

Regulation of nitrate absorption in plants

July 7, 2022

In news—A team of researchers from National Centre of Biological Sciences and Tata Institute of Fundamental Research, Bengaluru (NCBS-TIFR) have found a new pathway that regulates nitrate absorption in plants.

A brief note on the new method-

- The **researchers studied the gene MADS27, which regulates nitrate absorption, root development and stress tolerance, is activated by the micro-RNA, miR444,** therefore offers a way to control these properties of the plant.
- They studied this **mechanism in both rice (monocot) and tobacco (dicot) plants.**
- **The micro-RNA 'miR444' is specific to monocots. When this is not made,** its target, **MADS27, is produced in higher abundance,** and it improves biosynthesis and transport of the hormone auxin, which is key for root development and its branching .
- This regulatory **miR444 switch is known to turn off at least five genes called MADS box transcription factor genes.**
- The **speciality of the MADS box transcription factors is that they function like switch boxes of their own.** They **bind to their favourite specific DNA sequences** and they switch the neighbouring genes “on.”

Controlling nitrate absorption in plants

A novel pathway has been found, which can use gene editing to achieve this objective



Approach: The researchers used rice and tobacco plants to study the mechanisms. **SPECIAL ARRANGEMENT**

■ Plants mainly absorb nitrogen from the soil in the form of nitrates and ammonium

■ An important macronutrient, nitrogen is a part of chlorophyll, amino acids and nucleic acids

■ There is a need to regulate and optimise nitrogen intake in plants, so that the excess is not dumped in soil and water

■ The hormone auxin is responsible for well-developed roots across all plants, influencing nitrate absorption

ALTERNATE PATHWAY

■ The regulatory micro-RNA switch - miR444 - is known to turn off at least five genes

called MADS box transcription factor genes

■ A target gene of miR444 called MADS27, has a three-pronged effect: regulating nitrate absorption and root development, and stress tolerance

■ Tinkering with MADS27 may help regulate nitrate absorption and engineer abiotic stress tolerance

About Nitrogen-

- It is one of the **most important macronutrients needed for development of a plant.**
- It is a **part of chlorophyll, amino acids and nucleic acids**, among others.
- It is **mostly sourced from the soil** where it is mainly absorbed in the form of nitrates and ammonium by the roots.
- Nitrates also **play a role in controlling genome-wide gene expression** that in turn regulates root system architecture, flowering time, leaf development, etc.
- Thus, while a lot of action takes place in the roots to absorb and convert nitrogen into useful nitrates, the absorbed **nitrates in turn regulate plant development apart from being useful as a macronutrient.**
- However, the **overuse of nitrates in fertilizers, for instance**, can lead to the dumping of nitrates in the soil which leads to accumulation of nitrates in water and soil.