Plant Pandemics

Why in news?

Plant pandemics have been forecasted as the next big contagion and posing threats to global food security.

What is Plant pandemic?

- **Plant pandemic** - It is the disease outbreak that spreads across continents or subcontinents and causes mass mortality in plants.

Major Pandemic Plant Diseases and Outbreak			
Disease	**Pathogen**	**Origin**	**Outbreak**
Wheat blast disease	Mangalore oryzae Triticum (Moot) - Fungus	South America - Brazil	In Bangladesh in 2016 and 2018 outbreak in South Africa and Zambia
Banana Fusarium Wilt	Fusarium oxysporum - Soil fungus	Central America	By 1960, it spread to tropical America, the Caribbean and West Africa
	Fusarium Tropical race 4	Taiwan, East Asia	Spread to 20 countries, including India
Maize lethal necrosis	Combination of 2 viruses—maize chlorotic mottle virus (MCMV) & sugarcane mosaic virus (SCMV)	United States in the 1970s.	Now prevalent in Rift valley region East Africa, Southeast Asia, and South America.
Coffee leaf rust	Fungus Hemileia vastatrix	East Africa	Spread to all coffee cultivation areas in Asia, the Americas and Africa
Cassava brown streak	Cassava brown streak virus	Tanzania in 1935	Now spread to central and southern Africa.
Late blight disease - Tomato & potato	Fungus Phytophthora infestans		In India, the disease continues to cause outbreaks since the 1800s.

Citrus tristeza disease	Closterovirus	First recorded in Argentina in the 1930s	Spread to South Africa, West Africa and California

What are the factors driving plant pandemics?

- **Climate Change** – With the consequent expansion of warmer and more humid conditions to higher latitudes, tropical diseases are spreading to temperate and higher latitudes.
- **Higher global trade** - *Introduction of foreign crops* and flow of agricultural produces across the globe enables the pathogens to spread across the globe favouring disease outbreak
  - In the *1980s, citrus plants infected by Citrus tristeza virus* were shipped in vast numbers to unaffected countries, leading to a large-scale infestation and extending the pandemic.
- **Increased industrial Farming** – Large scale mono cropping pattern facilitates the quick spread of the pathogen across the field.
  - High-density monocultures soybean and wheat are *compromised by the fungus Phakopsora pachyrhizi*.
  - Wheat blotch caused by the fungus Zymoseptoria tritici.

What are the impacts of plant pandemic?

- It could provoke a humanitarian crisis that could deprive people of livelihood and lead to widespread hunger.
- **Threats global food security** – Plant pandemics affects the yields of diverse food crops and cause food shortage across the globe
  - Yield losses of more than 50% have been documented during severe epidemics.

Fungal disease outbreak could reduce global wheat production by 13% by 2050.

- **Famine** – Plant pandemics causes famine and large-scale death
  - **1943 Bengal famine** - Caused by Cochliobolus miyabeanus, a brown spot disease in rice led to the death of over 2 million people.
- **Loss of Livelihood** – Farmers lose their livelihood and are pushed to poverty.
- **Promote out migration** – Loss of crops causes farmers and people to migrate to other regions for food and livelihood.
  - Between 1845 and 1852, Phytophthora infestans wiped out potato

crops in Ireland, resulting in famine & mass migration.

- **Damage ecosystem** – Pathogen outbreak disrupts the natural food web and ecosystem functions.

Impact of Climate Change in Plant Pandemic
• **Support pathogen transmission** – Extreme weather events like hurricanes can *transport pathogen* spores over continents. - In a warming climate, *wheat blast will spread to countries* that so far remain untouched. • Rise in global warming from 1.5°C to 4°C is expected to increase the *risk of Pierce's disease*. • **Reduce plant immunity** – Elevated temperatures can *suppress plant immunity*, leading to increased pathogen infection. • **Increase virulence** – *Elevated carbon dioxide levels* in the atmosphere are also seen to *increase the severity* of certain pathogens. - For example, *powdery mildew that infects gourds*.

***Pierce's disease** is a bacterial disease that affects grapevines and can cause epidemics in vineyards of southern Europe, particularly in France, Italy and Portugal.*

What are the challenges in controlling plant pandemic?

- **Ineffective fungicides** – Existing fungicides are ineffective in controlling these newly evolved pathogens.
- **Increasing resistance** – High usage of fungicides is making the pathogens like Magnaporthe oryzae Triticum to develop higher resistance to those fungicides.

***Magnaporthe oryzae Triticum (MoT)**, a fungus that attacks wheat crops and can wipe out the entire harvest in a matter of days.*

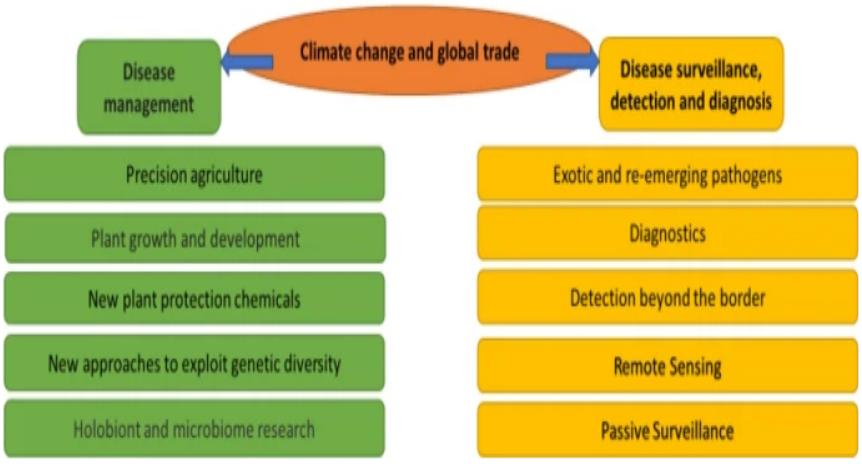
- **Complexity pathogen** – Physiological and genetical complexity of the pathogens makes it difficult to understand their interaction with the target crops.
  - For example, in case of MoT fungal infection, there is difficulty in deciphering the gene responsible in MoT or in wheat that confer durable resistance to it.
- **Evolution** - Pathogens are evolving fast to reproduce quickly infect new hosts.

- As the fungus spreads to wider geographies, it may evolve to become more virulent or infect other species.
- **Inter species spread** – Some pathogens could jump to other crops.
    - For instance, pathogens may jump from wheat to paddy.

Measures by India to Tackle Magnaporthe oryzae Triticum (MoT)
• **Burning infected crops** – The state's agriculture department directed farmers in the villages, which had reported wheat-blast-like infection, to set fire to the standing crops to prevent the fungal spores from spreading further. - 400 ha of wheat fields were reportedly set ablaze. • **Declaration of Wheat holiday** - Since the fungus can survive on seeds for up to 22 months, the government also announced a "wheat holiday" for three years in the state. • **Banned cultivation** – India have banned cultivation of the crop within 5 km of the border with Bangladesh. • **Enhanced surveillance** – The Border Security Force was also instructed to keep a vigil on grain trading. • **Growing alternative crops** – Farmers in the border villages of West Bengal are reluctant to grow wheat and are shifting to banana, maize and lentils.

What lies ahead?

- Diversify crops to limit the outbreak and yield loss.
- Create genetic libraries of crops and pathogens to mitigate the future risk.
- Screen seeds and certify them for the fungus and quarantine measures to help thwart its spread to other countries.
- Model the global food system using advanced technologies like data analytics to forecast the disease outbreak in plants.
- Implement a greater disease surveillance by improved detection.



References

1. Down To Earth| Magnaporthe oryzae Triticum Infection across Ind0-Bangladesh Border
2. Down To Earth | Plant Diseases – Causes, Origin and Impacts
3. Down To Earth| Efforts to be taken to control Plant Pandemic

