Original Research Article

Assessment of Soil Fertility Status of Radaur block of Yamunanagar District of Haryana for better fertilizer management

Abstract

The present investigation was carried out to assess the fertility status of the soils of Radaur Block in Yamunanagar, Haryana. The results presented are compiled using the soil test report of two hundred thirteen soil samples collected from 0-15 cm depth by the farmers of Radaur during 2021-22 and bought to Regional Soil Testing Laboratory, CCS HAU, KVK, Karnal for analysis. The observed data revealed that pH of almost 99.53% soil samples were near neutral ranging between 7.1-8.0. This pH range is very much appropriate for the availability of majority of plant nutrients. Likewise 96.71% soil samples exhibited EC in very low range making the soil very much suitable for agricultural activities. About 8.45 and 29.11% of Radaur block were found deficient in OC and available K content, respectively. OC status of the soil depicts that 83.09% soil samples were in medium range of OC content and only 8.45% samples exhibited high OC content. As far as P availability is concerned nearly 74% of the soil samples were having available P in high range clearly indicating the buildup of P in Radaur soils. Although none of the sample was found deficient in available P content. Contrary to K status of Yamunanagar soils in 2010-11, in 2021-22 exactly 10 years later the scenario has completely changed and a continuous decline in available K status is exhibited. This decline may be due to low rate of K application through fertilizer and manures with K removal by crops exceeding the replenishment. The results revealed that only 9.39% soil samples were in high range and 61.50% in medium range of K availability.

Key Words: Soil fertility assessment; Radaur; RSTL, CCS HAU, Karnal; nutrient availability

1. Introduction

India is one of the major players in the agriculture sector worldwide and it is the primary source of livelihood for about 65 % of India's population. Agriculture is the backbone of Indian economy and soil is the most important basic resource for agricultural production which provides water, nutrients and anchorage to crop plants. Haryana is the country's food bowl and makes significant contributions to the nation's food security. Among twenty two districts of Haryana Yamunanagar is a gem for the state of Haryana as far as industries and revenue is concerned. This city generates the second highest revenue for the state and this could be possible only due to its fertile land.

Lack of understanding about soil health among farmers is leading to indiscriminate or imbalanced use of chemical fertilizers. Among different diagnostic techniques for fertility evaluation soil testing provides the most accurate information on the availability of various plant nutrients [1]. Soil-test based fertility management is an effective tool for increasing productivity of agricultural soils. The evaluation of soil fertility is perhaps the most basic decision making tool in order to impose appropriate nutrient management strategies [2]. Soil testing assess the current fertility status and provides information regarding nutrient availability in soils which forms the basis for the fertilizer recommendations for maximizing crop yields and to maintain the adequate fertility in soils for longer period [3][4].

In this paper an attempt has been made to assess the fertility status of the soils of Radaur block in Yamunanagar district of Haryana with respect to macronutrients. Accordingly soils of Radaur block are delineated under low, medium and high categories to provide useful information to the stakeholders regarding overall fertility status of the soil.

2. Material and Methods

2.1 General Description of the study area:

Yamuna Nagar district of Haryana is located in north-eastern part of Haryana State and lies between 29.55°- 30.31° N latitudes and 77.00°- 77.35° E longitudes. Yamunanagar district is situated on north-eastern tip of Haryana. It is bounded by Himachal Pradesh on northern side and Uttar Pradesh on eastern side. Land is plain with Siwalik hills on northern side, some high cliffs can also be found on northern side. The boundary of this district touches state of Himachal Pradesh in the north and Uttar Pradesh in the east. Ambala district of Haryana surrounds Yamunanagar from its West and Karnal and Kurukshetra districts surrounds it from its south. Total geographical area of Yamunanagar is 1756 sq. km which comprises 4% of total area of the Haryana state. Yamunanagar district is divided into seven blocks which are Jagadhri, Chhachhrauli, Radaur, Sadhaura, Bilaspur, Saraswati Nagar, Partap Nagar. The normal annual rainfall of the district is 1107 mm, which is unevenly distributed over the area in 43 days. The south west monsoon sets in from last week of June and withdraws in end of September, contributing about 81% of annual rainfall. July and August are the wettest months. Rest 19% rainfall is received during non-monsoon period in the wake of western disturbances and thunderstorms. Soil texture of Yamunanagar is predominantly silty loam and clay loam.

The soil analysis data presented in the research paper is basically of those samples collected and brought by the farmers of Radaur, Yamunanagar for analysis to the Regional Soil Testing Laboratory**,** Chaudhary Charan Singh Haryana Agricultural University, KVK, Karnal during 2021-2022.

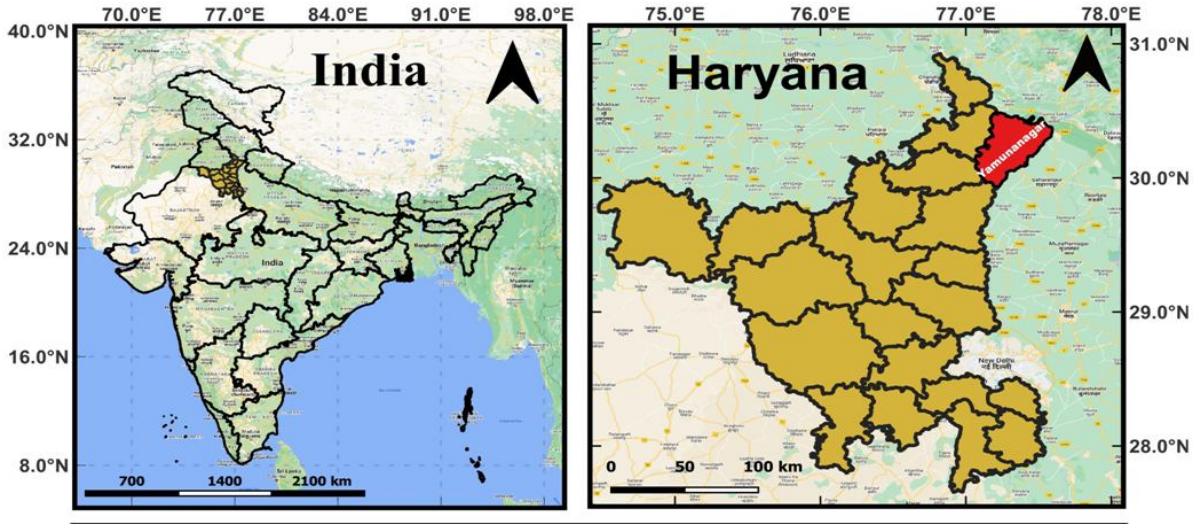


Fig. 1. Map showing study area

2.2 Samples preparation and laboratory procedures:

A total of 213 surface soil samples were brought to RSTL, KVK, Karnal from Radaur block during 2021-22. The soil samples received by the laboratory were air dried at room temperature and stored in polythene bags for further laboratory analysis. The samples were ground using a wooden mortar and pestle and sieved through 2 mm sieve. Soil pH, EC, organic carbon, available phosphorus and potassium were the parameters measured. The pH and EC of the collected soil samples were determined following the method proposed by Jackson (1973) [5]. Organic carbon content of the soil samples was determined using wet digestion method as suggested by Walkley and Black (1934) [6]. Available P was determined using the method proposed by Olsen et al. (1954) [7] using 0.5 M $NaHCO_3$ as extractant. Neutral ammonium acetate extractable K was determined using the method proposed by Jackson (1973) [5].

Table 1: Criteria for Assessment of soil based on macronutrients status

Nutrients	Rating of Soil Test Values		
	Low	**Medium**	**High**
pH	< 7.0	7-8	> 8.0
EC (dS/m)	<0.8	0.8-1.6	>1.6
Organic C (%)	< 0.4	0.4 - 0.75	> 0.75
Available P (Kg/ha)	< 10	10 - 20	>20
Available K (Kg/ha)	< 125	125 - 300	> 300

2.3 Statistical Analysis:

Descriptive statistics (mean, range, standard deviation, standard error, coefficient of variation) of soil parameters were computed using the Minitab 17 package. Nutrient ranges and mean values of the each nutrient were calculated following standard procedures as described by Gomez and Gomez (1984) [8].

3. Result and Discussion:

3.1 Soil pH:

Soil pH is important chemical parameter of soil that affects nutrient availability. Soil pH also affects activity of soil microorganisms. The population of bacteria that decompose organic matter declines and their activity is hindered in highly acidic soil, which results in accumulation of organic matter and the bound nutrients, particularly nitrogen [9]. The pH of soil collected from different locations of Radaur varied from 7.1 to 8.6 with a mean value of 7.97 (Table 2). Out of 213 soil samples 99.53% i.e. 212 samples were had neutral reaction and only one sample reported alkaline pH i.e. 8.6. All the soil samples except one was in neutral pH range which is most suitable for nutrient availability and there is no need of any type of reclamation. 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.

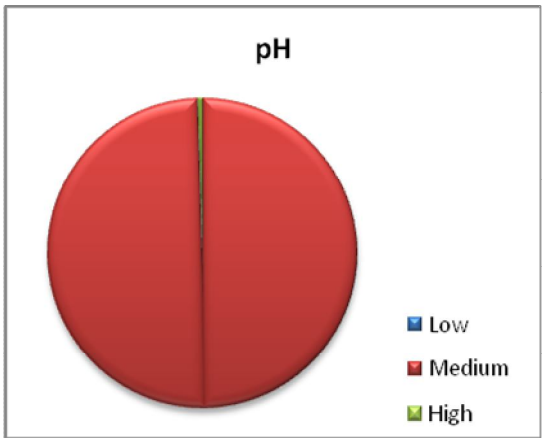
Table 2: Descriptive statistics of soil properties in the area (n = 213).

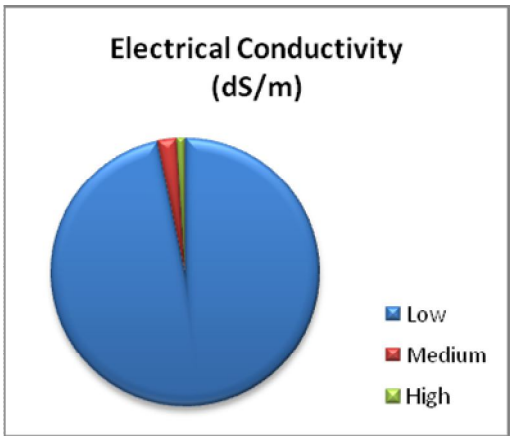
Descriptive Statistics	pH	EC	OC (%)	P (Kg/ha)	K (Kg/ha)
Minimum	7.10	0.08	0.15	11.20	38.00
Maximum	8.60	2.22	1.07	98.00	955.00
Mean	7.97	0.30	0.58	31.86	193.71
Medium	8.00	0.24	0.58	26.90	152.00
Standard Deviation	0.29	0.24	0.13	14.99	161.86
Coefficient of Variance (%)	3.62	80.21	22.36	47.04	83.56
Skewness	-0.49	4.52	0.33	1.72	3.14
Kurtosis	-0.14	28.16	1.48	4.56	10.68

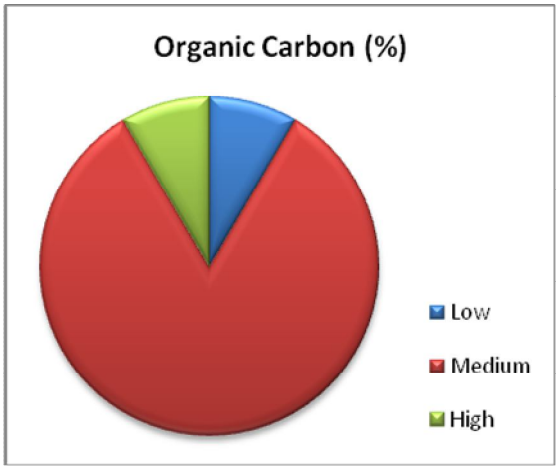
Table 3. Numbers of variables fall under different categories (n=213)

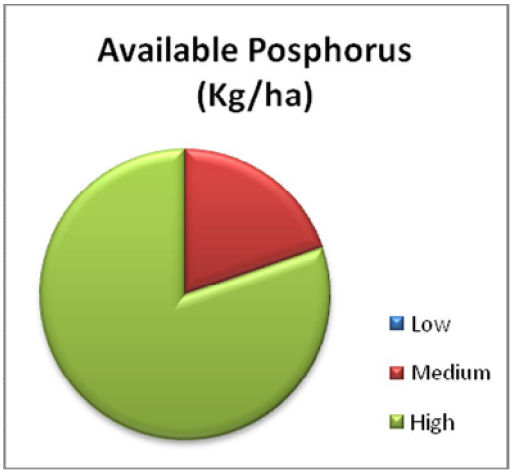
Soil variables	Low	Medium	High
pH	0	212 (99.53%)	1(0.47%)
EC (dS/m)	206 (96.71%)	5(2.35%)	2(0.94%)
OC (%)	18 (8045%)	177(83.09%)	18(8.45%)

P (Kg/ha)	0	42(19.72%)	171(74.03%)
K (Kg/ha)	62(29.11%)	131(61.50%)	20(9.39%)









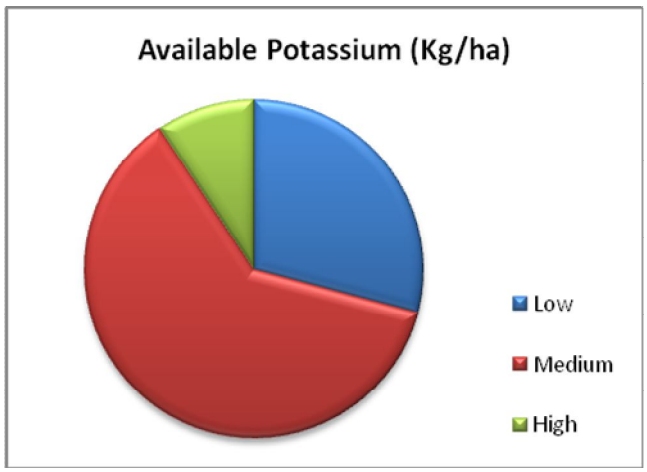


Fig. 2. Pie charts showing available nutrient content

Most secondary and micronutrient deficiencies are easily corrected by keeping the soil at the optimum pH value.

3.2 Soil EC:

Soil EC does not directly affect plant growth but has been used as an indirect indicator of the amount of nutrients available for plant uptake and salinity levels. Most microorganisms are sensitive to salt (high EC). Actinomycetes and fungi are less sensitive than bacteria, except for halophyte (salt-tolerant) bacteria. Microbial processes, including respiration and nitrification, decline as EC increases (table 2). Therefore, EC is also a very important parameter which depicts the soil health. Soil EC of Radaur block varied from 0.08 to 2.22 dS/m with mean value of 0.30 dS/m which means soils are non saline in nature (Table-4). Out of 213 soil samples 96.71% soil samples were non saline and only 0.94% sample were having EC more than 1.6 dS/m.

3.3 Organic Carbon:

Organic carbon is important source of plant essential nutrients after their decomposition by microorganisms. It supplies plant nutrients; improve the soil structure, water infiltration and retention, feeds soil micro-flora and fauna, and the retention and cycling of applied fertilizer [10]. The organic carbon content varied from 0.15 to 1.07 % with a mean value of 0.58 % (Table 2). 8.45% samples had low OC content i.e. less than 0.4% and only 8.45 % samples were having OC in high range i.e. more than 0.75%. However, majority of soil samples i.e. 83.09% were in medium range. Therefore, there is scope of increasing OC content of Radaur soils. Incorporation of OC adding materials is imperative for organic carbon improvement in soils. Low to medium OC can be attributed to continuous cultivation, removal of

crops residues without return, effects of water and wind erosion which preferentially remove the soil colloids including the humidified organic fractions [3], [11].

3.4 Available Phosphorus:

Phosphorus is the second most important crop nutrient after Nitrogen. It is an essential macronutrient that plays important role in all crop biochemical processes such as photosynthesis, respiration, energy storage, transfer, cell division, cell enlargement and nitrogen fixation. It is also important in seed germination, seedling establishment, root, shoot, flower and seed development. Despite its importance in crop nutrition, availability of the nutrient in soils for plant uptake is limited by several soil factors. The factors include: soil pH levels, clay mineralogy, organic matter, free iron and aluminium, calcium carbonate, soil temperatures and availability of other nutrients among other factors [12]. The growth of both cultivated and uncultivated plants is limited by availability of P in the soils [13]. The available P ranged from 11.20 to 98 kg/ha with a mean value of 31.86 kg/ha (Table 2). It is very much evident from data presented in Table 2 that none of the sample of Radaur block of Yamunanagar was deficient in P availability and 19.72% soil samples were found in medium range. Nearly 74% of the soil samples were having available P in high range clearly indicating the buildup of P in Radaur soils. This build up may be attributed to continuous application of phosphatic fertilizers to both the Kharif and the Rabi crops consequently leading to continuous buid up of P in the soils. Similar results have been reported by Antil et al (2016) [14].

3.5 Available Potassium:

Next to N and P, K is the third most important essential element that limits plant productivity. Potassium is associated with many metabolic processes and functions within the plant. It is known that K activates as many as 60 enzymatic and plant hormonal reactions. It is vital to photosynthesis and protein synthesis. It has a fundamental role in regulating leaf stomata openings and controlling water use, particularly under dry conditions [15]. The available K content in Radaur soils ranged from 38 to 955 kg/ha with a mean value of 193 kg/ha. Out of 213 soil samples 29.11% soil samples were deficient in available K and only 9.39% soil samples were having high range of available K. Maximum soil samples i.e. 61.50% soil samples out of 213 were falling in the medium range. It is clearly evident from the outcomes of Soil survey conducted by Department of Soil Science, CCS HAU, Hisar during 2010-11 that in 2010-11 none of the sample of Yamunanagr was deficient in K. 39.1% samples were in medium range and 60.9% samples were in high range of K availability [14][16]. Within 10 years K availability has shifted from sufficient towards deficient. These results indicate that attention must be given for balanced nutrient fertilization with K as a key component especially where intensive cultivation is practiced

4. Conclusion:

Analysis of soil samples collected across Radaur block of Yamunanagar, Haryana showed wide variability in availability of pH, EC, OC and major nutrients in the soil. pH of almost 99.53% soil was near neutral ranging between 7.0-8.0. This pH range is very much appropriate for the availability of majority of plant nutrients. Likewise 96.71% soil samples exhibited EC in very low range making the soil more suitable for agricultural activities. About 8.45 and 29.11% of Radaur block were found deficient in OC and available K content, respectively. OC status of the soil depicts that 83.09% soil samples were in medium range of OC content and only 8.45% samples exhibited high OC content. As far as P availability is concerned nearly 74% of the soil samples were having available P in high range clearly indicating the buildup of P in Radaur soils. Although none of the sample was deficient in available P content. Contrary to K status of Yamunanagar soils in 2010-11, in 2021-22 exactly 10 years later the scenario has completely changed and a continuous decline in available K status is exhibited. This decline may be due to low rate of K application through fertilizer and manures with K removal by crops exceeding the replenishment. The results revealed that only 9.39% soil samples are in high range and 61.50% in medium range of K availability.

Considering the status of soil organic carbon the practices like manure or compost incorporation, crop residue retention, green manuring etc. can be suggested for its improvement. Results are indicating the scope to cut use of phosphatic fertilizers and increase the application of phosphatic fertilizers in agricultural activities. From this study, it can be concluded that for enhancing the efficacy of the agricultural research the future research strategy should be based on the soil fertility status of the farm.

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