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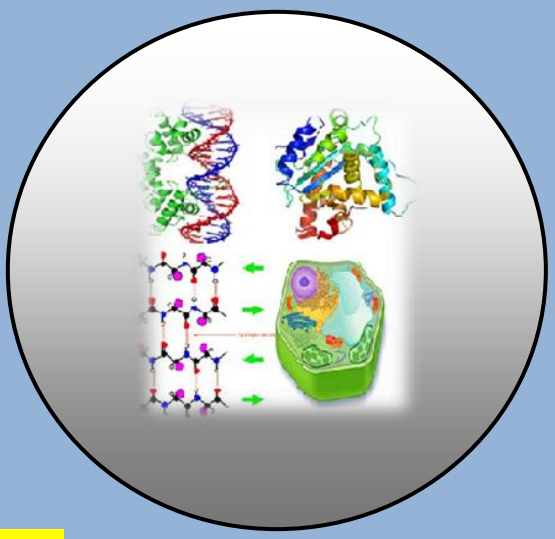

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RESEARCH PAPER

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Effect of Different Salinity Levels on Growth Characteristics, Herb Yield and Essential Oil Content in Peppermint (*Mentha piperita* L.)

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ABSTRACT

A pot experiment in sand culture was conducted in a simple randomised design during late 'rabi' season of 2014 according to standard agricultural practices in sandy loam soil at G.F. College Botanical Garden, Shahjahanpur, U.P. to study the effect of different salinity levels (0, 4, 8, 12 dSm^{-1}) on peppermint (Mentha piperita L.) variety 'Kosi' on growth characteristics (Shoot length, Shoot fresh and dry weight, leaf area, Root: Shoot ratio and Leaf: Stem ratio) at 50, 90 and at harvest as well as herb yield and essential oil content at harvest only. The crop was sown on 15 January 2014 and harvested on 10 May 2014. A uniform dose of 100kg N, 60kgP and K was applied uniformly at the time of stolon planting.It was observed that increased salinity levels decreased shoot length, leaf area total dry matter due to inhibitory effects of higher salinity levels as a results of decreased water potential. Salinity level 4dSm^{-1} proved best and significantly recorded higher values for most of the growth characteristics as compared to control (0 dSm^{-1}). Similarly herb yield and essential oil content coping up with the salinity environment (4 dSm^{-1}) in peppermint crop (Mentha piperita L.). Higher salinity levels more than 4 dSm^{-1} proved deleterious for all parameters.

Key words: Salinity Levels, Growth Characteristics, Herb Yield, Essential Oil Content, and Peppermint (Mentha piperita L.).

INTRODUCTION

After independence during the last 50 years, the essential oils and other natural products industry has made excellent progress. India has been successful in making of exports of a large number of natural products like essential oils extracts and absolute of jasmine and tuberose, spice oils and oleoresins and natural colors. The annual world production of mint oils is nearly 30,000 tones. Farooqui and Sharma (1988): Farooqui et al. (1999).

Peppermint (*Mentha piperita* L.) is a hardy aromatic herb. This species is a cross between *M. spicata* and *M. aquatica*. This plant has strong odour and a more aromatic taste. It is rich in essential oil. This species originated in Europe. It is commercially cultivated in America, France, South Africa, Yugoslovakia, Hungary, England, Thailand, Vietnam and Bulgaria. In India, it is commercially cultivated annually in tarai regions (Vaze et al. 1999 and Bhattacharjee, 2000) with Uttar Pradesh and Punjab as leading states. The herb yield, essential oil 0.5-1.5%, containing 56% menthol and 4% esters (Bhatia 1983; Breslow 1965; Chopra et al., 1956; Kapoor 1990; Kirtikar and Basu, 1984; Reberto 1984 and Verghese 1982). The peppermint stimulant properties. There are several pharmaceutical preparations of mint. It is used in lotions and fomentations, externally as a resolvent for bruises and scabies. The plant distilled in water or syrup made from it is recommended for treatment of vomiting in children and for gout. The essence is also applied for toothache and swollen gum.

It is administrated in serious nervous disorders in headaches, collics nervous vomiting and tympanitis, hiccups, flatulence and periodic discharges with nervous symptoms. As a flavouring agent peppermint is used in wide range of pharmaceuticals, confectionary, alcoholic drinks, dental creams and mouth washes (Bhattacharjee, 2000; Chopra et al., 1956; Kapoor 1990; Rastogi and Mehrotra, 1993a, 1993b and 1995). In the present study peppermint (*Mentha piperita* L.) variety 'kosi' was tested under different salinity levels for growth characteristics, herb yield and essential oil content under local conditions.

MATERIAL AND METHODS

A pot experiment with sand culture was conducted in simple randomised design during late 'rabi' season of 2014 under different salinity levels (EC, 0, 4, 8 and 12 dSm^{-1}) at G.F. College Botanical Garden, Shahjahanpur, U.P. and observed growth characteristics (Shoot length, Shoot fresh and dry weight, leaf area, Root: Shoot ratio and Leaf: Stem ratio) at 50, 90 and at harvest as well as herb yield and essential oil content at harvest only with "kosi" variety of *Mentha piperita* L. maintained in 10 inch clay pot replicated thrice. Planting was done on 15 January 2014 with irrigations provided with rain water fortnightly. However, the doses of NaCl and Na_2SO_4 salinity levels were re-added. After completion of 50 days, only one plant was maintained in each pot to study various parameters. Weeding was done when required. A uniform dose each of 100kg N, 60 kg P and K was given uniformly to each pot before planting. The crop harvested on 15 May 2014.

The two salts viz. NaCl and Na_2SO_4 were used to prepare different salinity levels. These salts were dissolved separately in 1000ml of rain water as per their electric conductance (E.C.)- 0, 4, 8 and 12 d Sm^{-1} salts given in combination for the present study. The controls were supplied with rain water only.

At harvest herb yield was calculated by taking average weight of three plants in gm/plant.

Harvested foliage was allowed to partial drying by spreading them for 2 days to avoid staling. 100gm foliage from each sample was allowed hydrodistillation for four hours to extract essential oil content by Clevenger's apparatus and expressed in percentage Clevenger (1928).

Table showing different salinity levels of NaCl and Na_2SO_4 (Richard 1954).

Salinity level	Quantity of salt (g) per liter of solution	
dSm^{-1}	NaCl	Na_2SO_4
0	0.000	0.000
4	0.994	0.639
8	0.047	1.313
12	3.159	1.987

RESULTS AND DISCUSSION

Mint suckers have very poor tolerance to salt (Gupta, 1965). Most mesophytos when exposed (Na^+) and chloride (Cl^-) ions in the plants environment may cause their specific toxic effects also on the plants by growth inhibition in the first instance.

Table 1. Effect of different salinity levels on growth characteristics in *Mentha piperita* L. (Mean of three replicates).

Parameters	Salinity levels (dSm^{-1}) at 50 days					Salinity levels (dSm^{-1}) at90 days					Salinity levels (dSm^{-1})at harvest				
	0	4	8	12	Mean	0	4	8	12	Mean	0	4	8	12	Mean C.D. at 5%
Shoot length(cm)	13.5	14.5	14.0	10.0	13.0	50.3	48.5	48.0	29.5	44.09	60.0	53.0	51.0	32.0	49.0 1.1
Shoot Fresh wt.(g)	18.0	19.0	12.5	2.0	12.8	55.0	110.0	42.5	9.5	54.2	60.0	121.0	45.0	10.0	59.0 1.6
Shoot Dry wt.(g)	5.5	7.7	5.7	2.7	5.4	8. 0	15.6	9.5	4.5	9.4	9.0	20.0	10.0	5.0	11.0 0.6
Leaf Area/plant (cm^2)	1250.0	1390.0	980.0	900.0	1130.0	4550.0	5660.0	2100.0	2000.0	3577.5	6050. 0	7120.0	3150.0	900.0	4305.0 115.2
Root: Shoot ratio	1.2	1.3	1.1	0.1	0.9	1.0	1.1	1.0	0.2	0.8	1.1	1.2	0.9	0.1	0.8 0.01
Leaf: Stem ratio	1.1	1.3	1.1	0.8	1.0	1.3	1.4	0.8	0.7	1.0	1.0	1.2	0.7	0.6	0.8 N.S.

N.S. = Non Significant

Table 2. Effect of different salinity levels on Herb yield (g/plant) and essential oil content in *Mentha piperita* L. at harvest (Mean of three replicates).

Parameter	Salinity levels (dSm^{-1})				
	0	4	8	12	Mean & C.D. at5%
Herb yield (g/plant)	60.0	121.0	45.0	10.0	59.0 7.9
Essential oil content (%)	0.32	0.38	0.36	0.32	0.35 0.04

Increased salinity levels decreased shoot length (Table-1). Salinity affects growth in three ways (a) Omotic inhibition: of water availability (b) toxic effect of the ions and (c) nutritional imbalance caused by such ions under saline. Habitat, excessive amount of metabolic energy is used for the uptake of ions. It result in decreased availability of energy for other growth and developmental processes and consequently cause reduction in plant height, leaf area, total dry matter production and herb yield as observed (Table-1 and 2) corroborate (Srivastava et al. 1990; Narayana, 1981 and Gupta et al. 1987). Hence the inhibitory effects of higher salinity levels showing deleterious effect of salt stress could either be due to toxic actions of specific ions of the salt and disturbed Osmotic labyrinth. A $4dSm^{-1}$ salinity levels proved best and recorded higher values for most of the growth characteristics (Table- 1) such as shoot fresh weight, shoot dry weight, leaf area/plant, root: shoot ratio, leaf: stem ratio, carotenoid content probably just to cope up with the salinity in the environment showing a fighting spirit of *Mentha piperita* L. Almost similar results have been obtained by Prasad et al. (1996) in *Mentha piperita* L. as Yeo and Flowers (1984) reported that yet no single factor or group of factors has been identified to promote salt tolerance. Maximum mean value for oil content was noted under $4dSm^{-1}$ salinity level corroborating Prasad et al. (1996). The value decilned critically afterwards with increased salinity level in *Mentha piperita* L due to intense salt stress conditions.

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