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YIELD AND QUALITY OF ESSENTIAL OIL OF JAPANESE MINT AS AFFECTED BY N-RATES AND ROW-SPACING[1]

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Japanese mint (*Mentha arvensis* Linn) was harvested twice during the growing season in a field trial conducted at Lucknow (26.5° N, 80.5° E; 120 m alt). High herb, drymatter and essential oil yields were associated with high rates of N application up to 160Kg/ha (in the range of 80, 120, 160 & 200 kg N/ha), and 45 cm row spacing (30, 45 & 60 cm). Though the menthol content in oil decreased significantly with increasing N levels to 200 kg/ha but the menthol yield increased up to the application of 160Kg N/ha. Row spacing did not cause significant variation in menthol content, however, highest menthol (%) was observed at 45 cm row-spacing.

Japanese mint (*Mentha arvensis* Linn) was introduced in India as a potential source of natural menthol. Its commercial cultivation was started in the *Tarai* area of Uttar Pradesh by the Central Institute of Medicinal & Aromatic Plants. Recently it is being introduced in the semi-arid climate of sub-tropical India to make the country self sufficient in natural menthol. To maximise the production of herb, oil and menthol, it is necessary to provide optimum nutrition and proper spacing. Dutta (1971), Gulati *et al.* (1971) and Dudan *et al.* (1975), found an increase in the yield of herb and oil by application of N. Gulati *et al.* (1971) also observed higher yields of herb and oil with 60 cm row spacing compared to 75 and 90cm. In this study the effect of N and row spacing on yields of herb, drymatter and oil quality was investigated in semi arid sub-tropical climates of Lucknow.

MATERIAL AND METHODS

A field trial was conducted in a split-plot design at the Agricultural Research Farm of the Central Institute of Medicinal & Aromatic Plants, Lucknow (26.5°N, 80.5° E & 120 m. altitude). Four N levels (80, 120, 160 & 200 kg N/ha) and three row spacings (30, 45 & 60 cm) were studied in a sandy loam soil of alkaline pH (8.2) and medium fertility status (Total N=0.02%). N was applied as urea; half at the time of planting as plough sole application and remaining N was top dressed five days after first harvest. Planting was done on February 7, 1981 using 4 qntls suckers/ha. The crop was harvested twice, first on June 8, 1981 and second on August 28, 1981. Essential oil in plant sample was determinted by steam-distillation on cleavengers apparatus. Oil quality in terms of its menthol, methone and methyl acetate content was estimated by GLC on Perkin Elmer 390 Gas Chromatograph.

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RESULTS AND DISCUSSION

Herb and drymatter yield :

The yield of herb increased significantly with increase in the dose of N up to 160 kg/ha in first harvest (Table 1). In second harvest, 120 and 160 kg N/ha produced significantly higher herb than 80 and 200 kg N/ha. Total herb yield of both the harvests however, increased significantly upto 160 kg N/ha. The differences of herb yields at 120 and 200 kg N/ha were not significant. The drymatter production, on the other hand, did not improve significantly beyond 120 kg N/ha (Table 2). This indicates that N application beyond 120 kg/ha increased the sacculancy (moisture content) of the plants.

Total herb and drymatter yields were significantly higher at 45 cm row spacing than at 30 and 60 cm spacings Duhan *et al*, (1975) also observed higher yields at 45 cm row spacing. Although under wider row spacing (60 cm) the supply of nutrients per plant from the soil may have increased the number of plants per unit area were less and production thus could not compete with that obtained under 45cm spacing. Under closer spacing (30 cm) on the other hand the supply of nutrients fall short of the requirements of large number of plants per unit area, Also, at this spacing, large population caused shading on lower leaves which affected the photosynthesis adversely and thus the yields were less at closer spacing.

Nitrogen and row spacing interaction indicated that at 45 cm row spacing 80 kg N/ha produced as much yields as 160 kg N/ha at 60 cm spacing.

Essential oil yields and Content :

The per cent content of oil in plants, however, decreased with increasing N application (Table 3) though in terms of oil yield, it was similar as that of herb yield.

The interaction between N levels and row spacing indicated that significantly higher yields of total oil were obtained at 45 cm spacing with 120 kg N/ha. Yields obtained by 160 and 200 kg/ha N application at the same spacing were also at par.

Menthol yield and oil quality :

Menthol content in oil decreased significantly when N levels were increased to 200 kg/ha. Christopher (1967) also observed similar results. The menthol yield (kg/ha). on the other hand, increased significantly with increasing N application upto 160 kg N/ha (Table 4). The content of menthone in oil increased upto 120 kg N/ha and that of methyl acetate upto 160 kg N/ha. Further application of N reduced the methone and methyl acetate content of the oil.

Though, the row spacing did not influence the menthol content of oil significantly, the highest menthol content was observed under 45 cm row spacing. Duhan *et al*, (1975) also advocated 45 cm row spacing to obtain higher menthol in the oil of Japanese mint.

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Table-1. Herb yield (p/ha) of Japanese mint as influenced by N-rates X Row-spacing

N-rates	I harvest				II harvest				Total			
	spacing				spacing				spacing			
	30-cm	45-cm	60-cm	Mean	30-cm	45-cm	60-cm	Mean	30-cm	45-cm	60-cm	Mean
N_{80}	32.4	39.6	30.3	34.1	20.8	33.9	34.0	29.6	53.2	73.5	64.3	63.7
N_{120}	34.3	52.3	39.5	42.0	20.2	51.8	29.5	33.8	54.5	104.1	69.0	75.8
N_{160}	57.4	64.5	42 0	54.6	28.0	39.2	30.0	32.4	85.4	103.7	74.4	87.0
N_{200}	59.1	49.3	36.6	48.4	23.8	40.4	22.8	29.0	82.9	89.7	65.6	77.4
Mean	45.8	51.4	37.1		22.0	41.3	29.1		67.8	92.7	66.2	
CD 5%												
(i) N-rates				3.6				2.4				5.4
(ii) Row-spacing				4.2				4.0				8.6
(iii) Interaction				7.4				6.8				12.3

Table-2. Drymatter production (q/ha) of Japanese mint as influenced by N-rates X Row-spacing.

Treatments	I harvest				II harvest				Total			
	spacing				spacing				spacing			
	30-cm	45-cm	60-cm	Mean	30-cm	45-cm	60-cm	Mean	30-cm	45-cm	60-cm	Mean
N_{80}	10.7	11.1	10.9	10.9	6.0	10.4	10.4	9.0	16.7	21.5	21.3	19.9
N_{120}	11.4	17.0	12.8	13.7	6.3	15.9	9.1	10.5	17.7	32.9	22.8	24 2
N_{160}	15.6	18.9	12.8	15.8	8.3	11.6	8.2	9.4	23.9	30.5	21.0	25.2
N_{200}	17.0	15.9	12.3	15.1	7.3	12.0	7.4	8.9	24.3	27.9	19.7	24.0
Mean	13.5	15.7	12.2		7.0	12.5	8.8		20.5	28.2	21.0	
CD 5%												
(i) N-rates				1.8				NS				3.2
(ii) Row-spacing				2.1				3.4				4.5
(iii) Interaction				3.7				5.6				7.5

Table 3. Essential oil content (%) in Japanese mint as influenced by N-rates X Row-spacing

N-rates	I harvest				II harvest			
	30-cm	45-cm	60-cm	Mean	30-cm	45-cm	60-cm	Mean
N_{00}	0.80	0.90	0.90	0.87	0.98	0.92	0.98	0.96
N_{120}	0.82	0.83	0.77	0.81	0.98	0.92	0.97	0.96
N_{140}	0.85	0.77	0.77	0.80	0.88	0.95	0.95	0.93
N_{160}	0.83	0.77	0.77	0.79	0.85	0.92	0.90	0.89
Mean	0.83	0.82	0.80		0.92	0.93	0.95	
CD 5%								
(i) N-rates				0.04				0.05
(ii) Row-spacing				NS				NS
(iii) Interaction				0.09				NS

Table 4. Essential oil quality as influenced by N-rates and row spacing

Treatment	Menthol (%)			Menthol yield (Kg/ha)			Menthone (%)			Methylacetate		
	I	II	Mean	I	II	Total	I	II	Mean	I	II	Mean
N_{00}	83.7	80.9	82.3	23.9	21.7	45.6	7.2	7.0	7.1	7.0	9.6	8.3
N_{120}	81.7	77.9	79.8	27.9	23.8	51.7	8.8	10.3	9.6	8.1	9.4	8.8
N_{160}	80.3	80.9	80.6	36.0	23.6	59.6	6.8	7.3	7.1	8.7	10.1	9.4
N_{200}	77.5	73.8	75.7	32.8	19.4	52.2	6.2	7.2	6.7	7.7	6.7	7.2
CD 5%	1.3	1.7	1.5	2.4	2.8	3.4	0.9	0.5	0.6	0.2	0.5	0.6
Row-spacing (cm)												
30	81.1	75.7	78.4	30.7	16.0	46.7	6.9	6.3	6.6	7.1	8.6	7.9
45	80.8	80.7	80.8	36.4	30.0	66.4	6.8	8.0	7.4	8.5	9.2	8.9
60	80.6	78.7	79.7	24.0	20.9	44.9	8.0	9.6	8.8	8.1	8.8	8.5
CD 5%	NS	NS	NS	3.2	3.9	5.4	1.2	0.9	1.1	9.4	NS	NS