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**PHYTOSANITARY SIGNIFICANCE OF SOIL AND SOIL BIODIVERSITY**

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**ABSTRACT**

Soil is one of the natural habitats having a huge biodiversity, including micro and macro-organisms and a seed bank for a wide variety of plants. Life in soil may be either beneficial or may be noxious pests of agriculture. Therefore, soil plays a significant role in Plant Protection, explicating the importance of the regulatory activities on international movement of soil and soil biodiversity. This specific review aims to discuss the phytosanitary significance of soil and the current phytosanitary status of soil in international trade, with special emphasis on Sri Lanka. As the National Plant Protection Organization of Sri Lanka, the National Plant Quarantine Service plays a significant role in regulation of international trade of commodities having phytosanitary significance. Importation of soil to Sri Lanka as a commodity is entirely prohibited. However, permission is granted to import soil in small quantities for scientific research or in bulk quantities for industrial purposes with stringent regulations. This includes soil contaminations in other imported goods also. In contrast, all the plant commodities to be exported are tested at the quarantine laboratories for the phytosanitary requirements of the importing country, wherever necessary for soil, and confirmed by issuing a phytosanitary certificate.

**Key words:** *Plant Quarantine, IPPC, NPPO, Phytosanitary certificate, soil*

**INTRODUCTION**

**1. International Plant Protection Convention**

The International Plant Protection Convention (IPPC) is a multilateral treaty that came in to function in 1951 and is overseen by the Food and Agriculture Organization (FAO). The IPPC aims to secure coordinated, effective action to prevent and to control the introduction and spread of pests of plants and plant products throughout the world. The core functions of the IPPC extend beyond the protection of agricultural biodiversity to the protection of nature and natural biodiversity. It also takes into consideration both direct and indirect damage by pests, and therefore it recognizes weeds also as a pest (<http://www.fao.org/agriculture/crops/thematic-sitemap/theme/treaties/en/#c15940>).

The Commission on Phytosanitary Measures (CPM) was established under the IPPC with the aim of overseeing the implementation of the IPPC. As of July 2013, the IPPC has 179 parties, which include 176 United Nations (UN) member states, the Cook Islands, Niue, and the European Union. The IPPC is recognized by the World Trade Organization's (WTO) Agreement on the Application of Sanitary and Phytosanitary Measures as the only international standard setting body for plant health (<https://www.ippc.int/>).

While the IPPC's primary focus is on plants and plant products moving in international trade, the Convention also covers Soil and other growing media, research materials, biological control organisms, germplasm banks, containment facilities, food aid, emergency aid and anything else that can act as a vector for the spread of plant pests – for example, containers, packaging materials, soil, vehicles, vessels and machinery (<https://www.ippc.int/>).

The IPPC places emphasis on three core areas, namely 1) international standard setting, 2) information exchange, and 3) capacity development for the implementation of the IPPC and associated international phytosanitary standards. The Secretariat of the IPPC is housed at FAO headquarters in Rome, Italy, and is responsible for the coordination of core activities under the IPPC work program (<https://www.ippc.int/>).

## **2. Soil and its phytosanitary significance**

The word “Soil” represents soil as it is (a collection of earth particles of size less than 2 mm), soil related matter (in bulk, *i.e.* soil with associated earth) as well as any other commodity contaminated with or in contact with soil (Items contaminated with soil and related matter, such as logs/lumber, containers, equipment, blocks of stone, machinery, tools, vehicles, military equipment and vehicles, etc.) (CFIA, 2010).

Soil is a high-risk pathway for the movement and introduction of pests. The position paper on soil movement signed on April 24, 2003 by the three member countries (Canada, United States of America and Mexico) of North American Plant Protection Organization (NAPPO) describes the risks and complexities associated with soil and associated pests:

"Soil, as evidenced from the international restrictions and prohibitions concerning its movement, is considered to be a high risk pathway for spreading a wide range of pests including, but not limited to: bacteria, fungi, insects, nematodes and weeds. Numerous soil-borne pests can survive for many years, with or without suitable hosts. Some of these pests can be detected visually while the detection of others requires sophisticated diagnostics." (NAPPO, 2003)

Therefore as a commodity or a contaminant, soil is an almost universally prohibited item to trade internationally. Soil contains an enormous microbial and microfaunal population, only a fraction of which is known and which varies with soil type and from place to place. Soil is very difficult to sterilize in large quantities, so when used in growing media it should normally be regarded as non-sterile, and its risk will vary with that of its place of origin. Many plant pests inhabit soil during all or part of their life cycle and often produce durable resting stages in the soil which may be difficult to detect. Normally, living plants moving in international trade are required to be virtually soil-free or to be in soil-less media. Planting material such as tubers, bulbs and corms are usually required to be soil free or to carry the minimum amount of soil practicable (<http://www.inspection.gc.ca>).

Requirements covering plant produce for consumption can be less stringent because the risk of imported soil finding its way on to agricultural land is much less. Soil is often found as a contaminant or substrate in goods where it may escape attention. Soil is also often overlooked, even when present in substantial quantities, when adhering to imported used vehicles, agricultural machinery, or military equipment that has been used in the field. Some pests associated with soil and related articles, which have phytosanitary significance, are listed in Table 1. Other than these species, a wide variety of weeds are also considered as regulated pests under quarantine by many countries.

**Table 1: Some Soil-borne quarantine pests regulated by different countries (www.biosecurity.govt.nz; Morschel, 1961; Cook and Dube, 1989; McLeod *et al.*, 1994)**

Common Name	Scientific Name
Alfalfa snout beetle	<i>Otiorynchus ligustici</i> (L.)
Apple maggot	<i>Rhagoletis pomonella</i> Walsh
Blueberry maggot	<i>Rhagoletis mendax</i> Curran
Columbia root knot nematode	<i>Meloidogyne chitwoodi</i> Golden, O'Bannon, Santo & Finley
European brown garden snail	<i>Cornu aspersum</i> (Müller) syn. <i>Helix aspersa</i> (Müller)
Golden nematode	<i>Globodera rostochiensis</i> (Wollenweber) Behrens
Japanese beetle	<i>Popillia japonica</i> Newman
Pale cyst nematode	<i>Globodera pallida</i> (Stone) Behrens
Potato rot nematode	<i>Ditylenchus destructor</i> Thorne
Potato wart	<i>Synchytrium endobioticum</i> (Schlib.) Percival
Ralstonia (potato brown rot)	<i>Ralstonia solanacearum</i> Race 3 (Smith) Yabuchi <i>et al.</i>
Ramorum blight and dieback	<i>Phytophthora ramorum</i> Werres <i>et al.</i>
Soybean cyst nematode	<i>Heterodera glycines</i> Ichinohe
Verticillium Wilt	<i>Verticillium dahliae</i>
Citrus Nematode	<i>Tylenchulus semipenetrans</i>
Needle Nematode	<i>Paralongidorus eucalypti</i>
Sheath Nematode	<i>Hemicycliophora arenaria</i>

## PRESENT STATUS

Sri Lanka ratified IPPC in 1952 (<http://www.fao.org>) and therefore, is a party holding the responsibilities designated by the convention. Facilitation of phytosanitary activities required for the international trade is done by the National Plant Quarantine Service (NPQS) of Sri Lanka, which is also designated as the National Plant Protection Organization (NPPO) for IPPC in Sri Lanka ([www.ippc.int](http://www.ippc.int)).

Further, the NPQS has the responsibility of enforcing the implementation of Plant Protection Act No.35 of 1999 and Regulations made thereunder in relation to plant quarantine activities.

Since the regulations made under the Plant Protection Act are still in the process of enactment, the regulations made under the Plant Protection Ordinance are still in operation (The extraordinary gazette No. 165/2 – Monday the 02<sup>nd</sup> of November 1981).

Responsibilities of the NPQS of Sri Lanka lie in both importation and exportation activities. It is bound to function in accordance with the IPPC as well as the provisions given by the Plant Protection Act No. 35 of 1999.

When the importation of plant and plant products in to Sri Lanka is considered, the plant protection regulations recognize “soil” as an article prohibited to import from any country in the world. This includes soil attached to imported plants and plant material such as tubers (potato) and other underground parts, crop seeds for planting purpose, machinery and vehicles, wood and timber, peat *etc.* (Director General of Agriculture, 1991).

However, the Plant Protection Act permits importation of prohibited items for research purposes, under stringent conditions. Thereunder, soil as such is also permitted to import into Sri Lanka strictly for scientific purposes, with a special permission of the Director General of Agriculture, and the permission will be given only to the chief authority of a government department or a public corporation engaged in scientific research.

Further, the report compiled by a special committee which conducted a Pest Risk Analysis (PRA) for importation of sand for cement testing (2006) has elaborated the importance of allowing importation of sand as a raw material for cement industry. The committee has taken into consideration and declared three major factors. 1. The necessity and importance of importation of soil, 2. Phytosanitary conditions to be officially fulfilled by the NPPO of the country of export/ origin, and 3. The recommendations to the Sri Lankan plant protection authority (Liyanarachchi *et al.*, 2006).

According to the committee recommendations (Liyanarachchi *et al.*, 2006), the Director General of Agriculture Sri Lanka (Authority for Plant Protection Act) at present issues the official permission for importation of bulk quantities of specialized quality sand only for the cement industry. The importation permit demands following conditions to be fulfilled at the country of origin and upon arrival to Sri Lanka if sand is to be imported.

1. The consignment should accompany a phytosanitary certificate certifying that the lot is free from pests including insects, nematodes, microbes, weeds and any other organism that can be a plant pest, based on a test report issued by an accredited laboratory in the country of origin.
2. Quantity per consignment (one importation) should not exceed 10,000 kg.
3. Upon arrival, a representative sample should be tested at the quarantine laboratories for the presence of above mentioned pests, before releasing to the importer.
4. If the consignment is found to have contaminated with any pest, the Director General of Agriculture (Depending on the test reports) will decide the consignment to be destroyed, re-exported or release after a recommended phytosanitary treatment.
5. Sand imported should strictly used only for manufacturing purposes and sand or any refuse should not be discharged to open environment so that no accumulation of remnant sand (Liyanarachchi *et al.*, 2006).

Soil can be moved from any other country to Sri Lanka in international trade activities, both as the main commodity and as a contaminant with other imported articles. Therefore, when the Plant import permits are issued for other plant or plant based commodities, a special import phytosanitary condition is stipulated on the permit. This indicates the import requirement of Sri Lanka that is, the NPPO of exporting country should certify that,

- the commodity is free from soil (or growing media if the consignment is a live plant species), or
- a declaration for freedom from any specific soil-borne pest, or
- an "area freedom" for such devastating soil-borne or soil inhabiting pest.

Further, if any used machinery or vehicle is imported to Sri Lanka, plant quarantine officers inspect for any possible contamination with soil. This is very important since this small quantity of soil may harbor huge number of pests (Import permits issued by the NPQS No.s-NPQS/SP/2013/05 and NPQS/PIP/2013/707). For example, the invasive giant Mimosa (*Mimosa pigra*) is said to have introduced with some used agriculture machinery and invasive Parthenium weed (*Parthenium hysteropus*) is believed to have introduced with the soil in the shoes of Indian peace force (Ranwala, 2011). Both the weed species are at present recorded as very noxious invasive species causing huge damage to the Agriculture and environment.

In contrast, the exports commodities also require a certification for freedom from soil or any specific pest. These phytosanitary requirements are solely dependent on the country of import. In such situations, the NPQS, Sri Lanka carries out official tests or surveys fulfilling the importing country requirements. Some of the country requirements are given in the Table 02.

## **PROCEDURE FOR IMPORTATION OF SOIL**

The importer shall submit an application to the Director General of Agriculture according to the format specified by the Department of Agriculture, Sri Lanka. The Technical Committee for Evaluation of Plant Quarantine Issues (A technical panel consists of experts in Plant Protection) will evaluate the purpose of importation of soil and decide whether to approve or disapprove the importation of consignment. If the purpose complies with the policy decisions and regulations (Liyanage *et al*, 2006 and Plant Protection Act No. 35 of 1999) the importation will be approved with strict phytosanitary conditions specified by an official plant import permit in duplicate copies. One copy of the import permit should be sent to the exporter at the country of origin. Exporter should refer the phytosanitary conditions given in the import permit of Sri Lanka and should fulfill them through the NPPO of the particular country. NPPO of the country of origin should confirm the phytosanitary conditions by an official phytosanitary certificate, which should accompany the consignment.

Upon entry to Sri Lanka at the port of entry, the plant quarantine officers will verify the documents (Phytosanitary certificate, Import permits, Bills of lading *etc.*) and inspect the consignment. Random representative samples will be submitted for further testing to the laboratories at National Plant Quarantine Service. Considering the results given by the test reports issued by the NPQS, the consignment will be released to the importer if there is no threat reported, or destroyed, re-exported or treated with a NPQS recommended procedure to eliminate any pest present in the consignment (If any pest is recorded). Further, according to the import phytosanitary conditions, a post entry quarantine procedure will be carried out. Post entry quarantine activities assure strict use of imported soil only for manufacturing purposes or research purposes and sand or any refuse will not be discharged to open environment so that no accumulation of remnant sand (Manual of Plant Quarantine Procedures, Sri Lanka).

## **CONCLUSIONS AND RECOMMENDATIONS**

Soil may contain large number of inhabitant species, where some of them are possibly of phytosanitary significance. Testing for a wide variety of soil pests is not practically achievable since some life stages of the pests may not be detect in available tests. Therefore, regulatory mechanism should be established to manage the international transfer of soil inhabitant pests. According to the IPPC international transfer of soil as such or as a contaminant is prohibited considering its high risk.

According the Plant Protection Act, No 35 of 1999, Sri Lanka, importation of soil was prohibited, considering its high risk nature. However, depending on the industry requirement, as a raw material or for scientific research, soil can be imported into Sri Lanka under stringent quarantine regulations.

**Table 02: Some importing Country requirement for Soil**  
([www.biosecurity.govt.nz](http://www.biosecurity.govt.nz); [www.ippc.int](http://www.ippc.int))

<b>Country</b>	<b>Regulatory status</b>
Belize	Earth, soil or dung- prohibited, At the port of entry an inspection will be done
Brunai Darussalam	Soil from outside Sabah and Sarawak – prohibited. Import Permit for soils intended for chemical and physical analysis and only imported by the Director of Agriculture
Cyprus	Soil Gravel, Leaf and garden mould including when present with other materials (Plants, Seeds or Vehicles) except guano, bone dust and peat moss - prohibited
Egypt	Soil that can be used for growing or containing organic matter - prohibited
Fiji	Sand and clay or earth except for experimental scientific, manufacturing or industrial purposes under import permit- prohibited
Grenada	Soil as such, unless under special permit for recognized research laboratories, Plants, Plant products, machinery, equipment, conveyances or non- plant articles must be free of soil or freed of soil. Non plant articles are subjected to cleaning and/ or treatment if soil contaminated
Hong Kong	soil with plants, soil including earth, sand, clay, and peat except with prior permission and if sterilized- prohibited. Permitted items should carry an Phytosanitary certificate with additional declarations stating that soil is free from plant parasitic organisms and an inspection on arrival
Kenya	Any rooting medium for plants which consists either or wholly or in part of soil, whether or not it is attached to any plant- prohibited
Napal	Soil, Humus, Forest litter, Saw dust, or any other medium in which plants can grow except as indicated for growing/ rooted plants - prohibited
Newzealand	Soil by it self or adhering to goods- prohibited. Peat from the United Kingdom/ Ireland if accompanied by a veterinary certificate; clean sand, stone, clay for processing or manufacturing; soil for special purposes subject to conditions of Import permit
Pakistan	Soil and any other unsterilized medium such as compost, litter, humus, or sawdust capable of carrying pathogens.
Singapore	Soil as such and with plants except from west Malaysia
Sweden	Soil, compost, animal manure- prohibited. Exception given for technical purposes and some amount of soil with plants
United States of America	As such and with plant, plant products or contaminating any commodity, except from Canada- prohibited

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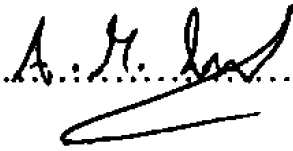
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