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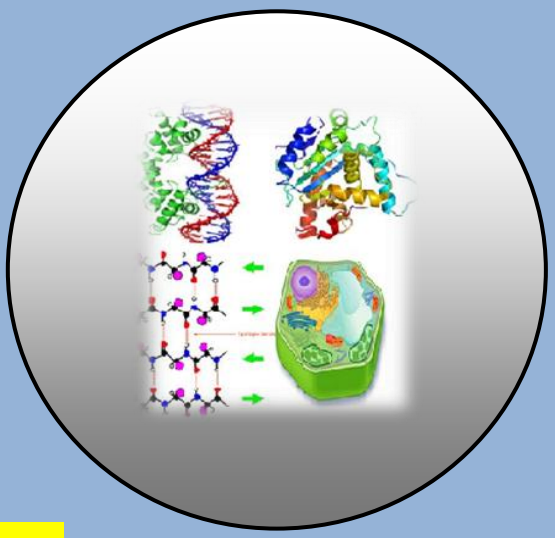

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Effect of Soil-Applied Nitrogen and Rice Bran on Photosynthetic Pigments, Herb Yield and Essential Oil Content in Peppermint (*Mentha piperita* L.)

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ABSTRACT

A field experiment was conducted in a factorial randomized design during late 'rabi' season of 2013 according to standard agricultural practices in sandy loam soil at G.F. College Botanical Garden, Shahjahanpur, U.P. to study the effect of soil-applied nitrogen (0, 50, 100, and 150kg N/ha) with different doses of rice bran (0, 20, 40 and 80 kg/ha) alone and in combination, applied at the time of planting on peppermint (Mentha piperita L.) variety 'Kosi' on photosynthetic pigments at 50, 90 and at harvest as well as herb yield and essential oil content at harvest only. The crop was shown on 5 January 2013 and harvested on 10 May 2013. A uniform dose of 60kgP and K was applied uniformly at the time of stolon planting. It was observed that 50kg N in combination with 20 kg rice bran/ha seems to be appropriate for the selected parameters. Higher doses of nitrogen in combination with higher doses of soil applied rice bran proved inhibitory. Treatment 100kg N in combination with 20kg rice bran/ha proved significantly best for herb yield and essential oil content in peppermint crop, under local conditions.

Key words: Nitrogen, Rice Bran, Photosynthetic Pigments, Herb Yield, Essential Oil Content, and Peppermint (Mentha piperita L.).

INTRODUCTION

Mentha piperita L. (Peppermint) comes in the second largest group of essential oils. It is mainly produced in India and China. India has emerged as one of the largest producer of mint oils during the last 8 to 10 years. However, the Indian production is only 50% of the world demand. There is a very good scope to increase this production to have a better share in the world market. Development of proper strains of *M. piperita* and *M. spicata* which can be grown successfully under Indian climatic conditions especially in Uttar Pradesh requires proper attention. The herbage and essential oil yield per acre will be an important factor

including the composition of the oil, as per accepted international standards. The herb synthesize and concentrate oil in its leaves in highly specialized epidermal secretory structures known as glandular trichomes Mc Caskill et al. (1992). The oil from aerial plant parts (mainly foliage) is isolated commercially through hydrodistillation, exploiting volatility of the constituent terpenoides Guenther (1955). Peppermint (*Mentha piperita* L.) is a hardy aromatic herb. This species is a cross between *M. spicta* and *M. aquatica*. This plant has strong odour and a more aromatic taste. It is rich in essential oil. This species origanated in Europe. It is comercially 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%; Kapoor 1990; Kirtikar and Basu, 1984; Reberto 1984 and verghese 1982). The peppermint oil has fine adour and posses carminative, antiseptic, preservative and gastrostimulant properties. There are several pharmaceuical preparations of mint. It is used in lotions and fomentation, 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. With new peppermint lines being available for research, the present author decided to test from the point of view the effect of different levels of soil-applied nitrogen alone as well as in combination with different doses of soil-applied rice bran an important vitamin B6, pyridoxine natural source (Kumar et al. 2012) on this important medicinal crop plant under local conditions.

MATERIAL AND METHODS

Shahjahanpur is located at latitude 27.53^{o}N, longitude 79.54^{o}E and and altitude 154.53 meter. It has a semi-arid and sub-tropical climate with hot dry summers and cold winters. The average annual precipitation in years 2012 and 2013 was 102.325 meter and 80.46 meter respectively. Most of this annual precipitation was received during the three months of July, August and September. The temperature touched 37.5^{o}C and 39.6^{o}C during the crop growth period, whereas occasionally it fell to as low as 7.86^{o}C and 6.5^{o}C respectively in the two years. This experiment was performed during late “rabi” season of 2013. The experiment was designed to study the effect of different levels of soil applied nitrogen (0, 50, 100, and 150kg N/ha) with different doses of rice bran (0, 20, 40, and 80 kg rice bran/ha) alone and in combination applied at the time of planting on peppermint (*Mentha piperita* L.), variety “kosi”, on chlorophyll and carotenoid content, herb yield and essential oil content. In a factorial randomized block design, 16 treatments each replicated thrice were given in each bed of 2m^{2}. The sowing was done on 5 January 2013. A uniform dose of 60kgP as well as K /ha in the form of calciam superphosphae and muriate of potash respectively were used. The crop was irrigated fortnightly and weeding was done when required. The harvesting was done on 10 May 2013. At harvest herb yield was calculated by taking entire foliage weight from each bed and expressed in ton/ha. The leaves for photosynthetic pigments (chlorophyll and carotenoids) analysis were collected at 50, 90 and at harvest (Arnon, 1949). Harvested foliage was allowed to partial drying by spreading them for 2 days to avoid staling. 500gm of partially dried foliage was taken from each allowed hydrodistillation for four hours to extract oil content by Clevenger’s apparatus and expressed in percentage Clevenger (1928).

RESULTS AND DISCUSSTION

The selection or creation of new varieties of plants to suit special conditions or for special purposes is primarily a genetic problem. However, it is necessary before undertaking genetic surgery to know precisely what is required. Productivity of plant could be thought of initially as a combination of its capacity for growth, favorable biochemical reactions leading to final yield potential. It seems probable that many more widely useful commercial properties of plants could be improved by selection of the appropriate cultural practice to affect the physiology of the plant in the required way. Profitable investigations, as in mint might be conducted in such qualities as growth, herb yield and essential oils used for flavoring. There is a sound physiological basis for most successful agricultural practices. Many such practices were developed empirically, but the growth of plant physiology has made possible the discovery of the scientific basis of many successful "arts" so that their usefulness has been greatly extended (Kishor 2006).

Table 1. Effect of different doses of soil applied Nitrogen and Rice bran on Chlorophyll content (mg/g) in *Mentha piperita* L. (Mean of three replicates).

Nitrogen	Soil Applied Rice bran (Kg/ha) at 50 days					Soil Applied Rice bran (Kg/ha) at90 days					Soil Applied Rice bran (Kg/ha) at harvest				
Kg N/ha	0	20	40	80	Mean	0	20	40	80	Mean	0	20	40.00	80.00	Mean
0	0.51	0.58	0.60	0.70	0.60	0.53	2.70	2.90	3.00	2.28	2.08	2.15	2.50	2.00	2.18
50	0.65	0.68	0.75	0.85	0.73	2.59	3.00	3.10	3.50	3.05	2.10	2.35	2.55	2.20	2.30
100	0.66	0.69	0.74	0.80	0.72	2.70	3.10	3.20	3.00	3.00	2.30	2.40	2.70	2.80	2.55
150	0.65	0.70	0.75	0.80	0.73	2.85	3.50	3.15	3.25	3.19	2.20	2.10	2.00	2.10	2.10
Mean	0.62	0.66	0.71	0.79		2.17	3.08	3.09	3.19		2.17	2.25	2.44	2.28	
				C.D. at 5%				C.D. at 5%					C.D. at 5%		
Soil applied rice bran =				0.02				0.16					0.06		
Nitrogen =				0.02				0.16					0.06		
Rice bran X Nitrogen =				N.S.				0.32					0.12		
*	Significant														
N.S.	Non=significant														

Table 2. Effect of different doses of soil applied Nitrogen and Rice bran on Carotenoid content (mg/g) in *Mentha piperita* L. (Mean of three replicates)

Nitrogen	Soil Applied Rice bran (Kg/ha) at 50 days					Soil Applied Rice bran (Kg/ha) at 90 days					Soil Applied Rice bran (Kg/ha) at harvest				
Kg N/ha	0	20	40	80	Mean	0	20	40	80	Mean	0	20	40	80	Mean
0	0.14	0.17	0.20	0.25	0.19	0.53	0.60	0.65	0.68	0.62	0.48	0.53	0.58	0.60	0.55
50	0.20	0.30	0.35	0.30	0.29	0.54	0.56	0.58	0.66	0.59	0.65	0.70	0.75	0.70	0.70
100	0.21	0.28	0.36	0.28	0.28	0.55	0.58	0.40	0.50	0.51	0.60	0.58	0.50	0.50	0.55
150	0.20	0.30	0.28	0.25	0.26	0.50	0.48	0.40	0.35	0.43	0.50	0.48	0.40	0.35	0.43
Mean	0.19	0.26	0.30	0.27		0.53	0.56	0.51	0.55		0.56	0.57	0.56	0.54	
	C.D. at 5%					C.D. at 5%					C.D. at 5%				
	Soil applied rice bran =		0.01			N.S.					N.S.				
	Nitrogen =		0.01			0.02					0.02				
	Rice bran X Nitrogen =		0.03			0.05					0.05				
	*	Significant													
	N.S.	Non=significant													

Table 3. Effect of different doses of soil applied Nitrogen and Rice bran on Herb yield (ton/ha) in *Mentha piperita* L. at harvest

(Mean of three replicates)					
.....	.....	.....	.....	.....	.....
Nitrogen	Soil Applied Rice bran kg/ha)				
kg/ha	0	20	40	80	Mean
.....	.....	.....	.....	.....	.....
0	12.50	17.00	12.00	9.00	12.63
50	14.00	14.95	9.00	6.00	10.99
100	15.50	17.50	11.00	2.30	11.58
150	15.00	16.00	8.00	2.00	10.25
Mean	14.25	16.36	10.00	4.38	
					C.D. at 5%
Soil applied rice bran = 1.08			*		
Nitrogen = 1.08			*		
Rice bran X Nitrogen = 2.17	*				
*	Significant				

Table 4. Effect of different doses of soil applied Nitrogen and Rice bran on Essential oil content (%) in *Mentha piperita* L. at harvest.

(Mean of three replicates)			.....	.....	.....
Nitrogen	Soil Applied Rice bran (Kg/ha)				
kg/ha	0	20	40	80	Mean
.....					
0	0.39	0.45	0.31	0.27	0.36
50	0.39	0.48	0.37	0.31	0.39
100	0.46	0.62	0.28	0.30	0.42
150	0.30	0.40	0.25	0.20	0.29
Mean	0.39	0.49	0.30	0.27	
			C.D. at 5%		
Soil applied rice bran = 0.02			*		
Nitrogen = 0.02			*		
Rice bran X Nitrogen = 0.05			*		
*	Significant				

Among the various interactions 100kg N in combination with 20kg rice bran/ha proved best and most suitable for herb yield and essential oil content in *Mentha piperita* L. (Table 3 and 4) due to favourable combined effects of nitrogen and rice bran as well as relatively significantly higher leaf chlorophyll and carotenoids contents till maturity (Table 1 and 2).

It was very interesting to note (Table 3) that 20kg/ha rice bran alone was significantly equally effective as the best combination resulting in almost absolute nitrogen fertilizer saving in peppermint. This might be due to rice bran, a natural vitamin B6 source probable role in controlling fertilizer leaching, soil water retention and increased fresh absorbing surface Kishor and Abbas, 2003 and Kishor et al. 2006 as well as its role in decreasing redox potential (Eh) of soil, Swarup (2004). Moreover, these results are not surprising because nitrogen is of extreme importance in plants because it is a constituent of proteins, nucleic acids and many other important substances. It does not; however, appear to have any specific catalytic or electrochemical roles apart from the fact that it is structurally involved in most catalytic molecules.

Kodandaramaiah and Gopal Rao (1985) suggested that B-vitamins participate in plant growth and development indirectly by enhancing the endogenous levels of various growth factors such as cytokinins and change, if any, in the concentration of various endogenous growth regulators in response to the application of the B-vitamins. The task could be simplified by using labeled vitamins to probe their involvement in various processes.

Higher doses of rice bran beyond 20kg/ha were deleterious for herb and oil content (Tables 3 and 4) which might be due to toxicities caused by higher concentrations of rice bran in the soil causing damage to the root system. Similarly, higher doses of nitrogen (150kg/ha) has shown decreased herb and oil content (Table 3 and 4) in peppermint, the results corroborate with findings of other workers Duhan et al. (1977) and Yadav, (1984) who have observed this aggravated situation in medicinal and aromatic plants because of decrease in the active constituents of these crops with heavy N-application.

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