AN INVESTIGATION OF SEED-BORNE PATHOGENS OF CROP PLANTS CULTIVATED IN SRI LANKA

by

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ABSTRACT

In a systematic survey of seed infections in crop plants cultivated in Sri Lanka, seed samples of rice, other cereals, pulses, vegetables, condiments and oil-seed crops from various agro-ecological regions of the country were examined for the presence of seed-borne pathogens adopting standard techniques and procedures devised during these studies. Effects associated with seed-borne organisms were also investigated.

Seed samples were, in general, free of infestations such as galls, sclerotia and pycnidia. Occasionally, impurities such as plant debris and soil particles were found.

Over 40 genera of fungi were recorded in these studies and about 90 species identified. They included several economically important pathogens, weak pathogens and saprophytes, some of which were antagonistic to pathogenic forms.

Seed-transmitted viruses were detected in leguminous crop plants which were able to infect other leguminous species and several hosts, including weeds, from other families.

In rice, 26 genera of fungi were recorded as seed-borne, the most important of which were Drechslera oryzae and Trichoconis padwickii. The degree of infection with these two fungi differed markedly with different cultivars, locations and seasons. They caused adverse effects only in seed paddy of relatively poor quality originating from crops matured, processed and stored under unfavourable conditions. Pyricularia oryzae was not detected in incubation tests though non-viable spores were observed in washing tests.

With other cereals, 18 genera of fungi were recorded as seed-borne, 13 in finger millet (Eleusine corocana), five in foxtail millet

(Setaria italica), three in maize (Zea mays), 13 in barley (Hordeum vulgare), and six in wheat (Triticum aestivum). The more important pathogens detected were Pyricularia grisea in finger millet, Drechslera maydis in maize, and Drechslera graminea, Drechslera teres and Drechslera sorokiniana in barley.

In leguminous crops, 33 genera of fungi were recorded, 19 in bean (Phaseolus vulgaris), 16 in black gram (Vigna mungo), 17 in green gram (Vigna radiata), 24 in cowpea (Vigna unguiculata), 25 in soybean (Glycine max), and eight in groundnut (Arachis hypogea). The more important of them as pathogens were Ascochyta sp., Cercospora sp., Cladosporium sp., Colletotrichum dematium, Corynespora cassiicola, Fusarium oxysporum, Macrophomina phaseolina and Rhizoctonia solani in bean, Macrophomina phaseolina, Myrothecium roridum and Phoma sp. in black gram, Cercospora sp., Corynespora cassiicola and Macrophomina phaseolina in green gram, Ascochyta sp., Diaporthe phaseolorum, Fusarium oxysporum and Macrophomina phaseolina in cowpea, Cercospora kikuchii, Fusarium spp., Macrophomina phaseolina, Myrothecium roridum and Phomopsis sojae in soybean, and Aspergillus spp. and Macrophomina phaseolina in groundnut. In addition, saprophytic fungi with antagonistic properties such as species of Aspergillus, Chaetomium, Trichoderma and Penicillium were also detected.

In solanaceous crops, 16 genera of fungi were recorded, 13 in brinjal (Solanum melongena), 11 in chilli (Capsicum annuum) and five in tomato (Lycopersicon esculentum). The more important pathogens detected were Colletotrichum dematium, Macrophomina phaseolina and Myrothecium spp. in brinjal and chilli.

In cucurbitaceous crops, 25 genera of fungi were recorded, 17 in bitter gourd (Momordica charantia), six in cucumber (Cucumis sativus), two in pumpkins (Cucurbita spp.), 20 in snake gourd

(Trichosanthes cucumerina) and four in sponge gourd (Luffa acutangula). The more important of them were Macrophomina phaseolina in bitter gourd, cucumber, snake gourd and sponge gourd, Didymella bryoniae in cucumber and snake gourd and Fusarium spp. in bitter gourd, cucumber, pumpkins, snake gourd and sponge gourd.

In several other crops investigated, the more noteworthy fungi detected included species of Alternaria such as A. alternata in gingelly (Sesamum indicum), A. brassicicola in cabbage (Brassica oleracea var. capitata), cauliflower (Brassica oleracea var. gongyloides) and radish (Raphanus sativus), A. longissima in Amaranthus spp. and A. tenuis in fennel (Foeniculum vulgare), species of Curvularia, Drechslera and Fusarium in several crops and Macrophomina phaseolina in ladies finger (Hibiscus esculentus), gingelly, coriander (Coriandrum sativum and fennel.

The stage of infection of crop plants and the timing of cultural operations had an important bearing on the nature of infections in matured seed. With fungal infections, this was clearly demonstrated with the harvesting time of crops of soybean. Thus, infection with the fungi Phomopsis sojae and Fusarium sp. were minimal in seed samples harvested at 2 wk after maturity and highest in samples at 4 wk, the extent of infection being also reflected in germination percentages which were higher with the samples harvested at 2 wk which had less fungal infection. This emphasises the importance of timely harvesting to obtain seeds with low fungal infection thereby ensuring better germination, healthier seedlings and good stands. With virus infections, the strong influence of the stage of mother plant infection on the extent of seed transmission of virus was evident in vegetable cowpea cv. Polon Mae.

The pathogenic fungus Macrophomina phaseolina was recorded in 16 species of crop plants belonging to six families, extensively cultivated in Sri Lanka including bitter gourd, cucumber, snake gourd, and sponge gourd (Cucurbitaceae), bean, black gram, green gram, cowpea, soybean and groundnut (Leguminosae), ladies finger (Malvaceae), gingelly (Pedaliaceae), brinjal and chilli (Solanaceae) and coriander and fennel (Umbelliferae). This pathogen deserves special attention. It has been shown to be active under warm conditions and it is able to survive in the soil. Many variants of the fungus, both morphological and physiological appear to exist. With large extents of new lands being cultivated in the dry zone, the potential threat posed by this fungus needs to be recognised.

Another interesting aspect demonstrated was the ability of some of the seed-borne fungi affecting crop plants to produce toxins. Myrothecium roridum and Myrothecium verrucaria are two such fungi.

Besides the pathogens, numerous saprophytes were identified as seed-borne in several cultivated species. Of these, the saprophytes Aspergillus niger, Chaetomium globosum, Chaetomium funicola, Trichoderma hamatum and Trichoderma viridi were antagonistic to the pathogens Colletotrichum dematium, Corynespora cassiicola, Fusarium spp., Macrophomina phaseolina, Myrothecium roridum and Myrothecium verrucaria. Their activity was the probable cause of the failure of characteristic disease symptoms to develop in growing-on tests with some seed samples infected with pathogenic fungi. In contrast, symptoms induced by Macrophomina phaseolina were aggravated in the presence of some species of Fusarium, this probably being a synergistic effect.

Seed-transmitted viruses were detected in vegetable cowpea cv. Polon Mae and green gram cv. T 77. A virus detected in plots of winged bean (Psophocarpus tetragonolobus) at the International Winged

Bean (Dambala) Institute resembled a seed-transmitted virus prevalent in West Africa, probably introduced with imported seed. Embryonic seed-transmission of virus was confirmed in vegetable cowpea cv. Polon Mae. The seed transmitted viruses detected survived more than 30 months in seeds stored under refrigeration and seeds could not be readily freed of virus infection by heat treatment or by chemical means. These viruses also infected several crop plants and common weeds including Cassia occidentalis, Clitoria ternatea, Crotalaria spp., Hedyotis corymbosa, Mollugo sp., Macroptilium artopurpureum, Macroptilium lathyroides and Stachytarpheta indica. Rapid spread of virus infection from plants produced from infected seeds which served as primary foci of infection occurred in field crops of vegetable cowpea cv. Polon Mae. Seed infection and the survival of viruses in viable seed for long periods provide possibilities for progeny infection while the extensive host range of these viruses result in the creation of virus reservoirs in weed hosts, common in the vicinity of cultivated sites, thus providing enhanced opportunities for the spread of viruses and their perpetuation from season to season, thereby endangering the health of subsequent crops. These aspects emphasise the need for the highest standards of seed health with respect to seed-transmitted viruses.

During the early stages of this investigation, innovations were stimulated by limitations of facilities, among them the development of a method for seed-health testing using locally produced earthenware dishes which besides being inexpensive had the advantage over glass of porosity. This method, perfected with various modifications to suit different situations, became a standard procedure in our laboratory and the earthenware dish a symbol of the research on seed pathology pioneered in the Division of Plant Pathology.