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Effect of Planting Time and Micronutrient as Zinc Chloride on the Growth, Yield and Oil Content of *Mentha piperita.*

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Abstract

An experiment was conducted to find out the effect of essential oil percentage content and morphogenesis of *Mentha piperita* with foliar treatment of different concentration of zinc solution (1ppm, 1.5ppm, 2ppm, 2.5ppm, 3ppm and 3.5ppm as zinc chloride). An experiment was set up in earthen wear pots in three seasons of Bangladesh (winter, summer and monsoon). Zinc solutions were first applied as foliar treatment at 30days after planting, second and third treatment was applied after seven days intervals. Harvesting was carried out at 65 days after planting. In monsoon the maximum increase of leaves/hector (37.31 t /hector) with 3ppm Zn chloride solution and it was followed by summer (23.11t/hector) with 1ppm zinc chloride solution. 28.2% essential oil was increased compare with the control plant in summer with 3ppm zinc chloride solution; it followed by monsoon 6.7% essential oil when foliar treatment was 2.5ppm. Acid value, refractive index and density of oil were remaining more or less same in the whole period of the treatment.

Key words: *Mentha piperita*, Planting time, Zinc chloride, Oil content quality, Plot yield.

Introduction

Mentha piperita is one of the most important perennial herbs, is planted in February and March (Wealth of India 1962). It cultivated in the damp soil in the temperate region of Asia, Europe and America (Hill 1952). Agronomical studies showed that *M. piperita* prefer loose texture loamy soils. Having natural to slightly acidic pH. The plant produced maximum leaves, stems and dry matter under bright sun light at 30°C day temperature regardless to night temperature during growing well as harvesting periods. The peppermint oil is volatile which occurs in several minute oil glands on the upper and the lower surface of the leaves of the herbs.

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The stem also contains a little amount of such volatile oil. So it may be advised to grow Mentha plants to very bushy habit (Guenther and Van 1943). *M. piperita* is one of the main source of peppermint oil, used for flavoring and pharmaceutical industries(Wealth of India1962). The oil has mild antiseptic and local anesthetic properties. It is used as an external application in rheumatism, neuralgia congestive headache and fore headache (Wealth of India1962). The green plant, left after the extraction of oil, may be dried into hay or silages for use as cattle feed. The hay contains protein 12.7% and total digestible nutrients 49.4% (Wealth of India 1962).

Zinc chloride is used as a promoting agent for the growth of green plant. Zinc is one of the eight essential trace elements for the normal healthy growth and reproduction of crop plant (Parker and Thomason. 1992). In addition organic mater, water, texture and absorption capacity of the soil, also affected zinc nutrition of plants (Bergman, 1992).Crops suffering from Zn deficiency produce small leaves with stunted growth and poor yield. In a few studied conducted earlier, corps response to Zn was evaluated using only micronutrient mixtures of commercial formulations (Sharma *et al.*1980 and Singh *et al.* 1981). Nitrogen, Phosphorus and Potash concentrations and their up take of barley plants increase by increasing application of zinc (Hady. B.A.A. 2007). Application of zinc reduced higher herbage yield of *M. sp.* (Duraisamy. *et. al.*1990). The herb yield an essential oil biosynthesis in *M. sp.* is strongly influenced by several intrinsic and extrinsic factors including fertilizer, planting time, harvesting time and other agro-climatic factor (Singh *et al.* 1995)

In the present study an attempt was made to increase the percentage of essential oil of *Mentha piperita* with different concentration of zinc chloride solution in three different season of Bangladesh.

Materials and Methods

The experiment was set up on the open roof of glass and ceramic building of BCSIR Laboratories, Dhaka in three season of Bangladesh (winter, summer and monsoon). The herbs *(Mentha piperita)* were cultivated in equal sized (24.7 cm height and 28 cm inner diameter) earthenware pots. There were six treatments (1ppm, 1.5ppm, 2ppm, 2.5ppm, 3ppm and 3.5ppm) of aqueous solution of micronutrients and water treated control. Each treatment had three replicas, including control.The physico-chemical properties of soil of pot are given in Table I. In winter season the *Mentha piperita* was planted at the 1st week of January and it was harvested in the last week of March. In summer the planting time of *Mentha piperita* is 1st week of April and harvesting month was last week of June and in monsoon the planting time of *Mentha piperita* was 1st week of July and harvesting time was last week of September. In all the sets soil treatments was

same. Each pot contained equal amount of soil and cow dung. The solutions were sprayed on the one month old *M. piperita* leaves were uniformly grown. The solutions were sprayed one-week interval thrice a time with the experimental period. Data on plant height, number of leaves and number of branches per plant were recorded from 10 randomly selected plants. For total yield and the collection of leaves for oil extraction of all treated Mentha herbs were performed just after 35 days of the 1st foliar spray, i.e., two weeks after the last foliar spray.

For the essential oil extract steam dilution method was followed (Guenther 1949). The freshly harvested leaves from each plot was subjected to steam dilution for about three hours and the separated out from the distillate was dehydrated over anhydrous solution sulphate where by a pale yellow volatile oil was obtained in pure form, physical and chemical characteristics of Mentha oil collected from each treatment were determined accordingly to standard method (Association of Official Analytical Chemicals 1984).

The collected data were statistically analyzed and the mean values were shown in the Table II-IV.

Results and Discussion

Results of the study are summarized in Table II-VII. The number of branches was highest 17.06±2.97 with 3ppm zinc chloride solution in summer where the control was 7.9±3.53(Table III) and in monsoon number of branches were 15.53±0.06 with the same concentration of solution when the control was 10.6 (Table IV). But it was 8.26±2.07 in winter with 1.5ppm solution here control was 7.53± 1.89(Table II). The length of branches was maximum increased in monsoon 42.10 ±0.49 with 1.5ppm zinc chloride solution (Table IV). Maximum number of leaves was found in summer 74.47±26.33 with 2ppm zinc chloride solution (Table III) it followed by monsoon 56.77±3.06 with 1.5ppm zinc chloride solution (Table IV) and 28.2±6.39 number was found in winter with 2.5ppm zinc chloride solution (Table II). The leaves areas were found highest with 1.5ppm solution in monsoon 7.99± 0.04 (Table IV) it followed by summer 5.95±0.06 with 2ppm solution where the control was 6.89±0.08 and 5.25±1.13 respectively. Maximum leaves weight/plot was found in monsoon with 3ppm zinc chloride solution (Table IV), it follows by summer (with 1ppm zinc chlo

Table I. Physio-chemical properties of the soil in the experimental pot.

Texture	pH	Organic matter(%)	Total nitrogen(%)	Available elements in soil(µg/g)							
				N	P	K	Ca	Mg	Cu	Zn	Na
Sandy clay loam	7.2	1.51 %	0.04 %	79.4	45.0	21.2	135.1	242.8	4.07	7.4	20.4

Table II. Effect of foliar treatment of different concentration of zinc chloride solution on morphogenesis of *Mentha piperita* in winter season

	Con. of Zn (ppm)	No. of branch/plant mean ± SD	Length of branches/ plan (cm) mean ± SD	Number of leaves / plot mean ± SD	Leaves area plant (sq.cm) mean ± SD	Leaves wt/plot(g)	Total leaves (t/ha.)
	control	7.53 ± 1.89	19.30 ± 3.26	20.03 ± 4.71	4.62 ± 0.27	136.40	20.36
Winter	1.00	6.33 ± 1.30	17.93 ± 3.96	25.00 ± 6.23	3.79 ± 0.59	143.05	21.35
season	1.50	8.26 ± 2.07	18.50 ± 2.89	28.00 ± 5.19	5.14 ± 0.04	154.30	23.03
	2.00	7.23 ± 3.13	18.90 ± 2.12	25.00 ± 6.23	3.65 ± 0.02	134.60	20.09
	2.50	7.23 ± 1.57	18.20 ± 3.26	28.20 ± 6.39	4.99 ± 0.90	143.20	21.37
	3.00	7.23 ± 2.03	18.60 ± 3.26	27.60 ± 6.21	4.11 ± 0.20	148.20	22.12
	3.50	7.23 ± 2.37	18.10 ± 2.60	26.70 ± 6.23	3.03 ± 0.10	132.00	19.70

Table III. Effect of foliar treatment of different concentration of zinc chloride solution on morphogenesis of *Mentha piperita,* in summer season

	Con. of Zn (ppm)	No. of branch/plant mean ± SD	Length of branches/ plan (cm) mean ± SD	Number of leaves / plot mean ± SD	Leaves area plant (sq.cm) mean ± SD	Leaves wt/plot(g)	Total leaves (t/ha.)
	control	07.90±3.53	11.06±1.31	54.13±26.50	05.25±1.13	134.03	20.00
Summer	1.00	10.47±0.47	11.76±1.30	56.60±30.49	05.80±0.07	154.83	23.11
season	1.50	11.07±3.69	12.20±0.97	50.10±26.80	04.99±0.04	132.28	19.74
	2.00	12.47±3.42	11.70±1.09	74.47±26.33	05.95±0.06	142.50	21.27
	2.50	08.27±3.07	11.83±1.08	53.03±27.66	05.00±0.03	132.44	19.77
	3.00	17.06±2.97	11.73±1.00	54.73±22.05	05.65±0.25	150.25	22.43
	3.50	13.33±4.85	12.07±2.20	62.57±27.50	05.77±0.32	145.81	21.76

Table IV. Effect of foliar treatment of different concentration of zinc chloride solution on morphogenesis of *Mentha piperita, i*n monson season.

	Con. of Zn (ppm)	No. of branch/ plant mean ± SD	Length of branches/ plan (cm) mean ± SD	Number of leaves / plot mean ± SD	Leaves area plant (sq.cm) mean ± SD	Leaves wt/plot(g)	Total leaves (t/ha.)
	control	10.60±3.62	40.47±3.62	43.53±2.66	06.89±0.08	212.50	31.72
Monson	1.00	11.00±0.07	38.40±0.58	45.93±3.77	06.48±0.05	216.70	32.34
season	1.50	13.83±0.22	42.10±0.49	56.77±3.06	07.99±0.04	215.70	32.19
	2.00	12.67±0.57	41.63±2.36	47.53±1.40	07.75±0.06	240.00	35.82
	2.50	13.40±0.25	39.23±1.63	38.70±2.15	06.89±0.27	205.00	30.59
	3.00	15.53±0.06	39.27±0.67	50.06±1.99	07.36±0.21	250.00	37.31
	3.50	11.80±0.06	38.83±1.68	51.03±2.40	07.54±0.41	239.00	35.67

Table V. Effect of foliar treatment of different concentration of zinc chloride solution on the oil content of *Mentha piperita,* in winter season

	Con. of Zn (ppm)	Moisture content (%)	Essential oil content (%)	Acid value	Density (g/cc) (at 32°c)	Refractive index (at 32°c)
	control	84.39	0.28	04.54	0.91196	1.4532
Winter	1.00	84.93	0.24	04.50	0.91203	1.4536
season	1.50	85.00	0.23	04.48	0.91167	1.4532
	2.00	84.90	0.22	04.52	0.91198	1.4534
	2.50	83.90	0.22	04.48	0.91197	1.4530
	3.00	84.30	0.23	04.49	0.91189	1.4534
	3.50	84.40	0.24	04.58	0.91187	1.4535

Table VI. Effect of foliar treatment of different concentration of zinc chloride solution on the oil content of *Mentha piperita,* in summer season

	Con. of Zn (ppm)	Moisture content (%)	Essential oil content (%)	Acid value	Density (g/cc) (at 32°c)	Refractive index (at 32°c)
	control	79.44	0.39	04.52	0.91299	1.4544
Smmer	1.00	79.54	0.40	04.55	0.91302	1.4541
season	1.50	79.30	0.39	04.56	0.91305	1.4539
	2.00	78.30	0.44	04.54	0.91297	1.4544
	2.50	77.50	0.40	04.52	0.91303	1.4545
	3.00	78.30	0.50	04.54	0.91297	1.4543
	3.50	78.30	0.48	04.54	0.91296	1.4540

Table VII. Effect of foliar treatment of different concentration of zinc chloride solution on the oil content of *Mentha piperita,* in monson season.

	Con. of Zn (ppm)	Moisture content (%)	Essential oil content (%)	Acid value	Density (g/cc) (at 32°c)	Refractive index (at 32°c)
	control	79.70	0.45	04.52	0.91298	1.4530
Monson	1.00	79.90	0.47	04.52	0.91120	1.4523
season	1.50	79.40	0.47	04.53	0.91305	1.4544
	2.00	79.80	0.42	04.54	0.91122	1.4520
	2.50	78.40	0.50	04.56	0.91203	1.4523
	3.00	78.50	0.45	04.52	0.91304	1.4522
	3.50	78.80	0.47	04.51	0.91305	1.4523

ride solution Table III) and minimum in winter with 1.5ppm solution (Table II). In winter all treated plants showed less percentage of essential oil than the control group (Table VI). But in summer highest percentage of essential oil (0.50) was found with 3ppm zinc chloride solution when the control was 0.39(Table VI). The highest percentage (.50) of essential oil was found in monsoon with 2.5ppm zinc chloride here the control was

0.45. The percentage of moisture content in winter it was ranged 84.93-85.00, in summer it was 77.3-79.54 and in monsoon it was 78.4-79.9 (at 32^{O}). 3ppm zinc chloride solution as a foliar treatment gave the maximum essential oil 0.50% (Table VI) over the control. And the maximum leaves (37.3) ton weight per hector was found over the control also with 3ppm zinc chloride solution (Table IV) at monsoon season.

Conclusion

In this study it was found that the 3ppm zinc chloride solution for foliar treatment on *Mentha peperita* plant most effective for vegetative growth and as well as quantitative yield of its essential oil. To establish the present findings, further researches are needs in this direction with other varieties of *Mentha sp.*

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