

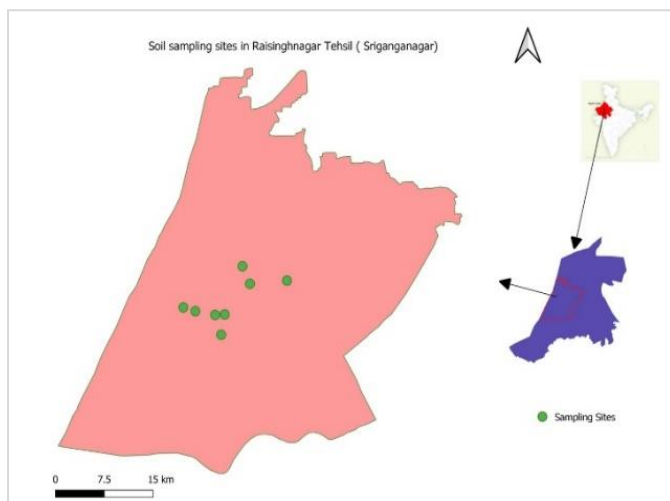


Figure 1. Sriganganagar district is lies between latitude 29.9094 N, and longitude 73.8738 E The total geographical area is 11,154.66 km² (1,115,466ha; 4,306.84 sq mi). It lies in a level plain of irrigated farmland about 12 miles (19km) south-east of Pakistan. Raisinghnagar town is surrounded by fertile and some desertic land. Its coordinates are 29.32'3.09" N 73.26'51.65" E.

Materials and Methods

The soil sample collected should be representative of the area sampled. A field can be treated as a single sampling unit if it is uniform in all respect. Variation in slope,

texture, colour, crop growth and management levels should be taken into account for soil sampling. Separate sets of composite samples need to be collected from areas differing in these characteristics. Recently fertilized plots, bunds, channels, marshy tracts, area near trees, farm ways buildings, wells, compost piles or other non-representative locations must be avoided during sampling. When crops are grown in rows, samples can be taken in between the rows. Soil samples should be taken in zigzag manner. For soft and moist soil, the soil tube auger, spade or khurpi are quite satisfactory. A screw type auger may prove more convenient on hard or dry soil while the post hole auger is useful for sampling excessively wet areas like rice fields. If a spade or khurpi is used a "V" shaped hole may be dug up to the plough layer to collect a uniformly thick slice of soil from the exposed surface. The sampling depth of the soil sample is 0-15 cm. A composite sample is obtained from surface layer by means of suitable sampling tools from at least 15 to 20 well distributed spots after scraping off the surface litter, if any. The soil Samples collected should be thoroughly mixed by hand on a clean piece of cloth paper. Reduce the bulk sample to about 500 gm by a quartering process in which the entire soil mass is spread, divided into four quarters, two opposite samples are discarded and the remaining two are mixed. Repeat this process until about 500 gm of soil is left.



Plate 1. Soil samples collection from various study sites subsequent with coning and quartering method. Samples can be drawn satisfactorily with any one of hand implements namely, soil tube auger, screw type auger, post hole auger, spade and khurpi

Methods for Soil Parameters

Determination of pH is based on the measurement of electrical potential developed by an electrode whose potential depends on the concentration of the (H⁺) ions in the solution voltage. The soluble salts in soil are determined by measuring electrical conductivity. Solution-containing salts offer some resistance to the passage of electrical current depending upon the concentration and type of salts (ions) present. Higher the salt content, lesser the resistance to flow of electric current. Electrical conductivity (EC) is the reverse of resistance. So, electrical conductivity is defined as the reciprocal of the resistance of a conductor 1 cm long and 1 cm in cross-sectional area or a salt solution's ability to carry electric current by the migration of ions under the influence of an electric field. The organic matter (humus) in the soil gets oxidized by chromic acid (potassium dichromate), and the heat of dilution of sulphuric acid facilitates the reaction. The organic carbon in soil is thus oxidized to CO₂. The P content in soil is estimated by spectrophotometer.

Spectrophotometric analysis is based on the measurement of the intensity of radiant energy after it passes through a sample solution. The soil is extracted with 0.5M NaHCO₃ pH 8.5 in the presence of Activated charcoal /Darco G-60 (which adsorbs dispersed organic matter and helps in giving clear extract). The most commonly used method for K determination is flame photometry. In flame photometry, a large number of atoms, when excited in flame, emit radiation at a characteristic wavelength. The method is based on the principle of equilibrium of soils with an exchanging cation made of the solution of neutral normal NH₄OAC in a given soil solution ratio. During an equilibrium, ammonium ion exchange with exchangeable K ions of the soil. Chelating agents offer to assess readily available micronutrient cations (Zn, Fe, Cu and Mn) in soil. These agents combine with metal ions in solution, forming stable complexes and thus reducing the activities of free metal ions in solution.

Results and Discussion

The data of parameters pertaining to soil depicts that the Command (canal irrigated) area has easily availability of water from the canal. The electrical conductivity and organic carbon in Command (canal irrigated) area is higher among all Uncommand (well irrigated and rainfed) areas. The potential of conducting electricity is high, which means porosity is high when wet. High clay content will have higher EC values than sandier soils due to moisture retention in the soil. Canal water contains various amounts of essential nutrients and micronutrients, so these areas have slightly high amounts of Phosphorus, Potassium. The micronutrients like Zinc and Manganese are lowest as compared to Uncommand areas. The Iron and Copper were found to be medium amounts compared to Uncommand areas (well irrigated and rainfed). The crop productivity of the Command (canal-irrigated) area was even as compared to Un-command (well-irrigated) areas and high as compared to Uncommand (rainfed) areas due to more availability of water and nutrients from the canal (Table 1).

Table 1. Data of parameters pertaining to soil depicts of Command (canal irrigated)

S. No.	Soil parameters	7KSD	58NP	55NP
1.	pH (acidity/basicity)	8.66	8.98	8.90
2.	Electric conductivity (dS/m)	0.13	0.08	0.28
3.	Organic carbon (%)	0.28	0.24	0.19
4.	Available Phosphorus (kg/ha)	32	29	28
5.	Available Potassium (kg/ha)	302	347	325
6.	Zinc (ppm)	0.44	0.49	0.27
7.	Iron (ppm)	3.95	4.20	3.20
8.	Copper (ppm)	0.19	0.29	0.22
9.	Manganese (ppm)	2.90	2.20	2.45

The data of parameter pertaining to soil depicts that the Uncommand areas that is more irrigated by well means underground water source. Underground water extracted salts and elements. Well covers the limited areas for irrigation. Well-irrigated areas have a slightly high pH as compared to canal-irrigated areas. The Electrical conductivity is lower among both command (canal irrigated) and Uncommand (rainfed). Phosphorus is low among Command (canal irrigated) and Uncommand (rainfed) areas. The content of Potassium is approximately same as canal irrigated areas. The areas have the highest amount of Zinc, Iron and Manganese compared to canal-irrigated and rainfed areas. The copper is low among both the Command (canal irrigated) and Uncommand (rainfed) areas. So, it required more supplements to fulfill the Zinc requirement in soil. The crop productivity of well-irrigated area is evenly as canal irrigation areas, but high as compared to the rainfed area due to the availability of underground water from wells (Table 2).

Table 2. Data of parameters pertaining to soil depicts of Un-Command

S. No.	Soil parameters	50NP	58NP	1LPM
1.	pH (acidity/basicity)	9.04	9.02	8.98
2.	Electric conductivity (dS/m)	0.10	0.14	0.16
3.	Organic carbon (%)	0.24	0.17	0.15
4.	Available Phosphorus (kg/ha)	32	25	27
5.	Available Potassium (kg/ha)	325	269	269
6.	Zinc (ppm)	0.39	0.44	0.39
7.	Iron (ppm)	2.90	2.44	3.89
8.	Copper (ppm)	0.24	0.27	0.24
9.	Manganese (ppm)	3.20	2.90	2.49

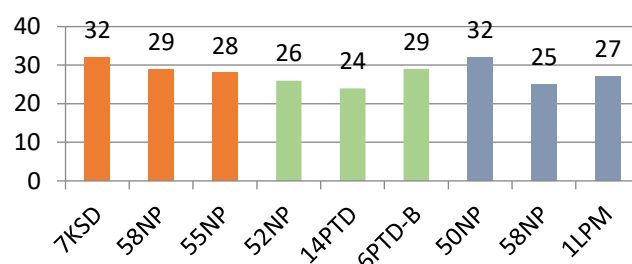
The data of parameters pertaining to soil depicts that the areas under Uncommand (rainfed) field have more pH level means soil is alkaline in nature. As far concern of Organic content it was depicted that non irrigated areas have less amount, so need more supply of supplement

for more production. The Potassium is lowest as compared to both Command (canal irrigated) and Uncommand (well irrigated) fields means the plant leaves are prone to wilting. Despite that those micronutrients, Iron is low as compared to Command (canal irrigated) and Uncommand (well irrigated) areas, so it essential to supply supplements of these elements as micronutrient but the Copper content was found highest in rainfed areas as compared to both Command (canal irrigated) and Uncommand (well irrigated) areas. Rainfed areas mainly depend on rainfall so they have low crop productivity due to scarcity of water.

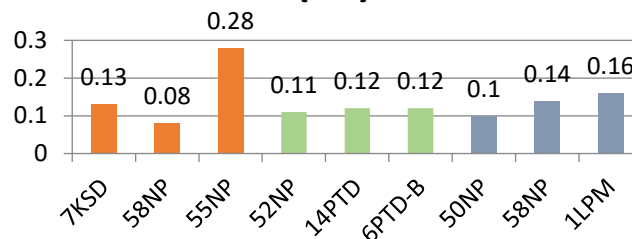
Table 3. Data of parameters about soil depicts of Uncommand (rainfed)

S. No.	Soil parameters	52NP	14PTD	6PTD-B
1.	pH (acidity/basicity)	9.02	8.92	8.80
2.	Electric Conductivity (dS/m)	0.11	0.12	0.12
3.	Organic Carbon (%)	0.22	0.29	0.12
4.	Available Phosphorus (kg/ha)	26	24	29
5.	Available Potassium (kg/ha)	269	358	302
6.	Zinc (ppm)	0.54	0.41	0.65
7.	Iron (ppm)	3.90	4.60	3.29
8.	Copper (ppm)	0.22	0.22	0.24
9.	Manganese (ppm)	2.90	3.92	2.44

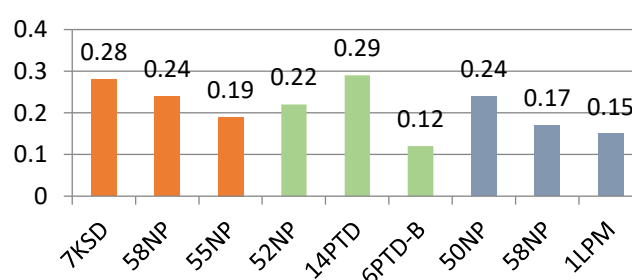
Available Phosphorous (P)



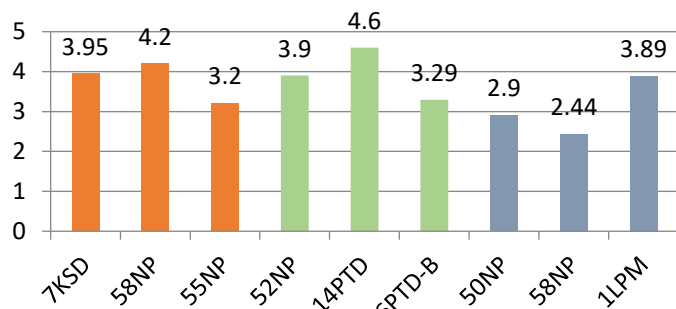
Electrical conductivity (EC)



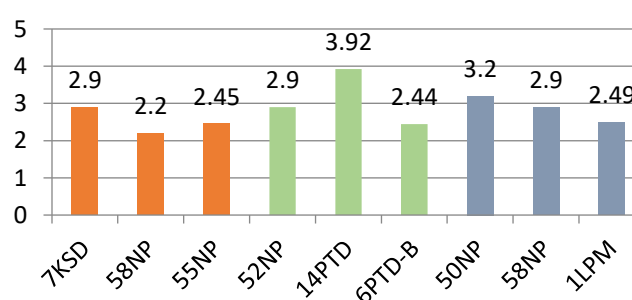
Organic carbon (%)



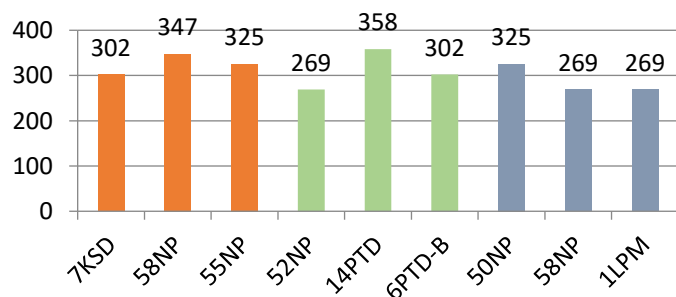
Iron (Fe)



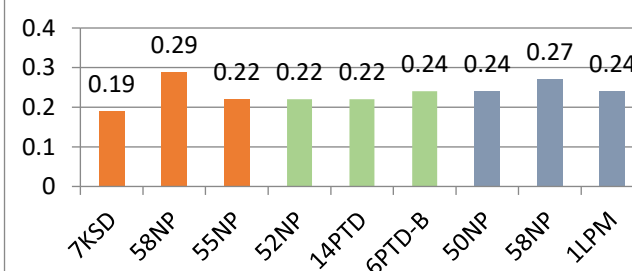
Manganese (Mn)

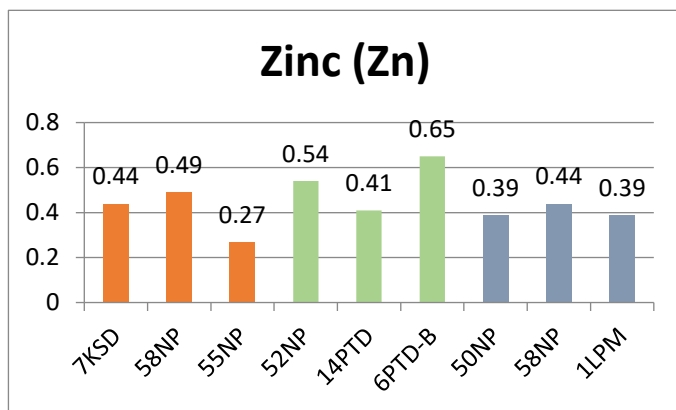


Available Potassium (K)



Copper (Cu)





Conclusion

During the study period, observations are made for three categories of the soil chemical parameters pertaining to Command (canal-irrigated) and Uncommand (well-irrigated and rainfed) are taken for consideration in Raisinghnagar, district Sriganganagar. Therefore, the results pertaining to all three categories of study areas with having various parameters are near about the permissible limits. However, the concentration of organic matter in soil is low. Therefore, it is suggested to enhance the organic matter by applications like mulching, farm yard manure and other organic input. The concentration of elements like Zinc, Iron also depicts low concentrations; therefore, it is suggested to apply Zinc Sulphate, Ferrous Sulphate as in a gradient. It is also recommended that best agriculture practices be adopted in consonance with modern tools and techniques and encourage the application of biofertilizers, integrated pest management, bio manure, vermicompost and other sustainable agriculture practices. This study has shown the broad spectrum of challenges in the agriculture sector by management of domesticated agro-diversity.

Declarations of interests

All authors of this manuscript declare that they have no conflict of interest.

Data sharing

All relevant data are within the manuscript.

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