as quarantine pests (Anonymous, 2003). Bacterial wilt (*R. solanacearum*) was intercepted in groundnut accessions from eight countries. The disease expression took place only at higher temperatures (30^{0}C and above). A diagnostic schedule involving grow-out of imported groundnut seeds for four weeks and plating the leaf bits and twig pieces on Tetrazolium Chloride Agar medium was found effective for the detection of infection (Anitha *et al.*, 2004).

Several serological tests are available for detection and identification of plant viruses for the past four decades. Relatively, little work is done on serological detection of fungi and bacteria prior to development of Enzyme linked immunosorbent assay (ELISA) and monoclonal antibody techniques. At present there are many examples where fungal and bacterial pathogens can be detected routinely by ELISA. With the advent of molecular biology and the ability to compare regions of genomic DNA representing conserved sequences, the development of diagnostic techniques increased at an amazing rate. The major condition associated with pathogen detection techniques applied for the enforcement of plant quarantine regulations and policies includes cost, duration of testing, sensitivity, reproducibility and suitability to screen a large number of samples. Although molecular diagnostic techniques satisfy most of the needs, few barriers prevent their wider adaptability.

Pest risk analysis (PRA) has gained importance due to liberalization of world trade. Moreover, it has become obligatory to member countries of WTO to base their phytosanitary measures on scientific evidence of pest risk. Capacity for pest risk analysis is an area of concern, which needs immediate attention. PRA needs to be worked out for important crops having fungal and bacterial disease problems. For example, sunflower germplasm is mostly available in Europian countries. Hence PRA on sunflower with special reference to quarantine significant pathogen like downy mildew (*Plasmopara halstedii*) is essential for the exchange of germplasm. Identification of pest free areas based on surveys and surveillance is important. Pathogens like *Fusarium poae* in wheat, downy mildews of sorghum (*Peronosclerospora sorghi*) and pearl millet (*Sclerospora graminicola*), where many races and biotypes are reported all over the world, should be included in different schedules of Plant Quarantine Order, 2003. Establishment of National Referral laboratories, electronic linking of all quarantine laboratories, development of National database, identifying research on detection techniques and treatment schedules for fungi and bacteria of quarantine importance are the steps suggested in the context of phytosanitary measures.

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Colletotrichum spp. Intercepted in Exotic Germplasm during 1976-2004

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Key Words: *Colletotrichum* spp., Interception, Quarantine, Germplasm

The international exchange of the Plant Genetic Resources (PGR) has contributed towards increase in crop productivity in India. Since several pathogens have been reported as seed-borne, there is always a risk of inadvertent introduction of seed-borne pathogens along with such imports. Therefore, a thorough and critical examination of introduced material for associated pests is essential for plant quarantine clearance. National Bureau of Plant

Genetic Resources, New Delhi receives about 60,000 samples of germplasm and trial material each year for quarantine clearance. All the samples are first subjected to visual examination and then blotter test for detection of the associated pathogens. As a result of critical examination, a large number of seed-borne fungi including the destructive *Colletotrichum* spp. have been detected (Agarwal *et al.*, 2004; Khetarpal *et al.*, 2001). Information on these species on various crops introduced from several countries during 1976-2004 and their economic significance is discussed.

The genus *Colletotrichum* is having a number of pathogenic species causing considerable economic losses in a wide range of crops. Species of *Colletotrichum* produce different types of symptoms such as dieback, seedling blight, leaf blight, leaf spot, anthracnose, red rot and fruit rot etc. Richardson (1990) reported a large number of species as seed-borne in various crops. Species of *Colletotrichum* intercepted in exotic germplasm introduced during 1976-2004 is presented in Table 1.

Colletotrichum acutatum Simmonds ex Simmonds, which causes black spot and leaf curl, was intercepted on *Capsicum* spp. from Taiwan, *Lycopersicon esculentum* and *Medicago* spp. from USA, *Panicum maximum* from Australia and *Solanum melongena* from Bangladesh. Wright and Heaton (1991) reported 25-50% losses in celery crop in Australia.

Colletotrichum dematium (Pers.) Grove causing dieback, leaf blight, leaf spot and anthracnose was intercepted on a large number of hosts from many countries. Awashthi and Bhargava (2000) reported significant reduction in yield of chickpea in India due to *C. dematium.*

Colletotrichum falcatum Went [*Glomerella tucumanensis* (Speg.) Arx & E. Müll.] the causal agent of red rot of sugarcane was intercepted on *Saccharum* spp. from USA. Viswanathan and Samiyappan (1999) reported up to 100% yield losses to cane production by *C. falcatum* in many states in India under severe epiphytotic conditions.

Colletotrichum gloeosporioides (Penz.) Sacc. [*Glomerella cingulata* (Stonem.) Spauld. & Schrenk]

Table 1. Species of *Colletotrichum* intercepted in exotic germplasm during the years 1976-2004

Fungi	Host	Country/Source
Colletotrichum acutatum Simmonds ex Simmonds	*Abelmoschus esculentus*	Bangladesh
	Capsicum spp.	Taiwan
	Coriandrum sativum	USA
	Lycopersicon esculentum	USA
	Medicago spp.	Australia
	Panicum maximum	Australia
	Solanum melongena	Bangladesh
Colletotrichum dematium (Pers.) Grove	*Abelmoschus esculentus*	Bangladesh, Nepal
	Beta vulgaris	Belgium, Romania, USA, Former USSR
	Capsicum spp.	Bangladesh, Nigeria, Taiwan, USA
	Carica papaya	Bangladesh
	Cyamopsis tetragonoloba	USA
	Corchorus spp.	Bangladesh
	Desmenthus sp.	Ethiopia
	Glycine max	Nigeria, Poland, Taiwan, Thailand, USA
	Hibiscus spp.	Bangladesh, Nigeria, UK
	Indigofera sp.	USA
	Linum sp.	Hungary, Poland
	Lagenaria siceraria	USA
	Lycopersicon esculentus	Taiwan
	Lotus sp.	USA
	Macrotyloma uniflorum	Ethiopia, USA
	Medicago sp.	USA
	Melilotus alba	Taiwan, USA
	Ocimum sp.	Nigeria
	Ornothogalum setifolium	UK
	Phaseolus aureus	Taiwan
	Piper nigrum	Malaysia
	Solanum melongena	Bangladesh, USA
	Stylosanthes sp.	USA
	Triticum sp.	Italy
	Vigna unguiculata	Indonesia, Italy, Nigeria, Philippines
Colletotrichum falcatum Went *Glomerella tucumanensis* (Speg.) Arx & E. Müll.	*Saccharum* spp.	USA

Contd.

Table 1. Contd.

Fungi	Host	Country/Source
Colletotrichum gloeosporioides (Penz.) Sacc. [*Glomerella cingulata* (Stonem.) Spauld. & Schrenk]	*Alnus rubra*	USA
	Brachiaria sp.	USA
	Capsicum spp.	Brazil, Italy
	Cnidoscolus sp.	Mexico
	Corchorus spp.	Bangladesh
	Cucumis sp.	USA
	Cucurbita sp.	Japan, USA
	Glycine max	UK, USA
	Leucaena sp.	UK
	Linum sp.	USA
	Mangifera indica	Brazil, USA
	Medicago sp.	USA
	Piper nigrum	Indonesia, Malaysia
	Pyrus sp.	Malawi
	Sesamum sp.	Italy
	Sesbania rostrata	Philippines
	Setaria sp.	Mexico
	Solanum melongena	Bangladesh
	Stylosanthes sp.	USA
	Vigna unguiculata	USA
	Vitis sp.	Former Czechoslovakia
Colletotrichum graminicola (Ces.) Wilson [*Glomerella graminicola* Politis]	*Crotolaria* sp.	Indonesia, USA
	Corchorus spp.	Bangladesh
	Glycine max	Taiwan
	Solanum melongena	Bangladesh
	Sorghum spp.	Nigeria, South Korea, Sudan
	Vigna unguiculata	USA
	Zea mays	USA
	Z. diploperennis	USA
Colletotrichum lagenarium (Pass.) Ellis & Halst.	*Cucumis melo*	USA

the dieback, anthracnose, fruit rot and stem canker fungus was intercepted on a large number of hosts from several countries. Seeds from infected pods failed to germinate in case of *Stylosanthes hamata* (Davis, 1987).

Colletotrichum graminicola (Ces.) Wilson [*Glomerella graminicola* Politis] anthracnose, leaf blight, seedling blight and stalk rot fungus was intercepted on many crops from several countries. More than 50% losses were reported in grain yield from severe infection by *C. graminicola* in USA (Harris *et al.*, 1964). In India, Sharma (1980) estimated cultivar-dependent losses of 41 to 60% by comparing the yields of chemically protected and unprotected plots.

Colletotrichum lagenarium (Pass.) Ellis & Halst. [*Colletotrichum orbiculare* (Berk. & Mont.) Arx] which causes anthracnose was intercepted on *Cucumis melo* from USA. Amin and Ullasa (1981) reported yield losses up to 63% in watermelon under artificial inoculation.

Interceptions of *Colletotrichum* spp. from South Asian countries include-*C. dematium* on *Beta vulgaris, Corchorus* spp., *Hibiscus* spp., *Solanum melongena*; C. *gloeosporioides* on *Corchorus* spp.; *C. graminicola* on *Corchorus* spp., *S. melongena* from Bangladesh. *C. dematium* was also intercepted on *Abelmoschus esculentus* from Nepal.

Keeping in view the quarantine significance and yield losses caused by different species of *Colletotrichum*, it is essential to carry out a thorough examination of exotic germplasm for associated pests.

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Implementation of Cartagena Protocol on Biosafety for Safe Transfer, Handling and Use of LMOs in India

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A national biosafety system to regulate production and release of living modified organisms (LMOs) is presently considered essential in any country with a biotechnology programme. A globally harmonized regime for biodiversity was negotiated under the Convention on Biological Diversity (CBD) and "Cartagena Protocol on Biodiversity to the Convention on Biological Diversity" was finally adopted by Conference of the Parties on January 29, 2000. India has ratified the Cartagena Protocol on Biosafety on January 17, 2003 and it has come into force on September 11, 2003, becoming legally binding in the international legal system.

The objective of Cartagena Protocol is primarily to contribute for ensuring adequate level of protection in respect of safe transfer, handling and use of LMOs resulting from modern biotechnology that may have adverse effects on the conservation and sustainable use of biological diversity taking also into account the possible risks to human health and specifically focussing on transboundary movements.

The Protocol enables the signatory countries an opportunity to obtain information before new biotech organisms are imported. It acknowledges each country's right to regulate bio-engineered organisms, subject to existing international obligations. It also creates a framework to help improve the capacity of developing countries to protect biodiversity. To become a party to the protocol, a country or a regional economic integrated organization must first be a party to the CBD. The Inter-governmental Committee on the Cartagena Protocol on Biosafety (ICCP) was created to prepare for the Protocol's entry into force. The ICCP has highlighted capacity building as a key requirement for the early entry into force and for the effective implementation of the Protocol. To this end the Global Environmental Facility (GEF) has initiated a project through United Nations Environmental Programme (UNEP) to assist the signatories to the Cartagena Protocol in establishing national biosafety frameworks as well as country based demonstration projects, through any of the GEF implementing agencies.

India already has in place a biosafety framework in the form of rules for manufacture, use, import, export and storage of hazardous microorganisms/ genetically engineered organisms or cells, 1989 notified under the Environmental Protection Act, 1986. Therefore, it has accessed for funds for country based demonstration project from GEF through World Bank for the project on "Capacity Building for the Implementation of Cartagena Protocol on Biosafety". Ministry of environment and Forests is the nodal point to implement and coordinate the project in four research organisations *viz.* National Bureau of Plant Genetic Resources, New Delhi; GB Pant University of Agriculture and Technology, Pantnagar; Indian Agricultural Research institute, New Delhi and Central Food Technology Research Institute, Mysore. The capacity building project is expected to enhance