



Soil Nitrogen and Nutrient Management Interventions (Tools/ Apps) at Farm Level

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Abstract

Soil nitrogen and nutrient management interventions are crucial for sustainable agriculture and reducing negative environmental impacts. Various tools and apps help farmers optimize nitrogen and nutrient management at the farm level. These tools and apps can do many different things like figure out how much nitrogen and nutrients a crop needs, test the soil and recommend fertilizers. Farmers can improve their efficiency and reduce costs by adopting these tools and apps while minimizing environmental impacts such as soil erosion and water pollution. The use of precision agriculture techniques, such as variable-rate nutrient applications, soil nitrogen and nutrient management interventions, can further optimize crop yields and reduce the need for excess fertilizer use. Overall, soil nitrogen and nutrient management interventions and associated tools and apps can be important in ensuring sustainable agriculture and environmental protection.

Keywords: Apps, Nitrogen, Soil testing, Tools

Introduction

Soil nitrogen and nutrient management are crucial for sustainable agriculture, as they significantly impact crop yield, soil health, and environmental sustainability. If nitrogen and other nutrients in the soil are not managed well, this can lead to soil degradation, water pollution, and more greenhouse gases being released into the air. With the rise of technology, many tools and apps have been made to help farmers better manage their soil's nitrogen and other nutrients. In this article, we will talk about some of the best ways for farmers to manage nitrogen and nutrients in the soil at the farm level. According to the World Bank, as of the mid-2000s, more people had access to mobile technologies than clean water. Mobile technologies were quickly seen as great, high-performing tools for work, so they were immediately used in agriculture. They offer exciting ways to improve farming, such as strategies for managing fertilizers in a way that is good for the environment and giving farmers more help. The mobile technologies designed to boost existing methods of fertilizer management were reviewed, and challenges to their adoption and missing links in their development process were highlighted. Mobile technologies offer many different ways to make these kinds of tools. As

soon as smartphones became affordable and thus available to the general public, they were repurposed for use in farm management. They continue to be important as decision support tools (DSTs) (Golicz *et al.*, 2021). In this article, we discuss about the different tools and decision support systems for the nitrogen and other nutrient management in soil.

Soil testing is the first and most essential step in soil nutrient management. It tells farmers about the nutrients, pH, and amount of organic matter in the soil, so they can make smart decisions about fertilization and other ways to take care of the soil. A soil test will help farmers choose the type and amount of nutrients needed to improve soil health and crop yield. Fertilizer management apps are developed to help farmers handle fertilizer use more effectively. These apps use weather and soil data to guide the type and quantity of fertilizer required for a crop. These apps can support farmers in reducing fertilizer use, saving money, and preventing over-fertilization, which can lead to soil and water pollution. Nitrogen monitoring tools are used to measure soil nitrogen levels in real time. These tools can help farmers figure out when the best time is to put nitrogen fertilizers on their crops. This cuts down on wasted fertilizer and pollution of the

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environment. Some of the most popular nitrogen monitoring tools include soil nitrate testers and leaf colour charts.

Tools and Apps for Nitrogen Management

1. Pusa STFR Meter Kit (PUSA Soil Test and Fertilizer Recommendation Meter Kit)

It is developed by ICAR-IARI, New Delhi. This advanced Soil Testing Kit tests 14 parameters of soil, recommends fertilizer dose for over 100 crops, prints Soil Health Card through in-built thermal printer, sends Soil Testing Report to mobile via Bluetooth and computer via USB. After a single day of training, any high school graduate can operate it due to how simple it is to use. It can be used by governments, farmers, business owners, young people from rural areas, agriculture companies, non-governmental organizations, and development funds to build their own soil testing labs and give farmers access to soil testing facilities. Pusa STFR can analyze 14 parameters such as N, P, K, S, Zn, S, B, Cu, Fe, Mn, lime requirement, gypsum requirement, EC and SOC.

2. Nutrient Expert®

Nutrient Expert® (NE) for Rice was developed by the International Plant Nutrition Institute, Canada in 2009. Nutrient Expert® is an easy-to-use, interactive, and computer-based decision support device that can rapidly supply nutrient recommendations for an individual farmer field in the presence or absence of soil testing data. It is based on principles of site-specific nutrient management. Using SSNM guidelines and data from on-farm trials, an algorithm is made to figure out how much fertilizer is needed in NE. Using site-specific nutrient management (SSNM) NE, a nutrient decision support tool enables farm advisors to create fertilizer recommendations customized to a given field or growth environment. In order to generate a suggestion that is specific to a given location, NE considers the most significant aspects influencing nutrient management recommendations and employs a methodical approach to gathering information. Yet, unlike many advanced nutrient decision assistance programs, which run the risk of overwhelming the user, NE does not demand a large amount of data or precise information.

3. Leaf Color Chart (LCC)

The leaf colour chart (LCC) is an easy-to-use and affordable diagnostic device for observing the relative greenness of a rice leaf as an indicator of plant N status. Rice leaf N status is closely linked to photosynthetic rate and biomass production, and it is a sensitive indicator of differences in crop N demand during a growing season. A tool to rapidly estimate leaf N status and thereby guide the application of fertilizer N to maintain an optimal leaf N content is crucial for attaining a high rice yield with effective N management. The initial prototype of LCC was developed by IRRI and Philippines Rice Research institute (PhilRice). After that several other institutes developed the LCC based on the region and other parameters. Leaf Color Chart (LCC) is used to determine the N fertilizer needs of rice crops. LCC has four green strips, with color ranging from yellow green to dark green as shown in figure 1. It determines the greenness of the rice leaf, which indicates its N content (USAID, 2013).

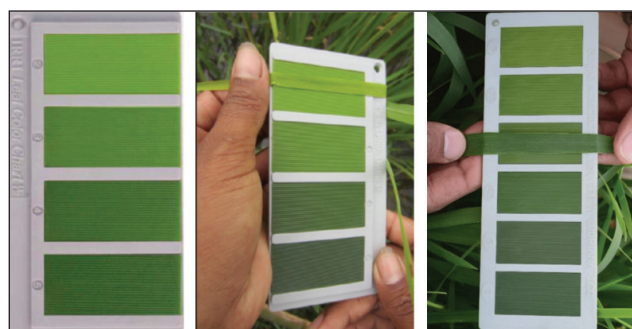


Figure 1: Comparison of leaf n content with the LCC colour strips (USAID, 2013)

4. Nitrogen Calculator (N Calculator)

CIMMYT and the Borlaug Institute for South Asia (BISA) have together developed and launched an application for Android called “N Calculator” to help smallholder farmers using the GreenSeeker, a compact sensor to assess crop vigour and estimate optimal fertilizer dosages quickly (Figure 2). The Greenseeker assures precise and balanced nitrogen fertilizer applications, cutting farmers’ costs, lowering nitrification and nitrogen runoff into groundwater, and increasing crop yields. But smallholder farmers often don’t know how to use the GreenSeeker’s raw data because they haven’t been trained to do so. The N Calculator automatically computes the best nitrogen and urea rate using normalized difference vegetation index (NDVI) values from GreenSeeker on a mobile handset (CIMMYT, 2015).

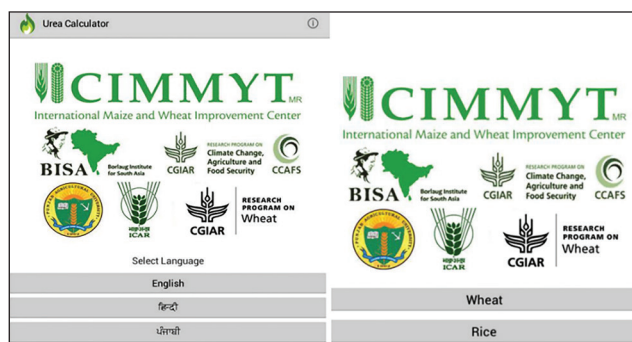


Figure 2: Mobile overview of N calculator (CIMMYT, 2015)

5. Fertilizer Calculator

There are several fertilizer calculators developed by different organization according to region, crops and based on irrigation situation of crops. Among them, ICAR-Central Coastal Agricultural Research Institute, Goa developed the Fertilizer Calculator (Figure 3). It is a completely offline soil test-based fertilizer recommender (STFR) app for Android. This app gets calculations according to the area of farm or the number of plants/ trees (Mahajan *et al.*, 2021). If users adhere to the fertilizer calculator’s suggestions, they can prevent or reduce fertilizer input loss and ensure that crops are appropriately nourished. This app easily adapts to other regions with varied crops, suggestions, and soil fertility levels.

6. Soil Health Card (SHC)

Soil Health Card (SHC) is a Government of India’s scheme



Figure 3: Fertilizer Calculator for agricultural crops (Mahajan et al., 2021)

promoted by the Department of Agriculture & Co-operation under the Ministry of Agriculture and Farmers’ Welfare (Figure 4). The Soil Health Card (SHC) is designed to provide each farmer with the soil nutrient status of their holding and advise on the amount of fertilizer and other soil amendments that are required to be applied to sustain soil health over the long term. SHC is printed information that a farmer will be handed over for the soil of each field. It will include the status of his soil concerning 12 parameters, namely N, P, K (Macro-nutrients); S (Secondary-nutrient); Zn, Fe, Cu, Mn, Bo (Micro-nutrients); and pH, EC, OC (Physical parameters). Based on the results, the SHC will also suggest fertilizer

recommendations and soil amendments required.

The card will include an advisory based on the soil nutrient status of a farmer’s holding. Every two years, farmers will be able to access SHC, which will tell them how healthy their land is at that time. The SHC provided in the next cycle of two years will be able to record the differences in the soil health for that subsequent period. Soil samples will be collected in a 2.5 ha grid in irrigated areas and 10 ha grid in rainfed areas using GPS tools and revenue maps. Soil samples are generally taken twice a year, after harvesting the Rabi and Kharif crops or when there is no standing crop in the field.

		SOIL HEALTH CARD			Name of Laboratory																						
		Farmer's Details			SOIL TEST RESULTS																						
Name		Address		Village		Sub-District		District		PIN		Aadhaar Number		Mobile Number		S. No.		Parameter		Test Value		Unit		Rating			
Soil Sample Number		Sample Collected on		Survey No.		Khasra No. / Dag No.		Farm Size		Geo Position (GPS) Latitude: Longitude:		Irrigated / Rainfed		1		pH											
Soil Health Card No.:		Name of Farmer:		Validity: From To:		3		4		5		6		7		8		9		10		11		12			
Secondary & Micro Nutrients Recommendations		General Recommendations		International Year of Soils 2015		Healthy Soils for a Healthy Life		Fertilizer Recommendations for Reference Yield (with Organic Manure)		1		2		3		4		5		6							
Sl. No.		Parameter		Recommendations for Soil Applications		1		2		3		4		5		6		1		2		3		4			
1		Sulphur (S)				Organic Manure		Biofertiliser		Lime / Gypsum		Crop & Variety		Reference Yield		Fertilizer Combination-1 for N P K		Fertilizer Combination-2 for N P K									
2		Zinc (Zn)										Paddy (Dhaan)															
3		Boron (B)																									
4		Iron (Fe)																									
5		Manganese (Mn)																									
6		Copper (Cu)																									

Figure 4: Format of soil health card

Conclusion

In conclusion, soil nitrogen management is critical for sustainable agriculture and reducing environmental impacts. Several tools and apps have been made to help farmers better manage nitrogen in the soil. These tools and apps provide real-time information on soil nutrient levels, crop requirements, and fertilizer recommendations. In addition, they provide predictive analytics and modeling to optimize nitrogen use and reduce environmental losses. Precision agriculture and digital farming technologies are being used by farmers more and more, so these tools and apps are becoming more accessible for farmers to find and use. Overall, tools and apps for managing soil nitrogen can improve soil health, boost crop yields, and reduce environmental damage.

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