SHORT COMMUNICATION

Salt Affected Soil and its Management in the University Crop Cafeteria, Gautam Buddha Nagar, Uttar Pradesh, India

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Abstract

The research paper pays attention related to the management of soil salinity assessment in the Galgotias University, Crop Cafeteria, located in Greater Noida, District Gautam Buddh Nagar, Uttar Pradesh, India. The research work analyzes the chemical, physical and biological properties of the soil quality assessment, before and after the reclamation to find out the feasible way to indulgence saline soils. The soil pH in 2018 was 8.75 which after three years of crop nurturing and reclamation efforts reduced to pH 8.0. The soil organic carbon was too low in the year 2018 and it was reported 0.27, 0.35, 0.39 and 0.45 % in the year 2018, 2019, 2020, and 2021 respectively which is positive sign for reclamation. The soil quality was improved through the scientific and traditional procedure using cow dung manure, vermicompost, neem cake, gypsum and grow green manure (*Sesbania bisponosa*) and found the improvement in the soil structure, size patterns and agriculture productivity.

Keywords: FYM, Green Manure, NCR, Reclamation, Saline Soil.

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Introduction

One of the major problems of agricultural soil is the quantity of salt available in it, which increases beyond a limit and makes the soil saline due to which the growth of salt-sensitive crops are restricted in such areas (Shrivastava and Kumar, 2014). The salinity in soil occurs due to the accumulation of water-soluble salt in soil called salinization which hampers the crop's ability to absorb water from the soil (USDA, 1998). The salt-affected soil contains soluble salts or exchangeable sodium or both, in such amounts that can retard vegetative growth and other development of plants (Godfray, *et al*., 2010). The glitches of saline soil are very common in semi-arid to arid regions in India, where annual rainfall is moreover less to maintain a regular filtration of rainwater through the soil (FAO 1988, Ghassemi, *et al*., 1995; Shahid, *et al*., 2018, USDA, 2011). Flood irrigation practice with no drainage facility can activate the accumulation of salts content in the root zone area, which may affect the properties of the soil, such soils cause a reduction in crop yield and are required to be managed and remediated for sustainable agriculture. Most salt-affected soils occur in semi-arid to arid regions but also are found in some humid to sub-humid climatic areas, where conditions are favorable for their development. In Pakistan 6.67 × 106 ha area is under salt contamination (Khan, 1998), this is due to the absence of good quality groundwater for irrigation. Increase the introduction as previous similar kinds of work done by different scientists.

Causes of Soil Salinization

There can be many reasons of soil salinization, such as weathering of parent rock; application of irrigation water having high concentration of salts, increasing ground water table, absence of drainage facility which extracts salts at the soil surfaces, water loss in the area either due to evaporation and transpiration from plants and excessive use of fertilizers, etc., (Shahid *et al*., 2018). Sometimes, rivers also play crucial roles in the accumulation of salt in plain areas, as when the rivers flow from upstream towards downstream, in their way they collect salt compounds and deposit them in the plain regions along with the sediments causing salinity of soil at the river banks (Kumar *et al*., 2020). The major causes of soil salinity are the natural factors viz., geological causes like weathering of parent rocks; hydrological causes like rivers, etc., and pedological causes are: evaporation and transpiration as well (Yadav, *et al*., 2011).

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Impact of Soil-salinization on Plants

The adverse impact of saline soil on plants depends upon the varying climatic factors like intensity of sunlight, conditions of soil and type of plant species to be sown (Motos, *et al*., 2017). Soil Salinization affects Plant growth mostly in two ways viz., osmotic stress and toxicity of ions. Plants needs several minerals to perform their biochemical processes, which can lead to the deposition of toxic elements for which they have self-regulated natural mechanism of ion-homeostasis to balance the concentrations of cytosol and other organelle (Mulet *et al*., 2020). This cytosolic concentration is maintained by K^+/ Na^+ ratio which is high under normal soil conditions but disrupts in saline soil as saline soil have high Na^+ ion concentration and due to the similar radius of both Na^+ and K^+, the Potassium transport channels of the Plant absorbs Na^+ ions more than the K^+ ions in saline soil which disturbs the cytosolic ion balance in the Plant

cells creating osmotic stress in root zones and thus affects the growth of plants in saline soil (Sharma *et al*., 2015). When the concentration of Na^+ ions increase beyond a limit, they create osmotic stress on the cell walls causing death of cells. Initially, after getting exposed to saline conditions, the plant cells will dehydrate and will recover after some time but this constant hydration and dehydration behavior of cells will affect the cell division and cell elongation due to which the leaf and root growth are reduced and the Plant wilts completely (Lauchli, *et al*., 1970).

The initial salt content of the soil in the University crop cafeteria was tested and found 8.5 pH which is higher enough to devoid the growth of salt sensitive crops. Several practices like soil washing, mixing of cow dung manures in soil and some other organic treatments were conducted in the crop cafeteria to reclaim the soil quality (Schulte and Hoskins., 2009; Godfray *et al*., 2010).

Materials and Methods

Study Area

The research work was conducted in the University campus crop cafeteria. The area is geographically located at Latitude of- 28.53 N and Longitude of- 77.38o E.

Climate and Geography

The area is exposed to good weather conditions supporting agriculture as its average annual rainfall is 700 mm with sub-humid type of Climate and the mean temperature reaches to its peak in June with 32.85 °C in summer season while drops at 14.2 °C in January in winter season (Joshi *et al*., 2009).

Soil

The study area has alluvial soil containing fine sand, silt and clay, characteristic of soils represented in the western part of Upper Gangetic Plain (Sharma *et al*., 2012; Tripathi *et al*., 2019). The area is subjected to Sandy-loamy to loamy soil because of the availability of Yamuna and Hindon river around the district and past records of saline groundwater is somehow responsible for the salinity of soil in the district which makes the soil unfit for the cultivation of salt sensitive fruits and vegetables (Saxena and Saxena, 2015, Sharma and Chaudhari, 2012 & Joshi *et al*., 2009, Koralage *et al*., 2015).

Agriculture

The climate and geography of this area is best suited for cultivation of Cereal grains like Wheat (*Triticum aestivum* L.), Paddy (*Oryza sativa* L.), Maize (*Zea mays* L.), Barley (*Hordeum vulgare* L.), Sugarcane (*Saccharum officinarum* L.) and Pearl Millet (*Pennisetum glaucum* (L.) along with some oilseed and Pulse crops (Ansari, 2015).

Flora

The study area is uninhabited by frequent bulky to miniature sized trees which are: *Butea monosperma* (Lam.) Taub., *Azadirachta indica* A. Juss., *Dalbergia sissoo* DC., *Ficus religiosa* L., *Holoptelea integrifolia* Planch., *Neolamarckia cadamba* (Roxb.) Bosser., *Prosopis cineraria* (L.) Druce, *P. juliflora* (Sw.) DC., *Phoenix sylvestris* (L.) Roxb., *Syzygium cumini* (L.) Skeels, *Tamarix ramosissima* Ledeb. and *Terminalia arjuna* (Roxb. ex DC.), *Ricinus communis* L., *Phyllanthus emblica* L., *Bauhinia variegata* L., *Acacia nilotica* (L.) Delile, *Pithecellobium dulce* (Roxb.) Benth., etc. The study area are also rich in the herb diversity specially in the medicinal plants which are: *Commelina benghalensis* Forssk., *Argemone mexicana* L., *Ranunculus sceleratus* L., *Tribulus terrestris* L., *Oxalis corniculata* L., Croton bonplandianus Baill., *Desmodium triflorum* (L.) DC, *Alysicarpus vaginalis* (L.) DC., *Melilotus indicus* (L.) All., *Cannabis sativa* L., *Lepidium didymum* L., *Abutilon indicum* (L.) Sweet, *Malva parviflora* L., *Sida cordifolia* L., *Urena lobata* L., *Chenopodium boscianum* Moq., *Anagallis arvensis* L., *Calotropis procera* (Aiton) Dryand., *Datura metel* L., etc., (Alam and Anis 1987).

The major crops which we have grown in university crop cafeteria are basically, Wheat (*Triticum aestivum*), Mustard (*Brassica* Spp.), Barley (*Hordeum vulgare*), Oats (*Avena sativa*) and Rice (*Oryza sativa*) and salt tolerant seasonal vegetables are: Broccoli (*Brassica oleracea*), Cabbage (*Brassica oleracea* var. capitata), Cauliflower (*Brassica oleracea* var. botrytis), Spinach (*Spinacia oleracea*), Radish (*Raphanus sativus*) Beetroot (*Beta vulgaris* subsp. vulgaris) etc.

Field Sampling and Data Analysis

To adopt an accurate soil management practice; it's very important to know the initial soil quality parameters for conducting any scientific practices in the field. Before conducting the soil reclamation practices, a few soil analyses were done, which are: pH, electric conductivity, soil organic carbon etc. (Choudhary, 2008, Provin and Pitt 2001).

Methodology

Soil Sample Collection

The samples of soil were collected from university crop cafeteria afterwards 8 to 10 locations were marked for soil samples collections (Daniel *et al*., 2018). For collecting the soil samples, prepared V shaped pits of about 6-inch-deep at the marked sites and then with the help of spade, took out the slices from the exposed walls of the pits in such a way that the slices are about ½ inch thick and uniform. The soil samples were collected from different locations of the crop cafeteria. The soil samples were air dry in the laboratory and were kept on a clean cloth in a warm and dry area and then mixed well (Bhanuben, *et al*. 2014., Walworth *et al*., 2006, Mehlich, 1953). The dried soils were then screened with a 2 mm sieve to segregate the coarse soil particles from the fine soil particles (Gil *et al*., 2014). The finer soil samples were then spread uniformly and were divided into 4 parts in which any two parts opposite to each other were removed and then the remaining two parts were mixed properly. This procedure was repeated till half kilogram of Soil was left. The sample was then filled into a Polythene bag labeled with Farmer's name, Village Name, Field identity, Sample number, district name etc. after which the soil samples are either sent to any soil laboratory for testing or one can test the soil parameters by themselves also if the equipments are available (Estefan *et al*.,2013, Tenedero *et al*., 1986).

Table 1: Comparative Soil Testing Reports

S. No.	*Parameter*	*Data under Standard Classifications*	*Value (2018)*	*Value (2019)*	*Value (2020)*	*Value (2021)*
1.	pH	6.5–8.5	8.75	8.40	8.30	8.00
2.	Soil Organic Carbon	0.35 (low) ≥ 0.80 %	0.27	0.35	0.39	0.45
3.	Phosphate	28 kg/ha ≥ 40.0 kg/ha (Medium)	36.20	28.00	34.00	18.00
4.	Electrical Conductivity (EC)	1.35 milimole/cm ≤ 1	0.94	1.35	0.98	0.67
5.	Potassium	101 kg/ha ≥ 250 (Medium)	87.58	101.00	122	193.00
6.	Available Sulphur	10.1 ≥ 15 ppm	14.00	15.60	14.80	15.00
7.	Available Zinc	0.61 ≥ 1.2 ppm	0.20	0.22	0.45	0.38

Result and Discussion

The data analysis confirmed the application of vermi-compost, cow dung manure, neem cake, gypsum and green manure (*Sesbania bisponosa*) and found the improvement in the soil structure, size patterns and agriculture productivity. The positive effect obtained by the combined use of these treatments in the cropping year 2018-19, 2019-20 and 2020-21 was found very effective (Table 1). The original salt content soil pH in 2018 was 8.75 which after three years of crop nurturing and reclamation efforts it reduced to pH 8.0 which again is not a good pH score for some crops (Choudhary, 2008). The soil organic carbon was too low in the year 2018 and it was reported 0.27, 0.35, 0.39 and 0.45 % in the year 218, 2019, 2020 and 2021 respectively which is positive sign for reclamation (Marwah, 2014 and Cardon *et al*., 2014).

Electrical conductivity (EC) is an important indicator scale of soil health. Soil EC was reported 0.94 (mmol), 1.35 (mmol), 0.98 (mmol) and 0.67 (mmol) in 2018, 2019, 2020 and 2021 respectively. The soluble salts comprise both cations and anions (Filho, 2019). It affects crop suitability, crop yields, plant nutrient availability, and activity of soil (Murtaza *et al*., 2020). As per soil analysis reports it has been observed that all the mineral nutrients which are essential for crop growth were present in very less quantity (Wolde, 2016, Shakir, *et al*., 2018, Fageria, 2007). After application of using cow dung manure, vermicompost, neem cake, flooding, gypsum and green manuring (*Sesbania bisponosa*) and found the improvement in the soil structure, size patterns and agriculture productivity (Herrera, 1997, Singh *et al*., 2015, Harris, 1995).

The salt tolerant crops has been also grown in every cropping year i.e. 2018-19, 2019-20 and 2020-21 for improvement of soil structure; Rice (*Oryza sativa*), Wheat (*Triticum aestivum*), Barley (*Hordeum vulgare*), Mustard (*Brassica* Spp.), Oats (*Avena sativa*) and others salt tolerant seasonal vegetables such as: spinach (*Spinacia oleracea*), Broccoli (*Brassica oleracea*), Cauliflower (*Brassica oleracea* var. botrytis), Cabbage (*Brassica oleracea* var. capitata), Radish (*Raphanus sativus*) Beetroot (*Beta vulgaris* subsp. vulgaris) etc. (FAO., 2019, Sarwar, 2014, Chhabra 2002).

Conclusion

Salt affected soil is a potential threat to irrigated agriculture in part of national capital region of district Gautam Buddh Nagar, Uttar Pradesh, India. It affects huge area of land and continues to severely reduced crop production in this region. Primarily, it should be identifying its source and causes of the salt problem with collecting detailed information about the affected area. For reclamation of salt affected soil, leaching practices with good quality of water for irrigation, application of vermicomposting, Gypsum, Ca-amendment, green manuring, farm yard manuring and growing of salt tolerant varieties of rice as well as other salt tolerant plants may appear advantageous.

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