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Perspective

GLOBAL FOOD SECURITY: PLANT HEALTH ISSUES NEED ATTENTION

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Plant pathogens and pests are responsible for major yield losses in important food crops worldwide. Plant disease epidemics caused by the plant pathogens have exerted a far greater impact on crop production, thus calling for concerted and continuous efforts to contain them. Pathogen related crop losses disproportionately affect food-insecure populations in poor and developing countries, often resulting in famines (Oerke, 2006; Savary *et al.,* 2019). The developed world cannot visualize the worst and desperate conditions the common people in the developing world have to pass through during such scenarios.

Van der Plank (1963) raised the understanding and vision of Plant Pathologists about plant disease epidemics, which have always influenced man's food, health and his economics. Following two examples bring forth a horrible influence plant disease epidemics have exerted on mankind. In the middle of 19th century; leaf blight disease caused by *Phytophthora infestans* struck potato vines in Ireland and rotted the potato tubers. Since there was no alternative to their staple food diet, the people suffered with malnutrition, starved, and an estimated 1.5 million Irishmen died. Almost 100 years after the potato famine, another famine struck in Bengal, India due to a fungal disease *Helminthosporium oryzae* and killed an estimated 2 million people.

And the list of these plant disease epidemics is quite exhaustive, putting clear emphasis on need for effective plant disease management based on epidemiological strategies. The relationship between epidemiology and plant disease management is of longstanding. Use of simpler approaches for analysis of disease progress curves and integrated measures such as recording area under disease progress curves will play a key role in defining disease behaviour in the field and taking strategic decisions on effective disease management. Embedding molecular biology techniques with epidemiology studies can help us achieve detection of latent infections and spatial spread of important plant diseases for their better management (Singh, 2013).

Plant pathogens and crop yield losses

Up to 40 per cent annual yield losses occur in maize, potato, rice, soybean and wheat crops worldwide. Crop losses caused by fungi, bacteria, viruses and nematodes alone cost the global economy USD 220 billion annually (Savary *et al.* 2019). These losses may be prevented, or contained, by implementing crop protection measures including cultural (cultivar choice, crop rotation, tillage, mechanical weeding, etc.), biological (use of biological control agents BCAs, parasitoids, predators etc.), and chemical measures (bio pesticides and synthetic pesticides).

Continuous disease monitoring and management of pests are critical for getting sufficient quantity and quality of the produce. A set of preventive and curative actions often needs to be followed to protect crops from pests, based on rationale of integrated pest management principles (Barzman *et al.,* 2015). These principles should be applied in a timely manner at different stages from pre-sowing to post-harvest of a given crop. Any variation in these interventions may lead to irreversible losses at different stages of a crop cycle , thereby altering the quantity and quality of a harvest with a huge burden on food security and safety (Lamichhane and Reay-Jones, 2021).

According to He and Creasey Krainer (2020), conventional methods such as biological and pesticide application have been utilised for decades, although it is well known that they do not eradicate the pathogens completely. The issue of plant disease management becomes more serious in case of perennial agricultural commodities which require huge initial investments and continuous adoption of plant protection and other agro-management practices.

Viruses make up almost half of the plant disease causing pathogens, at an annual global cost of more than USD 30 billions (Nicaise, 2014). Rice is cultivated in more than 100 countries supporting nearly half of the world's population, and is at risk from number of diseases including multiple vector-transmitted viruses, at a cost of USD 1.5 billion annually. In 2019, the International committee on Taxonomy of viruses recognized 1484 plant viruses. These are grouped on the basis of viral genomic structure.Belonging to the economically important DNA virus family, Geminiviridae, Cassava mosaic begomovirus infection resulted in an annual crop loss of 25 million tons. With half a billion people relying on this staple for a source of calories, epidemics of this virus directly lead to famine. Members of Bromoviridae,

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Closteroviridae, Luteroviridae and Potyviridae families are all positive–sense single stranded RNA viruses like SARS-Cov-2, and are economically the most damaging group of plant viruses. Bromoviruses cause disease epidemics in fruits, vegetables and feed crops. The most widely distributed viral disease of cereals, Barley yellow dwarf luteovirus, of the Luteoviridaee family, infects barley, maize, rice, oat, and wheat crops which sustain the world's population (Nicaise, 2014).

In the management of viral diseases, the expression of weaker related viruses or viral proteins leads to innate immunity/ disease resistance in plants. Antiviral resistance (R) genes prevent systemic spread by eliciting programmed cell death, and RNA silencing prevents viral replication (Soosaar *et al*.,2005). Successful RNA silencing based genetic resistance has been demonstrated in bean, papaya, pepper, plum, potato, squash and tomato (Khalid *et al.,* 2017). Bioengineering pathogen resistance could control plant pandemics, reduce yield loss and promote food security; however, limited funding and negative public opinion about genetically modified crops are obstacles to their development, subsequent cultivation and consumption.

The Covid crisis and agriculture

Agriculture sector was hit hard by the Covid-19 pandemic that started in the year 2019 resulting in sudden disruptions in the food supply chain, affecting the livelihood of millions of poor people and causing a major health crisis. Problems that arose due to aggregation and distribution of food items, pushed significant additional population around the globe below the poverty line, while the number of undernourished people increased significantly. The pandemic has affected the entire food system and has laid bare its fragility (WHO, 2020). One important learning from this pandemic is that our health depends on what we eat. The Covid-19 global outbreak should be taken as a wakeup call for a joint reflection among key stakeholders, who are concerned about human, veterinary and plant health (Balamatti, 2020).

Funding discrepancy

The Covid -19 pandemic has influenced our way of life and emphasized the need to review and prepare for future outbreaks. Reduced funding disproportionately affects agricultural research resulting in fewer investigators and international collaborations and ultimately exacerbating plant disease and crop loss.

Currently, there is large funding discrepancy between human and crop diseases. Just to quote an example, the 2020 US budget for only one human disease i.e. HIV research is USD 2.6 billion whereas the entire budget for agricultural research is about USD 150 millions only (He and Creasey Krainer, 2020). The story is the same with all the countries and funding priorities for agricultural research are abysmally low. Funding the crop disease research continues to decline, partly due to the sporadic nature of outbreaks.

In the coming decades, however, population growth will demand increased agricultural output, while we battle against environmental changes that cause drought, flooding and exacerbated plant diseases threatening global food production. Hence, there is absolute need for the Government and other agencies to step up investments and funding in agricultural research and innovations in crop protection.

International consciousness about biosecurity and plant health

Covid-19 pandemic has also shown the world how adopting preventive measures is essential to secure global health from the introduction and spread of devastating pests (Lamichhane and Reay-Jones, 2021) . We know that this fundamental truth applies to human health as it does to animal and plant health.

More specifically to plant health, re-designing of phytosanitary standards will certainly help build the resilience in agriculture that can readily face similar challenges in the future. Covid-19 pandemic may have affected a range of measures needed to ensure plant health. They include quarantine measures, implementation of plant health regulations, especially those related to plant passporting requirements . It is yet unclear whether the existing biosecurity systems remained fully operational during the pandemic for an effective surveillance and management of potential biological threats to plant health or whether these systems were relaxed or restricted to some extent.

We have to recognise that the future of global food security and safety is linked across borders. A weak biosecurity in one country not only threatens neighbouring countries and/or continents but the entire planet. Therefore, reviewing regulations and their implementation to secure crop protection, harvests and food supply is critical to safeguard food systems. Application of science-based preventive measures to contain invasive pests threatening global food security and safety is critical to protect plant health.

A new international consciousness about plant health was sought in the 15th commission on Phytosanitary Measures (CPM-15) - the governing body of the International Plant Protection Convention (IPPC) (FAO, 2020). It was recognized that international movement of people, goods, containers, and cargos, as well as the increasing volume of goods traded via e-commerce and climate change, are factors that increase the possibility for plant pests to be introduced and established in new

countries and regions. International travel and trade which has tripled in volume in the last decade, is also spreading pests and diseases.

To mitigate the effects of these risks, the world needs adoption of preventive measures at country level, as a standardised policy. These preventive mechanisms need to be implemented at regional and national levels. The IPPCs ePhyto Solution, has allowed countries to exchange electronic phytosanitary certificates throughout the pandemic, thus assuring the continuing safe trade of plants. This raised consciousness about biosecurity and plant health should be translated in the form of research grants and collaborations to achieve the desired goals.

Recognizing importance of plant health issues

Food and Agriculture Organization (FAO, 2022) has recognised the fact that both our health and the health of our planet depend on plants. Plants make up 80% of the food we eat and 98% of the oxygen we breath and yet they are under threat. Up to 40% of food crops are lost to plant pests and diseases every year affecting both food security and agriculture, which is the main source of income for vulnerable rural communities. The United Nation's General Assembly (UNGA) adopted the resolution A/RES/76/256 on 29th March 2022 and proclaimed the 12 May of every year as "The International Day of Plant Health" (IDPH). The resolution also invited the FAO of the United Nations in collaboration with International Plant Protection Convention (IPPC) for observance of this day. The idea behind this is to raise awareness that protecting plant health can help end world hunger, reduce poverty, protect biodiversity and the environment, and boost economic development. The resolution sets out that plant health is key to the sustainable development of agriculture required to feed a growing global population by 2050.

The United Nation's resolution adopted five specific objectives underlining the importance of healthy plants in survival of this planet. These are:

1. Increased awareness of the importance of keeping plants healthy.
2. Campaign to minimize the risk of spreading plant pests through trade and travel, by triggering compliance with international plant health standards.
3. Strengthening monitoring and early warning systems to protect plants and plant health.
4. Enable sustainable pest and pesticide management to keep plants healthy while protecting the environment.
5. Promote investment in plant health innovations, research, capacity development and outreach.

In view of today's global challenges, world requires food security. The increase in crop production is required to ensure supply of healthy food to its population. Global efforts are needed to accord due attention to plant health and reduce crop losses. This underlines the importance of healthy, disease free plants to the mankind.

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