## Nitrate absorption

- Researchers led by those from the National Centre of Biological Sciences, Tata Institute of Fundamental Research, Bengaluru (NCBSTIFR), have found a new pathway that regulates nitrate absorption in plants.
- The gene MADS27, which regulates nitrate absorption, root development and stress tolerance, is activated by the micro-RNA, miR444, therefore offering a way to control these properties of the plant.
- Nitrogen is one of the most important macronutrients needed for the 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.
- The presence of nitrates is important for the plant development and also for grain production.
- However, the overuse of nitrates in fertilizers, for instance, can lead to the dumping of nitrates in the site which leads to accumulation of nitrates in water and soil.
- This accumulation adds to soil and water pollution and increases the contribution of greenhouse gases. To avoid this, there should be the optimal use of nitrates.
- Also, since the whole process of nitrate absorption takes place in the roots, a well-developed root system is needed for taking place optimal.
- At one level, it is known that the hormone auxin is responsible for well-developed roots across all plants.
- A number of genes are known to help with auxin production, improved nitrate transport and assimilation in plants.
- In addition to this route, several gene regulatory switches that regulate nitrate absorption and root development, such as the micro-RNA, miR444, are known in monocot plants, such as rice.
- This regulatory miR444 switch is known to turn off aMADS-box five genes called MADS box transcription factor genes.
- The specialty of the MADS-box transcription factors is that they

 

function like switch boxes of the favourite.

- They bind to their favorite specific DNA sequences and they switch the neighbouring genes "on."
- The researchers have studied a target gene of miR444 called MADS27, a transcription factor that hasn't been studied well before.
- They have found that this transcription factor has a three-pronged effect on the plant.
- First, it regulates nitrate absorption by switching "on" proteins involved in this process.
- Second, it leads to better development of the roots by regulating auxin hormone production and transport.
- Finally, and somewhat surprisingly to the researchers, it helps in the abiotic stress tolerance by keeping the main stress player proteins "on."

**THE HINDU**

## Rise in temperature

- Global emissions are expected to cause the planet to continue heating rapidly over the next few decades, prompting the global average temperature to overshoot the Paris agreement's target, which aimed to limit warming to between 1.5°C and 2°C.
- The results suggest that a temporary overshoot would cause waves of irreversible extinctions and lasting damage to tens of thousands of species.
- Just a few years of global temperatures above 2°C could transform the world's most important ecosystems.
- The consequences of this exposure could be irreversible and include the tropical forest turning into a savanna.
- The world would lose a critical global carbon sink, leaving more planet-warming gases in the atmosphere.

**THE HINDU**

## Patent and monopolies

- In 2005, lawmakers from all political parties amended the Indian patent law to ensure that the Indian patent office did not grant monopolies on old science or for compounds already in the public domain.
- The new law now prevents drug corporations from indulging in "evergreening", a common abusive patenting practice aimed at obtaining separate patent monopolies relating to the same medicine.
- And to bring this to the notice of the patent examiners, the amended patent law allowed any person to file a pre-grant opposition 'anytime' before the patent office decides to grant or reject a patent application.

- Evergreening monopolies on medical products is a lucrative game for pharmaceutical corporations allowing them to charge high prices.

**THE HINDU**

## Spatial transcriptomics

- Researchers are getting closer to their goal of revealing exactly where in a cell or tissue each gene is expressed. Spatial transcriptomics allows them to study gene expression in samples.
- The resulting 'atlases' of spatial information can tell which cells make up each tissue, how they are organized and how they communicate.
- Spatial transcriptomics is an overarching term for a range of methods designed for assigning cell types to their locations. This method can also be used to determine the subcellular localization of mRNA molecules.

**THE HINDU**

## CAPSTONE

- The National Aeronautics and Space Administration's (NASA) CAPSTONE spacecraft launched from New Zealand on June 28 should reach the Moon by November 13.
- CAPSTONE will study the lunar orbit where NASA plans to lodge a space station that will orbit the Moon in a stable path, making it easier for astronauts to reach more parts of the Moon.

**THE HINDU**

## Antibiotic development

- Antimicrobial resistance (AMR) is a looming public health crisis impacting every country globally with a disproportionate impact on lives and livelihood in low and middle-income countries.
- A recent report from the Global Research on AntiMicrobial resistance (GRAM) project found that in 2019, an estimated 4.95 million people suffered from at least one drug-resistant infection and AMR directly caused 1.27 million deaths.
- AMR is one of India's major public health problems, directly contributing to about 30% of deaths.
- These are due to multi-drug resistant (MDR) hospital-acquired infections in many cases.
- Over 30% of the COVID-19 deaths in India could be attributed to our failure to treat the secondary bacterial infections caused by MDR pathogens with the appropriate antibiotics.
- Irrational antibiotic use by the medical community, the general public, and the farmers generate drug-resistant superbugs.

- Inadequate infection control measures in the hospitals and the sanitation issues in the community result in the dissemination of these superbugs.
- To tackle the AMR crisis, we need robust investment in research and development of new antibiotics, rapid and affordable diagnostics, strengthening infection control and prevention practices, formulating and implementing antibiotic stewardship programs across the country, and ensuring equitable access to life-saving antibiotics.
- One such immediate intervention is a welcome move by the Government of India to pass legislation banning the use of streptomycin and tetracycline in agriculture and the growth promotional use of Colistin in poultry farming.

**THE HINDU**

## How are earthquakes measured?

- Earthquakes are measured by seismographic networks, which are made of seismic stations, each of which measures the shaking of the ground beneath it.
- In India, the National Seismological Network does this work.
- It has a history of about 120 years and its sensors can now detect an earthquake within five to ten minutes.
- The wave parameters are measured, not the total energy released.
- There is a relationship between the quantum of energy released and the wave amplitude.
- The amplitude of the wave is a function of the time period of the wave.
- It is possible to convert the measured wave amplitude into the energy released by that earthquake.
- This is what seismologists call the magnitude of the earthquake.

### What is the Richter magnitude scale?

- This is a measure of the magnitude of an earthquake and was first defined by Charles F. Richter of the California Institute of Technology, U.S., in 1935.
- The magnitude of an earthquake is the logarithm of the amplitude of the waves measured by the seismographs.
- Richter scale magnitudes are expressed as a whole number and a decimal part, for example, 6.3 or 5.2.
- Since it is a logarithmic scale, an increase of the whole number by one unit signifies a tenfold increase in the amplitude of the wave and a 31-times increase of the energy released.

**How are zones designated?**

- Based on seismicity, intensity of earthquakes experienced, and geological and tectonic qualities of a region, countries are divided into several zones.
- In India, for example, there are four zones, designated Zone II-Zone V.
- Among these, Zone V is the most hazardous and Zone II the least hazardous.

**Can you build early warning systems for earthquakes?**

- Since the parameters of the earthquake are unknown, it is near impossible to predict an earthquake.
- The problem with earthquakes is that they are heavily dependent on the material property, which varies from place to place,
- If there are elastic waves propagating through a material, there are two kinds of waves the primary wave which reaches first, and the second one called the secondary wave, which is more destructive.
- Suppose the primary wave is measured, and we have efficient computer systems, all the inputs, and excellent data collection, then it can be said that a possible earthquake of this much magnitude and energy has occurred and this could lead to a ground amplitude which could be destructive.
- If it is known that the amount of energy released is extremely high, trains and power grids can be shut down and damaged Minimized.
- "The most successful early warning systems are in Japan.
- They have several hundreds of thousands of recording devices. Responses are sent to a central point where they estimate whether it is large enough to form a tsunami or some other hazard, and precautionary steps are taken," he points out.

**THE HINDU**