forestry research institutions in the developing countries have expanded in the past. However, this expansion has not kept pace with changes especially those related to growing population and resultant ecosystem degradation. The research organizations were rather slow in their response to these changes because of their structural limitations. These limitations will have to be overcome now so that these organizations are in a position to provide research information for integrated approach to ecosystem management. Forestry research managers have a special role to play in this regards, and would need special skills and talent to meet the emerging challenges.

CULTIVATION PROSPECTS OF MENTHA ARVENSI S Linn. AT PESHAWAR

Anwar Ahmad Khan, Medicinal Plants Botanist and Shakeel Haider Zaidi, Assistant Economic Botanist, Pakistan Forest Institute, Peshawar.

ABSTRACT

Mentha arvensis is a well-known plant reputed for its menthol content all-over the world. In order to determine the possibility of its cultivation as a crop, introduction and fertilizer trials were conducted for two consecutive years at Medicinal Plants Farm, Peshawar. Yield data indicated that 3-cuttings proved better as compared to two cuttings/annum. Application of split doses of NPK at the rate of 150:30:30 kg/ha significantly increased the yield of green herb as compared to other doses. The mint oil content are comparable with the main producing countries like Japan, India and China. Pilot-scale cultivation of Japanese mint in the irrigated areas is recommended to the farmers for growing as specialized crop.

INTRODUCTION

Mentha arvensis (Japanese mint) is a strongly scented essential oil bearing plant reputed for its high menthol content extracted from mint oil. It is cultivated on commercial scale in the tropical and subtropical regions of Argentina, Brazil, South America, China and Japan for commercial utilization of its essential oil and menthol contents. M. arvensis has been recently introduced in Pakistan and trials were conducted to determine its cultural and agronomical requirements at Peshawar. The crop is gaining importance for commercial utility of mint oil and its conversion in Menthol and other valuable by-products widely used in perfume, pharmaceutical products, foods, cosmetics, aftershave lotions and tooth pastes industries. Presently Pakistan imports Menthol and by-products of mint oil worth Rs. 15 - 20 million every year from Japan and other countries to meet the requirements of pharmaceutical and other industries in the country.

Japanese mint can be cultivated under a wide range of soil and climatic conditions in tropical and subtropical countries (Hussain et al 1968). The climate of Peshawar valley is congenial for the cultivation of M. arvensis crop. The extraction of mint oil can easily be carried out with an investment of about Rs. 0.25 million by installation of a distillation unit and thus a sizeable amount of foreign exchange can be saved on the import of mint oil and menthol from abroad.

The percentage of essential oil ranges from 0.45 to 0.6% extracted from freshly wilted leaves
of *M. arvensis* Chopra *et al* 1946 has reported that foliage yield increased by the application of phosphatic fertilizer. Bains *et al* (1971) conducted cultural and fertilizer trials at Ludhiana and concluded that maximum foliage yield could be obtained when planted at 45 cm row to row distance and recommended application of 150 kg N/ha in two split doses for vegetative growth of the plant. Later, Shelke and Morey (1978) described the effect of four levels of nitrogen application with 3 topping treatments on the growth and essential oil content. They found that yield of leaves and oil content was maximum with an application of 40 kg N/ha. It was further observed that plants topped at 42 days after planting gave highest oil yield (19.19 kg/ha) in the first cutting. Singh and Singh (1979) determined the effect of varying levels of nitrate on the growth and nitrogen metabolism in *M. arvensis*. They found that growth was maximum at 16 mg/litre of nitrate beyond which (32.0 & 64.0 mg/l) it reduced considerably. Bhardwaj *et al* (1980) studied the effect of different levels of nitrogen on herbage yield and oil content in Mentha species and found that highest herbage yields of *M. piperita* and *M. citrata* for two years were obtained with the application of 225 kg N/ha and 300 kg N/ha respectively.

Keeping in view, the economic importance and potential for development as minor cash crop, cultivation and fertilizer trials were conducted for two consecutive years (1985-87) under irrigated conditions at Medicinal Plants Farm, Peshawar. Results of these trials are presented in this article.

**RESULTS AND DISCUSSION**

Data on fresh herb yield for two consecutive years is tabulated as under:

Mean fresh herb yield of *M. arvensis* in kg/plot (25 m²) as affected by cultural and fertilizer treatments.

Results of the study during two consecutive years indicated that 3-cuttings of green herb proved its superiority over 2-cuttings per annum. Projection of yield data on hectare basis gave an estimated yield of 36.0 tonnes/ha from three cuttings as compared to two cuttings (28.8 tonnes/ha) per annum. Application of 150:30:30 NPK kg/ha gave significantly higher yield of green herb (36.8 tonnes/ha) as compared to other doses i.e., 100:20:20 NPK kg/ha. (32.8 tonnes/ha) against control treatment (21.6 tonnes/ha). No significant differences were observed in the mean
yield of treatments 150:30:30 NPK and 300:60:60 NPK kg/ha respectively. Therefore, fertilizer mixture having NPK in the ratio of 150:30:30 NPK kg/ha was economical and would provide more income to the cultivators.

<table>
<thead>
<tr>
<th>Fertilizer</th>
<th>3-cutting</th>
<th>2-cutting</th>
<th>Mean</th>
<th>Pooled mean for fertilizer treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>N P K</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>64</td>
<td>45</td>
<td>55</td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>20</td>
<td>96</td>
<td>78</td>
<td></td>
</tr>
<tr>
<td>150</td>
<td>30</td>
<td>113</td>
<td>88</td>
<td></td>
</tr>
<tr>
<td>300</td>
<td>60</td>
<td>100</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>93</td>
<td>75</td>
<td>81</td>
<td></td>
</tr>
<tr>
<td>1985-86</td>
<td></td>
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<tr>
<td>0</td>
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<td>90</td>
</tr>
<tr>
<td>Mean</td>
<td>87</td>
<td>68</td>
<td>79</td>
<td></td>
</tr>
<tr>
<td>1986-87</td>
<td>90*</td>
<td>72</td>
<td>82</td>
<td></td>
</tr>
</tbody>
</table>

* Significant at 5% probability level.

The plant is perennial and showed luxuriant vegetative growth in the first year and a decline in the yield of green herb (8%) was observed during second year's growth which might be due to successive cuttings and age of plant. Therefore replanting is necessary after two year's growth.

Average yield of green herbs obtained in 3-cuttings/annum was calculated to be 28 tonnes/ha which would yield 126 kg essential oil. The economics of cultivation of this plant is given below. It is based on current market rates of sale of oil, yield and cost of production of fresh herb.

Yield of fresh herb 28 tonnes/ha
Average yield of oil 126 kg/ha @ 0.45 percent.
Cost of cultivation Rs. 6100/-
Land rent/annum Rs. 4000/-
Cost of extraction of mint oil from 28 tonnes green herb @ Rs. 250/tonne Rs. 7000/-
Total expenditure Rs. 17100/-
Income from sale of 126 kg Rs. 37800/-
oil @ Rs. 300/kg
Net profit per hectare Rs. 20700/-

Cultivation of Japanese mint is an economically feasible proposition as it can provide net income of Rs. 20700/- per hectare annually to the cultivator.

CONCLUSION

_Mentha arvensis_ is an important essential oil bearing plant with a variety of uses in various industries. Cultivation trials conducted at Peshawar, indicated that the Japanese mint having potential of industrial utilization can be introduced as crop in irrigated areas. Keeping in view the net income from the crop it is recommended that pilot-scale cultivation of this crop may be taken up by progressive farmers who are in a position to install their own distillation unit. The marketing of mint oil be ensured before taking up this venture.

ACKNOWLEDGEMENTS

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SOME OBSERVATIONS ON THE EFFECT OF FOREST TREE SPECIES ON GROUND VEGETATION AT PABBI FOREST, KHARIAN

Bashir Hussain Shah, Director, Forestry Research Division, Pakistan Forest Institute, Peshawar

ABSTRACT

Observations on the percent cover and forage production of ground vegetation under four years old plantation showed that Eucalyptus camaldulensis, Acacia nilotica and Leucaena leucocephala have a higher allelopathic effect on the growth of grasses under them as compared to Zizyphus mauritiana, Acacia modesta, Dalbergia sissoo and Albizia lebbek. The cover percent of the vegetation was lowest (8.25%) under Eucalyptus camaldulensis and highest under Zizyphus mauritiana (83%). The cover percent under Acacia modesta, Dalbergia sissoo, Albizia lebbek, Acacia nilotica and L. leucocephala was 64, 60, 53, 29 and 16% respectively. The forage production data also showed the same trend. It was 4675, 4050, 3200, 2450, 1775, 775 and 662 kg per hectare in the plots planted with Z. mauritiana, A. modesta, D. sissoo, A. lebbek, A. nilotica, L. leucocephala, and E. camaldulensis respectively.

INTRODUCTION

Pakistan is a wood deficit country with only 4.8% area under forests which is not sufficient to meet the fuelwood and timber demands of the country. Therefore Government of Pakistan is giving priority to increasing the forest area in the country. For this purpose, the government wastelands which are commonly used for grazing, are planted with trees to increase the fuelwood production. Selection of tree species for planting on wastelands is very important so that