

SHORT COMMUNICATION

PLANT PATHOGENS IN FRUITS IMPORTED INTO SRI LANKA

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INTRODUCTION

Sri Lanka imports a large amount of fresh fruits. The list includes apples, cherries, grapefruits, grapes, kiwi fruits, nectarines, oranges, peaches, pears, plums, and pomegranates that are imported with permission under the Plant Protection Act (PPA). Quantities legally imported per month vary from 1000-1200 t of apples, 150-350 t of grapes, 1000-1500 t of oranges, 30-50 t of pomegranates, and 25-50 t of pears. Plant quarantine sources indicate that there was a four-fold increase in total quantities of all fruit imports from 1994 to 1999 (National Plant Quarantine Service Information). During the mango seasons in the neighbouring countries, people smuggle mangoes into the country.

Under regulations of the PPA, the risk of introduction of alien fruit flies is the main concern for imposing restrictions on fruit importation. Furthermore, zero tolerance to mango pulp weevil (*Sternochetus frigidus*) led to the prohibitive attitude of plant quarantine towards the importation of mangoes. Some countries have imposed quarantine restrictions on fruit imports considering danger of introduction of certain pathogens (van der Zwet, 1989 and Smith *et al.*, 1992). On the other hand, fruit pathogens do not have any quarantine concerns in Sri Lanka even though imported consignments often had such infections (de Silva and Weerasinghe, 2000). The detected pathogens were considered to be quality pests.

The pest interceptions are indications of possible invasions (Mathys and Baker, 1980) and these may be considered while making amendments to the plant quarantine regulations. The National Plant Quarantine Service (NPQS), Katunayake always monitors pathogens found in fruits imported into the country. Here we report the pathogens detected in fresh fruits imported into Sri Lanka during 1997-2001 enabling the scientists to discuss the dangers involved. Such discussions will be important for analysis of associated pest risk.

MATERIALS AND METHODS

The fruit samples received from the international airport, Katunayake and the seaport of Colombo and those collected from local markets from 1997 to 2001 were examined to detect the associated pathogens. After culturing, fungi were examined under the microscope for identification based on their morphology, nature and arrangement of spores. Bacteria were sub-cultured in selective media and biochemical and serological tests were used for their identification (Holt *et al.*, 1994).

RESULTS

Isolated pathogens were mostly fungi (Table 1). Anthracnose caused by *Colletotrichum gloeosporioides* was frequently detected. Subsequently, secondary

pathogens invaded the tissues degrading the quality of fruits. Some grapes had shown symptoms of dry shrivelling but *Xylella fastidiosa* could not be detected.

Table 1. Plant pathogens detected in fruits imported into Sri Lanka during 1997-2001

Pathogen	Host fruits
Fungi	
<i>Alternaria alternata</i>	Apples, Grapes, Mangoes, Oranges, Pears,
<i>Alternaria citri</i>	Oranges
<i>Aspergillus niger</i>	Apples, Grapes, Mangoes, Oranges, Pears, Pomegranates
<i>Botryosphaeria obtusa</i>	Apples
<i>Botrytis</i> sp.	Mangoes
<i>Colletotrichum gloeosporioides</i>	Apples, Grapes, Mangoes, Oranges, Pears
<i>Cladosporium herbarium</i>	Apples, Grapes
<i>Diplocarpon maculatum</i>	Pears
<i>Dothiorella</i> sp.	Apples, Mangoes
<i>Elsinoë fawcettii</i>	Oranges
<i>Elsinoë mangiferae</i>	Mangoes
<i>Fusarium</i> sp.	Mangoes
<i>Geotrichum candidum</i>	Oranges
<i>Lasiodiplodoa theobromae</i>	Mangoes, Oranges
<i>Mucor</i> sp.	Grapes, Mangoes, Oranges, Pears, Pomegranates
<i>Penicillium</i> sp.	Apples, Grapes, Pears, Pomegranates
<i>Pestalotia</i> sp.	Grapes
<i>Phomopsis</i> sp.	Apples, Oranges
<i>Phytophthora palmivora</i>	Mangoes
<i>Rhizopus stolonifer</i>	Apples, Grapes, Oranges, Pears, Pomegranates
<i>Sclerotinia sclerotiorum</i>	Oranges
<i>Venturia inaequalis</i>	Apples
Bacteria	
<i>Erwinia amylovora</i>	Apples
<i>Erwinia</i> sp.	Mangoes
<i>Pantoea agglomerans</i>	Apples, Oranges, Pears
<i>Xanthomonas arboricola</i>	Peaches
<i>Xanthomonas campestris</i>	Apples
<i>Xanthomonas campestris</i> pv. <i>citri</i>	Oranges
<i>Xanthomonas campestris</i> pv. <i>mangiferaeindicae</i>	Mangoes

DISCUSSION

Most of the detected fungi were quality pests responsible for post-harvest decay of fruits. Precooling of fruits before despatch from the source is a phytosanitary requirement prescribed by the plant quarantine of Sri Lanka to prevent the introduction of alien fruit flies. The recommended in transit temperature is around zero degrees Celsius (0°C). If the sea voyage takes more than the prescribed duration of cooling, the cold storage during transport by sea-freight is acceptable as the cold treatment. Majority of retail fruit sellers keep the imported fruits in the open thus subjecting the material to ambient temperatures. The humid high temperatures may enhance the development of fungi like *Colletotrichum gloeosporioides*, which prefers an optimal temperature of 27-29°C (Holliday, 1980). The effect of temperature shock was not properly evaluated but it could lead to a rapid decay of fruits. Even though airlifted from the neighbouring countries, the illegally imported mangoes were often infested with pathogens on arrival. The smuggled mangoes were without proper phytosanitary certification of authorities in the exporting country. Anthracnose in

mangoes caused by *Colletotrichum gloeosporioides* would usually account for 30-40% of post-harvest losses (Morton, 1987). The same disease in oranges was more economically important in mature green fruits when subject to ethylene (Holliday 1980), which would indicate that the locally produced oranges would be more susceptible to alien strains of anthracnose fungus.

Citrus scab (*Elsinoë fawcettii*) was regularly intercepted in imported oranges but it has been reported to occur in Sri Lanka (Smith *et al.*, 1992). Whiteside (1978) has described the occurrence of biotypes of this pathogen. The pathogen in scab pustules could be a source of inoculum for the spread of new biotypes if hosts are readily available. Even though it may be a dangerous pest in some regions of orange cultivation, the pathogen may not survive temperatures higher than 25°C and prolonged drought (Smith *et al.*, 1992). Hence, it may have a very minimal risk to citrus cultivation in Sri Lanka, unless the biotypes were proven to withstand the high temperatures in dry climates.

Apple scab (*Venturia inaequalis*) and pear scab (*Venturia pirina*) were two of the common diseases partly responsible for the decline of a thriving apple and pear cultivation in the upcountry regions in Sri Lanka (Kelaniyangoda and Heenkenda, 1993). The detection of *Venturia inaequalis* in imported apples may not be of quarantine concern but could indicate the poor quality of the material. Apples were earlier imported from Australia, New Zealand and some European countries. Recently, the importers have chosen Asian countries to get their requirement, where *Venturia nashicola* is prevalent in Asian pears (Smith *et al.*, 1992). It has not been reported to occur in Sri Lanka and hence plant quarantine must keep vigilance on its entry. Any programme for revival of apple and pear cultivations in Sri Lanka needs the import of planting material of superior germplasm. The planting material would help more than fresh fruits in the introduction and establishment of new diseases. The comparative risks of the two commodities must be evaluated to take appropriate safeguards.

Detection of fire blight organism (*Erwinia amylovora*) of apples and pears also indicated the poor quality of the imported apples. Smith *et al.* (1992) remarked that the bacterial ooze on fruit containers was responsible for the first introduction of *Erwinia amylovora* into northern Europe but they were doubtful of the idea. Hale *et al.* (1996) supported that view by figuring out that the pathogen present in mature fruits could not offer any help for its spread. According to Smith *et al.* (1992), the international trade practices used for fruits present an insignificant risk for the spread of fire blight. Some scientists have attempted its risk assessment (Smith, 1996 and Kovacs, 1996). Most countries, especially those who have signed the agreements such as European and Mediterranean Plant Protection Organization (EPPO), Comité Regional de Sanidad Vegetal Para el Cono Sur (COSAVE) and Interafrican Phytosanitary Council (IAPSC) consider *Erwinia amylovora* as a quarantine pest (Smith *et al.*, 1992). Even if present in their territories, some countries have imposed specific phytosanitary restrictions for the import of hosts (including fruits) of fire blight (van der Zwet, 1989). Accordingly, area freedom with buffer zones was a prerequisite for import of apples and pears. The detection of *Pantoea agglomerans* from some fruits was interesting because some strains of this bacterium were antagonistic to *Erwinia amylovora* (Pánková *et al.*, 1999 and Wright *et al.*, 2001).

Black spot of pears caused by *Diplocarpon maculatum* (synonym *Fabraea maculata*) was a serious disease of pears in some states of the USA (Pierson *et al.*, 1971). The pathogen was not reported to occur in Sri Lanka. It is very difficult to predict at this stage whether *D. maculatum* present in imported pears has the ability to become the inoculum for disease establishment in a new area. *Xanthomonas arboricola* detected on peaches and other stone fruits is a quarantine pest listed by countries that have stone fruit cultivations but its importance to Sri Lanka was not assessed by a risk analysis.

Illegally imported mangoes often had bacterial pathogens such as *Erwinia* sp. and *Xanthomonas campestris* pv. *mangiferaeindicae* causing fruit rot. Yet, they were not reported to occur in Sri Lanka and perhaps be considered as pests of quarantine concerns. Mango is a popular garden crop grown everywhere in the country. If importations and selling of mangoes in the open roadside markets coincide with the seasons of any glut of locally produced fruits, there is a high risk of establishment of new fruit diseases because the alien pathogen could easily find a suitable host in the vicinity.

Geotrichum candidum, causal agent of sour rot of oranges and lemons is a wound pathogen, which can infect several crops and animals including man (Holliday, 1980). Plant quarantine in Sri Lanka has specified a tolerance level for its occurrence in imported seed potatoes but not in oranges. Strain on citrus fruits was considered to be a virulent form (Holliday, 1980) and would cause mild health hazards to people. Seeds of imported oranges may be directed to planting by some people. However, seeds of *Citrus* are considered to be an appropriate material for the introduction of germplasm because they may yield true to type nucellar seedlings (Knorr, 1977). Anyway, there were reports of seed transmitted pathogens especially virus diseases in *Citrus* (Brunt *et al.*, 1995).

Among the pathogens detected, only few have plant quarantine significance. They are quarantine pests in other countries but are not declared as such in Sri Lanka. Hence, the legislators' aim of not restricting the fruit imports based on pathogens needs rethinking. Criticism of the intention of legislator for prohibiting the import into Sri Lanka of fruits infested with alien fruit flies is not the objective of the present study. Well-informed risk analysis should be done in reference to the pathogens in imported fruits for acceptance of them as quarantine pests. However, the country can take urgent actions to avoid imminent dangers, an idea accepted by agreements such as World Trade Organization/Sanitary and Phytosanitary (WTO/SPS) and International Plant Protection Convention (IPPC). The study supports the attitude of plant quarantine on prohibiting the import of mangoes into Sri Lanka.

The importers always propose new areas from where they intend importing fruits into Sri Lanka. For them, the cheaper price and the lower transport cost are important factors. Importation of fresh fruits has become a very important issue when Sri Lankans show a preference towards imported fruits. Sometimes administrative and political decisions interfere with plant quarantine activities. Under such circumstances, continuous vigilance of fruit pathogens is necessary and a well-informed risk analysis is very important to effect any changes in the present regulations.

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