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NITROGEN USE EFFICIENCY IN WHEAT

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INTRODUCTION

Internationally, wheat is the leading vegetal protein source in human food, with a protein content of 13 per cent, which is comparatively large relative to other major cereals and staple foods. High grain yield with appropriate protein content, particularly for bread wheat (*Triticum aestivum* L.), is an important crop improvement objective. Unfortunately, it has been shown that these two characters are genetically negatively linked in different cereals, including wheat, although this correlation can be broken down by sufficient supply of nitrogen (N) late in crop development. Nitrogen fertilizers are used as an important agronomic tool to enhance both production quality and quantity in all grown plants. Current agricultural and economic environmental concerns, however, require farmers to continually optimize the use of nitrogen fertilizers over the growing season to prevent nitrate pollution while, maintaining their economic margin. Therefore, it is becoming increasingly essential to breed for cereal cultivars that absorb and metabolize nitrogen most effectively for the production of grain or silage. Such crops would make greater use of supplies of nitrogen fertilizer providing greater returns with better protein content.

NITROGEN AND WHEAT

Wheat is more responsive to higher dose of nitrogen whereas, sensitive to less nitrogen nutrition similarly to most cereal crops. It grows fast if there is abundant available N in the soil which is most important to fulfill plant demand. Reduction in plant vegetative growth (tillering) appears if there is a less soil N which leads to reduction in grain yield. In the greater part of the plants including wheat symptoms of N deficiency show up in older leaves as yellow by uprightness of less chlorophyll content.

Wheat production includes application of nitrogen fertilizer previously or at sowing or six week to about two months after sowing. Nitrogen is accessible in many soils in the inorganic structures as N_2, NH_4^+ and NO_3^- and in the organic structure as urea and amino acids. The predominant type of N utilized by wheat plants is regularly NO_3^- which is seeing frequent in aerated, warm and pH adjusted natural ecosystems and agricultural soils.

Urea is a cheap form of dry fertilizer and most widely used fertilizer in wheat and other crops. It is powerful when broadcast, followed by application after rain. Utilization of N fertilizer regularly develops initial root frameworks that lead to the development of vigorous root systems that recover nitrogen

fertilizer and nitrogen from the soil. Nitrogen uptake relies upon root architecture and accessible moisture, so topdressing of nitrogen fertilizer for example urea, relies upon soil moisture to be available immediately after N application. The requirement of nitrogen fertilizer by plant at early development stage is little since, plants are young and depend on leftover N in the soil. As plants reaches development and maturity stage, demand for nitrogen will increase this demand will be met with extra applications. The plants extend peak demand at tillering, heading and grain filling stages. At the point when there is deficient N at the seedling stage there is a decrease in tillering (expanded tiller mortality) and loss of soil water from dissipation while, excessive seedling N leads to lodging, foliar diseases and haying-off. Split application techniques that respond to plant demand at various development stages is an important approach that improves N use efficiency (NUE) by plant and decreases N loss because of volatilization, denitrification or draining.

IMPORTANCE OF NITROGEN USE EFFICIENCY (NUE)

Traditional varieties have been replaced in the post-Green Revolution era by a few selected and widely adapted semi-dwarfs, early maturing; high-yielding, disease-resistant varieties that demand high N input conditions. By 2050, the amount of fertilizers consumed is anticipated to have doubled, rising from 112 Mt in 2015 to 236 Mt. However, the utilization of nitrogen fertilizer is not very effective. Nitrogen applied always vanishes from the plant-soil system by a proportion of 50–70%. With the exhaustion of natural resources like nutrients and water, the excessive intake of commercially accessible fertilizers has resulted in the degradation of the quality of the air, soil, and water. When there is a surplus of nitrogen available compared to the demand from crops, nitrogen accumulates in the soil, rendering plants vulnerable to various loss pathways. To reduce the negative effects of increased yield on the environment and natural resources, it is vital to increase the resource use efficiency of wheat crops. Enhancing nitrogen use efficiency (NUE) in wheat must be a priority in breeding programmes in order to manage sustainable feeding for the increasing global population and limit the impact of increased fertilizer use on climate change.

Nitrogen use efficiency is a way of understanding the relationships between the total nitrogen input compared to the nitrogen output. In its most basic form nitrogen use efficiency can be described from the grain yield (kg) per unit (kg) of total available nitrogen (applied nitrogen + soil mineral nitrogen).

Most crop plants, including wheat, are inefficient in the uptake and to use applied nitrogen fertilizer. This emphasizes the breeding of wheat cultivars with enhanced nitrogen use efficiency to avoid excessive fertilizer input and maintain an acceptable yield. Nitrogen use efficiency research in India, focusing primarily on the responsiveness of wheat genotypes to high-input supply. But consistency in a variety's output (yield and quality) under different concentrations of nitrogen input and climatic conditions varies and acts as a major goal for breeders.

Therefore, developing wheat lines that increases yield with minimum N inputs is a priority in the present situation. In fields with low nitrogen fertility or low nitrogen input, two fundamental methods can be taken to sustainably enhance crop productivity. First, it

is possible to develop innovative agronomic methods to better use organic matter nitrogen, and nitrogen inputs from biological fixation and atmospheric deposition. Instead of focusing solely on nitrogen supply, the second strategy would be to reduce plant demand for nitrogen by breeding. This strategy can also assist to tackle the constraints of productivity in nitrogen-poor fields and nitrate leaching issues, and can help to decrease dependence on finite resources used to generate synthetic nitrogen fertilizers and decrease fertilizer expenditure.

NEED FOR CONDUCT OF NITROGEN USE EFFICIENCY RESEARCH IN WHEAT

The majority of Indian soils are low in soil N available for plants. A mega wheat variety, HD 2967 which occupies major area in the northern Indo-Gangetic plains of India is the highest yielding genotype at the recommended dose of N, *i.e*. 120kg ha^{-1}. If germplasm can be identified as having higher NUpE and NUtE (which are major components of NUE under lower N application), then it may replace the HD 2967 with the advantage of the reduced N fertilizer application and lower pollution rate related to N fertilizer. Therefore, most likely NUE will be relevant even if the objective is to select genotypes requiring low Nf for the same or higher yield potential. Unless we don't have improved NUE, the probability of reducing N application will be difficult.

CONCLUSION

The huge application of nitrogen (N) fertiliser on farms since the Green Revolution has significantly enhanced global food production. Nitrogen is essential for increasing crop production and lowering food security risks. In fact, it has been observed that N fertiliser can increase grain yield. However, overuse of N can have a range of adverse effects, including soil acidification, greenhouse gas emissions, and water contamination. Therefore, for sustainable global agricultural production and climate change mitigation, there must be a balance between nitrogen intake and nitrogen use efficiency (NUE). Breeding N-efficient wheat cultivars is one strategy for lowering nitrogen fertilizer inputs while maintaining acceptable yields. Improving NUE is pivotal for sustainable crop growth and yield especially under low nitrogen soils.