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SOIL FERTILITY STATUS IN DIFFERENT BLOCKS OF RAMPUR DISTRICT OF UTTAR PRADESH RICE–WHEAT+MENTHA (*Mentha arvensis* L.) FARMING SYSTEM

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ABSTRACT
The present study was undertaken during 2016-17 to assess the soil fertility status under Rice–Wheat +Mentha (*Mentha arvensis* L.) farming system in different blocks of Rampur district of Uttar Pradesh. Six blocks namely Milak, Chamrauva, Bilaspur, Shahabad, Saidnagar and Swar were selected. The soil sample was taken from 0-15cm depth with the help of augur and physical & chemical properties of the soil were analyzed. It was observe that over all of district 93.41% samples were normal (6.5-8.5), 2.04% samples were alkaline (pH more than 8.5) and 4.55 % samples were acidic (pH less than 6.5). Organic carbon content in the soil of the district 35.18 % samples were less than 0.5, 51.01 % samples were ranged in 0.5 % to 0.75 % and 13.79 % samples were more than 0.75 %. The nitrogen content in soil of district indicated that soils were low in nitrogen. 82.53 % samples were less than 280 kg /ha, 17.47 % samples were ranged in 280 to 560 kg/ ha and no samples were found more than 560 kg/h. In case of available phosphorus 6.20 % samples were less than 10 kg /ha, 74.43 % samples were ranged in 10 to 24.6 kg/ ha and 19.37 % samples were more than 24.6 kg/ ha. While in potassium content 97.72 % samples were ranged in 108 to 280 kg/ ha, only 1.77 % samples were found more than 280 kg/ha and 0.51% samples were found less than 108 kg/ha.

KEY WORDS: Soil fertility, Nitrogen, Phosphorus, Organic matter.

INTRODUCTION

Estimation of soil fertility generally consists of physic-chemical properties and their interaction with one another variation in nutrients supplying capacity is a natural phenomenon and somewhere it may be sufficient while somewhere deficient with soil variability. Therefore different management practices required at different locations of the soil to sustained crop productivity so, the nutrient status of soil is very important (Kumar *et al*., 2017). Agricultural production systems have been developed to meet the food and feed needs of the growing human population at the cost of natural ecosystem. Sustainable agriculture is a way of farming that integrates three primary objectives *viz*. environmental health, economic profitability, and social and economic equity. It is hoped that, over time, sustainable agriculture will i) meet human needs for food ii) protect the natural resource base and prevent the degradation of soil and water quality, iii) use nonrenewable resources efficiently, iv) use natural biological cycles and controls, and v) assure the economic survival of farming and the well-being of farmers and their families (Kumar *et al*., 2017) observed that soil differ generally in there morphological, physical, mineralogical and biological characteristics. Rice based crop sequences are being practiced extensively all over India and wheat is being followed by a large number of farmers in Rampur district of Uttar Pradesh as it helps in better irrigation and weed management which leads to an increase in wheat yield over traditionally sown wheat crop. Therefore, intercropping in wheat raised on beds offers a good scope for increasing the productivity per unit area and income of the farmers. In bed planting system, wheat seed is sown on raised beds at 15cm distance (three rows on 70cm beds). Mentha is coming up as a promising crop under the irrigated conditions in district Rampur. Menthol mint (*Mentha arvensis* L.) is menthol rich essential oil which is widely used in pharmaceuticals, cosmetics, flavour and confectionary industries (Rathi *et al*., 2014). In recent years, India has become a major producer of *Mentha arvensis* L. oil and menthol in the world and now its share is around 85 %. Kosi is an early short duration (90-100 d) variety of menthol mint and produces higher oil content (0.8-1.0%) containing menthol (81-83%). However, recently released variety SimSaryu1 is of 100-110 d duration and contains oil (0.8-0.9%). Mentha seems to have a good potential to become a substitute for summer paddy as it is an economically profitable crop. However, there is need to develop proper management practices to ensure good production of oil. Selection of variety is important factor influencing productivity of mentha grown in between the raised beds of wheat. Therefore, the present investigation was carried out to assess the performance of two mentha varieties grown as intercrop with wheat crop sown on raised bed in Rampur district of Uttar Pradesh. It has been observed during the past years that yield of rice and wheat has reached a plateau in these regions due to declining factor productivity. The loss in organic matter has been assigned as the prime reason for this decline in the productivity. Soil organic matter influences almost all the component of soil linked with crop production. Macro

nutrient (N, P, & K) and micronutrients (Cu, Fe, and Mn & Zn) are important soil elements that control its fertility. Soil fertility is one of the factor controlling yields of the crops. Soil characterization in relation to fertility evaluation of the soil of an area of region is an important aspect for sustainable crop production. Because of imbalance and inadequate fertilizer use efficiency of chemical fertilizer has decline tremendously under intensive cropping system in recent year (Chandra *et al*., 2008). Use of high yielding varieties, intensive cropping, increase use of high analysis fertilizers and restricted use of organic sources of Nutrients has resulted in the deficiency of macro and micro nutrients in general particularly in the irrigated lands. Nutrient removed by crop depends on cultivar, soil moisture status, management levels and residue management. Macro and micro nutrients are important soil elements that control its fertility. Soil fertility is one of the important factors controlling yields of the crops. Soil characterization in relation to evaluation of fertility status of soil of an area or region is an important aspect in context of sustainable agriculture production. Because of imbalanced and inadequate fertilizer use coupled with low efficiency of other inputs, the response efficiency of chemical fertilizer nutrients has declined tremendously under intensive agriculture in recent year. Recent diagnostic survey indicate that in many intensively cultivated area farmers have resorted to use greater than recommended doses of fertilizer, especially N Fertilizer, to maintained the crop productivity at levels attained previously with relatively small fertilization rates. This is an indication of decline in factor productivity. Low fertility of India soil is the major constant in achieving high productivity goals. In both agriculturally advanced irrigated ecosystems, nutrient replenishment through fertilizers and manures remain far below crop removal, thus causing the mining of native nutrient reserves over year. Wide spread deficiencies of macro and micro nutrients have emerged, and significant crop response to application of these nutrients are reported. The deficiencies are so intense and severe that visual symptoms are very often observed in major crops (Kumar *et al*., 2013**).**

MATERIALS & METHODS

The district Rampur is located between longitude 78-0-54 & 69-0-28 east and latitude 28-25 & 29-10 north. Spread in area of 2367 Sq Km. Falls in Moradabad division of Uttar Pradesh state. It is surrounded by district Udham singh Nagar in north, Bareilly in east, Moradabad in west and Badaun in south. The height from sea level is 1902 meter in north and 166.4 meter in south. The study area covers all blocks of (Milak, Chamrauva, Bilaspur, Shahbad, Saidnagar and Swar) Rampur district of Uttar Pradesh. Soil samples of 0-15cm depth were collected from 2569 sites covering six blocks. Collected soil samples were air dried in shade, crushed gently with a wooden roller and pass through 2.0 mm sieve to obtain a uniform representative sample. Samples were properly labeled with the aluminum tag and stored in polythene bags for analysis. The processed soil samples were analyzed by standard methods for pH and electrical conductivity (1:2 soil water suspensions), organic carbon (Walkley and Black, 1934), available nitrogen (Subbiah and Asija, 1956), available phosphorus (Olsen *et al*.,1954), available potassium (Jackson, 1973). All the analysis of soil samples were carried out in the laboratory of Krishi Vigyan Kendra, Rampur, SVPUA&T, Modipuram, Meerut (U.P.) India.

RESULTS & DISCUSSION

The Soil samples collected from different six blocks *viz*- Milak, Chamrauva, Bilaspur, Shahbad, Saidnagar and Swar at surface soil. Farmers usually apply 130-150kg nitrogen per hectare along with 60-80 kg phosphorus per hectare and 50-60 kg potassium. Zinc application in farming system done by almost all the farmers and compost application was done by 45% of the farmers while green manuring practiced by 10-12% farmers and biofertilizers use was not prevalent. It was noted that 85 percent farmers reported increase use of fertilizers to harvest same quantity of yield.

TABLE 1: Soil Fertility Status under Rice – Wheat +Mentha (*Mentha arvensis* L.) Farming System in Different Blocks of Rampur District

S.No	Name of Block	Total samples analyses	Percent Samples pH < 6.5	pH 6.5-8.5	pH >8.5	Percent Samples EC <4.0 dSm^{-1}	EC >4.0 dSm^{-1}	Percent Samples OC < 0.5 %	OC 0.5-0.75 %	OC >0.75 %
1	Milak	212	2.69	93.5	3.81	100	0	37.54	50.43	12.03
2	Chamrauva	105	15.3	81.52	3.18	100	0	43.56	49.90	6.54
3	Bilaspur	111	7.05	92.95	00	100	0	19.92	39.96	40.12
4	Shahbad	102	0.00	92.08	7.92	100	0	39.99	60.01	0.00
5	Saidnagar	135	19.05	80.95	0.00	100	0	25.13	59.95	14.92
6	Swar	125	19.2	76.8	4.00	100	0	30.02	59.42	10.56
Over all		790	4.55	93.41	2.04	100	0	35.18	51.03	13.79

Soil pH

Soil pH or soil reaction is an indication of the acidity or alkalinity of soil and is measured in pH units. It was observed (Table 1) that soil pH of soil of different blocks under Rice–Wheat+Mentha (*Mentha arvensis* L.) farming system *viz.* Milak 93.50 % samples were normal (6.5-7.5), 3.81% samples were alkaline (pH more than 8.5), 2.69 % samples were acidic (pH less than 6.5), Chamrauva, 81.52 % samples were normal (6.5-8.5), 3.18 % samples were alkaline (pH more than 8.5), 15.3% samples were acidic (pH less than 6.5), Bilaspur 92.05 % samples were normal (6.5-8.5) and 7.05% samples were acidic (pH less than 6.5), Shahbad 92.08 % samples were normal (6.5-8.5) and 7.92% samples were alkaline (pH

more than 8.5), Saidnagar 90.95 % samples were normal (6.5-8.5) and 9.05 % samples were acidic (pH less than 6.5) and Swar 76.80 % samples were normal (6.5-8.5), 4.00 % samples were alkaline (pH more than 8.5), 19.20 % samples were acidic (pH less than 6.5). Over all of district 93.41% samples were normal (6.5-8.5), 2.04 % samples were alkaline (pH more than 8.5), 4.55 % samples were acidic (pH less than 6.5).

Electrical Conductivity

The electrical conductivity (EC) is the measure of the soluble salt present in the soil and is affected by cropping sequence, irrigation, land use pattern, and application of fertilizer and manures, and compost. The soil samples of all blocks under Rice – Wheat +Mentha (*Mentha arvensis* L.) farming system were falls under less than 4.0 dSm^{-1} (Table 1). On the basis of the limit suggested by Muhar *et al.* (1973) for judging salt problem of soil all the samples found normal (EC 1.0 to 2.0 dSm^{-1}).

Organic matter content

Organic carbon content of the soil in different blocks of Rampur district under Rice–Wheat + Mentha (*Mentha arvensis* L.) farming system *viz.* Milak 37.54 % samples were less than 0.5 %, 50.43 % samples were ranged in 0.5 to 0.75 % and 12.03 % samples were more than 0.75%. In the Chamrauva block , 43.56 % samples were less than 0.5, 49.90% samples were ranged in 0.5 to 0.75% and 6.54 % samples were more than 0.75 %. In the block of Bilaspur 19.92% samples were less than 0.5, 39.96 % samples were ranged in 0.5 to 0.75 % and 40.12% samples were more than 0.75%. In Shahbad block 39.99 % samples were less than 0.5, 60.01% samples were ranged in 0.5 to 0.75 % and no samples were found under more than 0.75 % in Shahbad block of Rampur. In the Saidnagar block 25.23% samples were less than 0.5, 59.95 % samples were ranged in 0.5 to 0.75 % and 14.92 % samples were more than 0.75 % and Swar block 30.02% samples were less than 0.5, 59.42 % samples were ranged in 0.5 to 0.75 % and 10.56 % samples were more than 0.75 %. Over all samples of the district 35.18 % samples were less than 0.5, 51.01 % samples were ranged in 0.5 to 0.75 % and 13.79 % samples were more than 0.75 %, on the basis of data (Table 1) it was revealed that about more than 50% samples were found 0.5 to 0.75 percent organic carbon content .High temperature and more tillage practice in the soil increases the rate of oxidation of organic matter resulting reduction of organic carbon content.

TABLE 2: Soil Fertility Status under Rice – Wheat +Mentha (*Mentha arvensis* L.) Farming System in Different Blocks of Rampur District

S. N.	Name of Block	Total samples analyses	Percent Samples			Percent Samples			Percent Samples		
			N <280 Kg/ha	N 280-560 Kg/ha	N >560 Kg/ha	P <10 Kg/ha	P 10-24.6 Kg/ha	P >24.6 Kg/ha	K <108 Kg/ha	K 108-280Kg/ha	K >280 Kg/ha
1	Milak	212	82.52	17.48	0	7.19	79.77	13.02	0	98.40	1.60
2	Chamrauva	105	86.90	13.10	0	6.52	58.69	34.78	0	93.44	6.56
3	Bilaspur	111	72.07	27.93	0	3.03	81.06	15.90	6.01	81.11	12.88
4	Shahbad	102	87.25	12.75	0	0.00	40.09	59.90	0	100	0
5	Saidnagar	135	78.51	21.49	0	5.97	55.97	38.05	0	100	0
6	Swar	125	84.80	15.20	0	3.80	71.43	24.76	0.94	98.10	0.95
Over all		790	82.53	17.47	0	6.20	74.43	19.37	0.51	97.72	1.77

Available Nitrogen Content

The available nitrogen content of different blocks of Rampur district under Rice – Wheat +Mentha (*Mentha arvensis* L.) farming system, The data (Table 2) revealed that status of nitrogen content in Milak 82.51% samples were less than 280 kg /ha, 17.48 % samples were ranged in 280 to 560 kg/ ha and no samples were found more than 560 kg/ha. In case of Chamrauva block 86.90 % samples were less than 280 kg /ha, 13.10% samples were ranged in 280 to 560 kg/ ha and no samples were found more than 560 kg/ha. In block Bilaspur 72.07% samples were less than 280 kg /ha, 27.93% samples were ranged in 280 to 560 kg/ ha and no samples were found more than 560 kg/ha. Shahabad 87.25% samples were less than 280 kg /ha, 12.75% samples were ranged in 280 to 560 kg/ ha and no samples were found more than 560 kg/ha. In Saidnagar block 78.51% samples were less than 280 kg /ha, 21.49 % samples were ranged in 280 to 560 kg/ ha and no samples were found more than 560 kg/ha and in Swar block 84.80 % samples were less than 280 kg /ha, 15.20% samples were ranged in 280 to 560 kg/ ha and no samples were found more than 560 kg/ha. Over all range of nitrogen in soil of all blocks 82.53% samples were less than 280 kg /ha, 17.47 % samples were ranged in 280 to 560 kg/ ha and no samples were found more than 560 kg/ha. On the basis of rating suggested by Subbiah and Asija (1956).

Available phosphorous content

The data presented in table (Table 2) revealed that status of available phosphorous in blocks of district under Rice – Wheat +Mentha (*Mentha arvensis* L.) arming system *i.e.* Milak 7.19% samples were less than 10 kg /ha, 79.77% samples were ranged in 10 to 24.6 kg/ ha and 13.02% samples were more than 24.6 kg/ ha, Chamrauva 6.52% samples were less than 10 kg /ha, 58.69% samples were ranged in 10 to 24.6 kg/ ha and 34.78% samples were more than 24.6 kg/ ha. In block Bilaspur 3.03 % samples were less than 10 kg /ha, 81.06 % samples were ranged in 10 to 24.6 kg/ ha and 15.9% samples were more than 24.6 kg/ ha. In block Shahabad no samples were less than 10 kg /ha, 40.09 % samples were ranged in 10 to 24.6 kg/ ha and 59.9 % samples were more than 24.6 kg/ ha. In the block of Saidnagar 5.97% samples were less than 10 kg /ha, 55.97% samples were ranged in 10 to 24.6 kg/ ha and 38.05% samples were more than 24.6 kg/ha. In the block of Swar 3.80 % samples were less than 10 kg /ha, 71.43 % samples were ranged in 10 to 24.6 kg/ ha and 24.76 % samples were more than 24.6 kg/ ha. Over all range of available phosphorus in soil of all blocks were 6.20% samples were less than 10 kg /ha, 74.43% samples were ranged in 10 to 24.6 kg/ ha and 19.37% samples were more than 24.6 kg/ h. On the basis of rating suggested by Subbiah and Asija (1956).

Available potassium content

The data presented in table (Table 2) revealed that available potassium content of different blocks of Rampur districts Rice–Wheat +Mentha (*Mentha arvensis* L.) farming system *i.e*. Milak 98.40 % samples were ranged in 108 to 280 kg/ ha, 1.60% samples were found more than 280 kg/ha and no samples were found less than 108 kg/ha. In the block of Chamrauva 93.44 % samples were ranged in 108 to 280 kg/ ha, 6.56% samples were found more than 280 kg/ha and no samples were found less than 108 kg/ha. In Bilaspur block 81.11% samples were ranged in 108 to 280 kg/ ha, 12.88% samples were found more than 280 kg/ha and 6.01% samples were found less than 108 kg/ha. In the Shahabad block 100 % samples were ranged in 108 to 280 kg/ ha, no samples were found more than 280 kg/ha and no samples were found less than 108 kg/ha. In the Saidnagar block 100% samples were ranged in 108 to 280 kg/ ha, no samples were found more than 280 kg/ha and no samples were found less than 108 kg/ha. Swar 98.10 % samples were ranged in 108 to 280 kg/ ha, 0.94% samples were found more than 280 kg/ha and 0.95 % samples were found less than 108 kg/ha. Over all range of potassium in soil of all blocks 97.72% amples were ranged in 108 to 280 kg/ ha, 1.77% samples were found more than 280 kg/ha and 0.51% samples were found less than 108 kg/ha. On the basis of rating suggested by Subbiah and Asija (1956). According to limit suggested by Mahr *et al.* (1963), all samples were medium (125 to 300 K_2O kg ha^{-1}) in potassium content. A significant positive correlation (r =0.615) was observed between organic carbon and available potassium. This might be due to creation of favorable soil environment with presence of high organic matter. Similar result was also reported by Paliwal (1996).

CONCLUSION

The study of soil samples reveals that the soil of all blocks of Rampur district in different block under rice –wheat+ mentha farming system were did not followed a particular pattern with different block which may be due to variation in management practices and yield potential. Nutrient status regarding to the available macro nutrient in surface soil indicate that soils are low in available N and medium in available P and K. Normal to slightly alkaline in reaction, low to medium in organic carbon content.

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