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**SUCCESS OF NUTRIENT
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ABSTRACT

The present yield gaps in wheat between expected and actual one has to be decreased through improved use of nutrient inputs which is the basic technology for helping much needed increases in wheat production. Plants grown in a field mostly take their required amount of nutrients from soil which must be protected from the addition of fertilizers in excess rates. Any deterioration in the quality of soil can significantly hamper the crop yield. The management of nutrients for wheat requires

adjustments in N, P₂O₅ and K₂O applications to accommodate the field-specific needs of wheat crop for supplemental nutrients. This article is a mini review, provides an overall idea on Nutrient Expert-Wheat software and its significant positive effect on the wheat yield obtained and profit of wheat cultivation *vis-à-vis* nutrient use efficiency by influencing the available pool of nutrients in the soil. Adoption of the use of Nutrient Expert in wheat cultivation is highly necessary to improve the grain yield and profit in a sustainable manner following the principle site-specific nutrient management guidelines on wheat under both conservation and conventional agriculture.

Keywords: Nutrient expert, nutrient use efficiency, soil quality, wheat

INTRODUCTION

Wheat is a key source of calories for the ever-rising human population. The yearly increase in production of cereals including wheat by 1.2 to 1.5% to meet the necessary requirement and ensure food security (Mondal, 2014). The existing yield differences in the target and actual one has to be decreased through better management of nutrient inputs which is the best technology for getting much needed increment in wheat yield. The development and widespread adoption of best practices for managing fertilizers is becoming critical for producing sufficient wheat at affordable prices by farmers without damaging the ecosystems. At present, most of the recommended fertilizer doses for wheat crop are blanket doses which generally consist of fixed NPK application rates for large areas which assume that the requirement of wheat for fertilizer nutrients is same in all seasons and all fields in a large area. But actually, the requirement for supplemental nutrients of wheat crop can differ to a great extent among fields, seasons and years in a vast area as a result of variation in field situations, micro climate, soil and crop managing techniques. Hence, stewardship of nutrients needs a strategy that enables proper adjustments in major nutrient applications to accommodate the field-specific needs of wheat crop.

Satyanarayana *et al.* (2011) reported that promotion of generalized fertilization rate for K over a huge area ignoring the geographical variability in nutrient status among small land holdings showed in

diminishing yield with excessive K removal from soils resulting in K deficiency in that large area. A perspective for covering all these concerns is site-specific management of nutrients, which takes into account the effect of geographical variations in K fertility status of soil. In this perspective, the major nutrient demands are depending on the relations between balanced nutrient uptake at harvesting stage and grain productivity (Buresh *et al.*, 2010). Nutrient expert (NE)-wheat, new nutrient decision support system software, is depended on the principles of site-specific management of nutrients and provides balanced fertilization as per the requirement of wheat crop. This software was a creation by the large stakeholders of wheat in India involving the representatives from national research and extension system, private industries, International Wheat and Maize Improvement Centre (CIMMYT) and International Plant Nutrition Institute (IPNI) together. This software enables the educated farmers and crop advisors to quickly develop field specific recommended doses of fertilizers for wheat cultivation which enhanced productivity and profitability of producers in comparison to the current practices (Pampolino *et al.*, 2012).

NE requires some information as mentioned below:

- a) Characters of the growing environment: water availability (irrigated, fully rainfed, rainfed with supplemental irrigation) and any occurrence of flood or drought
- b) Soil fertility indicators: texture, color and organic matter content of soil, soil test for P or K (if any), history of using of organic matters (if any), problematic soils (if any)
- c) Crop sequence in the existing cropping system followed by growers
- d) Crop residue management, fertilizer inputs and current yield level of growers

This computer-based software calculates the target grain productivity and response of yield to nutrient application from existing information of the location using decision acts created from farmers' field experiments (Pampolino *et al.*, 2012).

DISCUSSION

Site specific management of nutrients provides a strategy to “feeding crops” with nutrients at proper time and as per their requirement and hence making coordination between nutrient supply and demand under a cropping system. Such a technique together with proper management of other factors for crop production, allowed in obtaining attainable grain yields and efficiency factors those become much higher than the present levels. But soil testing is still the prime limitation to understand possible profits of these new and upgraded technologies. The decision support tools are now increasingly used to ease application of best management practices (BMP) of nutrients in on-farm experiments. Therefore, validation of the newly developed Nutrient Expert-Wheat software was done under farmers’ field trials in conventionally till, reduced and no till system to establish a smooth delivery system that helps the wheat farmers to progressively implement site specific management of nutrients for individual plots. The Nutrient Expert-Wheat was developed in the year 2010-11 which is a smooth handling, communicative and computer operated decision support system (DSS) that can quickly provide recommended nutrient rates for individual fields of wheat farmers with or without using the soil testing result.

The outcomes of farmers’ field validation assessments of NE based prescriptions in wheat across the Indo-Gangetic Plain region (IGPR) showed that the NE guided fertilizer doses significantly improved grain productivity of wheat and profitability of wheat cultivation (Majumdar *et al.*, 2013). Grain yield of wheat, use efficiency of nutrients as well as net return were recorded higher under the NE-based nutrient management strategies in comparison to fertilizer recommendation of state, farmers’ fertilization practice etc. Sapkota *et al.* (2013) suggested that no-till system along with site-specific techniques for precise management of nutrients can increase grain productivity, use efficiency of nutrients and net return from wheat cultivation in North-Western part of India. Site specific management of nutrients principles-based software, Nutrient Expert is a technology for management of nutrients precisely to the tune of enhancement in crop yields, environmental-quality and overall agricultural sustainability specifically under the South-Asian region of IGP. SSNM-NE has a great significance in maize-wheat cropping system

in respect to maintain soil-fertility and betterment of farm nutrient-use efficiency with least environmental hazard (Pooniya *et al.*, 2015).

Dutta *et al.* (2014) reported that the NE-Wheat software validation trials were conducted in farmers' fields (n=109) for comparing NE-Wheat recommended fertilizer application with fertilizer practice of farmers and state fertilizer recommendations across three states of India including Bihar, Punjab and Haryana where wheat was cultivated very largely during 2010-11 and 2011-12. Among these 109 trials, 65 were carried out under conventional wheat cultivation and 44 (22 in every winter season) were carried out under zero tilled fields. Wheat farmers of these 3 states generally not applied K in their crop. The NE software, while judging the nutrient balance of rice-wheat system, identified a huge requirement of K and recommended high doses to decrease the shortage of available K in the soil. They also reported that the NE based fertilizer recommendation enhanced wheat productivity and profitability for growers. NE recommendations of nutrients were made after considering for the inherent status of available nutrients in soil, nutrient equilibration at cropping system level in the concerned plot and attainable yield. Therefore, NE recommendations provided more balanced application of fertilizers in comparison with different blanket fertilizer recommendations (Sapkota *et al.*, 2014).

Further, Jat *et al.* (2018) showed the significantly higher results of all the yield attributing characters of wheat under SSNM-NE compared to FFP and other fertilizer recommendation in maize-wheat system. According to Mondal *et al.* (2018), NE provided 11% more grain productivity over fertilization at recommended rate and superiority towards higher benefit-cost ratio. Mitra *et al.* (2019) reported higher N, P and K uptake under NE based fertilization over recommended dose of fertilizers (RDF) under ZT but higher N and P uptake under NE based fertilization over RDF and statistically similar K uptake in NE recommendation and RDF under CT. They also reported significantly broader nitrogen use efficiency economically in NE based treatments which were mainly because of balanced N fertilization and better N utilization leading to more productivity of wheat. However, there is also a need to improve NE-wheat software through more validation trials as the grain yield obtained by following the recommendation of this software was considerably lesser than the targeted grain yield (Seth *et al.*, 2019).

CONCLUSION

NE-Wheat tool is competent of providing proper fertilizer source, rate, application time, place and application method guidance to achieve optimum crop response. It is formulated using the data of on-farm experiments recorded from the various agro-ecological zones of South Asia and becoming a powerful nutrient decision taking computer-based tool, which can be smoothly and efficiently used by the crop advisors and farmers or computer-trained farmers. The Nutrient Expert-Wheat model also provides an analysis of production economics to attract the farmers towards the change in their nutrient application schedule related to yield targets and profits. With the above-described capabilities, Nutrient Expert tool can improve the skill of extension specialists to create the SSNM based fertilizer doses of small and marginal wheat farmers.

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