Effect of modern agricultural practices on chemical properties of rhizospheric and non-rhizospheric soils of Chaka block of Allahabad district, U.P.

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Abstract

The rhizosphere is an important ecological region that is utilized to study the relationships among plant communities, soil, and microbial communities. In the plant rhizosphere area, particularly in the small region near the root of the plant, there are great differences in acid-base properties, redox potential, and microbial populations than in the general soil because of root secretions. The Experiment was carried out in the in laboratory of Department of Environmental Science, SHUATS, Allahabad to study the effect of modern agricultural practices on chemical properties of rhizospheric and non-rhizospheric soils of Chaka block of Allahabad district, U.P. The soil samples were collected from 12 different sites of farmer’s field and analyzed for chemical properties i.e. pH, EC, Organic matter, total organic carbon, available N, P and K. Soil pH range from 7.10 - 8.96, EC range from 0.18 -0.31 dSm⁻¹, Organic matter 0.10-0.60 %, total organic carbon range from 2925 kg ha⁻¹-13500 kg ha⁻¹, available nitrogen 124-221 kg ha⁻¹, available phosphorus 19-22 kg ha⁻¹, available potassium 240 - 270 kg ha⁻¹, respectively for rhizospheric soil. In case of non rhizospheric soil pH range from 7.00-8.96, EC range from 0.09-0.22 dSm⁻¹, Organic matter 0.12-0.50 %, total organic carbon range from 1200-2625 kg ha⁻¹, available nitrogen 97-187 kg ha⁻¹, available phosphorus 12-15 kg ha⁻¹, available potassium 219-248.33 kg ha⁻¹, respectively. Our results showed synthetically that the quality of rhizosphere soil was better than that of the non-rhizosphere soil.

Keywords: EC, pH, rhizospheric soil, available N, available P, available K

Introduction

The green revolution (1965-1966) started the excess use of chemical fertilizers, pesticides and herbicides in to agricultural fields. They increase the productivity (kg ha⁻¹). Over utilization of all these practices are affecting the chemical properties of soil and causes fertility loss and soil erosion. Loss of organic matter, water holding capacity of soil and consequent deterioration of soil fertility are often driven by unsustainable agricultural practices, such as deep ploughing, excessive use of fertilizer and pesticides. Modern agricultural practices have changed significantly the physical, chemical and biological properties of soil in terms of the production patterns.

The processes of modernization have not been uniformly distributed among all the agricultural areas and some typologies of agriculture have remained excluded from modernization Sortino et al., (2008) [9]. Along with the many advantages there are compelling reasons why farmers may not retain them as their agriculture modernizes. For example, crop diversity in the form of mixed cropping can be incompatible with mechanization and can in general have a high management "overhead" (dealing with the problems of many crops instead of one) unless the diversity is in the form of an agricultural system already proved to function smoothly. That is because the traditional typologies of agriculture do not accept exogenous/industrial elements (i.e. mountainous agriculture where mechanization is applied with low efficiency /effectiveness) Sortino et al., (2008) [9].

Soil organic matter (SOM) is the key component of soil, consisting of plant and animal residues at various stages of decomposition, cells and tissues of soil organisms, and substances synthesized by soil organisms. Soil organic matter (SOM) is the foundation for productive soil. It promotes healthy crops, supplies resources for microbes and other soil organisms, and regulates the supply of water, air and nutrients to plant (Wang et al., 2006) [13]. Agricultural management, such as crop rotation, tillage, compost, manure, herbicide and synthetic fertilizer application, and water regime, are key determinants of microbial community structure in soil. Vegetation is also an important factor since plants are providing
Materials and Methods

Study Site

Main site is Chaka block area is situated on the right bank adjacent to Yamuna river in south of Allahabad city, which is located at 25.80 °N Latitude and 81.50 °E Longitude and 98 meter above the sea level.

Soil sampling

Chemical analysis of soil was done to ascertain the fertility of the soil and achieve the goal of experiment. The soil samples were collected from 0-15 cm and 15-30 cm depths from the different villages selected as sites of experiments randomly.

Preparation and analysis of soil samples

The samples were mixed sites viz. and its weight was reduced by air drying, conning, quartering and passing it through 2 mm sieve. To obtain composite soil sample in respective to different villages viz. the soil was stored for chemical analysis. The soil samples were analyzed for chemical property of Soil pH, EC, % OM, total O.C. available, N, P, K, in soil. The different methods employed for analysis are presented below.

Chemical Properties of soil

The chemical analysis of soil was done by different standard methods. The soil pH, EC, %O.C., Available carbon, Available Nitrogen, Available Phosphorus, Available Potassium of soil was determined by the following methods Jackson, (1958) [3] through digital pH meter MK-IV, Jackson, (1958) [3] through digital conductivity meter, Walkley and Black, (1947) [12] Method, Alkaline permanganate method Subbiah and Asija, (1956) [10], Olsen’s colorimetric method (Olsen et al., 1954) [5], Flame Photometric method Toth and Prince, (1949) [11].

Results and Discussion

Soil pH

The results revealed in fig. 2 shows that the maximum pH 8.96 of rhizospheric soil was found at Baswar village while the minimum pH 7.10 was recorded at Chaka village, which gave the significant difference in soil pH at different villages of Chaka block. The maximum soil pH 8.96 in non rhizospheric soil was found at Bharuha village while the minimum 7.0 pH was found at Maduka Kacchar which shows the significant difference between other villages of Chaka block. It may be due to due to use fertilizer and irrigation water of the field in of the soil in different villages. In samples of Rhizospheric and Non-rhizospheric soil of different sites of Chaka block were found slightly alkaline except Chaka, Dadari Taluka Naini and Mahewa Patti Purb Kacchar.

The desirable soil pH range for optimum plant growth varies among crops generally; soil pH 6.0-7.5 is acceptable for most plants as most nutrients become available in this pH range. Soil pH is important because it affects the availability of nutrients to plants. Most secondary and micronutrient deficiencies are easily corrected by keeping the soil at the optimum pH value. Similar results were corroborated by Singh et al (2018) [8].
Electrical conductivity
The results revealed in fig. 3 shows that maximum EC 0.31 dS m$^{-1}$ of rhizospheric soil was found in Dhanuha and Chaka Kripam villages while the minimum EC 0.18 dS m$^{-1}$ was recorded at Dadari Ta Naugawa village, which gave the significant difference in soil EC at different villages of Chaka block. The maximum soil EC 0.22 dS m$^{-1}$ in non rhizospheric soil was found at Dadari Ta Naugawa and Sarapatahiya villages while the minimum 0.09 dS m$^{-1}$ EC was found at Mahewa Patti Purb Kacchar which shows the significant difference between different villages of Chaka block. It may be due to presents of cation and salt in the field in of the soil in different fields of villages. Similar results were corroborated by Mukesh (2003) [4], Amin (2014) [1] and Singh et al. (2017) [7].

Organic matter and total organic carbon
The results revealed in fig. 4 shows that maximum OM 0.60% of rhizospheric soil was found at Mohabatganj Uparhar and Mahewan Patti Purb villages while the minimum OM 0.10% was recorded at Arail village, which gave the significant difference in soil % OM at different villages of Chaka block. The maximum soil OM 0.50% in non rhizospheric soil was found at Dadari Ta Naugawa and Bharuha villages while the minimum 0.12% OM was found at Mohabatganj Uparhar which shows the significant difference between other villages of Chaka block.

The results revealed in fig. 5 shows that the maximum total organic carbon 13500 kg ha$^{-1}$ of rhizospheric soil was found at Mohabatganj Uparhar and Mahewan Patti Purb Kacchar villages while the minimum total organic carbon 2925 kg ha$^{-1}$ was recorded at Arail village, which gave the significant difference in soil available carbon at different villages of Chaka block. The maximum soil total organic carbon 1200 kg ha$^{-1}$ in non rhizospheric soil was found at Bharuha village while the minimum 2625 kg ha$^{-1}$ total organic carbon was found at Chaka which shows the significant difference between other different villages of Chaka block. It may be
due to application of manure, FYM and irrigation of sewage water in of the soil in different fields of villages. Soil organic matter improve the soil structure stability. It is maintain the WHC, infiltration rate of sub soil layer. Maintain the availability of nutrients such as phosphorus in a potentially available form and prevent them from becoming unavailable. SOM provides a source of energy and food for microorganisms that are essential to biological processes in the soil. It is large reservoir of nutrients (especially nitrogen but also phosphorus and Sulphur, and the micronutrients) which are released to the plant available pool by decomposition processes essential to the recycling of nutrients. It can contribute to the biological control of disease organisms in the soil.

![Image of organic matter variation](image)

**Fig 4:** Variation in organic matter of rhizospheric and non rhizospheric soil of different villages of chaka block

![Image of total organic carbon variation](image)

**Fig 5:** Variation in total organic carbon of rhizospheric and non rhizospheric soil of different villages of chaka block

**Available nitrogen, phosphorus and potassium**

The results revealed in fig. 6, 7 and 8 shows that the maximum available nitrogen 221 kg ha\(^{-1}\) of rhizospheric soil was found in at Mohabatganj Upahar village while the minimum available nitrogen 124 kg ha\(^{-1}\) was recorded at Arail village, maximum available phosphorus 22 kg ha\(^{-1}\) of rhizospheric soils was found in at Bharuha and Mohabatganj Upahar village while the minimum available phosphorus 19 kg ha\(^{-1}\) was recorded at Chaka and Chaka Kripam villages, maximum available potassium 270 kg ha\(^{-1}\) of rhizospheric soil was found at Mohabatganj Upahar and Arail villages while the minimum available potassium 240 kg ha\(^{-1}\) was recorded at Chaka, Sarapatahiya and Mahewa Patti Purb Kacchar villages, which gave the significant difference in soil available nitrogen at different villages of Chaka block. The maximum soil available nitrogen 187 kg ha\(^{-1}\) in non-rhizospheric soil was found at Dadari Ta Naugawa village while the minimum 97 kg ha\(^{-1}\) available nitrogen was found at Chaka Kripam, maximum soil available phosphorus 15 kg ha\(^{-1}\) in non rhizospheric soil was found at Chaka, Bharuha, Arail and Mohabatganj Upahar villages while the minimum 12 kg ha\(^{-1}\) available phosphorus was found at Chaka Kripam, Dadari Taluka Naini and Baswar which shows the non significant difference between other villages of Chaka block and maximum soil available potassium 248.33 kg ha\(^{-1}\) in non rhizospheric soil was found at Arail village while the minimum 219 kg ha\(^{-1}\) available potassium was found Maduka Kacchar which shows the significant difference between other villages of Chaka block, which shows the significant difference between other different villages of Chaka block. It may be due to due to application of chemical fertilizer in the soil in different villages. Rawat et al. (1996) [6] reported that the nutrient availability, particularly P and N in the rhizosphere, affects root growth and root hair length.
Fig 6: Variation in available nitrogen of rhizospheric and non-rhizospheric soil of different villages of Chaka block

Fig 7: Variation in available phosphorus of rhizospheric and non-rhizospheric soil of different villages of Chaka block

Fig 8: Variation in available potassium of rhizospheric and non-rhizospheric soil of different villages of Chaka block

Conclusions
In view of the above experimental results it is concluded that the chemical properties pH, EC, %OM, total OC, available N, P, K. in satisfactory to grow crops of Rhizospheric and Non-rhizospheric soil of different villages of Chaka block, except few villages (Chaka, Dadari Taluka Naini, Mahewa Patti Purb Kacchar) were found slightly alkaline.

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