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PLANT QUARANTINE AS AN AID TO SAFER EXCHANGE, CONSERVATION AND UTILIZATION OF PLANT GENETIC RESOURCES

P.C. Agarwal, Baleshwar Singh and P.L. Gautam

National Bureau of Plant Genetic Resources,
Pusa Campus, New Delhi 110 012

Exchange, conservation and utilization of Plant Genetic Resources (PGR) are the key factors towards providing food security to humankind & animals in the next century. Globally there are several instances of plant disease epidemics through introduced seed and other planting materials. In India, more than 60,000 samples each year are processed for quarantine examination for the detection of exotic pests and pathogens and weeds by employing various techniques such as joint visual inspection, washing test, incubation test, serological examination, nematode extraction techniques, X-ray radiography and post entry isolation growing etc. Such examination resulted in the detection of several pests and pathogens of very high quarantine significance including those not known to occur in India. Some of these are as follows : fungi-*Peronospora manshurica, Fusarium nivale, Uromyces betae, Claviceps purpurea* etc.; nematodes- *Ditylenchus destructor, D dipsaci, Heterodera gottingiana, H. schachtii* and *Rhadinaphelenchus cocophilus*; insects- *Acanthoscelides obtectus, Bruchidius halodendri, Carpocarpa pomonella, Ephestia elutella, Eriococcus araucaria, Sitophilus granarius* etc. On an average 88 per cent of the infected/infested samples were salvaged using various techniques such as hot water treatment, fumigation, ethyl alcohol wash, acid-treatment and pesticidal treatments etc. In this paper we are discussing in depth only fungi intercepted.

Key words: Germplasm, quarantine, interception

Population pressure particularly in developing countries emphasizes the need for sustainable efforts in crop improvement strategies, a wide genetic diversity in various crops is the backbone to such efforts. To build such diversity, introduction of Plant Genetic Resources (PGR) from different countries of the world is of paramount importance. However, such introductions always carry an element of inadvertent introduction of exotic pests and pathogens into new areas. Severe crop losses are reported in India due to inadvertent introduction of pests and pathogens viz., *Phytophthora infestans* (Late blight of potato, 1883), *Hemileia vastatrix* (Coffee rust, 1879), *Plasmopara viticola* (Downy mildew of grapes, 1906), *Synchytrium endobioticum* (Potato wart, 1953), *Peronospora destrutor* (Onion downy mildew, 1977), *Plasmopara halstedii* (Sunflower downy mildew, 1985), *Quadraspidiotus perniciosus* (San Jose Scale, 1910), *Icerya purchasi* (Fluted scale, 1912), *Cydia pomonella* (Codling moth, 1919), *Globodera rostochinensis* (Golden nematode, 1961) etc.

MATERIALS AND METHODS

During last one decade (January, 1987- December, 1996) a total of 7,12,295 germplasm samples of various agri-horticularal crops and their wild relatives (including international trials) were received and processed for quarantine clearance. Exotic samples constituted 6,87,203 and those meant for export were 25,292 (Table 1). Five thousand seven hundred twenty one Phytosanitary Certificates were issued. The samples processed were comprised of true seeds, bulbs, nuts, cuttings, rhizomes, suckers, rooted plants etc. After visual examination all the germplasm samples were subjected to detailed examination for the detection of associated pests and pathogens by employing various techniques such as washing test, blotter test, infectivity test, serological testing, X-ray radiography, nematode extraction techniques, growing in post entry quarantine nursery (PEQN) (for chemically treated seeds) and grow out tests in environment controlled Poly- house/glass-house (for legumes). The whole procedure of examination is presented in Fig. 1. Germplasm samples found infected/infested/contaminated were salvaged by employing various techniques such as mechanical separation, hot water treatment (HWT) at 50-52°C for 20-30 minutes, ethyl alcohol wash (Agarwal *et al.*, 1990b), acid wash (Ram Nath *et al.*, 1986), standard fumigation and pesticidal treatments.

All the paddy germplasm introduced (> 10,000 samples per year) in the country was given prophylactic HWT at 52°C for 30 minutes.

RESULTS AND DISCUSSION

Interception of pathogenic fungi

A number of pathogenic fungi of high quarantine significance were intercepted in various germplasm material which include: *Peronospora manshurica* (Naum.) Syd. (Downy mildew of soybean), *Uromyces betae* Tul. ex Kickx. (Sugarbeet rust), *Fusarium nivale* (Fr.) Ces. (Snow mould of cereals), and *Claviceps purpurea* (Fr ex. Fr.) *Tul.* (Ergot of cereals), not yet reported from India; *Drechslera maydis* (Nisik.) Subram. & Jain (Maydis leaf blight of maize), *Phoma betae* Frank (Black leg of sugarbeet) and *Puccinia carthami* Corda (Safflower rust) are known to possess a large number/more virulent races; *Botrytis cinerea* Pers. ex Pers. (Grey mould fungus), *Fusarium solani* (Mart.) Sacc. (Wilt fungus) *Colletotrichum dematium* (Pers. ex Fr.) Grove (Anthracnose fungus) and *Macrophomina phaseolina* (Charcoal rot fungus) are known to have a wide host range.

Downy mildew of soybean is not yet reported from India. However, it was intercepted on seeds of soybean imported from various countries (Mukewar *et al.*, 1980 and Agarwal *et al.*, 1990 a). Agarwal and Singh (1998) reported that while processing of 10,336 soybean samples during 1978-1995 downy

mildew was intercepted in 1514 samples from 15 countries. *P. manshurica* was also intercepted on seeds imported from Malaysia (Agarwal and Khetarpal, 1985) and Indonesia (Anitha *et al.*, 1993) where it was not reported as well.

Table 1. Quarantine clearance of seed and other planting material processed during 1987-1996

Year	Total No. of Samples Received	Total No. of Samples Imported	Total No. of Samples Exported	No. of Samples Found Infected/Infested /Contaminated	No. of Samples Salvaged
1987	86,922	83,945	2,977	3,198	3079
1988	67,424	65,311	2,113	3,006	2709
1989-90	72,899	69,380	3,519	1,538	1487
1990-91	62,136	60,503	1,633	889	862
1991-92	62,041	60,017	2,024	1,702	1692
1992-93	78,922	74,392	4,530	1,020	1013
1993-94	70,511	68,520	1,991	2,384	2369
1994-95	67,655	64,564	3,901	566	555
1995-96	72,990	71,121	1,869	899	894
1996-97	70,995	69,450	1,545	1,590	1567
Total	7,12,495	6,87,203	25,292	16,792	16,227

Uromyces betae (beet rust) which was intercepted from Bulgaria, Denmark, Germany, USA and U.S.S.R. during 1987-96 is not yet reported from India. *U. betae* was intercepted for the first time in 1983 in seeds imported from USA and Italy (Agarwal *et al.*, 1984). Later, a quarantine treatment was developed by Ram Nath *et al.*, 1986. They have found concentrated sulphuric acid highly effective in eliminating the inoculum from seed. Seed-borne rust spores can cause epidemics in new areas (Emdal and Foldo, 1979).

Fusarium nivale, the snow mould fungus is a serious pathogen of cereals and grasses, was intercepted in a large number of wheat germplasm samples received from U.K. during 1988 (Dev *et al.*, 1989); infection level was as high as 70% in some of the samples. *F. nivale* is reported to cause total loss of winter wheat and rye in parts of U.S.S.R., Japan, Canada and Central Europe (Blomqvist, 1970; Jamalainen, 1970). Fungicidal resistant strains are also reported in *F. nivale* (Olvang, 1984).

Claviceps purpurea, the causal agent of ergot of cereals was intercepted on a wide range of hosts i.e. *Aegilops* spp., *Agropyron* spp., *Avena sativa,*

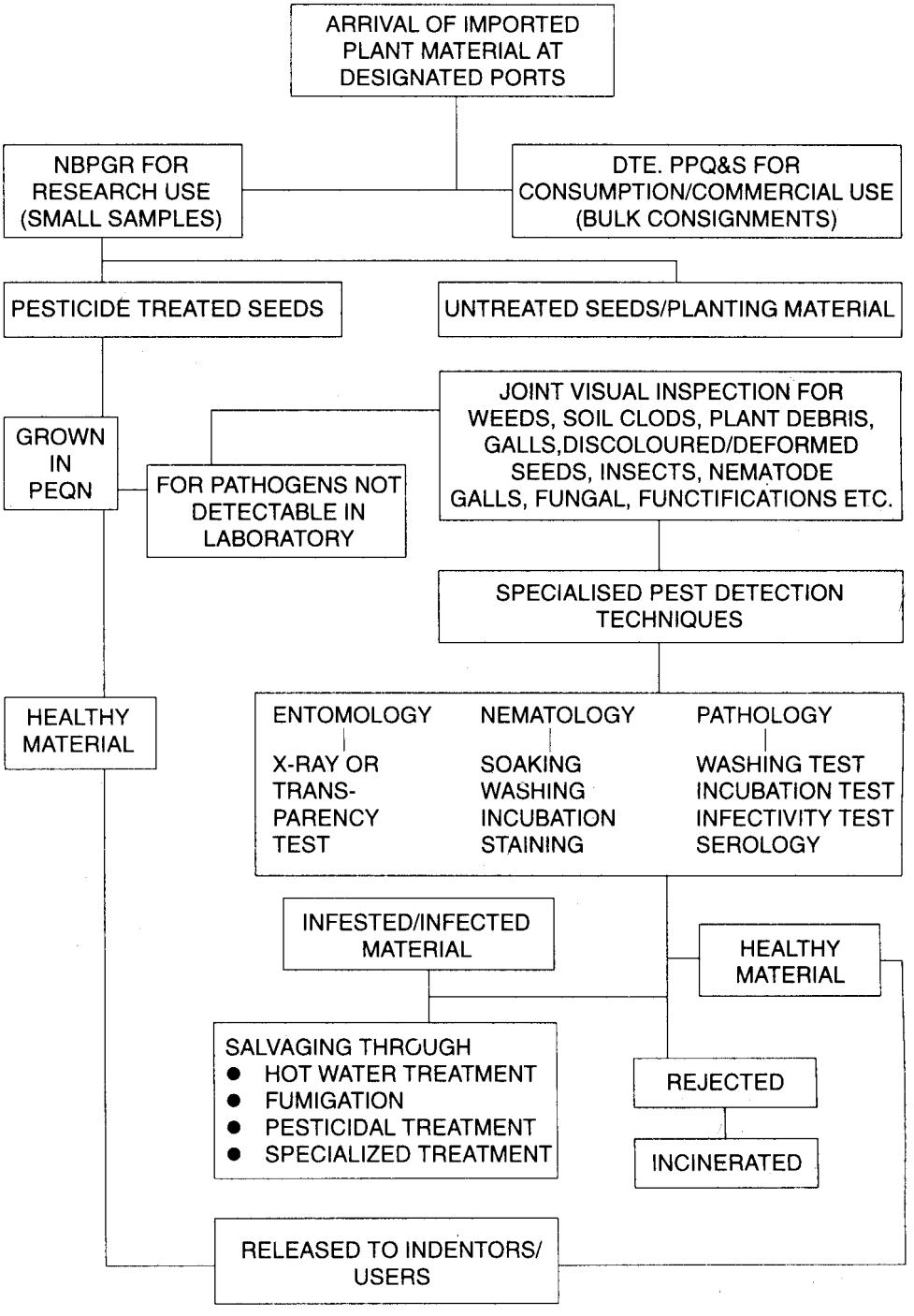

Fig. 1. Quarantine processing of imported plant germplasm

Festuca spp., *Hordeaum vulgare, Lolium* spp., *Secale cereale, Triticum* spp., etc. The destructive ergot pathogen of rye, has caused epiphytotic conditions on *Agropyron repens* in America and Russia. However, it was not reported to attack this crop in India.

Teliospores of *Piccinia carthami* were detected in seeds received from a number of countries (Canada, China, Ethiopia, and USA). *P. carthami* has caused severe epiphytotics in USA during 1949 and 1950 (Thomas, 1952). Also a number of races are reported in this fungus.

Neovossia indica, the causal agent of karnal bunt of wheat was detected in seeds of wheat from Mexico, Nepal, Pakistan, and U.S.S.R., is a serious pathogen. European and Mediterranean Plant Protection Organization (EPPO) has declared *N. indica* to be a pathogen of high quarantine importance (Anonymous, 1979). Recently it has also been reported from a few states of USA and it has been listed as a very high risk pathogen, since the US trade is very badly affected due to infection of *N. indica.*

Drechslera maydis, the Maydis leaf blight fungus detected on maize and sorghum from Thailand and USA, respectively, has a devastating race i.e. race T which has caused the great epidemics of 1971 in U.S.A. due to use of cytoplasmic male sterile (cms) lines.

Botrytis cinera, the grey mould fungus which was detected in a number of crops has a wide host range. It has caused heavy crop losses to chickpea crop in states of Bihar, Haryana, Punjab and U.P. (Lambat *et al.,* 1985). However, *B. cinera* is considered as a common saprophyte in European countries.

Fusarium solani, Macrophomina phaseolina and *Colletotrichum dematium* are known to posses a wide host range. These three pathogens have been intercepted on a large number of hosts from different countries.

Fungi observed in PEQN were loose smut (*Ustilago tritici*) in wheat and barley, covered smut (*U. segetum var. hordei*) in barley, rust (*Puccinia carthemi*) in safflower, stripe disease (*Pyrenophora graminea*) in barley and leaf blight (*Drechslera sorokiniana*) in wheat.

Interception of pathogenic bacteria

Xanthomonas campestris pv. *campestris,* black rot of crucifers was detected in *Brassica* spp. from several countries; *X. oryzae* pv. *pryzae* was detected in paddy seeds from Philippines; and *Pseudomonas syringae* pv. *syringae* was detected in *Hibiscus cannabinus* seeds from Bangladesh (Singh *et al.,* 1995).

Interception of viruses

Plant viruses detected in legumes and cereals were: barley stripe mosaic virus in wheat (USA); pea seed-borne mosaic virus in pea (Netherlands and Syria), in faba bean (Syria); bean common mosaic virus in soybean (USA); soybean mosaic virus in soybean (Argentina, Philippines and USA) and yellow mosaic virus in french bean (Syria).

Interception of insects and mites

The insects and mites of high quarantine significance intercepted in exotic germplasm include; *Acanthoscelides obtectus* in *Cajanus cajan* (Brazil and Colombia), in *Phaseolus vulgaris* (Italy and Nigeria); *Anthonomus grandis* in *Gossypium* spp. (USA), in *Hibiscus* spp., *Sesamum* spp., *Vigna unguiculata* (Italy and Zambia); *Ephestia elutella* in *Macadamia* spp. (nuts) and *Vigna* spp. (USA) and *Quadrastichodella eucalypti* in *Eucalyptus* spp. (Australia).

Interception of nematodes

More than 65 spp. of plant parasitic nematodes were intercepted. Among the major interceptions, nematodes not reported in India include : *Heterodera schachtii, H. glycines, Ditylenchus dipsaci, D. destructor* and *Rhadinaphelenchus cocophilus.*

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