



Review Paper

## Role of Bio security in Plant Health Management

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### Abstract

*Bio-security is a set of precautions or an approach that encompasses the policy and regulatory frameworks to prevent the introduction and spread of harmful organism (insect pests, pathogen or invasive alien species). It analyse relevant risks to human, animal, plant life/health and to the environment. In general "Bio-security is the safeguarding of resources from biological threats." Main focus of Bio-security program is to restrict the entry of any threat responsible for hazardous effect on environment by collaboration with Central government. Plant quarantine, national and international stalk holders play a key role in plant bio security program. Pest Risk Analysis, Survey and Surveillance are the different step to detect the pest incidence and also provide a direction for the further process of investigation and control. Bio-security advocates a strategic and integrated approach, to meet the consumer expectations in relation to the food safety, preventing and controlling relevant risk and zoonotic aspects of public health, safeguarding the resources and protecting environment and biodiversity. Agricultural Bio-security Authority of India regulates the import and export of plants, animals and related products, preventing the introduction of quarantine pests from other countries and implementing post-entry quarantine measures. Bio-security is an essential element in Plant health management by regulating different components require for plant growth and food production.*

**Keywords:** Bio-security, plant health management, sustainable agriculture, quarantine, pest risk.

### Introduction

In today's scenario main focus on to gain maximum food production by modifying different agricultural practices or by adopting new technologies, the introduction and release of living modified organisms (LMOs) and their products (e.g. genetically modified organisms or GMOs) as are resulting in greater incidence of diseases, spread of insect pests and hazards to public, animal, plant health, economy and food security. To prevent or manage the risks to plant health and to protect the environment, there is requirement for the development of a tool to manage this risk. In doing so, bio-security is an essential element to overcome this problem and direct relevance to sustainable agricultural development. In other words, bio security is a set of precautions or an approach that encompasses the policy and regulatory frameworks to prevent the introduction and spread of harmful organisms have relevant risks to human, animal, plant life/health and environment. The strategic and integrated approach of bio security provides a regulatory framework in association with higher authorities and policies to provide safety of food supply, prevent the zoonotic aspects of public health, ensure the sustainability of agriculture, and safeguard the terrestrial, freshwater and marine environments and biodiversity. Globalization in the world, ever-increasing requirement of food production, adoption of new technologies, legal obligations for signatories of relevant international agreements, movement of people across borders increase the incidence of pest and disease across the world,

dependence of some countries on food, import/ export are the important factors to meet the requirement of bio security at global level as well as for Plant Health Management. The increasing demand to gain more production by adopting new technologies and changing agricultural practices results in new hazards to health that are readily able to cross borders. Changing human ecology and behaviour also contribute to the greater incidence and spread of hazards. Due to which public awareness is increasing towards impact of adverse bio-security events and interventions<sup>1</sup>.

National programs are already in place to prevent, control and manage associated risks to life, health and environment but bio security work as a new concept by encompassing polices, planning, sciences and all the operations in a strategic way to safeguarding the natural resources from biological threats. The strengthening of policy and regulatory frameworks for bio-security in food and agriculture must be the main priority for their development. These policies and legislative frameworks need to include bio-safety, risk analysis and management which will provide an opportunity to harmonize terminology and methodology. Several commonalities in risk assessment and management across the sub-sectors and organisms which must ideally be addressed by the National Agricultural Bio-security System<sup>2</sup>. Risk Analysis of commodities and their management constitute bulk of the animal and plant health management, thus bio security would automatically occupy the centre stage in Agriculture and Plant health management.

## Regulatory Framework for bio-security

Codex Alimentarius Commission (CAC), the World Organisation for Animal Health (OIE) and the Commission on Phytosanitary Measures (CPM) are the International standard-setting organizations and bodies, develop standards for different bio-security sectors in accordance with their mandates. Responsibilities for sectors of bio-security at the international level are shared among a number of organizations and bodies. FAO plays a leading role in normative work and technical assistance, at the both national and international levels. FAO hosts the Secretariat for the Codex Alimentarius Commission, under the Joint FAO/WHO Food Standards Programme, as well as the Secretariat for the International Plant Protection Convention (IPPC). In addition, FAO's participation in the Standards and Trade Development Facility (STDF) aims to enhance collaboration between the three SPS-recognized standard-setting bodies and FAO, the World Bank, the World Health Organization (WHO) and WTO. In addition to the standards and related texts developed by the Codex Alimentarius Commission (CAC), the World Organization for Animal Health (OIE) and the Commission on Phytosanitary Measures (CPM), several other international legal authorities, agreements and texts are relevant to bio security. These include the Sanitary and Phytosanitary agreement (SPS) and to some extent, the Agreement on Technical Barriers to Trade (TBT Agreement), the Convention on Biological Diversity (CBD) its Cartagena Protocol on Bio safety, and the International Health Regulations.

At national level different stakeholders are involved in bio-security. Government agencies, scientific research institutes, specialist interest groups, nongovernmental organizations (NGOs), several branches of government, both the national and sub-national levels, general public, food safety, public health, agriculture, forestry, fisheries and the environment all have a vital role to play in Bio-security. However, other parts of government responsible for sectors such as trade, customs, transport, finance and tourism are also important in bio security, depending on national circumstances<sup>3</sup>.

**Areas of bio-security:** i. Human life and health (including food safety), ii. Animal life and health (including fish), iii. Plant life and health (including forests), iv. Environmental protection.

Bio-security approach in a holistic manner used to manage biological risks associated with food and agriculture and also focus to enhance productivity, sustainability and profitability. It also covers food safety, zoonoses, the introduction of animal/plant diseases and pests, introduction/release of living modified organisms and their products (e.g. genetically modified organisms or GMOs), their introduction and management of invasive alien species. Thus, bio-security is a wide-ranging aspects to the public health, plant health and protection of the environment. The overarching goal of bio security is to prevent, control and/or manage risks to life and health. In accordance with, bio-security is an essential element

of sustainable agricultural development and food safety at global level.

## Need of bio-security

In Agro ecosystem Humans, plant, animal life and environment are associated to each other. If any harm taken at one stage then it will affect whole ecosystem. If homeostasis of environment disturb then it will affect all associated entities. This is the fundamental rationale for an integrated approach to bio security development. Bio security hazards of various types exist in each sector and have high potential to move and establish. In respect of food chains, hazards can be introduced anywhere from production to consumption level. If any pest enters through import/export or any other mean then it can affect trophic levels. At the national and international level, there are likely to be significant benefits in integrating bio security activities to overcome these problems.

## Process of bio-security

Bio-security is a strategic and integrated approach require collaboration, high level support across different agencies, their agreement on purpose, scope and process, profile the bio-security context at the country level, assess existing bio-security capacity, describe the desired future situation of bio security, identify capacity needed to reach desired future and generate options to address identified needs are the essential components for bio security. Successful bio security program require conveying the information, needing to convince policy and decision-makers, to ensure transparency and best use of available resources, examine the context for bio-security at the national level. Bio-security issues, general needs, prevailing challenges and opportunities, context shape bio security goals, programs and activities for essentiality to establish bio-security as a national priority and ensure cross-sectoral collaboration and participation. Assess existing bio-security capacity by examine current situation of bio-security capacity and performance, ensure capacity building activities and provide broad framework for the successful development of bio-security system. Next steps for Bio-security program are to describe the desired future situation of bio-security (developing vision and goals across the bio security system, enhancement of the future outcome, effectiveness and maximized potential cross-sectoral gains), identify capacity needed to reach desired future and generate options (Bio security policy framework, legal and Institutional framework).

## Bio-security laws in India

India has a plethora of laws which deal with Bio-security but it needs to be noted that they do not stem from an understanding of the term. The pieces of legislation have been enacted with differing objectives and public concerns in mind. Though disparate and scattered, these pieces of legislation serve an essential function in specifically addressing the sectoral concerns, and they carry forth the intent contained in the

preambles. Likewise, the institutions, though numerous, have been established to serve the purposes of the original enactments.

## Constitution of India

Though there is no specific reference or use of the term Bio security in the Constitution of India, a number of its provisions are of relevance to understanding the legal framework dealing with bio-security in the country. The Constitution is also the key to understanding how the general legal set-up works.

## Fundamental rights

Part III of the Constitution of India contains the fundamental rights. Among these is the right to life, which is enshrined in article 21, and which has the most relevance for the legal framework for Bio-security. Since the late 1970s, the Supreme Court, which is the highest court of the country, has progressively widened the scope of the rights granted under this article. This has been achieved by giving an expansive interpretation of the term "life". As a result of judicial interpretation, the right to life has become a sort of repository of various human rights. Some of the pertinent rights thus included are: i. The right to health, ii. The right to a healthy environment, iii. The right to pollution-free water and air; and iv. Protection against hazardous industries.

**Federal scheme:** Since India has a federal Constitution, it necessarily provides for a division of power and functions between the centre and the federal units (states). The Indian federal system leans slightly in favour of the centre while keeping a federal pattern and framework. The Constitution has created three functional areas regarding law-making by the two components of the federal system.

These are: i. An exclusive area for the centre called the Union List, ii. An exclusive area for the states called the State List; and iii. A common or concurrent area in which both the centre and the states may operate simultaneously, though with the centre having overall supremacy, called the Concurrent List.

**Plant bio-security programme and its need:** "Plant bio-security is a set of measures designed to protect a crop or a sub-group of crops from plant pests at national, regional and individual farm levels."

Several control measures has been developed to control or manage exotic pests and diseases. Plant Bio-security program develops quarantine policies that protect the plant health from exotic pests. Threat or quarantine pest identification and pest risk analysis are significant components of plant bio-security. Plant Bio-security policies are based on our national and international obligations under the World Trade Organisation (WTO) and in particular the Sanitary and Phytosanitary (SPS) measures. Globalisation and movement of people across world are increasing the chances of spreading the diseases and exotic

pests among different forests and woodlands. Pests are mostly transported in soil or organic material, such as plant debris, that can be carried on footwear or by the wheels of vehicles and forest machinery. Diseases may also be spread via the equipment. Some pathogens are dispersed in water and so the risk of these being spread increases when conditions are wet<sup>3</sup>. Several insect pests and diseases were introduced into country and now become a serious threats to our plant health and environment viz., *Agrobacterium tumefaciens*, *Corynebacterium michiganense*, bacterial pathogens, Ficus mosaic virus, Grape fan leaf virus, *Puccinia helianthi* from Europe, North America, North America, South Pasific Asia, Africa respectively. Cottony cushion scale, *Icerya purchasi*, Citrus Pest introduced from Australia, San Jose scale, *Quadraspidiotus perniciosus*, apple pest from China and Woolly apple aphid, *Eriosoma lanigerum*, a pest of apple entered from European countries are now become a serious threat for our crops and plant health So there is essential to secure plant health by adopting Plant Bio-security.

**Plant health:** With increase in population, agricultural production has to be increased in order to feed billions of people. So for this we are adopting new technologies to enhance the production. But on the other hand, these technologies are affecting the plant health. So the main focus is plant health management.

**Threats affecting plant health:** Insects, nematodes, bacteria, virus and fungal pathogens are the serious threat for plant health. They affect the plant growth, development and the associated environment through which food production collapse, chances of diseases transmission and insect pest movement all over world increase. Some of the important threats are:

**Bacterial and Fungal Pathogens:** Bacterial wilt and ring rot of potato, Fire blight of apple and pear, Black pod of cocoa, Powdery rust of coffee, Sudden death of oak, South American leaf blight of rubber, Vascular wilt of oil palm, Soybean downy mildew, Blue mold of tobacco, Tropical rust of maize.

**Nematodes:** Pine wood nematode, Red ring nematode of coconut. Barley stripe mosaic virus, Coconut cadang cadang (Viroid), Palm lethal yellowing (Phytoplasma)

**Insect biotypes:** "A population of a pest species that differs from other populations of the species in its ability to attack a particular cultivar is known as biotype". The continuous growing of insect-resistant varieties may lead to certain physiological and behavioural changes in insect pests so that they are capable of feeding and developing on the resistant varieties. i. Hessian fly has developed 16 biotype, these are maximum in all insects but in insect groups maximum no. of biotypes developed in Aphids. ii. Biotypes in Rice brown plant hopper is 5 while in Rice gall midge no. is 13.

**Table-1**  
**Invasive alien insect species in India<sup>4,5</sup>**

Sr. No	Common name	Scientific name	Host	Year of Introduction
1.	woolly apple aphid	<i>Eriosoma lanigerum</i> (Hausmann)	Apple, pear	1889
2.	San Jose scale	<i>Quadraspidiotus perniciosus</i> Comstock	Apple	1911
3.	Lantana bug	<i>Orthezia insignis</i> (Browne)	Lantana, coffee, citrus, potato	1915
4.	Cottony cushion scale	<i>Icerya purchasi</i> (Maskell)	Cotton, <i>Acacia sp.</i>	1921
5.	Potato tuber moth	<i>Phthorimaea operculella</i> (Zeller)	Potato, tobacco, tomato, brinjal and beat	1937
6.	Diamond-back moth	<i>Plutella xylostella</i> (Linnaeus)	Cabbage, cauliflower, radish	1941
7.	Pine woolly aphid	<i>Pineus pini</i> (Macquart)	<i>Pinus sp.</i>	1970
8.	Subabul psyllid	<i>Heteropsylla cubana</i> Crawford	Subabul	1988
9.	Serpentine leaf miner	<i>Liriomyza trifolii</i> Burgess	cucurbits, tomato, castor	1990
10.	Coffee berry borer	<i>Hypothenemus hampei</i> Ferrari	Coffee	1990
11.	Spiraling whitefly	<i>Aleurodicus disperses</i> Russell	Polyphagous	1994
12.	Silver leaf whitefly	<i>Bemisia argentifolii</i> Bellows	Tomato	1999
13.	Blue gum chalcid	<i>Leptocybe invasa</i> (Fisher and LaSalle)	Eucalyptus	2006

**Invasive alien species:** Alien species are not of native origin; they introduced from another country or continent and become serious threat in the introduced country or region. Introduction, establishment, spread and naturalization are the important process for invasion of alien species.

### Plant Protection Organisation in India

Plant Protection has significant importance in plant health management and sustainable agriculture. Plant protection aims to minimize crop losses or to manage the incidence of insect pests, diseases, weeds, nematodes, rodents etc. Enforcement of Destructive Insects and Pests Act (DIP Act, 1914), promotion of Integrated Pest Management, implementation of Insecticide Act, 1968, monitoring and control of desert locust in the Scheduled Desert Area, providing the information through different trainings are the key role in Plant Protection<sup>6</sup>. The Central Directorate of Plant Protection is functioning with the support of 87 Sub offices: 29 Central Integrated Pest Management Centres, 35 Plant Quarantine Stations, 2 Regional Pesticides Testing Laboratories, 29 Locust Control Stations, 1 National Plant Protection Training Institute.

At present 12 divisions/units are functioning in the Directorate: i. Locust Warning and Control unit. ii. Plant Protection Division. iii. Pest /Disease Surveillance Division. iv. Biological Control Unit. v. Plant Quarantine Division, vi. Implementation of the Insecticide Act. vii. Storage Unit. viii. Rodent Control Unit. ix. Pesticide Monitoring Unit. x. Planning and

Coordination Unit. xi. Documentation Unit. xii. Plant Protection Training Institute.

### Plant Quarantine system in India

Plant quarantine refers to the legal restriction to prevent the entrance and establishment of a plant disease or insect pest in an area uninfected area. In India, plant quarantine is regulated under DIP Act, 1914.

There is various method of plant quarantine like: i. Inspection at point of destination: Inspection at point of destination of consignment is necessary as many pests can be discovered and accidental introduction of these pests may be eliminated. ii. Inspection at point of origin: Inspection at point of origin is also necessary to check the insect infestation or plant disease infection, material are allowed to enter the state or the country but they bear a certificate issued by the plant quarantine officer. iii. Embargoes: Embargoes means the exclusion of the plant material or commodities which can be the hosts of insects. iv. Controlled introduction: The introduction of only a very limited quantity of plant materials are allowed for propagating purpose obtaining, should be free from insects pests and diseases<sup>7,8</sup>. If any infestation or infection is found in the material then it will not allowed for introduction and proceed for rejection. Several countries have strict quarantine laws for importation and spread of pests. African countries import pome fruit from Asia and America is very rigorously controlled because of the danger of importation of San jose scale, *Quadraspidiotus perniciosus*, which is the most destructive orchard pest in Southern USA<sup>7,8</sup>.

## National Standards for Phytosanitary measures

In India following eight National Standards has been developed some of which confirm to some of the International Standards but a lot more work is needed in this direction for their development: i. National Standard for Pest Risk Analysis. ii. Guidelines for certification of forced hot-air treatment facilities for wood packaging material. iii. Quarantine treatments and application procedures: I. Methyl bromide fumigation. iv. Guidelines for assessment, audit and accreditation of fumigation agencies for undertaking methyl bromide fumigation. v. Requirements for establishment of pest free areas for mango nut (seed) weevil (*Sternochaetus mangiferae*) and pulp weevil (*S. frigidus*). vi. Requirement for establishment of pest free areas for Tephritid fruit flies. vii. Guidelines on certification of hot water immersion treatment facilities for mango fruits. viii. Accreditation treatment for ISPM-15 Compliance.

## Pest Risk Analysis in Plant Bio-security

Pest Risk Analysis is a process of investigation, evaluation of information and decision making with respect to a certain pest that starts once it is known or determined that this is a quarantine pest. Subsequently, an evaluation of the potential of introduction of the pest into country is done along with its economic, social and environment consequences. With identification, determination and evaluation done, the process of culminates with decision making to avoid or reduce the probability of entrance or establishment of the pest into the country. Initiation points for PRA: i. The identification of a pathway, usually an imported commodity that may allow the introduction and spread of quarantine pest. ii. The identification of a pest that may qualify as a quarantine pest. iii. The review or revision of phytosanitary policies and priorities.

The PRA process as described in the International Standards for Phytosanitary measures (ISPM) is divided into four phases- Pest risk initiation, Pest Risk assessment, Pest risk management and Pest risk communication/documentation<sup>9</sup>.

## Survey and Surveillance in plant bio-security

To examine the situation of a region or incidence of insect pest or disease Survey and Surveillance of that region is essential. Survey is a procedure to determine the characteristics of a pest population or to determine which species occur in an area and in Surveillance collection and data on pest occurrence or absence are maintained for the future incidence of pest in that region<sup>10</sup>.

**Current Status:** Recently “The Agricultural Biosecurity Bill , 2013” as introduced in Lok Sabha, on March 11, 2013 by the Minister of Agriculture, Mr. Sharad Pawar. It contains different chapters related to agricultural bio- security authority, liabilities, powers and functions to regulate the Bio-security obligations under international agreements etc. The Bill aims to establish an integrated national bio-security system covering plant, animal and marine issues to combat threats of bioterrorism from pests and weeds.

## Agricultural Bio-security Authority of India, Faridabad

Central government specified the direction and policies of Agriculture Bio-security Authority of India, regulating the import and export of plants, animals and related products, preventing the introduction of quarantine pests from another country and implementing post-entry quarantine measures. The Authority may prohibit import material whose use it considers risky. No person shall import any plant, animal, and plant or animal products in contravention of guidelines issued by the bill. In this case phytosanitary certificate will be required, issued by the Authority officers. Authority may notify any pest to be a quarantine pest and shall communicate the quarantine measures that the state government. If any bio-security emergency declares by the central government in an area in case of an outbreak, distribution, or spreading of a pest or organism, which has the potential to cause a significant loss to bio security then centre may give direction to control the situation. The Authority shall act as the national organisation under various international conventions such as the International Plant Protection Convention and may award penalty to any person for loss or damage to non-infested plants, animals or related products incurred by him as a result of any sanitary or phytosanitary measures.

## National Institute of Plant Health Management (NIPHM)

NIPHM, Hyderabad (An autonomous Institution under DAC, Ministry of Agriculture) is a premier capacity building institution in the field of Plant Health Management, Bio-security and Incursion Management and Pesticide Management. The Institution also acts as a policy support centre to the Department of Agriculture and Cooperation.

The Institute is the designated nodal centre at the National Level for capacity building in: i. Plant Health Management, ii. Bio-security and Incursion Management, iii. Rodent Pest Management, iv. Pesticide Management.

NIPHM organise different trainings related to Plant Bio-security and Incursion Management every year in to signify the Pest Risk Analysis, Pest Surveillance and diagnostics in bio-security management and threats of invasive alien species in the context of globalization are highlighted in the programme, besides exposure to SPS Measures and the relevant International standards.

**Advantages:** i. Enhanced International trade, ii. Improved agriculture production, iii. Improved public health, iv. Protection of the environment.

## Conclusion

Developing countries, focusing on to maximum food production to meet the requirement of large number of population and to gain maximum profit, in this context if the bio-security program continues to receive inadequate attention across people then unaffordable loss to global environment, agriculture and biodiversity would take place. Investment of resources and approaches in a systematic manner to establish bio-security program is the most effective option to achieve food security goals.

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