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Prospects of *Mentha spicata* under mid-hill conditions of Himachal Pradesh

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ABSTRACT

A field trial was conducted at the research farm and laboratory of the Department of Forest Products, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, HP to study the performance of *Mentha spicata* under varying dates of planting, row spacings and fertilizers. The results revealed that transplanting time had significant effect on growth and yield of the species. The crop transplanted on 15 February gave maximum values for plant height (36.82 cm), herb yield (173.15 q/ha), oil content (0.24%) and oil yield (50.89 kg/ha) as compared to January and March transplanted crop. Among different spacings 30 x 45 cm spacing registered maximum plant height (38.26 cm), herbage yield (188.30 q/ha), oil content (0.25%) and oil yield (48.72 kg/ha). Use of NPK registered maximum plant height (43.39 cm), herb yield (271.96 q/ha), oil content (0.42%) and oil yield (81.38 kg/ha) followed by application of vermicompost, FYM and *Azotobacter*. Use of optimum dose of NPK gave maximum cost/benefit ratio for this species.

Keywords: *Mentha spicata*; essential oil; planting time; row spacing; organic fertilizers

INTRODUCTION

Mentha a small genus of aromatic herb belongs to Labiateae (Lamiaceae) family. *Mentha spicata* popularly known as spearmint is considered industrial crop as it is a source of essential oil enriched in certain monoterpenes like carvol, dihydrocarveole, dihydrocarveylacetatae, menthol, menthone, caryophyllene, terpineol and cubebene which is commercially exploited in food, flavor, cosmetic and pharmaceutical industries (Chattopadhyay et al 2002). The crop is propagated by stolons from which 30 to 60 cm erect and ascending branches arise. The leaves are sessile, smooth, lanceolate or ovate-lanceolate, sharply serrate, smooth above and glandular below; the apex is acute and up to 6.5 cm long. The flowers are sharply pointed, long and narrow hence the name spearmint is attributed to the plant (Guenther 1974). Essential oil biosynthesis in *M spicata* L is strongly influenced by several intrinsic and

extrinsic factors including fertilizers, planting time, harvesting time and other agro-climatic factors (Singh and Misra 2000). Spearmint is well adapted to climatic conditions in tropical and subtropical areas. A climate with adequate and regular rainfall and good sunshine during its growing periods ensures a good yield. Both high water moisture content and water stress conditions decrease essential oil yield in this crop.

M spicata has proved out to be of great commercial importance in flavouring and pharmaceutical industries and consequently has fascinated the attention of the researchers. Transplanting time and spacing have greater influence on yield and oil content of *M spicata* (Mekonnen and Kassahun 2011). It responds well to nitrogen in conjugation with phosphorus and results in increased herbage and oil yield (Dua and Randhawa 2002). Moreover combined applications of inorganic and organic fertilizers have greater affect on improved spearmint essential oil yield.

Keeping in view the above facts a study was conducted in mid-hill conditions of Himachal Pradesh to access the effect of different fertilizers, spacings and transplanting time on growth and essential oil yield of *M spicata.*

MATERIAL and METHODS

Study was conducted at Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, situated at 1200 m amsl under the sub-temperate zone of Himachal Pradesh. The experiment was laid out in split-plot design with three replications. The soil of experimental area was sandy loam in texture having pH 7.71, EC 0.43 m mhos/cm, available nitrogen, phosphorus, potassium 318, 12.60 and 285.97 kg/ha respectively. The treatment consisted of three dates of planting (15 January, 15 February and 15 March), three row spacings (30 x 30, 30 x 45 and 45 x 45 cm) and three organic fertilizers viz FYM (10 tons/ha), vermicompost (10 tons/ha), *Azotobacter* (10 kg/ha) and one standard dose of NPK (120:50:40 kg/ha). Fresh, healthy and disease free suckers were transplanted in furrows at a depth of 4-5 cm as per the treatments. At the time of planting a light shower of water was given to enhance crop production. The crop was harvested twice, first from mid May to June end and second from mid August to mid September. The data on fresh herb and oil yield were recorded at the time of each harvest.

RESULTS and DISCUSSION

Effect of transplanting time

The studies revealed that the15 February was the best transplanting time for *M spicata* as compared to 15 January and 15 March thereby giving higher values for plant height (36.82 cm), herb yield (173.15 q/ha), oil content (0.24%) and oil yield (50.89 kg/ha) (Tables 1-4). The low

Table 1. Effect of transplanting time, spacings, organic manures and fertilizers on plant height (cm) of *Mentha spicata*

Treatment	S_1						S_2						S_3						Overall Mean
	F_1	F_2	F_3	F_4	F_5	Mean	F_1	F_2	F_3	F_4	F_5	Mean	F_1	F_2	F_3	F_4	F_5	Mean	
T_1	29.44	35.21	39.33	37.18	40.17	36.27	31.25	37.47	41.36	39.22	43.23	38.54	27.58	31.20	34.37	33.99	35.30	32.49	35.76
T_2	32.43	34.55	37.39	36.41	41.46	36.45	35.39	37.50	41.38	40.20	43.39	39.54	31.52	32.28	30.18	37.18	39.31	34.49	36.82
T_3	27.93	33.29	36.42	35.18	38.38	34.24	34.35	32.21	38.50	37.39	41.15	36.72	25.38	31.36	36.27	34.31	38.44	33.15	34.70
Mean	29.93	34.35	37.71	36.26	40.00	35.65	33.66	35.73	40.41	38.94	42.59	38.26	28.16	31.61	33.61	35.16	37.68	33.37	-
$CD_{0.05}$																			
	Transplanting time (T)					3.09						3.12						3.14	
	Fertilizer (F)					3.16						4.26						4.23	
	T x F					3.54						4.78						3.61	
Overall $CD_{0.05}$																			
	Transplanting time (T)					2.63													
	Spacing (S)					3.18													
	Fertilizer (F)					3.35													
	T x F x S					3.84													

T_1= 15 January, T_{2-}= 15 February, T_3-= 15 March, S_1= 30 x 30 cm, S_2= 30 x 45 cm, S_3= 45 x 45 cm, F_1= No fertilizer, F_2= FYM 10 tons/ha, F_3= Vermicompost 10 tons/ha, F_4= *Azotobacter* 10 kg/ha, F_5= NPK (120:50:40 kg/ha)

Table 2. Effect of transplanting time, spacings, organic manures and fertilizers on herb yield (q/ha) of *Mentha spicata*

Treatment	S_1						S_2						S_3						Overall Mean
	F_1	F_2	F_3	F_4	F_5	Mean	F_1	F_2	F_3	F_4	F_5	Mean	F_1	F_2	F_3	F_4	F_5	Mean	
T_1	121.41	134.64	162.42	159.45	201.12	155.78	155.33	171.24	223.34	173.56	226.21	189.90	86.29	114.44	148.50	132.31	155.98	127.48	157.72
T_2	135.34	143.25	203.21	168.30	218.49	173.68	167.37	171.58	223.54	151.32	271.96	197.10	96.67	115.54	184.25	134.82	212.20	148.67	173.15
T_3	117.63	142.24	179.30	164.57	196.35	159.98	127.45	160.34	200.33	169.30	232.3	177.92	92.27	101.32	141.44	106.65	149.45	118.19	152.03
Mean	124.77	140.00	181.63	164.07	205.27	163.14	150.00	167.67	215.70	164.70	243.47	188.30	91.74	110.40	158.03	124.57	172.50	131.44	-

$CD_{0.05}$			
	Transplanting time (T)	3.26	5.78	4.37
	Fertilizer (F)	12.78	13.34	8.63
	T x F	14.91	16.64	9.29

Overall $CD_{0.05}$		
	Transplanting time (T)	5.28
	Spacing (S)	13.71
	Fertilizer (F)	7.43
	TxFxS	19.08

T_1= 15 January, T_2.= 15 February, T_3-= 15 March, S_1= 30 x 30 cm, S_2= 30 x 45 cm, S_3= 45 x 45 cm, F_1= No fertilizer, F_2= FYM 10 tons/ha, F_3= Vermicompost 10 tons/ha, F_4= *Azotobacter* 10 kg/ha, F_5= NPK (120:50:40 kg/ha)

Table 3. Effect of transplanting time, spacings, organic manures and fertilizers on oil content (%) of *Mentha spicata*

Treatment	S_1						S_2						S_3						Overall Mean
	F_1	F_2	F_3	F_4	F_5	Mean	F_1	F_2	F_3	F_4	F_5	Mean	F_1	F_2	F_3	F_4	F_5	Mean	
T_1	0.19 (0.43)	0.20 (0.44)	0.26 (0.57)	0.25 (0.49)	0.37 (0.60)	0.25	0.16 (0.38)	0.18 (0.41)	0.32 (0.57)	0.21 (0.43)	0.36 (0.64)	0.25	0.11 (0.33)	0.12 (0.34)	0.22 (0.46)	0.21 (0.45)	0.35 (0.59)	0.20	0.23
T_2	0.16 (0.39)	0.21 (0.45)	0.24 (0.48)	0.23 (0.47)	0.32 (0.56)	0.23	0.18 (0.43)	0.21 (0.46)	0.33 (0.56)	0.22 (0.52)	0.42 (0.60)	0.27	0.15 (0.38)	0.19 (0.43)	0.26 (0.50)	0.20 (0.44)	0.27 (0.51)	0.21	0.24
T_3	0.13 (0.36)	0.16 (0.39)	0.22 (0.46)	0.21 (0.45)	0.27 (0.51)	0.20	0.21 (0.45)	0.24 (0.48)	0.26 (0.50)	0.25 (0.48)	0.29 (0.53)	0.25	0.14 (0.37)	0.17 (0.41)	0.20 (0.44)	0.18 (0.42)	0.22 (0.43)	0.18	0.21
Mean	0.16	0.19	0.24	0.23	0.32	0.12	0.18	0.21	0.30	0.23	0.35	0.25	0.13	0.16	0.22	0.19	0.28	0.19	

$CD_{0.05}$				
	Transplanting time (T)	0.02	0.02	0.02
	Fertilizer (F)	0.03	0.03	0.03
	T x F	0.02	0.03	0.02
Overall $CD_{0.05}$				
	Transplanting time (T)	0.02		
	Spacing (S)	0.02		
	Fertilizer (F)	0.02		
	T x F x S	0.02		

T_1= 15 January, T_2= 15 February, T_3-= 15 March, S_1= 30 x 30 cm, S_2= 30 x 45 cm, S_3= 45 x 45 cm, F_1= No fertilizer, F_2= FYM 10 tons/ha, F_3= Vermicompost 10 tons/ha, F_4= *Azotobacter* 10 kg/ha, F_5= NPK (120:50:40 kg/ha)

Table 4. Effect of transplanting time, spacings, organic manures and fertilizers on oil yield (kg/ha) of *Mentha spicata*

Treatment	S_1						S_2						S_3						Overall Mean
	F_1	F_2	F_3	F_4	F_5	Mean	F_1	F_2	F_3	F_4	F_5	Mean	F_1	F_2	F_3	F_4	F_5	Mean	
T_1	23.49	25.42	46.24	35.45	66.58	40.75	28.78	33.49	51.43	40.37	80.47	46.91	18.54	22.35	41.34	30.38	54.44	33.41	40.36
T_2	30.39	37.24	62.45	43.38	73.17	48.01	34.12	50.43	67.41	62.22	81.38	59.11	23.31	36.23	54.23	47.47	66.48	45.54	50.89
T_3	21.17	34.23	41.37	35.49	48.50	36.15	28.24	39.62	43.29	36.38	53.20	40.15	17.51	22.48	40.42	30.35	45.42	31.24	35.85
Mean	25.02	32.30	50.02	38.11	62.75	41.63	30.38	41.18	54.04	46.32	71.68	48.72	19.79	27.02	45.33	36.07	55.45	36.73	-

$CD_{0.05}$			
Transplanting time (T)	3.78	4.46	3.14
Fertilizer (F)	5.27	5.08	5.79
T x F	5.56	5.82	6.02

Overall $CD_{0.05}$	
Transplanting time (T)	4.19
Spacing (S)	6.04
Fertilizer (F)	5.22
T x F x S	5.39

T_1= 15 January, T_2-= 15 February, T_3-= 15 March, S_1= 30 x 30 cm, S_2= 30 x 45 cm, S_3= 45 x 45 cm, F_1= No fertilizer, F_2= FYM 10 tons/ha, F_3= Vermicompost 10 tons/ha, F_4= *Azotobacter* 10 kg/ha, F_5= NPK (120:50:40 kg/ha)

yield in the crop transplanted on 15 January might be due to low temperature in the initial stages and higher temperature during 15 March. Moreover under delayed planting as a consequence of higher temperature plant height might have remained less due to less diversion of photosynthates for stem formation than leaves as reported by (Singh et al 1998). However the crop transplanted during February got all the favorable conditions for the growth of plants which might have contributed towards higher growth and yield parameters.

Effect of spacings

The effect of plant spacings on different growth and yield parameters (plant height, herb yield, oil content and oil yield) in *M spicata* revealed that spacing of 30 x 45 cm gave significant increase in all the growth and yield parameters. At this spacing average plant height, herb yield, oil content and oil yield were 38.26 cm, 188.30 q/ha, 0.25 per cent and 48.72 kg/ha respectively (Tables 1-4). Higher yield in 30 x 45 cm spacing might be due to more number of plants per unit area and less competition among plants for nutrients, light, water etc which contributed more towards increased herb yield and oil content. On the other hand low herb yield under wider row spacing might be due to less plant population per unit area.

Effect of organic manures and fertilizers

Application of adequate quantities of fertilizers is considered as one of the most important factors for getting higher mint yields. In the present studies application of vermicompost in *M spicata* resulted in enhanced plant height (41.38 cm), herb yield (223.54 q/ha), oil content (0.33%) and oil yield (67.41 kg/ha) (Tables 1-4). These values were significantly higher than application of FYM, *Azotobacter* and PSB. Vermicompost has been reported to be a potential source of readily available source of plant nutrients, growth enhancing substances and number of beneficial microorganisms like nitrogen fixing, phosphorus solublising and cellulose decomposing organisms (Sultan 1997) which increases the uptake of nutrients by plants thereby giving more yield due to increased availability of nutrients (Rajkhowa et al 2000). All these values were compared with standard dose of NPK fertilizer (120:50:40 kg/ha).

In *M spicata* values of all the parameters like, height (43.39 cm), herb yield (271.96 q/ha), oil content (0.42%) and oil yield (81.38 kg/ha) were higher under optimum dose of NPK (120:50:40 kg/ha) as compared to other treatments. The essential oil content was increased significantly by nitrogen application during the second harvest ie 150 days after transplanting. As reported by Duhan et al (1975) more leaf area, size of epidermal cells and number of oil glands per unit area are the important factors which are responsible for higher essential oil content and herbage yield. Since nitrogen has well marked effect on the yield of herbage and

essential oil and *Mentha* being a leafy crop responds favourably more to the higher doses of nitrogen (Bhardwaj and Kaushal 1990) thus application of nitrogen contributes more towards higher herbage yield in spearmint. The beneficial effect of phosphorus in influencing herbage yield is due to its role in various metabolic activities of plant which might have resulted in increased herbage yield. The results obtained in the present study are in agreement with those of Munsi and Mukherjee (1982) who reported a significant increase in the yield of Mentha oil by application of 60 kg P_2O_5/ha.

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