Jasmonate Hormone and Rice Productivity

Why in News

A new study by a team of scientists at **National Institute of Plant Genome Research (NIPGR),** New Delhi suggested that targeting a specific plant hormone **Jasmonate (JA)** would help rice plants have greater tolerance to potassium (K) deficiency and improve productivity.

Key Points

- **Findings:**
  - The **overexpression** of a **gene** called **OsJAZ9** helped make rice plants more tolerant of potassium deficiency.
  - There was an enhanced accumulation of **JA-Ile —** a **bioactive** form of the hormone **Jasmonate (JA),** in OsJAZ9 overexpressing rice, on potassium deficiency.
    - The **JA-lle** helps in modulating various K transporters and root system architecture.
    - **JA-Ile** contributes to several aspects of plant growth and development and levels increase under stress conditions.
  - The study suggests that targeting research towards **JA** could help achieve both, **nutrient- efficient** crops and **protection against pests.**
  - JA is often associated with the plant's **defence against biotic factors** like insects, pests and other pathogens.

- **Potassium.** Potassium (K) is considered a **macronutrient** for plants and is the most abundant cation within plant cells.
    - **Significance of Potassium:**
        - Plants require, among other things, a **high and stable concentration** of potassium ion **to activate many enzymes** that are involved in **respiration and photosynthesis.**
        - Potassium is also involved in key cellular processes such as **energy production,** and **cell expansion.**
            Cell expansion is the process of taking cells extracted from tissue, culturing them in the lab and encouraging them to reproduce.
    - **Potassium Deficiency:** It affects plants by inhibiting the growth of the roots and the shoots.
        - Studies have shown that plants that are deficient in potassium are more susceptible to salt, drought, chilling and other abiotic and biotic stresses.
        - Potassium deficiency occurs frequently in plants grown on sandy soils resulting in a number of symptoms including curling of leaf tips and yellowing (chlorosis) of leaves, as well as **reduced growth and fertility.**
    - **Potassium Availability to plant Roots:** Despite being among the most abundant minerals in the soil, its availability to plants is limited.
        - This is because most of the soil potassium (about 98%) is in **bound forms** and its release into the soil solution is far slower than the rate of its acquisition by the roots.
        - The availability of potassium in the soil solution or exchangeable form depends on **multiple factors** like **soil acidity,** presence of other **monovalent cations** like sodium and ammonium ions and the **type of soil particles.**

Macro and Micro-nutrients

- **Macronutrients** are divided into two groups: **primary** and **secondary.**
- The **primary macronutrients** are those that are needed in the highest concentration: **nitrogen (N), phosphorus (P), and potassium (K).** In fact, these three primary nutrients are needed in higher concentrations than the rest of the macronutrients combined.
- **Secondary** macronutrients are also required for sustained plant health, but in lower quantities than the primary macronutrients. **Calcium (Ca), Magnesium (Mg), and Sulfur (S)** comprise the secondary macronutrients.

- **Micronutrients** are also essential to plant development and growth but are needed only in trace amounts, compared to their macro-counterparts. The seven critical micronutrients are:
    - Boron (B)
    - Zinc (Zn)
    - Iron (Fe)
    - Manganese (Mn)
    - Copper (Cu)
    - Molybdenum (Mo)
    - Chlorine (Cl)

Way Forward

- The **Green Revolution** of the 1960s was driven by another plant hormone called **Gibberellins (GA).** JA hormone can be the new focus.
- **Future agriculture** has to be **input efficient** rather than input intensive. The genetic resources for improving fertiliser use efficiency in rice which is of prime value for achieving sustainable agriculture must be stressed upon.

Source DTE