together in the plantation and occasional use of chemical fertilisers, is advisable.

Diseases

Japanese mentha, especially in thick plantations of ' meadowmint ' more than two years old, is affected by fungus, wilt, rust, anthracnose and other plant diseases. For keeping down any diseases, 20—80 copper-lime dust is applied as

spray and for insects, calcium arsenatc and pads green are used. For rust, the root cuttings are steeped in water at 40°C, prior to planting. In America, if infection is severe, the herb is harvested even if not mature and the crop is rotated with wheat, beans or other leguminous cash crops.

**Harvesting**

From an analysis of the oil of Mentha piperita obtained from plants of different stages ofgrowth, Kleber, (Ber. Schimmel. 1914 p. 79) suggested that the cells of the plant develop mentfaone first which by phytocheraical reduction gets converted later to menthol. Rutovski and Travin (Riechstoff Ind, 4, 1929, 124} found in a farm near Moscow, that the free and ester menthol content continuously increases with the development of the plant while the menthone content decreases.

The stems and branches are cut when they are in the first full bloom, as that is the time when there is maximum yield of oil and menthol in the plant. The lower stems without leaves are discarded. Later the oil content diminishes sharply. **In** Kerala climate, 10—12 weeks after planting the plant grows to about 1—2 1/2 feet, the branches become covered with small light blue flowers and it is ready for the first cutting.

Harvesting should be carried out on a fine sunny forenoon after the dews have evaporated, this condition being necessary to get optimum yield of menthol.

The fresh cuttings of flowering shoots (about 70-75% water content, by air-drying) can either be steam-distilled, or as in Japan, hung in small bundles on wire supports in the shade under trees or in sheds until it is dry or half-dry. The oil distilled from the fresh herb is said to be better in quality but gives slightly less yield and uses up very much more steam and fuel. In a few distilleries in America, the herb is said to be allowed to dry and kept like hay in a cool shed until it can be distilled in batches, there being some loss of oil.

Care should be taken to see that the leaves are not bruised or lost. The cuttings should not be kept heaped up as they may ferment. The maximum loss of oil by drying is well below 10 percent, but the oil comes out easily during the distillation. Drying in the sun leads to considerable loss and resinification of oil.

In Kerala continuous cuttings from the same planting can be used for about three or more years, when the rows disappear due to overgrowth of plants. Plants, ten years old are known in Kerala, the shoots of which are so great in number that considerable thinning of the plants have to be carried out after each harvesting. The second cropping is heavier than the first and the third is still heavier.

**Yields** obtained

As the average of several weights taken, every 100 gm of fresh herb collected here gave about 32 gm of air dry

herb of which 14-21 gm were stems and 11-19 gm leaves and flowers.

The yield of oil in the different parts of the dried material as the mean of several laboratory experiments is given below.

TABLE II

| Parts of plant | Approximate Percentage on \vt of fresh herbs | Yield of oil V/W on dry weights | Occurrence of total oil |
|---|---|---|---|
| Flowers and seeds only (from overgrown plants) | 2-5 % | 4.3% I | 85—88% |
| Leaves | 35—50% | 3.4—3.5% | |
| Stem and branches | 45-65% | 0.45% | 12.15% |
| Whole plant cut 2" | | 1.8-2.1% | |

On the average the leaves and flowers together contain about 85 - 88% of the total oil, while the stems and branches contain \2 - 15%.

The above analytical values were obtained as the mean of several estimations carried out in a glass apparatus of 5 litres capacity fabricated for this purpose based on the general outlines of method used for the micro estimation of essential oils in raw materials (B.P.1953 p 765).

**In** Kerala climate, 3 harvests can easily be had annually, which can be ascribed to its high average temperature and rainfall. Yields of oil vary between 0.5 to 1.1% on fresh herb and about 2-2.5% on the dry. From results calculated from growing the herb in small plots in rather unsuitable clayey soil in the University compound the yield per hectare comes to about 40-50 kg of oil in three cuttings in the first year. During the second and third years they will be higher. The yield of oil in Japan varies from 40 to 108 kg per hectare. In the Kashmir farm at low elevation and under best soil and manurial conditions, only two cuttings are possible, the yield being 90 kg per hectare (38 kg. of oil per acre). At high elevations the yield is much poorer. In California, it can be harvested twice and yields about 20 to 80 kg per hectare. In Brazil one hectare is said to yield an annual harvest of 20 - 150 kg. of oil depending on soil fertility, manuring and weather.

**Laboratory and Pilot Plant Distillations**

Laboratory experiments of hydro-distillation of the herb were also conducted in a flask of 5 litre capacity. They simulate the open type 'herb and water distillation' of the common direct-fire

country stills used for lemon grass oil distillations in Kerala and field trials with a 10 gallon lemon grass oil Pilot Plant gave results after the same pattern.

One experiment gave, by the closed type distillation where cohobatiort waters were allowed to flow back into the distillation flask, a yield of 3.47% V/W of oil from the airdry leaves. Loss of oil in this method is nil. The same sample of leaves by open-type distillation (as with lemongrass in country stills) gave a yield of 3.34% V/W. In this method there are two chances of loss of oil, firstly due to loss of minute oil droplets and secondly due to the slight solubility in distillation waters of some constituents of the oil. The loss however, is only of the order of 3 - 5% of the total oil which can be considered negligible. The conclusion can therefore be drawn that ordinary country stills, used for lemon grass oil can also be used for the distillation of Japanese mint.

The slightly better techniqe of **'water** and steam distillation' by the use of a perforated plate, below which there is water and above which the herb is loosely packed will be more desirable. The Japanese small growers follow this method, but instead of the plate, a number of bamboo sticks and matting are laid at the bottom of the still.

The still more efficient method of 'direct steam distillation' was not carried out on a larger scale as equipment for that is costlier and not available in the country side. Growers of Japanese mentha, however, at present transport the crop to huge modern distilleries as in the U, S. A. where oil is extracted by direct distillation with steam under low pressure or up to 100 fts pressure.

**Distillation of menslia in the fresh or dry condition**

On the average, the laboratory distillation of semidry to dry herb takes about *1-2* hours, while in the fresh herb the oil takes a slightly longer time to come over so that it takes about 3 hours for practically all the oil to distil over. Under field conditions, it is expected that the distillation will take about 2-|- houis for the dry or semidry herb and about 3£ hours with the fresh herb.

The distillation of the semidry to dry leaves and flowering shoots rather than the fresh herb, after separating the thicker stems, is considered to be quicker and easier and therefore advisable where fuel has to be economised.

In Japan the spent herb is dried and said to be used either as fuel or as horse feed. In Kerala it may be possible to use it for pig or cattle feed.

The Table below gives the results of the water distillation experiment to illustrate ratio of oil to distillation water during the distillation.

TABLE m

Ratio of oil to distillation water **ID open** type **distillation**

| - | Vol. of the total distil-late cc | Vol. of oil cc | Percentage on total oil |
|---|---|---|---|
| Dry whole plant taken —332 gtns | 1st 100 cc | 4.1 | 66.5 % |
| | next 100 cc | 1.1 | 17.5 % |
| | 100 cc | 0.4 | 6.35% |
| | „ 100 cc | 0.3 | 4.8 % |
| Water added : 2 litres + 1 litre in small lots | 100 cc | 0.1 | 1.6 % |
| Yield of oil in this Expt : 1.9% V/W | „ 200 cc | 0.1 | 1-6% |
| | 300 cc | 0.1 | 1.6% |
| Total | 1000 cc | 6.3 | 99.95% |

Distillation in **Lcmongrass** Pilot **Plant**

In one experiment mentha plants were dried for two weeks by hanging on wire supports (Japanese method : 10.6 kg. fresh herb; a 10 gallon capacity pilot plant for lemon grass distillation). The dried sample consisted of 58,3% leaves and 41.7% stems. The results of the distillation are given in Table *TV.* In this distillation the time taken was too much as the cooling of vapours was inefficient.

TABLE IV

| Series | Vol. of distillate | Time | Water | Oil |
|---|---|---|---|---|
| 1st | 950 cc | 35 minutes | 902 cc | 48 cc |
| 2nd | 914 cc | 37 „ | 900 cc | 14 cc |
| 3rd | 905 cc | 37 „ | 900 cc | 4.5 cc |
| 4th | 1000 cc | 41 | 1000 cc | 1.5 cc |
| 5th | 1000 cc | 60 „ | 999 cc | 1.0 cc |
| 6th | 1200cc | 65 „ | 1200 cc | 0.2 cc |
| Total | 5969 cc | 4 hrs. 35 min. | 5900 cc | 69.2 cc |

The total yield was 2.103% on dry basis and 98.20% of the total oil was obtained in the first 2\ hours.

One pilot plant distillation of fresh mentha is given below in Table V. The total amounts of fresh herb taken was 8790 gms. (calculated to a dry weight of 2730 gms).

TABLE V

| Series | Vol. of distillate | Time | Oil | % of total oil |
|---|---|---|---|---|
| 1st | 1000 cc | 30 min. | 32 cc | 83.1 |
| 2nd | 1000 cc | 50 „ | 4cc | 10.4 |
| 3rd | lOOOcc | 35 „ | 2cc | 5.2 |
| 4th | 1000 cc | 35 „ | 0.5 cc | 1.2 |
| 5th | 1000 cc | 30 „ | 0.1 cc | 0.2 |

The yield on fresh plant in this experiment was only 0.44% V/W (equivalent to 1.40% on dry basis). This sample contained even thick stems just above ground level leading to lower yields than the average. The same fresh sample, after removal of the thick stems at the lower portion of the herb, gave in the oil estimation apparatus a yield of 0.80% of oil. Economic quantities of the oil distilled over in about 2 hours.

In actual field distillations in different countries, about 65-70% of the total oil is said to distil over from the dry herb in one hour and above 90% at the end of the second hour.

**Storage and use of the oil**

The oil should be dried and stored in a cold place in clean containers made of glass, galvanised iron or better, aluminium, filled to the brim and stoppered air-tight.

Peppermint oil is an ingredient of many medicinal preparations. It is an excellent carminative, gastric stimulant and flavouring agent, and has some antiseptic, anaesthetic and preservative properties. It is used extensively in the manufacture of tooth-pastes, mouth washes, medicinal mixtures and confectionery. The chief use of Japanese mint oil is for the production of crystalline menthol.

**Separation of Menthol**

Mentha piperita, Linn, gives a lesser yield of oil than the Japanese variety and contains between 45-65% free rnethol 3.1—9.6% of ester menthol and 9 - 25% menthane. It does not however lend itself to easy manufacture of menthol crystals. Trial cultivations in Nilgiris and Dehra Dun gave poor yields of mint oil which did not attain B. P. standard.

The Japanese variety of mint, whether growing in Japan, China, California,

Brazil or Kerala gives oils containing 65—87% of free menthol and 3—12% of ester menthol and can give up to 50—65% of crystalline menthol by mere cooling.

Different firms appear to have different methods of crystallising out the menthol. Even an ice cream freezer and fillration from linen bags under gravity serves the purpose. The aim however is to get as large crystals as possible. Slow cooling, first at 14°, then 10 and finally at -5° appears to secure the biggest crystals which are then centrifuged or filtered under pressure.' The adherent mother liquors are got rid of by exposure to a current of dry air.

On the average about 35—40% of menthol crystals were obtained in the first crystallisation from the dry oil by freezing and filtration at about -15°C, By a repetition of the process 50—55% of the weight of the oil was obtained as crystalline menthol which was further purified by recrystallisation from petroleum ether (B. P. 40—60°C) giving menthol ra.p. 41.5—42°C. Further quantities appear to be recoverable by a repetition of the above process.

By the chemical process of catalytic hydrogenation most of the menthone can be reduced to menthol and by hydrolysis the esters also can give menthol. About 90% should be recoverable from the Kerala oil as crystalline menthol. Experiments on these lines are in progress.

Analysis of the oil

The analysis of the oil from Trivandrum and Odakkali are compared with those of Kashmir and of Japan in Table VI.

TABLE VI

| | Trivandrum oil (30°) 1959 | Odakkali oil (30°) 1960 | Kashmir oil (Katra) 3000ft. | Japanese oil average | Dementholised oil from Trivandrnm oil 30° 1959) |
|---|---|---|---|---|---|
| Specific gravity | 0.8959 | 0.8966 | 0.9045 20°C | 0.8997 to 0.9011 25°C | 0.8957 |
| Optical rotation | —37.90° 30°C | —36.47 | ... | —37° 11′ (25°C) | -32.61° |
| Congealing point | 15–16°C | 15–16°C | 15–17°C | 16-27°C | below 0°c |
| Refractive Index nD' | 1.4548 | 1.4551 | 1.4580 t=20°C | 1.4590 t=20°C | 1,4550 |

| | | | | | |
|---|---|---|---|---|---|
| Solubility in 70% alcohol | 2.5-3.0 | 2.5-3.0 | 3-4 | 2-3 . | 2.5-3.0 |
| Acid value | 0.32 | 0.3468 | 0.57 | 1.1-2.1 | 0.34 |
| Ester content (as menthyl acetate) | 8.08% | 8.07% | 11.7% | 6.01 to 6.36% | 15.86% |
| Free menthol | 80.30% | 74.52% | 77.6% | 78.83% | 57.1% |
| Menthone* | 11.20% | 12.01% | ... | 11.85—13.75% | 22.46% |

* To provide for the future production of the oil in India, the Indian standard has laid down a maximum of 25% Ketones as menthone.

The menthone content is found to be the same in the oil obtained **from** Trivandrum as that of the Japanese oil. Menthone is known to have a slightly bitter flavour and the lower the menthone content the higher will be the demand for the oil especially in the foreign market,

The residual oil left after freezing out the menthol is **still** above B. P. standard in menthol and can be sold as such or processed to give further quantities of menthol.

**Cost of Cultivation per hectare on a three crop basis**

One hectare is equal to 2.47 acres; the spacing of plants is to be 3" • 6* and the rows 1' feet apart.

**A. Labour Charges**

| | | |
|---|---|---|
| 1. | Digging, levelling and manuring | 70 men |
| 2. | Preparing furrows | 25 „ |
| 3. | Planting rooted suckers | 15 „ |
| 4. | Weeding etc. for 12 months | 150 „ |
| 5. | Watering on dry days | 150 „ |
| 6. | Cutting 3 harvests | 40 „ |
| 7. | Miscellaneous items of farm work, distillation in lemongrass stills etc. | 100 „ |
| | | 550 men |
| | Labour charges at Rs. 2/- per man per day | Rs. 1100 |

B. Cost of manure

| | | |
|---|---|---|
| 8. | Cost of 1750 c. ft of farm yard manure | Rs. 375 |
| 9. | Ash 50 bags of 160 lbs each | Rs. 190 |
| 10. | Ammonium sulphate 12 cwts | **Rs.** 228 |
| 11. | Superphosphate 12 cwts | Rs. 144 |

**C. Factory and Laboratory Charges etc.**

| | | |
|---|---|---|
| 12. | Fuel charges calculated on water used | Rs. 200 |
| 13. | Cost of containers | Rs. 50 |
| 14. | Cost of freezing out menthol | Rs. 100 |
| | | Rs.1287 |
| | Total expenditure | Rs. 2387 |
| | In round figures | Rs. 2500 |

D. Sale of Products

It is expected that the yield of oil will be between 30 kg and 100 kilos per hectare averaging about 50 kg in the first year, 60 kilos in the second year and 70 kilos in the third year in suitable soil. The following is calculated at 60 kg of oil only, i. e. 20 kg of crystalline menthol and 20 kg dementholised oil,

| | |
|---|---|
| 30 kg menthol at Rs. 50/Ib (listed Rs. 75/-) | Rs. 3330 |
| 30 kg of dementholised oil at Rs. 15/ lb | Rs, 1000 |
| | Rs. 4330 |
| Net profit per hectare | Rs. 1830 |
| Net profit per acre | Rs. 830 |

Note:

1. The items of expenditure, we expect, will in practice come to half the figures given. The expenditure under A will be much less for the second and subsequent years as a plantation once established will continue and give-better yields for at least three years, when only weeding, watering, manuring and harvesting will be necessary. Under item E, the maximum amount of manures only about are given, lesser used especially in fertile soils. Lemongrass stills can be used, cost of water is not taken in to account as it vanes from place

2. The yield of crystalline menthol will be more than what is given here and

will be at least 1' times this amount, by further laboratory processing.

TO fill the indian deficit

To nil the Indian deficit m merfmol and mentha products and produce a surplus will require its cultivation m about 5000 hectares of suitable land.

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