Prospects and Potential of Salt-tolerant Crops in Nuh

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Introduction

Salinity is progressively threatening the livelihoods of farmers around the world as it impairs the soil and water. In India alone, 6.74 million hectares of land are disturbed by salt toxicity. The adverse effects on yield due to deteriorated soil quality are becoming more prominent as other environmental factors, like heat and water stress, add to the challenges of agricultural production. Farmers have a hard time producing enough to provide for their families, which leads poverty and malnutrition.

The adaptive technology in agriculture team of Sehgal Foundation explores the possibilities of making productive use of saline water in agriculture in the Nuh district, Haryana. The team identifies and tests the economic, social, and environmental suitability of new technology and farming practices before taking it to the farmers for mass-scale adoption.

While testing the tolerance of various crops and vegetables to soil and water salinity, the following factors need to be considered:

Environmental conditions include climate (rainfall, temperature, humidity, etc.) and soil conditions (nutrient availability, structure/texture, etc.). These factors help determine how well the crop will grow and how much yield will be produced.

Economic conditions include the income potential from yield, market strength (selling power, seed availability, etc.), and the costs (seed, labor, machinery, etc.). A farmer needs to be able to access the seed, sell it at the market, and gain a viable income.

Social conditions include the popularity of the crops and food habits. Do people want to grow the crop and buy it? Will it be used by the farmer for self-consumption? In addition, the knowledge requires caring for and growing the crop. If it is a very difficult process, it may defeat the farmer. If it can be easily grown and positive impacts are seen, other villages are more likely to accept and grow the crop.

Findings and Recommendations

Vegetables are more sensitive to salinity than grains or fruits, but they have high market value, making them important crops to be considered. When choosing crop prospects, irrigation facilities should be available to farmers. Even though some crops are salt tolerant, they still require irrigation to supplement rainwater.

Knowing the salinity content in the soil and/or water is very important for optimal vegetation growth. Salinity can produce different effects making it useful to observe the different salts. The excess of calcium, magnesium, and moderate-to-high pH causes poor germination and growth in seeds due to minimal access to nutrients.

Indicators such as electrical conductivity (EC)[1], sodium absorption ration (SAR)[2], exchangeable sodium percentage (ESP)[3] and total soluble salts (TSS) determine the suitability of plants at different level of soil and water salinity. The common pH should be taken into account when choosing which varieties to grow.

The following crops grown in a pH range of 6–8 and with EC range between 2–15 dS/m are beet, broccoli, cotton, okra, and paddy.

Beet is an edible taproot and leaves. This cash crop has a high market value, high salt tolerance, and it does better in a cool climate with well-drained sandy to sandy loam soils. Beet needs 6–8 weeks of low temperatures for flowers and will have the highest germination rate and success if irrigated during germination and intermittently thereafter. It is tolerant up to 4.0 dS/m with the current varieties available.

[1] Soil electrical conductivity (EC) is a measurement that correlates with soil properties that affect crop productivity, including soil texture, cation exchange capacity (CEC), drainage conditions, organic matter level, salinity, and subsoil characteristics. It determines the specific toxicity of a particular ion (such as sodium) and high osmotic pressure around the roots prevents an efficient water absorption by the plant roots. Units of measurement are deciSiemens per meter (dS/m) and parts per million (ppm).
[2] Sodium absorption ration is a ratio of concentration between sodium ions and calcium plus magnesium ions. If too high, the permeability can severely hinder the growth of plants.
[3] Exchangeable sodium percentage is for soils only and can test the severity of sodium in the soil. Total soluble salts measure the weight and amount of salt in the soil. The parameters help determine the suitability of a plant in the grower's soil.

Broccoli is a cash value vegetable with a high value of vitamins and nutrients. It can tolerate 2.8 dS/m of EC. The tolerance is higher than most vegetables, which brings in higher prices than most grains and fruits. A cool season crop grows best in 10–25°C. Light irrigation should be applied regularly to optimize yield. Silty loam and sandy soils are best suited for broccoli.

Cotton is a kharif season crop with one of the highest salt-tolerant fiber crops. It can withstand 7.7 dS/m of salt tolerance. It needs regular irrigation. It grows best in a moist and warm climate.

Okra (bhendi) is a high salt-tolerant crop. While conducting research, finding a definite salinity tolerance level was unsuccessful, but many sources have concluded it has a high salt tolerance. It is susceptible to frost and low temperatures and can be grown in kharif or spring seasons. Sandy loam soil with a fine texture is optimal for growth.

Paddy has one of the largest markets and consumption rates in India and the world. New research and varieties make it a very salt-tolerant crop and a good income source for farmers with saline water irrigation. It is grown in warmer conditions, ideally around 24°C. It can be grown in up to 11 dS/m and with little water in some cultivars. There is need for more advanced research for increasing salinity tolerance levels. In the future, as little to no fresh groundwater will be available, the paddy will be able to grow in the saline environment and provide food and an income to farmers.

Tropical sugar beet is a viable crop for saline conditions. It has a salinity tolerance of 7.0 dS/m. A good alternative for sugar demand is the sugar beet. It is best grown in the rabi season. The tropical sugar beet has a long taproot, allowing access to water deeper in the soil. Germination is most favorable at 15°C and can by grown successfully between 12 to 45°C. It grows best in light, loam fertile soils.

Amla is a fruit crop that can provide fruits for up to seventy-five years with minimal inputs. It has a very high salt tolerance and does well with limited water, producing high yields. One the main assets is that is does very well in an intercropping system. Marginal farmland can be rejuvenated by trees and improve wastelands.

Cowpea is already grown in much of India, except for Haryana. It is suitable for the district of Nuh because of its salt tolerance of 4.9 dS/m and draught tolerance capacity. It is suited to be grown in the summer season in sandy

to sandy loam soils. The ideal temperature for growing cowpea is 30°C, while the optimal germination temperature is 8°C, so sowing should occur in December or January, depending on rainfall amount. The ideal pH range is 5.6 to 6.5, lower than most crops.

Quinoa is one of the newest superfoods in terms of health benefits and adaptability to different growing conditions. It is a strong crop with a tolerance of 15 dS/m to salt and is very drought tolerant. It does the best in sandy loam soils and 20°C temperatures, but it can withstand up to 39°C. It has a short growing season and can withstand harsh conditions, making it ideal for climate change and environmentally degraded areas. Its market potential is growing as it has become a more popular source of protein and feed. It also has a high amount of fiber, minerals, vitamins, and fundamental fatty acids.

A way to use the saline soil and water in the future, that is too concentrated for plants, is **aquaculture**. Aquaculture allows farmers to use the resources available to them effectively and bring in an income. Possible creatures to raise are prawns, shrimp, and different species of fish. The limiting factor in this practice is the initial investment and problems like theft. Care would have to go into the implementation of these production areas.

Future prospects

Many farmers use methods and technologies for agriculture that are old and out of date, because they don’t have access to new education and information. Many organizations conducting research are available to provide recommendations, but there is no way for farmers to easily access them. An extension service is an optimal way to inform farmers of new technologies and help them succeed. As the population in Nuh and in India rises, it is important to find a way to easily reach out the farmers and provide a support system. Informing farmers about government schemes can help to encourage them to try new crops and systems, helping farmers gain a larger income and success for the future.

Institutes

Several institutes in India and around the world are dedicated to research, crop improvement, and education about water and soil salinity. I have used their resources to suggest recommendations for crops that have the possibility to grow well in Nuh.

One of them is the Central Soil Salinity Research Institute (CSSRI). They release new varieties of salt-tolerant crops and have trials for released crop varieties to test the tolerance levels. The institute has the latest salinity updates and an extension service. Other institutes include the Saline Agriculture Research Center (S.A.R.C.), Biosalinity Awareness Project, International Center of Biosaline Agriculture (ICBA), International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Organization for Agriculture in Saline Environments (OASE), the Food and Agriculture Organization (FAO), and the Indian Agricultural Research Institute (IARI). These agencies have sufficient information and data to inform farmers and researchers about salinity and ways to combat it.

Conclusion

As we look at the Nuh district and the changes occurring in the agriculture sector, efforts must be made to help farmers to sustain themselves. Salinity is spreading at a rapid rate that inhibits the farmers from growing profitable crops. Growing salt-tolerant crops is a way for farmers to have a productive growing season in the face of the high salinity in soil and groundwater.

(This article is the abridged version of the full report submitted by Natalie Bidner who did a study with the Adaptive Technology-Agriculture at S M Sehgal Foundation from June 5-August 8, 2017)