



# Generic Pest Risk Analysis Import of Transgenic Corn



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## INTRODUCTION

Corn [*Zea mays* (L.)] is the most versatile crop with wide adaptability to varied agro-ecologies. It has highest genetic yield potential among the food-grain crops. Globally, it is cultivated on nearly 150 m ha in about 160 countries with wide diversity of soil, climate, biodiversity and management practices that contribute nearly 37% (782 m tonnes) in the global grain production. The US has the highest harvest of corn in the world. The other major countries that contribute significantly to the global corn production are China, Brazil, Mexico, India and Indonesia. In India, corn is the third most important food crop after rice and wheat. It is cultivated in 8.12 m ha (2007-08) under a wide range of agro-ecological situations. It contributes nearly 8% in the national food basket and >Rs.100 m to the agricultural GDP (Anonymous, 2010). Given its nutritional and health benefits, corn has been gaining more prominence the world over, especially with the advent of transgenic crops. India is among the top ten corn producing countries in the world. The crop is susceptible to several pests, which substantially reduce yield and quality.

The ICAR-National Bureau of Plant Genetic Resources (NBPGR) is the nodal agency in India for management of plant genetic resources (PGR) and quarantine processing of imported germplasm including that of transgenics for research purposes. Corn was introduced into India by the Portuguese during the seventeenth century. However, India also harbours diverse corn germplasm and landraces (Sikkim Primitives). The National Genebank at ICAR-NBPGR, New Delhi houses > 6,000 indigenous accessions. Besides, Corn germplasm including transgenics is imported into India every year for crop improvement programmes. The germplasm of corn is exchanged in the form of true seed. The seed not only serves as a source of valuable genes useful for crop improvement, but also as a reservoir of many seed-borne and seed-transmitted pests. International exchange of germplasm and seed trade is now more extensive under the WTO regime. This has increased the probability of introducing new and dangerous pests or their virulent races/ pathotypes/ biotypes along with the movement of planting material. Peanut stripe virus was also introduced into India and is presently being regulated under the domestic quarantine program of DIP Act.

International spread of serious pests of various crops caused havoc and lead to profound political, economic and social consequences. The European corn borer, *Ostrinia nubilalis*, the pest introduced in North America from Europe in 1917 has been reported to cause damage worth about \$340M. *Peronosclerospora philippinensis* = *Sclerospora philippensis* (Downy mildew of maize) was introduced into India in 1918 from SW Asia. The worldwide distribution of many economically important viruses, is attributed to the unrestricted exchange of seed lots. *Peanut stripe virus* (later identified as a strain of *Bean common mosaic virus*) was introduced into the US in the 1980s through groundnut seed germplasm imported from China.

At ICAR-NBPGR, New Delhi, adopting a workable strategy several pests have been detected, identified and intercepted including the ones not reported from India in imported transgenics (Singh *et al.*, 2003; Khetarpal *et al.*, 2005; Bhalla *et al.*, 2008; Chalam *et al.*, 2009; Dev *et al.*, 2010). Recently, *Maize chlorotic mottle virus* and *Wheat streak mosaic virus* were detected in imported transgenic corn germplasm and the infected plants were uprooted and incinerated. It is therefore, mandatory to pay attention to the prescribed regulations to avoid the introduction of quarantine pests into the country and the appropriate

phytosanitary measures be adopted accordingly to facilitate safe import of plants and plant products.

The increased awareness in recent years regarding the dissemination of plant pests by seeds as well as agricultural commodities during exchange and trade has been due to liberalization of trade under WTO regime. The Agreement on Application of Sanitary and Phytosanitary Measures, under WTO, requires member countries to have uniform phytosanitary standards. The International Plant Protection Convention (IPPC) has developed International Standards for Phytosanitary Measures (ISPM) and so far 34 standards have been brought out. Of these guidelines for developing a pest risk analysis (PRA) is given in ISPM-2, ISPM-11 and ISPM-21. The preparation of PRA has three stages viz., initiation, risk assessment and risk management. The PRA should be fully documented in the event of a review or dispute. In fact, the first step is very crucial to start a PRA and requires both a list of pests reported to occur and a list of those not known to occur in the country.

ICAR-NBPGR has been empowered under the PQ (Regulation of Import into India) Order 2003 to undertake quarantine germplasm including transgenics under exchange. The Division of Plant Quarantine at ICAR-NBPGR has brought out publications on the potential quarantine pests (PQPs) in cereals and grain legumes (Dev *et al.*, 2005; Chalam *et al.*, 2011). In this context, the present compilation is an attempt to prepare a document on the PQPs of corn. Various parameters taken into account for compilation are: pests, their synonym(s), disease caused or the common name, pathway of introduction, host range, geographical distribution, economic impact and phytosanitary risk involved.

The information has been collected from various sources including *Crop Protection Compendium* (CAB International, 2007). PQPs were short-listed based on one or more of the facts that these pests are: i) not reported from India, ii) having limited distribution, iii) present in India on other crops but not on corn and iv) having physiological races. This data has been linked with the pests listed under the Schedule VI of Plant Quarantine (Regulation of Import into India) Order, 2003. The Schedule VI of the Order deals with plant/ plant material permitted for import with additional declarations. Fifty two pests (18 insects, four nematodes, six fungi, six bacteria, three viruses and 15 weed species) are listed as the PQPs for India in corn (Table 1). Forty nine pests (17 insects, three nematodes, five fungi, six bacteria, three viruses and 15 weed species) are not reported to occur in India. Once introduced and established, these pests or their virulent races/ strains/ biotypes can cause severe damage to agriculture.

Compilation of data on pests of quarantine significance, their global distribution and other aspects related to biology, survival and spread of these pests are essential components of risk analysis to meet international regulations. However, it may be noted that, this compilation is based on published literature and the non-availability of published literature should not be interpreted as absence of a pest in a country. This publication would, thus, facilitate smooth functioning of quarantine, benefit scientists while issuing import permit stating additional declarations required for import in addition to supplementing information for analyzing the pest risk. Therefore, it is hoped that this publication would be of help to scientists and others entrusted with the task of safe trade and exchange of germplasm of corn including transgenics.

**Table 1. Potential Quarantine Pests of Corn for India**

| S.No.          | Scientific Name<br>Synonyms and<br>Classification  | Common<br>Name   | Pathway of<br>Introduction | Host-range   | Geographical<br>Distribution  | Remarks   |
|----------------|--|--|----------------------------|--|---|---|
| <b>Insects</b> |  |  |                            |  |   |   |
| 1.             | <p><b>*<i>Acanthoscelides obtectus</i> Say<sup>1</sup></b></p> <p><u>Synonyms:</u><br/> <i>Acanthoscelides irresectus</i> Fåhraeus,<br/> <i>Acanthoscelides tetricus</i> Gyllenhal,<br/> <i>Bruchidius obtectus</i> Say,<br/> <i>Bruchus fabae</i> Riley,<br/> <i>Bruchus irresectus</i> Fahraeus,<br/> <i>Bruchus obtectus</i> Say,<br/> <i>Bruchus tetricus</i> Gyllenhal,<br/> <i>Laria obtectus</i> Say,<br/> <i>Mylabris obtectus</i> Say</p> <p><u>Order:</u> Coleoptera<br/> <u>Family:</u> Bruchidae</p> | American seed beetle, bean beetle, bean bruchid, bean weevil, common bean weevil, dried bean beetle, dried bean weevil | Seed, as contaminant       | <i>Cajanus cajan</i> , <i>Cicer arietinum</i> , <i>Glycine max</i> , <i>Lathyrus sativus</i> , <i>Phaseolus</i> sp., <i>P. acutifolius</i> , <i>P. lunatus</i> , <i>P. vulgaris</i> , <i>Pisum sativum</i> , <i>Vicia faba</i> , <i>Vigna unguiculata</i> , <b><i>Zea mays</i></b> | Albania, Angola, Argentina, Armenia, Australia, Austria, Belgium, Belize, Bolivia, Bosnia and Herzegovina, Brazil, Bulgaria, Burundi, Canada, Chile, Colombia, Congo, Costa Rica, Cuba, Czechoslovakia (erstwhile), Dominican Republic, Egypt, El Salvador, France, Georgia, Germany, Greece, Guadeloupe, Guatemala, Guyana, Honduras, Hungary, Iraq, Israel, Italy, Japan, Kazakhstan, Kenya, Lesotho, Luxembourg, Malawi, Malaysia, Mauritius, Mexico, Morocco, Myanmar, Netherlands, | <p>High potential for population growth (Howe and Currie, 1964; Meirleire, 1967).</p> <p>Wide temperature tolerance, occurs in cool highland areas, warmer lowland tropics and some temperate regions. Eggs lodged under cracks in the bean testa and on ripening pods.</p> |

|    |   |                 |                      |   |   |  |
|----|---|-----------------|----------------------|---|---|--|
|    |   |                 |                      |   | New Zealand, Nicaragua, Nigeria, Papua New Guinea, Paraguay, Peru, Poland, Portugal, Romania, Russian Federation, Rwanda, Saint Helena, Senegal, Seychelles, South Africa, Spain, Swaziland, Switzerland, Tajikistan, Tanzania, Thailand, Turkey, Uganda, USA, Venezuela, Vietnam, Yugoslavia (erstwhile), Zambia, Zimbabwe |  |
| 2. | <p><b>*<i>Acrosternum hilare</i> (Say)</b></p> <p><u>Synonyms:</u><br/> <i>Nezara hilaris</i> (Uhler),<br/> <i>Nezara (Acrosternum) sarpinus</i> Stål,<br/> <i>entatoma hilaris</i> Say,<br/> <i>Rhaphigaster sarpinus</i> Dallas</p> <p><u>Order:</u> Hemiptera<br/> <u>Family:</u> Pentatomidae</p> | Green stink bug | Seed, as contaminant | <i>Abelmoschus esculentus</i> ,<br><i>Acer negundo</i> , <i>Althaea</i> sp.,<br><i>Asparagus officinalis</i> ,<br><i>Brassica oleracea</i> var. <i>capitata</i> ,<br><i>Catalpa</i> sp.,<br><i>Cephalanthus occidentalis</i> ,<br><i>Cercis amestown</i> ,<br><i>Citrus inensis</i> ,<br><i>Cornus</i> sp.,<br><i>Coronilla varia</i> ,<br><i>Corylus avellana</i> ,<br><i>Crataegus</i> sp.,<br><i>Datura stramonium</i> ,<br><i>Desmodium</i> sp.,<br><i>Fragaria ananassa</i> ,<br><i>Fraxinus</i> sp.,<br><i>Glycine max</i> ,<br><i>Gossypium</i> sp.,<br><i>Ilex aquifolium</i> ,<br><i>Juglans nigra</i> , | Canada, Pakistan, USA   | <p>Feeding results in reduced pod filling, seed viability and vigour, loss of value of the seed for oil, meal or seed.</p> <p>Bugs aestivate as adults in plant debris and soil.</p> |

|    |  |                      |                       |   |   |  |
|----|--|----------------------|-----------------------|---|---|--|
|    |  |                      |                       | <i>Lonicera</i> sp.,<br><i>Lycopersicon esculentum</i> ,<br><i>Malus domestica</i> ,<br><i>Medicago sativa</i> , <i>Mimosa</i><br>sp., <i>Morus alba</i> ,<br><i>Phaseolus</i> , <i>P. lunatus</i> ,<br><i>Pisum sativum</i> ,<br><i>Platycladus orientalis</i> ,<br><i>Prunus armeniaca</i> ,<br><i>P. avium</i> , <i>P. domestica</i> ,<br><i>P. persica</i> , <i>P. serotina</i> ,<br><i>Pyrus communis</i> , <i>Quercus</i><br>sp., <i>Rhamnus cathartica</i> ,<br><i>Rhus</i> sp., <i>Robinia</i><br><i>pseudoacacia</i> , <i>Rubus</i><br><i>idaeus</i> , <i>Sambucus</i> sp.,<br><i>S. amestown</i> , <i>Solanum</i><br><i>melongena</i> , <i>Solidago</i> sp.,<br><i>Syringa vulgaris</i> , <i>Tilia</i><br><i>heterophylla</i> , <i>Trifolium</i><br>sp., <i>Ulmus rubra</i> , <i>Vigna</i><br><i>unguiculata</i> , <i>Vitis vinifera</i> ,<br><i>Wisteria</i> sp., <b><i>Zea mays</i></b> |   |  |
| 3. | <b><i>*Ahasverus advena</i></b> (Waltl)<br><br><u>Synonyms:</u><br><i>Cathartus advena</i> Waltl,<br><i>Silvanus advena</i> Waltl<br><br><u>Order:</u> Coleoptera<br><u>Family:</u> Silvanidae | Foreign grain beetle | Seed, stored products | <i>Avena sativa</i> , <i>Coffea</i> sp.,<br><i>Hordeum vulgare</i> , <i>Oryza</i><br><i>sativa</i> , <i>Theobroma cacao</i> ,<br><i>Triticum aestivum</i> , <b><i>Zea mays</i></b>  | Bangladesh, Canada,<br>Dominican Republic,<br>Ecuador, Ethiopia,<br>Jamaica, Lesotho,<br>Malawi, Nigeria,<br>Philippines, Puerto Rico,<br>Singapore, Solomon<br>Islands, Sri Lanka,<br>Suriname, Tonga, | Contamination with insect bodies and frass results in loss of market value.<br><br>Feeds on damaged seeds, abundant only when they are mouldy. |



|    |   |   |                              |   |  |  |
|----|---|---|------------------------------|---|--|--|
|    |   |   |                              |   | Trinidad and Tobago,<br>UK, USA  | Immature stages small<br>and invisible as these<br>are similar in colour<br>to the host.   |
| 4. | <p><b>*<i>Busseola fusca</i></b> Fuller</p> <p><u>Synonyms:</u><br/> <i>Busseola sorghicida</i> Thureau,<br/> <i>Calamistis fusca</i> Fuller,<br/> <i>Sesamia fusca</i> Fuller</p> <p><u>Order:</u> Lepidoptera<br/> <u>Family:</u> Noctuidae</p> | African<br>maize<br>stalk<br>borer,<br>maize<br>stem<br>borer,<br>sorghum<br>stalk/ stem<br>borer | Seed, cob, as<br>contaminant | <i>Eleusine coracana</i> ,<br><i>Panicum maximum</i> ,<br><i>Pennisetum glaucum</i> ,<br><i>P. purpureum</i> , <i>Saccharum</i><br><i>officinarum</i> , <i>Sorghum</i><br><i>halepense</i> , <b><i>Zea mays</i></b> | Angola, Benin, Burkina<br>Faso, Burundi,<br>Cameroon, Chad,<br>Congo, Ethiopia, Gabon,<br>Ghana, Guinea, Côte<br>d'Ivoire, Kenya,<br>Lesotho, Malawi,<br>Mozambique, Nigeria,<br>Rwanda, Sierra Leone,<br>Somalia, South Africa,<br>Sudan, Swaziland,<br>Tanzania, Togo, Uganda,<br>Zambia, Zimbabwe | <p>The pest is restricted<br/>to south of the Sahara,<br/>but could be<br/>accidentally<br/>introduced into other<br/>parts of the world,<br/>with possibly serious<br/>consequences.</p> <p>Major pest of maize in<br/>tropical Africa. In<br/>Tanzania and Kenya,<br/>yield losses of 12%<br/>for every 10% plants<br/>infested were reported<br/>(Walker 1960, Walker<br/>and Hodson, 1976).</p> <p>Larvae diapause in<br/>dry stem of cereals or<br/>grasses and can<br/>survive for 6 months<br/>or more.</p> |
| 5. | <b>*<i>Carpophilus hemipterus</i></b><br>(Linnaeus)   | Dried fruit<br>beetle   | Seed,<br>stored<br>products  | <i>Phaseolus vulgaris</i> ,<br><i>Prunus</i> spp.,<br><i>P. armeniaca</i> ,   | Indonesia, Malaysia,<br>Saint Lucia, Singapore,<br>Thailand, USA, Vietnam  | Important pest in<br>humid areas,<br>especially of maize   |

|  |  |  |  |  |  |  |
|--|--|--|--|--|--|--|
|  | <u>Synonym:</u><br><i>Carpophilus aterrimus</i><br>Macleay<br><br><u>Order:</u> Coleoptera<br><u>Family:</u> Nitidulidae |  |  | <i>P. domestica</i> , <b><i>Zea mays</i></b> |  | cobs. Infests moist grains/ seeds.<br><br>Adults and larvae infest damaged seeds/ commodities<br><br>Have high reproductive, spread and establishment potential<br><br>A single female lays about 1000 eggs, adults active fliers covering distances up to 3 kms, can live up to one year. |
|--|--|--|--|--|--|--|

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| 6. | <p><b>*<i>Caulophilus oryzae</i></b><br/>(Gyllenhal)</p> <p><u>Synonyms:</u><br/><i>Caulophilus latinasus</i> (auctt, non Say),<br/><i>Rhyncolus oryzae</i> Gyllenhal</p> <p><u>Order:</u> Coleoptera<br/><u>Family:</u> Curculionidae</p>   | Broad-nosed grain weevil, Broad-nosed granary weevil, broad-nosed weevil  | Seed, as contaminant | <i>Castanea</i> sp., <i>Cicer arietinum</i> , <i>Ipomoea batatas</i> , <i>Panicum miliaceum</i> , <i>Pennisetum</i> sp., <i>Persea americana</i> , <b><i>Zea mays</i></b> , <i>Zingiber officinale</i>  | Cuba, Guatemala, Jamaica, Mexico, Panama, Portugal, Puerto Rico, USA  | <p>The adults may live for 5 months. Females lay eggs throughout their lives. Adults fly into maize fields attacking damaged or exposed cobs and also breed in stores (Hill, 1990).</p> <p>Significant quarantine pest in Eastern Europe and the countries of the former USSR (Krôsteva, 1976) and Canada.</p> |
| 7. | <p><b>*<i>Cryptophlebia leucotreta</i></b><br/>Meyrick</p> <p><u>Synonyms:</u><br/><i>Argyroploce leucotreta</i> Meyrick,<br/><i>Cryptophlebia roerigii</i> Zacher,<br/><i>Olethreutes leucotreta</i> Meyrick,<br/><i>Thaumatotibia roerigii</i> Zacher</p> <p><u>Order:</u> Lepidoptera</p> | Citrus codling moth, false codling moth, orange codling moth, orange moth | Seed, as contaminant | <i>Abelmoschus esculentus</i> , <i>Abutilon hybridum</i> , <i>Ananas comosus</i> , <i>Annona muricata</i> , <i>Averrhoa carambola</i> , <i>Camellia sinensis</i> , <i>Capsicum</i> sp., <i>Ceiba pentandra</i> , <i>Citrus</i> sp., <i>C. sinensis</i> , <i>Coffea arabica</i> , <i>Gossypium</i> sp., <i>Litchi chinensis</i> , <i>Macadamia</i> sp., <i>M. ternifolia</i> ., <i>Mangifera indica</i> , <i>Olea europaea</i> subsp. <i>europaea</i> , <i>Persea americana</i> , <i>Prunus persica</i> , <i>Psidium guajava</i> , | Angola, Benin, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Congo, Côte d'Ivoire, Eritrea, Ethiopia, Gambia, Ghana, Israel, Kenya, Madagascar, Malawi, Mali, Mauritius, Mozambique, Niger, Nigeria, Rwanda Reunion, Saint Helena, Senegal, Sierra Leone, Somalia, South Africa, Sudan, Swaziland, | <p>Losses to the tune of 42 - 90% reported in late crops of cotton in Uganda (Reed, 1974).</p> <p>Causes internal feeding in maize seeds in West Africa.</p> <p>Larvae mine beneath the seed surface. Full-grown larva spins a silken cocoon in the soil / debris.</p>   |

|    |   |   |                      |  |   |   |
|----|---|---|----------------------|--|---|---|
|    | Family: Tortricidae   |   |                      | <i>Punica granatum</i> ,<br><i>Quercus</i> sp., <i>Ricinus communis</i> , <i>Sorghum</i> sp.,<br><b><i>Zea mays</i></b>  | Tanzania, Togo, Uganda,<br>Zambia, Zimbabwe   |   |
| 8. | <p><b>*<i>Gonocephalum macleayi</i></b> (Blackburn)</p> <p><u>Synonym:</u><br/><i>Dasus macleayi</i> (Blackburn)</p> <p><u>Order:</u> Coleoptera<br/><u>Family:</u> Tenebrionidae</p>   | Southern false wireworm   | Seed, as contaminant | <i>Cicer arietinum</i> , <i>Glycine max</i> , <i>Gossypium</i> spp., <i>Helianthus annuus</i> , <i>Sorghum alnum</i> , <i>S. bicolor</i> , <i>Triticum</i> , <b><i>Zea mays</i></b>  | Australia   | <p>Eggs laid under weeds/ crop residues. Generally have a one-year life cycle with over wintering adults/ larvae. Larvae may remain in the soil for 10-12 months (Allsopp, 1980).</p> <p>Adults and larvae congregates under crop residues (Robertson and Simpson, 1988).</p> |
| 9. | <p><b>*<i>Helicoverpa zea</i></b> (Boddie)</p> <p><u>Synonyms:</u><br/><i>Bombyx obsoleta</i> Fabricius,<br/><i>Chloridea obsoleta</i> Fabricius,<br/><i>Heliothis armigera</i> auct.nec Huebner Hübner,<br/><i>Heliothis ochracea</i> Cockerell,</p> | American cotton bollworm, bollworm, corn earworm, tomato fruit worm | Seed, as contaminant | <i>Abelmoschus esculentus</i> , <i>Abutilon theophrasti</i> , <i>Amaranthus</i> spp., <i>Arachis hypogaea</i> , <i>Brassica oleracea</i> var. <i>capitata</i> , <i>B. oleracea</i> , <i>Cajanus cajan</i> , <i>Capsicum</i> spp., <i>C. annuum</i> , <i>Cicer arietinum</i> , <i>Citrus</i> spp., <i>Coronilla varia</i> , <i>Cucumis melo</i> , <i>C. sativus</i> , <i>Fragaria</i> | Antigua and Barbuda, Argentina, Bahamas, Barbados, Bermuda, Bolivia, Brazil, Canada, Chile, Colombia, Costa Rica, Cuba Dominica, Dominican Republic, Ecuador, El Salvador, Falkland Islands, French Guiana, Guadeloupe, | Second most important pest in North America. Annual loss by <i>H. zea</i> and <i>H. virescens</i> together on all crops in USA is more than US\$ 1000 million, despite the expenditure of 250 million US\$ on   |

|     |   |   |                                       |  |  |  |
|-----|---|---|---------------------------------------|--|--|--|
|     | <p><i>Heliothis umbrosa</i> Grote,<br/> <i>Heliothis zea</i> Boddie,<br/> <i>Phalaena zea</i> (Boddie)</p> <p><u>Order</u>: Lepidoptera<br/> <u>Family</u>: Noctuidae</p> |   |                                       | <p>spp., <i>F. ananassa</i>,<br/> <i>Geranium carolinianum</i>,<br/> <i>Gerbera</i> sp., <i>Glycine max</i>,<br/> <i>Gossypium</i> spp.,<br/> <i>Helianthus annuus</i>,<br/> <i>Lactuca sativa</i>, <i>Lespedeza</i><br/> <i>cuneata</i>, <i>Lonicera</i><br/> <i>japonica</i>, <i>Lycopersicon</i><br/> <i>esculenta</i>, <i>Medicago</i><br/> <i>lupulina</i>, <i>M. sativa</i>,<br/> <i>Nicotiana tabacum</i>,<br/> <i>Panicum miliaceum</i>,<br/> <i>Pharbitis purpurea</i>,<br/> <i>Phaseolus vulgaris</i>,<br/> <i>Quercus</i> sp., <i>Salix</i> sp.,<br/> <i>Solanum melongena</i>,<br/> <i>Sorghum</i> spp., <i>Trifolium</i><br/> sp., <i>T. incarnatum</i>, <i>Vicia</i><br/> <i>sativa</i>, <i>V. villosa</i>, <i>Vigna</i><br/> <i>unguiculata</i>, <b><i>Zea mays</i></b></p> | <p>Guatemala, Guyana,<br/> Haiti, Honduras,<br/> Jamaica, Martinique,<br/> Mexico, Montserrat,<br/> Nicaragua, Panama,<br/> Paraguay, Peru, Puerto<br/> Rico, Saint Kitts and<br/> Nevis, Saint Lucia,<br/> Saint Vincent and the<br/> Grenadines, Suriname,<br/> Trinidad and Tobago,<br/> Uruguay, USA,<br/> Venezuela</p> | <p>insecticide application<br/> (Fitt 1989).</p> <p>Pest undergoes pupal<br/> diapause and pupation<br/> occurs in the soil.<br/> High fecundity (1500-<br/> 3000). In tropics, 10-<br/> 11 generations per<br/> year.</p> <p>Pest is migratory in<br/> nature and can fly<br/> hundreds of<br/> kilometers.</p> <p>Pest resistant<br/> transgenic maize is<br/> under<br/> commercialization in<br/> USA.</p> <p>Quarantine pest under<br/> APPPC and EPPO.</p> |
| 10. | <p><b>*<i>Limothrips cerealium</i></b><br/> Haliday</p> <p><u>Order</u>: Thysanoptera<br/> <u>Family</u>: Thripidae</p>   | <p>Corn<br/> thrips,<br/> grain<br/> thrips,<br/> wheat<br/> thrips</p> | <p>Seed,<br/> as<br/> contaminant</p> | <p><i>Agropyron</i> sp., <i>Avena</i><br/> <i>sativa</i>, <i>Brassica oleracea</i><br/> var. <i>capitata</i>, <i>Citrus</i> sp.,<br/> <i>Gossypium</i> sp., <i>Linum</i><br/> <i>usitatissimum</i>, <i>Nicotiana</i><br/> <i>tabacum</i>, <i>Pinus nigra</i>, <i>Poa</i><br/> spp., <i>Raphanus</i></p>  | <p>Australia, Austria,<br/> Belgium, Bulgaria,<br/> Canada, Chile, Cyprus,<br/> Czechoslovakia<br/> (erstwhile), Denmark,<br/> Egypt, Finland, France,<br/> Germany, Greece,</p>   | <p>May attack all cereals.<br/> Most common thrip<br/> pest of cereals in<br/> Britain (Empson,<br/> 1975).</p> <p>Larvae and adults</p>   |

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|     |   |   |                             | <p><i>raphanistrum</i>, <i>Sinapis arvensis</i>, <i>Secale cereale</i>, <i>Triticum aestivum</i>, <i>Vitis vinifera</i>, <b><i>Zea mays</i></b></p> <p>226 species of host plants recorded in Britain, of which 47 are Gramineae (CAB International, 2007).</p>  | <p>Guatemala, Hungary, Ireland, Israel, Italy, Libya, Morocco, Netherlands, New Zealand, Portugal, Seychelles, South Africa, Spain, Sweden, Switzerland, Syria, Turkey, USA, USSR (erstwhile), Yugoslavia (erstwhile)</p> | <p>cause internal feeding, grains discolored, empty and shriveled.</p> <p>Vector of <i>Tomato spotted wilt virus</i> (Pherson <i>et al.</i>, 1999).</p> <p>An alarming insect, triggers smoke detectors, which causes unnecessary call-outs of fire services (Cuthbertson, 1989).</p>                    |
| 11. | <p><b>*<i>Listronotus bonariensis</i></b><br/>Kuschel</p> <p><u>Synonyms:</u><br/><i>Hyperodes bonariensis</i> Kuschel,<br/><i>Hyperodes griseus</i> Marshall,<br/><i>Neobagous setosus</i> Hustache</p> <p><u>Order:</u> Coleoptera<br/><u>Family:</u> Curculionidae</p> | <p>Argentine stem weevil, ryegrass stem weevil, shoot weevil, wheat stem weevil</p> | <p>Seed, as contaminant</p> | <p><i>Agrostis anadensis</i>, <i>Anthoxanthum puelii</i>, <i>Avena sativa</i>, <i>Bromus</i> sp., <i>Cynodon</i> sp., <i>Dactylis</i> sp., <i>Digitaria</i> sp., <i>Echinochloa</i> spp., <i>Eleusine coracana</i>, <i>Festuca pratensis</i>, <i>F. rubra</i>, <i>Hordeum vulgare</i>, <i>Lolium multiflorum</i>, <i>L. perenne</i>, <i>Paspalum</i> sp., <i>Phleum pratense</i>, <i>Poa annua</i>, <i>Triticum aestivum</i>, <b><i>Zea mays</i></b></p> | <p>Argentina, Australia, Bolivia, Brazil, Chile, New Zealand, Uruguay</p>   | <p>Losses up to 98% have been recorded. Tillers killed by larvae range from 4 to 39%. Economic losses of about NZ \$ 78-251 M per annum in New Zealand reported.</p> <p>Changes in pasture quality affect animal health causing facial eczema and bloat.</p> <p>Introduced in Australia as adults in</p> |

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|     |   |   |           |  |   | <p>ryegrass seed and pupae can also be introduced with soil.</p> <p>A phytosanitary certificate for seeds of Poaceae is required from countries where <i>L. bonariensis</i> occurs (EPPO, 1992).</p> <p>A vector of <i>Cocksfoot mottle virus</i> and <i>Ryegrass mosaic virus</i>.</p> <p>A1 quarantine pest of EPPO.</p> |
| 12. | <p><b>*<i>Mussidia nigrivenella</i></b><br/>Ragonot</p> <p><u>Order</u>: Lepidoptera<br/><u>Family</u>: Pyralidae</p> | Cob borer, corn earworm, yam bean borer | Seed, cob | <p><i>Canavalia</i> spp., <i>Cola acuminata</i>, <i>Gossypium hirsutum</i>, <i>Musa</i> sp., <i>Mucuna</i> sp., <i>Phaseolus lunatus</i>, <i>Theobroma cacao</i>, <b><i>Zea mays</i></b></p> | Benin, Cameroon, Congo, Côte d'Ivoire, Ghana, Mali, Mozambique, Niger, Nigeria, Senegal, Sierra Leone, Tanzania, Togo, Zimbabwe | <p>Pest remains inside the maize cob. Percent of grains attacked (15-20%) renders them worthless for sowing (Moyal and Tran, 1991). Serious threat to seed producers. Damage results in higher aflatoxin contamination of maize (Setamou <i>et al.</i>, 1999).</p>   |

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| 13. | <p><b><i>Oscinella frit</i></b> Linnaeus <sup>I</sup></p> <p><u>Synonyms:</u><br/><i>Oscinis frit</i> Linnaeus</p> <p><u>Order:</u> Diptera<br/><u>Family:</u> Chloropidae</p> | Frit fly         | Seed, as contaminant | <p><i>Avena sativa</i>, <i>Festuca pratensis</i>, <i>F. rubra</i>,<br/><i>Hordeum vulgare</i>,<br/><i>Phalaris arundinacea</i>,<br/><i>Phleum pratense</i>, <i>Poa pratensis</i>, <i>Secale cereale</i>,<br/><i>Tritium</i> sp., <i>T. aestivum</i>,<br/><b><i>Zea mays</i></b></p> | <p>Australia, Austria, Belarus<br/>Belgium, Bulgaria, Canada,<br/>Denmark, Finland, France,<br/>Germany, Greece, Hungary,<br/>India, Ireland, Italy, Korea (DPR), Latvia, Mexico, Mongolia, Netherlands,<br/>Norway, Pakistan, Poland, Portugal, Romania, Russian Federation, Slovakia, Spain, Sweden, Switzerland, Turkey, Ukraine, UK, USA, Yugoslavia (erstwhile)</p> | <p>Causes loss of young plants, reducing grain yield upto 90%. In maize, it may prevent establishment of seedlings and cause upto 50% loss of yield. Prevents/reduces the establishment of new sowings of ryegrass.</p> <p>Pupation may occur in the shoot, surrounding leaf sheaths or in soil.</p> <p>Larvae can migrate upto several meters (Bentley and Clements, 1990) and adults capable of flying upto 1000 m (Johnson <i>et al.</i>, 1962).</p> <p><i>Restricted distribution in India and reported as present only in Punjab and Himachal Pradesh.</i></p> |
| 14. | <p><b>*<i>Ostrinia nubilalis</i></b> (Hübner)</p>  | Corn borer, corn | Seed, as contaminant | <p><i>Amaranthus retroflexus</i>,<br/><i>Arctium minus</i>, <i>Artemisia</i></p>  | <p>Algeria, Austria, Belgium, Bulgaria,</p>  | <p>Several reports on the losses on maize,</p>  |



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|  | <p><u>Synonyms:</u><br/> <i>Micracris nubilalis</i> Botys,<br/> <i>Pyrausta nubilalis</i> Meyrick</p> <p><u>Order:</u> Lepidoptera<br/> <u>Family:</u> Pyralidae</p> | <p>moth,<br/> European corn borer,<br/> European maize borer,<br/> European stalk borer</p> |  | <p><i>vulgaris</i>, <i>Avena sativa</i>,<br/> <i>Capsicum</i> sp., <i>C. annuum</i>,<br/> <i>Chrysanthemum</i> sp.,<br/> <i>Cynara scolymus</i>,<br/> <i>Datura stramonium</i><br/> <i>Echinochloa crus-galli</i>,<br/> <i>Glycine max</i>, <i>Gossypium</i><br/> sp., <i>Helianthus annuus</i>,<br/> <i>Hordeum vulgare</i>,<br/> <i>Humulus lupulus</i>,<br/> <i>Lycopersicon esculentum</i>,<br/> <i>Malus domestica</i>,<br/> <i>Pennisetum glaucum</i>,<br/> <i>Phaseolus vulgaris</i>,<br/> <i>Prunus persica</i>,<br/> <i>Setaria italica</i>,<br/> <i>Solanum tuberosum</i>,<br/> <i>Sorghum</i> sp., <i>S. halepense</i>,<br/> <i>Triticum aestivum</i>,<br/> <b><i>Zea mays</i></b></p> | <p>Canada, Cyprus,<br/> Czechoslovakia<br/> (erstwhile), Denmark,<br/> Egypt, France, Georgia,<br/> Germany, Greece,<br/> Hungary, Iran, Ireland,<br/> Israel, Italy, Lebanon,<br/> Libya, Moldova,<br/> Morocco,<br/> Netherlands, Norway,<br/> Poland, Portugal,<br/> Romania, Russian<br/> Federation, Spain,<br/> Sweden, Switzerland,<br/> Syria, Turkey, Tunisia,<br/> Ukraine, UK, USA,<br/> Yugoslavia (erstwhile)</p> | <p>sorghum, cotton,<br/> capsicum, potato and<br/> other crops are given.<br/> (CAB <i>International</i>,<br/> 2007).</p> <p>Full-grown larva is an<br/> over wintering stage,<br/> passed in their tunnels<br/> in stubble, stalk,<br/> maize ear etc.</p> |
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| 15. | <p><b>*<i>Peridroma saucia</i></b><br/>(Hübner)</p> <p><u>Synonyms:</u><br/> <i>Agrotis angulifera</i> Wallengren,<br/> <i>Agrotis impacta</i> Walker,<br/> <i>Agrotis inermis</i> Harris,<br/> <i>Agrotis intecta</i> Walker,<br/> <i>Agrotis ortonii</i> Packard,<br/> <i>Agrotis saucia</i> (Hübner),<br/> <i>Lycophotia margaritosa</i> (Haworth),<br/> <i>Lycophotia ochronota</i> Hampson,<br/> <i>Lycophotia saucia</i> (Hübner),<br/> <i>Noctua aequa</i> Hübner,<br/> <i>Noctua majuscula</i> Haworth,<br/> <i>Noctua margaritosa</i> Haworth,<br/> <i>Noctua saucia</i> Hübner,<br/> <i>Peridroma margaritosa</i> (Haworth),<br/> <i>Rhyacia margaritosa</i> (Haworth),<br/> <i>Rhyacia saucia</i> (Hübner),</p> <p><u>Order:</u> Lepidoptera</p> | Pearly underwing moth, pearly variegated cutworm, underwing moth | Seed, as contaminant | <i>Abies balsamea</i> ,<br><i>A. grandis</i> , <i>Acer</i> spp.,<br><i>A. negundo</i> , <i>A. saccharum</i> ,<br><i>Althea rosea</i> , <i>Allium cepa</i> ,<br><i>Alnus rubra</i> , <i>Ambrosia artemisiifolia</i> ,<br><i>Amelanchier canadensis</i> , <i>Anthemis cotula</i> ,<br><i>Apium graveolens</i> , <i>Arachis hypogaea</i> ,<br><i>Asparagus officinalis</i> ,<br><i>A. setaceus</i> , <i>Aster</i> sp.,<br><i>Avena sativa</i> , <i>Beta vulgaris</i> ,<br><i>Brassica napus</i> var. <i>napus</i> , <i>B. nigra</i> ,<br><i>B. oleracea</i> , <i>B. oleracea</i> var. <i>capitata</i> ,<br><i>B. rapa</i> subsp. <i>oleifera</i> , <i>Capsella bursa-pastoris</i> ,<br><i>Capsicum annuum</i> , <i>Chamaecyparis thyoides</i> ,<br><i>Chenopodium quinoa</i> , <i>Chrysanthemum</i> sp.,<br><i>Cicer arietinum</i> , <i>Cichorium</i> sp.,<br><i>Cirsium</i> sp., <i>Citrullus lanatus</i> ,<br><i>Citrus limon</i> , <i>C. sinensis</i> , <i>Conyza canadensis</i> ,<br><i>Corylus</i> sp., <i>Cucumis melo</i> ,<br><i>C. sativus</i> , <i>Cucurbita moschata</i> ,<br><i>Cynara scolymus</i> , <i>Dahlia</i> sp.,<br><i>Datura stramonium</i> , <i>Daucus carota</i> ,<br><i>Dianthus</i> | Albania, Argentina, Armenia, Austria, Belgium, Bermuda, Brazil, Bulgaria, Canada, Chile, China, Colombia, Costa Rica, Czech Republic, Denmark, Faroe Islands, Finland, France, Germany, Greece, Guatemala, Hungary, Iceland, Ireland, Israel, Italy, Jamaica, Japan, Lithuania, Luxembourg, Malta, Mexico, Morocco, Netherlands, Norway, Peru, Poland, Portugal, Puerto Rico, Romania, Russian Federation, Slovakia, Spain, Sri Lanka, Sweden, Switzerland, Syria, Tunisia, Turkey, UK, USA, Uruguay, Venezuela, Yugoslavia (erstwhile) | <p>Major pest in most of USA. Losses in major outbreak on potato in 1900s were estimated 2.5m\$ (Crumb, 1929).</p> <p>Mature larva buries in soil and pupates in silk-lined chamber.</p> |
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|  | Family: Noctuidae |  |  | sp., <i>Epilobium angustifolium</i> , <i>Erigeron</i> sp., <i>Eupatorium</i> sp., <i>Fragaria ananassa</i> , <i>Geranium</i> sp., <i>Gladiolus</i> hybrids, <i>Gleditsia triacanthos</i> , <i>Gossypium</i> sp., <i>Helianthus</i> sp., <i>H. annuus</i> , <i>Hordeum vulgare</i> , <i>Humulus lupulus</i> , <i>Inula helenium</i> , <i>Ipomoea batatas</i> , <i>Lactuca sativa</i> , <i>Lathyrus odoratus</i> , <i>Linum usitatissimum</i> , <i>Lolium</i> sp., <i>Lycopersicon esculentum</i> , <i>Maclura pomifera</i> , <i>Malus pumila</i> , <i>Medicago sativa</i> , <i>Melia azedarach</i> , <i>Melilotus alba</i> , <i>Mentha piperita</i> , <i>M. spicata</i> , <i>Morus alba</i> , <i>Nicotiana tabacum</i> , <i>Parthenium argentatum</i> , <i>Persea americana</i> , <i>Petunia</i> sp., <i>Phaseolus lunatus</i> , <i>P. vulgaris</i> , <i>Phleum pratense</i> , <i>Picea glauca</i> , <i>Pimenta dioica</i> , <i>Pisum sativum</i> , <i>Plantago</i> sp., <i>Polygonum</i> sp., <i>Populus</i> sp., <i>Portulaca oleracea</i> , |  |  |
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|     |  |   |                         | <i>Prunus</i> spp., <i>P. armeniaca</i> ,<br><i>P. cerasus</i> , <i>P. domestica</i> ,<br><i>P. persica</i> ,<br><i>Pseudotsuga menziesii</i> ,<br><i>Pteridium aquilinum</i> ,<br><i>Pyrus communis</i> ,<br><i>Raphanus sativus</i> ,<br><i>Rheum hybridum</i> , <i>Rhus</i> sp.,<br><i>Ribes uva-crispa</i> , <i>Rosa</i> sp.,<br><i>Rubus fruticosus</i> , <i>R. idaeus</i> ,<br><i>R. occidentalis</i> , <i>Rumex</i> sp.,<br><i>Salix</i> sp., <i>Salvia officinalis</i> ,<br><i>Secale cereale</i> , <i>Sinapis</i><br><i>alba</i> , <i>Solanum tuberosum</i> ,<br><i>Solidago</i> sp., <i>Sonchus</i> sp.,<br><i>Spinacia oleracea</i> ,<br><i>Stellaria media</i> , <i>Trifolium</i><br>sp., <i>Triticum aestivum</i> ,<br><i>Tropaeolum majus</i> , <i>Tsuga</i><br><i>canadensis</i> , <i>Vaccinium</i> ,<br><i>Vicia</i> spp., <i>V. faba</i> , <i>Viola</i><br>sp., <i>Vitis vinifera</i> ,<br><i>Xanthium strumarium</i> , <b><i>Zea</i></b><br><b><i>mays</i></b> , <i>Z. mexicana</i> , <i>Zinnia</i><br>sp. |   |  |
| 16. | <b><i>*Sesamia nonagrioides</i></b><br>(Lefebvre)<br><br><u>Synonyms:</u><br><i>Sesamia botanophaga</i> Tams | Mediterranean corn<br>stalk borer,<br>pink maize<br>stalk borer | Seed, as<br>contaminant | <i>Carex</i> sp., <i>Diospyros kaki</i> ,<br><i>Gladiolus</i> hybrids, <i>Musa</i><br>sp., <i>Oryza sativa</i> ,<br><i>Saccharum officinarum</i> ,<br><i>Solanum melongena</i> ,   | Burundi, Cape Verde,<br>Congo, Côte d'Ivoire,<br>Cyprus, France, Ghana,<br>Greece, Iran, Israel,<br>Italy, Kenya, Mali,<br>Morocco, | Causes serious<br>damage in wheat and<br>rice i.e. breaking of<br>stem and<br>inflorescence and<br>considered an |

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|  | <p>and Bowden, <i>Sesamia vuteria</i> nec Stoll</p> <p><u>Order</u>: Lepidoptera<br/><u>Family</u>: Noctuidae</p> |  |  | <p><i>Sorghum</i> sp., <i>Strelitzia</i> sp.,<br/><b><i>Zea mays</i></b></p> | <p>Nigeria, Portugal, Rwanda, Spain, Sudan, Tanzania, Togo, Turkey, Uganda</p> | <p>important pest of maize in Europe and North Africa.</p> <p>Can be transported as live eggs, larvae and/or pupae on plants and plant products.</p> <p><i>S. nonagrioides</i> is already widely distributed in Africa and around the Mediterranean but could be accidentally transported to other parts of the world, with possibly serious consequences as has already happened with some other stem borers.</p> |
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| 17.              | <p><b>*<i>Trogoderma variabile</i></b><br/>Ballion</p> <p><u>Synonyms:</u><br/><i>Trogoderma parabile</i> Beal,<br/><i>Trogoderma persica</i> Pic,<br/><i>Trogoderma persicum</i> Chao &amp; Lee</p> <p><u>Order:</u> Coleoptera<br/><u>Family:</u> Dermestidae</p> | Grain dermestid, warehouse beetle  | Seed, stored products | <i>Avena sativa</i> , <i>Hordeum vulgare</i> , <i>Oryza sativa</i><br><i>Triticum</i> sp., <b><i>Zea mays</i></b>  | Afghanistan, Australia, Canada, China, Finland, Kazakhstan, Mexico, Mongolia, Russian Federation, Saudi Arabia, South Africa, Tajikistan, Turkmenistan, UK, USA, Uzbekistan | <p>The larvae are known to enter diapause (Wright and Cartledge, 1994), which is less readily broken than that of <i>T. granarium</i>.</p> <p>It is under quarantine restriction in New South Wales (Australia).</p> |
| 18.              | <p><b>*<i>Typhaea stercorea</i></b><br/>(Linnaeus)</p> <p><u>Synonyms:</u><br/><i>Dermestes stercorea</i> Linnaeus,<br/><i>Typhaea fumata</i> Linnaeus</p> <p><u>Order:</u> Coleoptera<br/><u>Family:</u> Mycetophagidae</p>  | Fungus beetle, hairy fungus beetle | Seed, stored products | <i>Hordeum vulgare</i> , <i>Nicotiana tabacum</i> , <i>Oryza sativa</i> , <i>Sorghum</i> sp., <i>Triticum</i> sp., <i>T. aestivum</i> , <b><i>Zea mays</i></b> | Africa, Australia, Central America, China, Germany, Indonesia, North America, Singapore, South America, USSR (erstwhile)  | Fungivorous, also occurs in its absence and contaminates stored foods.   |
| <b>Nematodes</b> |   |                                    |                       |  |   |  |
| 19.              | <p><b>*<i>Aphelenchoides arachidis</i></b><br/>Bos</p>  | Groundnut testa nematode, peanut   | Seed, soil            | <i>Arachis hypogaea</i> , <i>Oryza sativa</i> , <i>Pennisetum glaucum</i> , <i>Saccharum officinarum</i> , <i>Sorghum</i>                                      | Nigeria   | In addition to the host crop plants, <i>A. arachidis</i> has also been found in large  |

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|     |  | testa<br>nematode   |                                  | <i>bicolor</i> , <i>Zea mays</i>   |  | numbers in roots of<br>wild grasses (Bos,<br>1977).   |
| 20. | <p><b>#<i>Aphelenchoides besseyi</i></b><br/>Christie</p> <p><u>Synonyms:</u><br/><i>Aphelenchoides oryzae</i><br/>Yokoo,<br/><i>Asteroaphelenchoides</i><br/><i>besseyi</i> (Christie)<br/>Drozdovski</p> | White tip<br>nematode<br>of paddy,<br>rice leaf<br>nematode,<br>summer<br>crimp<br>nematode | Seed,<br>inflorescence<br>, soil | <i>Allium cepa</i> ,<br><i>Chrysanthemum</i><br><i>morifolium</i> , <i>Colocasia</i><br><i>esculenta</i> , <i>Cyperus iria</i> ,<br><i>Digitaria sanguinalis</i> ,<br><i>Dioscorea</i> sp.,<br><i>D. trifida</i> , <i>Fragaria</i><br><i>ananassa</i> , <i>Glycine max</i> ,<br><i>Hibiscus</i> sp., <i>Ipomoea</i><br><i>batatas</i> , <i>Oryza</i> sp.,<br><i>O. breviligulata</i> ,<br><i>O. glaberrima</i> , <i>O. sativa</i> ,<br><i>Polianthes tuberosa</i> ,<br><i>Setaria viridis</i> , <b><i>Zea mays</i></b> | Widely distributed and<br>now occurs in most rice<br>growing areas | <p>Infection and damage<br/>caused are generally<br/>greater in lowland and<br/>deep water systems<br/>than in upland<br/>environments.</p> <p>Present in India, but<br/>many races are known<br/>to occur worldwide,<br/>hence it is of<br/>quarantine<br/>significance.</p> |
| 21. | <p><b>*<i>Ditylenchus africanus</i></b><br/>Wendt <i>et al.</i></p> <p><u>Synonym:</u><br/><i>Ditylenchus destructor</i><br/>Thorne</p>  |   | Seed, soil                       | <i>Arachis hypogaea</i> ,<br><i>Chenopodium album</i> ,<br><i>Datura stramonium</i> ,<br><i>Eleusine indica</i> , <i>Glycine</i><br><i>max</i> , <i>Gossypium hirsutum</i> ,<br><i>Helianthus annuus</i> ,<br><i>Lupinus albus</i> , <i>Medicago</i><br><i>sativa</i> , <i>Nicotiana tabacum</i> ,<br><i>Phaseolus vulgaris</i> , <i>Pisum</i><br><i>sativum</i> , <i>Solanum</i><br><i>tuberosum</i> , <i>Sorghum</i><br><i>bicolor</i> , <i>Tagetes minuta</i> ,   | South Africa   | The crops (Basson <i>et al.</i> , 1990) and weeds (De Waele <i>et al.</i> , 1990) listed are hosts under glasshouse conditions.   |

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|-----|--|---|------------|--|--|---|
|     |  |   |            | <i>Triticum aestivum</i> , <i>Vigna unguiculata</i> , <i>Xanthium strumarium</i> , <b><i>Zea mays</i></b>  |  |   |
| 22. | <p><b>#*<i>Ditylenchus dipsaci</i></b><br/>(Kühn) Filip'ev</p> <p><u>Synonyms:</u><br/> <i>Anguillula devastatrix</i> Kühn,<br/> <i>Anguillula dipsaci</i> Kühn,<br/> <i>Anguillula secalis</i> Nitschke,<br/> <i>Anguillulina dipsaci</i> (Kühn) Gervais &amp; Van Beneden,<br/> <i>Anguillulina dipsaci</i> var. <i>communis</i> Steiner &amp; Scott,<br/> <i>Ditylenchus allocotus</i> (Steiner) Filip'ev &amp; Sch. Stek.,<br/> <i>Ditylenchus amsinckiae</i> (Steiner &amp; Scott) Filip'ev &amp; Sch.,<br/> <i>Ditylenchus dipsaci</i> var. <i>tobaensis</i> Schneider,<br/> <i>Ditylenchus fragariae</i> Kir'yanova,<br/> <i>Ditylenchus sonchophila</i> Kir'yanova,<br/> <i>Ditylenchus trifolii</i> Skarbilovich,</p> | Stem and bulb nematode, onion bloat, brown ring disease of hyacinth bulb, eelworm ring disease of bulbs | Seed, soil | <i>Allium</i> spp.,<br><i>A. ascalonicum</i> , <i>A. cepa</i> ,<br><i>A. porrum</i> , <i>A. sativum</i> ,<br><i>Amaranthus deflexus</i> ,<br><i>Apium graveolens</i> ,<br><i>Astrantia</i> sp., <i>Avena sativa</i> ,<br><i>A. sterilis</i> , <i>Begonia</i> sp.,<br><i>Bergenia</i> sp., <i>Beta vulgaris</i> var. <i>saccharifera</i> , <i>Brassica napus</i> var. <i>napus</i> , <i>B. rapa</i> subsp. <i>rapa</i> , <i>Cannabis sativa</i> , <i>Carduus acanthoides</i> , <i>Chenopodium murale</i> , <i>Cirsium arvense</i> ,<br><i>Convolvulus arvensis</i> ,<br><i>Crocus sativus</i> , <i>Dianthus caryophyllus</i> , <i>Eupatorium pauciflorum</i> , <i>Fragaria ananassa</i> , <i>Gladiolus</i> hybrids, <i>Gnaphalium spicatum</i> , <i>Helianthus annuus</i> , <i>Hieracium pilosella</i> , <i>Hyacinthus orientalis</i> , <i>Hydrangea</i> sp.,<br><i>Ipomoea batatas</i> , <i>Lamium album</i> , <i>L. amplexicaule</i> ,<br><i>L. purpureum</i> , <i>Lens</i> | Albania, Algeria, Argentina, Armenia, Australia, Austria, Belgium, Bolivia, Bosnia and Herzegovina, Brazil, Bulgaria, Canada, Chile, China, Colombia, Costa Rica, Cyprus, Czech Republic, Denmark, Dominican Republic, Ecuador, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Iran, Iraq, Ireland, Israel, Italy, Japan, Jordan, Kazakhstan, Korea (Republic), Latvia, Lithuania, Macedonia, Mexico, Moldova, Morocco, Netherlands, New Zealand, Nigeria, Norway, Oman, Pakistan, Paraguay, | <p>Known to attack over 1,200 different plant species, including many weeds (Anonymous, 2010).</p> <p>It is one of the most devastating plant parasitic nematode. It may occurs in more than 30 biological races, each having their own host range . (Jansen 1994; Ladygina, 1982),</p> <p>The races that breed on rye, oats and onions seem to be polyphagous whereas those breeding on lucerne, <i>Trifolium pratense</i> and strawberries are virtually specific for their named hosts and appear to have relatively few</p> |



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|  | <p><i>Tylenchus allii</i> Beijerinck,<br/> <i>Tylenchus devastatrix</i> (Kühn) Oerley,<br/> <i>Tylenchus dipsaci</i> (Kühn) Bastian,<br/> <i>Tylenchus havensteinii</i> Kühn,<br/> <i>Tylenchus hyacinthi</i> Prillieux,<br/> <i>Tylenchus putrefaciens</i> Kühn</p> |  |  | <p><i>culinaris</i> subsp. <i>culinaris</i>,<br/> <i>Medicago sativa</i>,<br/> <i>Myriophyllum verticillatum</i>, <i>Narcissus</i> sp., <i>N. pseudonarcissus</i>,<br/> <i>Nerine sarniensis</i>,<br/> <i>Nicotiana tabacum</i>,<br/> <i>Onobrychis viciifolia</i>,<br/> <i>Oxalis corniculata</i>,<br/> <i>Petroselinum crispum</i>,<br/> <i>Phaseolus</i> sp.,<br/> <i>P. coccineus</i>, <i>Phlox drummondii</i>,<br/> <i>P. paniculata</i>, <i>Pisum sativum</i>, <i>Ranunculus arvensis</i>, <i>Raphanus raphanistrum</i>, <i>Secale cereale</i>, <i>Solanum tuberosum</i>, <i>Stellaria media</i>, <i>Taraxacum officinale</i>, <i>Trifolium pratense</i>, <i>T. repens</i>,<br/> <i>Triticum</i> sp., <i>Tulipa</i> sp.,<br/> <i>Vicia faba</i>, <b><i>Zea mays</i></b></p> | <p>Peru, Poland, Portugal, Romania, Russian Federation, Slovakia, South Africa, Spain, Sweden, Switzerland, Syria, Tunisia, Turkey, Ukraine, UK, USA, Uzbekistan, Yemen, Yugoslavia (erstwhile)</p> | <p>alternative host plants. The tulip race can also infest <i>Narcissus</i>, whereas another race commonly found in <i>Narcissus</i> does not breed on tulip.</p> <p>Some of the races can interbreed and their progeny have different host preferences. Sturhan and Brzeski (1991) briefly described 23 races, and three races that were raised to species or subspecies rank (<i>Ditylenchus dipsaci falcariae</i>, <i>D. galeopsidis</i> and <i>D. sonchophila</i>).</p> <p>It is extremely resilient to dessication.; fourth stage juvenoids can withstand dessication for longtime upto 20 years or more (Barker and Lucas, 1984).</p> |
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|              |   |  |                           |                 |  | It clumps together in a cryptobiotic state to form “nematode wool” and can be carried on infected seed, straw or hay (Anonymous, 2005).  |
| <b>Fungi</b> |   |  |                           |                 |  |  |
| 23.          | <p><i>*Cercospora zeae-maydis</i><br/>Tehon &amp; E.Y. Daniels</p> <p><u>Synonym:</u><br/><i>Mycosphaerella</i> sp.<br/>(Latterell and Rossi)</p> | Gray leaf spot of corn, grey maize leaf spot | Seed, plant debris        | Zea mays        | Brazil, Cameroon, Canada (Zhu <i>et al.</i> , 2002), China, Colombia, Congo, Costa Rica, Ecuador, Ethiopia, Kenya, Malawi, Mexico, Mozambique, Nigeria, Peru, South Africa, Swaziland, Tanzania, Tobago, Trinidad and Tobago, Uganda, USA, Venezuela, Zambia, Zimbabwe | <p>Disease of global importance in maize production (Gordon <i>et al.</i>, 2004). Yield losses upto 60% reported in the USA, South Africa and Ethiopia.</p> <p>Two distinct groups of isolates known to be present (Juan <i>et al.</i>, 1998).</p> <p>Though not seed-transmitted, some countries require seed testing for presence of spores on seed.</p> |
| 24.          | <p><i>*Claviceps gigantea</i> SF<br/>Fuentes, Isla, Ullstrup &amp; AE<br/>Rodr</p>  | Ergot of maize, horse's                      | Seed, inflorescence, soil | <i>Zea mays</i> | Mexico, South America  | Endemic in Mexico and South America.   |

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|     | <u>Synonym:</u><br><i>Sphacelia</i> sp.  | tooth   |                                   |   |   | A single sclerotium in a maize ear can cause a 50% reduction in seed germination.   |
| 25. | <b>#<i>Drechslera maydis</i></b><br>(Nisik.) Subram. & Jain<br>(Race-T) <sup>I</sup><br><br><u>Synonyms:</u><br><i>Bipolaris maydis</i> (Nisik & Miyake) Shoem.,<br><i>Cochliobolus heterostrophus</i> (Drechsler) Drechsler,<br><i>Helminthosporium maydis</i> Nisik. | Southern corn leaf blight, maydis leaf blight, southern leaf spot | Seed, inflorescence, plant debris | <i>Arachis hypogaea</i> ,<br><i>Cynodon dactylon</i> ,<br><i>Glycine max</i> ,<br><i>Helianthus annuus</i> ,<br><i>Oryza sativa</i> ,<br><i>Pennisetum glaucum</i> ,<br><i>Pisum</i> sp., <i>Populus deltoides</i> ,<br><i>Setaria glauca</i> ,<br><i>Sorghum</i> sp., <i>S. sudanense</i><br><i>Triticum</i> sp., <i>Vigna unguiculata</i> ,<br><i>Zea mays</i> , <i>Z. mexicana</i> | Argentina, Australia, Bangladesh, Bolivia, Brazil, Brunei, Bulgaria, Cambodia, Canada, China, Colombia, Croatia, Cuba, Cyprus, Denmark, Ecuador, Egypt, El-Salvador, Fiji, France, Germany, Ghana, Guatemala, Guinea, Guyana, India, Indonesia, Iran, Israel, Italy, Jamaica, Japan, Kenya, Korea (DPR), Korea (Republic), Laos, Madagascar, Malawi, Malaysia, Mauritius, Mexico, Nepal, New Zealand, Nicaragua, Niger, Nigeria, Pakistan, Panama, Papua New Guinea, Paraguay, Philippines, Portugal, Romania, Russian Federation, Senegal, | Race-T of <i>D. maydis</i> caused epidemic of maize leaf blight in Texas male sterile cytoplasm (T-cms) in USA resulting in crop losses of more than one billion US \$ in 1970.<br><br>Upto 99% infection by race-T has been detected in maize seeds.<br><br>Ram Nath <i>et al.</i> (1973) intercepted Race-T in sorghum seeds imported from USA. |

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|     |   |                             |                                     |   | Sierra Leone, South Africa, Spain, Sri Lanka, Sudan, Suriname, Swaziland, Switzerland, Tanzania, Thailand, Togo, Trinidad and Tobago, Ukraine, USA, Vietnam, Yugoslavia (erstwhile), Zambia, Zimbabwe |                         |
| 26. | <p><b>*<i>Mycosphaerella zae-maydis</i></b> D.M.Mukunya &amp; C.W.Boothroyd</p> <p><u>Synonyms:</u><br/> <i>Phoma zae-maydis</i> Punith.,<br/> <i>Phyllosticta maydis</i> Arny &amp; Nelson</p> | Yellow leaf blight of maize | Seed, plant debris                  | <i>Zea mays</i>   | Bolivia, Canada, Ecuador, France, Kenya, South Africa, USA  | Not reported from India |
| 27. | <b>* #<i>Physopella zae</i></b> (Mains) Cummins & Ramachar  | Tropical maize rust         | Plant debris                        | <i>Zea mays</i>   | Brazil, Colombia, Venezuela   | Not reported from India |
| 28. | <b>*<i>Rhizoctonia zae</i></b> Voorhees   | Root rot                    | Soil (Stegman <i>et al.</i> , 1994) | <i>Lolium perenne</i> , <i>Sorghum halepense</i> (Demirci and Kordali, 1999), <i>Zea mays</i> | Argentina, China (Li <i>et al.</i> , 1998), Brazil (Poltronierl <i>et al.</i> , 2002), Israel (unconfirmed record), Korea (Republic) (unconfirmed record),  | Not reported from India |

|                 |   |   |                                    |  |  |   |
|-----------------|---|---|------------------------------------|--|--|---|
|                 |   |   |                                    |  | Turkey (Demirci and Kordali, 1999), USA (unconfirmed record)   |   |
| <b>Bacteria</b> |   |   |                                    |  |  |   |
| 29.             | <p>* #<b><i>Clavibacter michiganensis</i></b> subsp. <b><i>nebraskensis</i></b> (Vidaver &amp; Mandel) Davis <i>et al.</i></p> <p><u>Synonyms:</u><br/> <i>Corynebacterium michiganense</i> pv. <i>nebraskense</i> (Vidaver &amp; Mandel) Dye &amp; Kemp, <i>Corynebacterium michiganense</i> subsp. <i>nebraskense</i> (Vidaver &amp; Mandel) Carlson &amp; Vidaver, <i>Corynebacterium nebraskense</i> Vidaver &amp; Mandel</p> | Goss's bacterial wilt and leaf blight, Nebraska leaf freckles and wilt              | Seed, inflorescence , plant debris | <i>Echinochloa crus-galli</i> , <i>Saccharum officinarum</i> , <i>Sorghum bicolor</i> , <i>S. sudanense</i> , <i>Triticale</i> , <i>Triticum aestivum</i> , <b><i>Zea mays</i></b> , <b><i>Z. mexicana</i></b>   | Canada, USA  | <p>85 strains reported (Vidaver <i>et al.</i>, 1981).</p> <p>Polymerase chain reaction (PCR) (Patrik and Rainey, 1996) and repetitive-sequence-based PCR (Louws <i>et al.</i>, 1998) can be used to differentiate sub species.</p> <p>The pathogen has only been found in the USA and considered a significant <b>quarantine risk</b> (Biddle <i>et al.</i>, 1990).</p> |
| 30.             | <p>*#<b><i>Pantoea stewartii</i></b> subsp. <b><i>stewartii</i></b> (Smith) Mergaert <i>et al.</i></p> <p><u>Synonyms:</u><br/> <i>Aplanobacter stewartii</i> (Smith) McCulloch, <i>Bacillus stewartii</i> (Smith) Holland,</p>   | Bacterial wilt, bacterial leaf blight of maize, maize bacteriosis , Stewart's wilt, | Seed, inflorescence , flea beetles | <i>Agrostis gigantea</i> , <i>Cucumis sativus</i> , <i>Dactylis glomerata</i> , <i>Digitaria</i> sp., <i>Panicum capillare</i> , <i>P. dichotomiflorum</i> , <i>Poa pratensis</i> , <i>Setaria lutescens</i> , <i>Sorghum sudanense</i> , <i>Tripsacum dactyloides</i> , <i>T. zea</i> , | Austria, Bolivia, Brazil, Canada, China, Costa Rica, Guyana, Mexico, Paraguay (unconfirmed record), Peru, Puerto Rico, Switzerland (unconfirmed record), USA | <p>More destructive on sweetcorn than on dent maize.</p> <p>Flea beetles, (<i>Chaetocnema pulicaria</i>, <i>C. denticulata</i>, <i>Delia platura</i> and <i>Agriotes mancus</i>) recognized</p>   |

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|     | <i>Bacterium stewartii</i> (Smith) Smith,<br><i>Erwinia stewartii</i> (Smith) Dye,<br><i>Phytomonas stewartii</i> (Smith) Bergey <i>et al.</i> ,<br><i>Pseudobacterium stewartii</i> (Smith) Krasil'nikov,<br><i>Pseudomonas stewartii</i> Smith,<br><i>Xanthomonas stewartii</i> (Smith) Dowson | Stewarts disease of maize   |                                   | <i>Triticum aestivum</i> ,<br><i>Zea mays</i> , <i>Z. mexicana</i>   |   | <p>as the important carrier of inoculum.</p> <p>22 strains varying in virulence were assessed and 124 isolates verified phenotypically (Wilson <i>et al.</i>, 1999).</p> <p>ELISA method was developed for detection of seed-borne infection in maize (Lamka <i>et al.</i>, 1991) and the kit (Pathoscreen-es) is available from Agdia, Elkhart, Indiana, USA. PCR with arbitrary primers can be used to develop a DNA probe to identify isolates of <i>P. stewartii</i>.</p> <p>In China it is under intensive quarantine measures.</p> |
| 31. | * # <i>Pseudomonas fuscovaginae</i> (ex Tanii <i>et al</i> ) Miyajima <i>et</i>  | Sheath brown rot, bacterial | Seed, inflorescence, plant debris | <i>Agrostis</i> sp., <i>Avena sativa</i> , <i>Bromus marginatus</i> , <i>Hordeum vulgare</i> , <i>Lolium</i> | Argentina, Bolivia, Brazil, Burundi, Chile, China (Guaulin, | Most important bacterial disease of rice in Hokkaido   |

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|     | <p><i>al.</i></p> <p><u>Synonym:</u><br/><i>Pseudomonas fluorescens</i><br/>biovar II</p>  | <p>sheath brown rot, bacterial sheath rot, bacterial rot of rice sheaths, rice sheath rot and grain discoloration, brown rot</p> |  | <p><i>perenne</i>, <i>Oryza sativa</i>, <i>Poa pratensis</i>, <i>Secale cereale</i>, <i>Sorghum</i> sp., <i>Triticale</i>, <i>Triticum</i> sp., <i>T. aestivum</i>, <b><i>Zea mays</i></b></p>  | <p>2003), Colombia, Congo, Costa Rica, Cuba, Dominican Republic, Ecuador, El-Salvador, Guatemala, Indonesia, Japan, Jamaica, Madagascar, Mexico, Nepal (Shakya and Manandhar, 1992), Nicaragua, Panama, Peru, Philippines, Russian Federation, Rwanda, Suriname, Tanzania, Trinidad and Tobago, Uruguay, Yugoslavia (erstwhile)</p> | <p>(Japan) and it is the principal limiting factor in irrigated rice cultivation at altitudes higher than 1500 m, with losses reaching 100%. Substantial yield losses in South America reported (CAB International, 2007)</p> <p>Presence of strains reported (Miyajima, 1983). PCR-RFLP demonstrated 25 composite 16S-rDNA haplotypes (Jaunet <i>et al.</i>, 1995).</p> |
| 32. | <p><b>*<i>Pseudomonas syringae</i> pv. <i>coronafaciens</i></b> (Elliott)<br/>Young <i>et al.</i></p> <p><u>Synonyms:</u><br/><i>Bacterium coronafaciens</i> Elliott,<br/><i>Chlorobacter coronafaciens</i> (Elliott) Patel &amp; Kulkarni,<br/><i>Phytomonas coronafaciens</i> (Elliott) Bergey <i>et al.</i>,<br/><i>Pseudomonas coronafaciens</i></p> | <p>Halo blight, chocolate spot of maize</p>  | <p>Seed, Inflorescence, plant debris</p> | <p><i>Arrhenatherum elatius</i>, <i>Avena fatua</i>, <i>A. sativa</i>, <i>Bromus catharticus</i>, <i>B. carinatus</i>, <i>B. inermis</i>, <i>B. rubens</i>, <i>Hordeum vulgare</i>, <i>Lolium multiflorum</i>, <i>L. perenne</i>, <i>Secale cereale</i>, <i>Triticale</i>, <i>Triticum aestivum</i>, <b><i>Zea mays</i></b></p> | <p>Argentina, Australia, Brazil, Canada, Chile, Denmark, Germany, Ireland, Japan, Kenya, Mexico, New Zealand, Poland, Russian Federation, UK, USA, Uzbekistan, Yugoslavia (erstwhile), Zimbabwe</p>   | <p>Epiphytotic populations can increase the sensitivity of crop to frost damage.</p>   |

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|     | (Elliott) Stevens,<br><i>Pseudomonas coronafaciens</i><br>pv. <i>zeae</i> Ribeiro <i>et al.</i>  |  |  |  |  |  |
| 33. | <p><b>*<i>Pseudomonas syringae</i> pv. <i>striaefaciens</i></b> (Elliott) Young <i>et al.</i>,</p> <p><u>Synonyms:</u><br/> <i>Bacterium striaefaciens</i> Elliott,<br/> <i>Chlorobacter striaefaciens</i> (Elliott) Patel &amp; Kulkarni,<br/> <i>Phytomonas striaefaciens</i> (Elliott) Bergey <i>et al.</i>,<br/> <i>Pseudomonas striaefaciens</i> (Elliott) Starr &amp; Burkholder</p> | Bacterial<br>barley<br>black<br>node,<br>bacterial<br>barley<br>stripe,<br>bacterial<br>oats blight,<br>bacterial<br>oats stripe<br>blight   | Seed   | <b><i>Avena sativa</i>, <i>Hordeum vulgare</i>, <i>Zea mays</i></b>  | Argentina, Australia, Canada, Colombia, Germany, Japan, Korea (DPR), Korea (Republic), Mexico, Russian Federation, South Africa (unconfirmed record), USA, USSR (erstwhile), Zimbabwe  | Not reported from India, hence it is of quarantine significance.   |
| 34. | <p><b>*<i>Pseudomonas viridiflava</i></b> (Burkholder) Dowson</p> <p><u>Synonyms:</u><br/> <i>Bacterium viridiflavum</i> (Burkholder) Burgvits,<br/> <i>Chlorobacter viridiflavus</i> (Burkholder) Patel &amp; Kulkarni,<br/> <i>Phytomonas viridiflava</i> Burkholder</p>   | Bacterial<br>leaf blight of tomato,<br>hydrangea<br>bud blight,<br>bacterial<br>leaf<br>necrosis of<br>basil,<br>bacterial<br>rot of<br>lettuce,<br>bacterial<br>rot of<br>Chinese<br>cabbage, | Seed, plant<br>debris<br><br>Weeds act as<br>reservoirs of<br>the bacterium<br>(Gitaitis <i>et al.</i> , 1998) | <i>Actinidia chinensis</i> , <i>Allium cepa</i> , <i>A. fistulosum</i> ,<br><i>Anethum graveolens</i> ,<br><i>Apium graveolens</i> ,<br><i>Brassica</i> spp., <i>B. oleracea</i><br>var. <i>botrytis</i> , <i>B. oleracea</i><br>var. <i>capitata</i> , <i>B. oleracea</i><br>var. <i>gemmifera</i> , <i>B. rapa</i> ,<br><i>Calendula officinalis</i> ,<br><i>Capsicum annuum</i> ,<br><i>C. frutescens</i> , <i>Carthamus tinctorius</i> , <i>Chrysanthemum coccineum</i> , <i>C. indicum</i> ,<br><i>Cichorium endivia</i> , <i>Citrus aurantium</i> ,<br><i>C. macrophylla</i> , | Argentina (Alippi <i>et al.</i> , 1999), Australia, China, France, Germany, Greece, Hungary, Iran, Italy, Japan, Kenya, Korea, Morocco, Nepal, Netherlands, New Zealand, Slovakia, Spain, Switzerland, Tanzania, Uganda, UK, USA, Yugoslavia (erstwhile) | Occasionally cause significant crop damage.<br><br>Variability reported using PCR- analysis (Saunier <i>et al.</i> , 1996; Manceau and Horvais, 1997).<br><br>Transgenic kiwi plants more susceptible (Balestra <i>et al.</i> , 2001). |



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|  |  | bacterial<br>soft rot of<br>tomato |  | <i>C. sinensis</i> , <i>Coriandrum sativum</i> , <i>Cryptotaenia canadensis</i> , <i>Cucumis melo</i> , <i>C. sativus</i> , <i>Cucurbita maxima</i> , <i>Cyclamen persicum</i> , <i>Eschscholzia californica</i> , <i>Euphorbia pulcherrima</i> , <i>Eutrema wasabi</i> , <i>Forsythia suspensa</i> , <i>Glycine max</i> , <i>Hydrangea</i> sp., <i>Lablab purpureus</i> , <i>Lotus corniculatus</i> , <i>Lupinus angustifolius</i> , <i>Lycopersicon esculentum</i> , <i>Medicago sativa</i> , <i>Nicotiana rustica</i> , <i>Ocimum</i> sp., <i>O. basilicum</i> , <i>Papaver nudicaule</i> , <i>Passiflora edulis</i> , <i>Pastinaca sativa</i> , <i>Petroselinum crispum</i> , <i>Petunia hybrida</i> , <i>Phaseolus coccineus</i> , <i>P. lunatus</i> , <i>P. vulgaris</i> , <i>Pisum sativum</i> , <i>Prunus armeniaca</i> , <i>P. avium</i> , <i>Pseudopanax</i> sp., <i>Pyrus communis</i> , <i>Raphanus sativus</i> , <i>Rosa</i> sp., <i>Sorghum bicolor</i> , <i>S. sudanense</i> , <i>Trifolium pratense</i> , <i>Tropaeolum</i> |  |
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|                |  |                           |      | <i>majus</i> , <i>Vaccinium corymbosum</i> , <i>Vicia faba</i> , <i>Vigna angularis</i> , <i>V. unguiculata</i> , <i>Viola</i> sp., <i>Vitis vinifera</i> , <b><i>Zea mays</i></b> , <i>Zinnia elegans</i> |     |  |
| <b>Viruses</b> |  |                           |      |  |     |  |
| 35.            | <sup>##</sup> <b>High plains virus (HPV)</b> | High plains virus disease | Seed | <i>Avena sativa</i> , <i>Hordeum vulgare</i> , <i>Secale cereale</i> , <i>Triticum aestivum</i> , <b><i>Zea mays</i></b>   | USA | A fully susceptible maize hybrid may be killed in the seedling stage by early infection. Infection at a later stage of development can lead to yield reduction of upto 75% in dent maize and upto 100% in sweet corn where the crop will not meet quality standards. HPV may be very destructive in an area for a time and then decline and become difficult to find. As an illustration of these types of observation, Washington state pathologists surveyed for HPV without success for several years. In 1998, in an |

|     |  |                                |                      |   |                              |   |
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|     |  |                                |                      |   |                              | area where previous surveys had failed to find HPV, a field of maize was completely destroyed by the virus.   |
| 36. | <b>*#Maize chlorotic mottle virus (MCMV)</b> | Maize chlorotic mottle disease | Seed, infected plant | <b><i>Zea diploperennis</i>,<br/><i>Z. mays</i></b> | Argentina, Mexico, Peru, USA | <p>In Peru, losses in floury and sweet maize varieties have been reported to be between 10 and 15%. In Kansas crop losses due to corn lethal necrosis (caused by MCMV and any potyvirus) have been estimated to be between 50 and 90% depending on the variety of maize and the year.</p> <p>Three serotypes of MCMV viz. Kansas serotypes 1 and 2 and the Peru serotype have been identified (Niblett and Claflin, 1978; Uyemoto <i>et al.</i>, 1980).</p> <p>In the US, all grass</p> |

|              |   |                             |                                      |   |   |   |
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|              |   |                             |                                      |   |   | clones in the Poaceae are quarantined and tested for viruses including MCMV prior to release. Bulgaria, Hungary, Indonesia, Morocco, New Zealand, and Poland include MCMV on lists of prohibited organisms.   |
| 37.          | * <sup>#</sup> <b><i>Wheat streak mosaic virus (WSMV)</i></b> | Wheat streak mosaic disease | Seed, mite ( <i>Aceria tulipae</i> ) | <i>Aegilops</i> sp., <i>Agropyron</i> sp., <i>Avena sativa</i> , <i>Bouteloua</i> sp., <i>Bromus</i> sp., <i>Cenchrus</i> spp., <i>Digitaria</i> sp., <i>Elymus</i> sp., <i>Eragrostis</i> sp., <i>Haynaldia</i> sp., <i>Lolium</i> sp., <i>Orizopsis</i> sp., <i>Phalaris</i> sp., <i>Poa</i> sp., <i>Stipa</i> sp., <i>Echinichloa crus-galli</i> , <i>Hordeum vulgare</i> , <i>Panicum capillare</i> , <i>Pennisetum glaucum</i> , <i>Secale cereale</i> , <i>Setaria viridis</i> , <i>Sorghum vulgare</i> , <i>Triticum aestivum</i> , <b><i>Zea mays</i></b> | Canada, Czech Republic, Hungary, Iran, Italy, Jordan, Mexico, Poland, Romania, Russian Federation, Turkey, Ukraine, USA, Yugoslavia (erstwhile) | WSMV-infected plants often develop sterile heads, so the effects on yield can be severe. WSMV causes an estimated 2% annual loss in crop yield in the US (Christian and Willis, 1993) and localized yield losses of upto 100% are common (McNeil <i>et al.</i> , 1996). |
| <b>Weeds</b> |   |                             |                                      |   |   |   |
| 38.          | * <b><i>Amaranthus albus</i> L.</b>                           | Tumble pigweed, white       | Seed as contamination                | <i>Arachis hypogaea</i> , <i>Beta vulgaris</i> , <i>Glycine max</i> , <i>Gossypium hirsutum</i> ,   | Albania, Argentina, Australia, Austria, Belgium, Bulgaria,  | Significant weed in a wide range of crops in USA, Spain, Hungary,   |

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|     |   | pigweed, tumbleweed, amaranth         |                       | <i>Helianthus annuus</i> , <i>Lycopersicon esculentum</i> , <i>Medicago sativa</i> , <i>Olea europaea</i> subsp. <i>europaea</i> , <i>Solanum tuberosum</i> , <b><i>Zea mays</i></b>   | Cambodia, Canada, China, Colombia, Cyprus, Czechoslovakia (erstwhile), France, Germany, Greece, Hungary, Italy, Mexico, Morocco, Netherlands, New Zealand, Portugal, Romania, Russian Federation, Spain, Switzerland, Turkey, Ukraine, USA, Yugoslavia (erstwhile)          | Turkey and Ukraine and listed as a 'principal' weed in Portugal and Mexico (CAB International, 2007). |
| 39. | <b>*<i>Amaranthus blitoides</i></b><br>S. Wats. | Spreading amaranth, prostrate pigweed | Seed as contamination | <i>Glycine max</i> , <i>Gossypium hirsutum</i> , <i>Helianthus annuus</i> , <i>Lycopersicon esculentum</i> , <i>Medicago sativa</i> , <i>Olea europaea</i> subsp. <i>europaea</i> , <i>Phaseolus vulgaris</i> , <i>Pisum sativum</i> , <i>Triticum aestivum</i> , <b><i>Zea mays</i></b> | Albania, Australia, Austria, Bulgaria, Canada, Czechoslovakia (erstwhile), France, Germany, Greece, Hungary, Iran, Iraq, Israel, Italy, Jordan, Lebanon, Mexico, Morocco, Netherlands, New Zealand, Poland, Portugal, Romania, Russian Federation, South Africa, Spain, USA | Significant weed in a wide range of crops in the USA, Europe and the Middle East.                     |
| 40. | <b>*<i>Brachiaria plantaginea</i></b><br>Link   | Marmeladegrass, Alexander grass       | Seed as contamination | <i>Citrus</i> sp., <i>Daucus carota</i> , <i>Glycine max</i> , <i>Gossypium</i> spp., <i>Helianthus annuus</i> , <i>Lactuca sativa</i> , <i>Oryza</i>  | Argentina, Brazil, Costa Rica, France, Guatemala, Mexico, Nicaragua, Puerto Rico,   | Seeds deeper in the soil can remain dormant for years.  |

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|     |  |  |  | <i>sativa</i> , <i>Phaseolus</i> spp.,<br><i>Prunus domestica</i> .,<br><i>Saccharum officinarum</i> ,<br><b><i>Zea mays</i></b>  | USA  | Biotypes resistant to<br>acetyl carboxylase<br>group of herbicides<br>reported from Brazil<br>(Adoryan <i>et al.</i> ,<br>1997).   |
| 41. | <b>*<i>Cardaria draba</i></b> (L.) Desv. | Heart-<br>podded<br>hoary<br>cress,<br>hoary<br>cress,<br>thanes<br>cress,<br>white top,<br>white<br>weed,<br>perennial<br>peppergrasses | Seed as<br>contamination,<br>creeping<br>roots | <i>Avena sativa</i> , <i>Beta<br/>vulgaris</i> , <i>Citrus</i> spp.,<br><i>Fragaria ananassa</i> ,<br><i>Gossypium hirsutum</i> ,<br><i>Helianthus annuus</i> ,<br><i>Hordeum vulgare</i> , <i>Lens<br/>culinaris</i> , <i>Medicago sativa</i> ,<br><i>Nicotiana tabacum</i> , <i>Pyrus<br/>communis</i> , <i>Quercus</i> spp.,<br><i>Secale cereale</i> , <i>Solanum<br/>tuberosum</i> , <i>Triticum<br/>aestivum</i> , <i>Vitis vinifera</i> ,<br><b><i>Zea mays</i></b> , Pastures | Afghanistan, Argentina,<br>Australia, Bulgaria,<br>Canada, Chile, Czech<br>Republic, Egypt,<br>France, Germany,<br>Greece, Guatemala,<br>Hungary, Iran, Iraq,<br>Israel, Italy, Jordan,<br>Lebanon, Mexico,<br>Netherlands, New<br>Zealand, Pakistan,<br>Poland, Portugal,<br>Romania, Russian<br>Federation, Saudi<br>Arabia, South Africa,<br>Spain, Syria, Tunisia,<br>Turkey, UK, USA,<br>USSR (erstwhile),<br>Yugoslavia (erstwhile),<br>Zimbabwe | Serious weed in<br>Europe. It is a<br>principal weed of<br>cereals in Australia<br>Canada, Greece, Iran,<br>Jordan, Tunisia and<br>Turkey.<br><br>Plants also acts as a<br>host of Beet western<br>yellow virus and<br>Tobacco mosaic virus<br>(CAB International,<br>2007). |
| 42. | <b>*#<i>Emex australis</i></b>           | Three-<br>cornered<br>jack,<br>doublegee,<br>spiny<br>emex,  |  | Polyphagous   | Australia, China,<br>Kenya, New Zealand,<br>South Africa, Taiwan,<br>Trinidad and Tobago,<br>USA, Zimbabwe   | Not reported from<br>India, hence it is of<br>quarantine<br>significance.  |

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|     |                                 | emex,<br>cathead,<br>devil's-<br>thorn                 |                              |  |  |   |
| 43. | * # <i>Emex spinosa</i>         | Devil's<br>thorn,<br>spiny<br>emex,<br>prickly<br>dock |                              | Polyphagous  | Australia, Egypt, Israel,<br>Kenya, Mauritius,<br>Morocco, Portugal,<br>USA  | Not reported from<br>India, hence it is of<br>quarantine<br>significance.                             |
| 44. | * <i>Fumaria officinalis</i> L. | Common<br>fumitory                                     | Seed as<br>contaminatio<br>n | <i>Allium cepa</i> , <i>Avena sativa</i> ,<br><i>Beta vulgaris</i> , <i>Brassica<br/>napus</i> var. <i>napus</i> , <i>B. rapa</i><br>subsp. <i>oleifera</i> , <i>Daucus<br/>carota</i> , <i>Hordeum distichon</i> ,<br><i>H. vulgare</i> , <i>Linum<br/>usitatissimum</i> , <i>Pisum<br/>sativum</i> , <i>Secale cereale</i> ,<br><i>Solanum tuberosum</i> ,<br><i>Triticum aestivum</i> , <i>Zea<br/>mays</i> | Albania, Algeria,<br>Argentina, Australia,<br>Austria, Belgium,<br>Bulgaria, Canada,<br>Chile, Czechoslovakia<br>(erstwhile), Denmark,<br>Egypt, Finland, France,<br>Germany, Greece,<br>Hungary, Iceland, Iran,<br>Iraq, Ireland, Israel,<br>Italy, Jordan, Lebanon,<br>Mauritius, Morocco,<br>Netherlands, New<br>Zealand, Norway,<br>Pakistan, Poland,<br>Portugal, Romania,<br>Russian Federation,<br>South Africa, Spain,<br>Sudan, Sweden,<br>Switzerland, Turkey,<br>Turkey, Uruguay, USA,<br>USSR (erstwhile), | Seeds can survive for<br>very long periods in<br>the soil, forming a<br>persistent soil seed<br>bank. |

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|     |  |  |                       |  | Yugoslavia (erstwhile)  |  |
| 45. | <p><b>*<i>Papaver rhoeas</i> L.</b></p> <p><u>Synonyms:</u><br/> <i>Papaver commutatum</i> Fisch. &amp; C. A. May,<br/> <i>Papaver insignitum</i> Jord.,<br/> <i>Papaver intermedium</i> Beck,<br/> <i>Papaver ramosissimum</i> Fedde,<br/> <i>Papaver roubiaei</i> Vig.,<br/> <i>Papaver strigosum</i> (Boenn.) Schur,<br/> <i>Papaver tenuissimum</i> Fedde,<br/> <i>Papaver trilobum</i> Wallr.,<br/> <i>Papaver tumidulum</i> Klokov</p> | Common poppy; corn poppy, field poppy, flanders poppy, shirley poppy | Seed as contamination | <i>Allium cepa</i> , <i>Avena sativa</i> , <i>Beta vulgaris</i> , <i>Brassica napus</i> var. <i>napus</i> , <i>Daucus carota</i> , <i>Helianthus annuus</i> , <i>Hordeum vulgare</i> , <i>Lens culinaris</i> subsp. <i>culinaris</i> , <i>Linum usitatissimum</i> , <i>Medicago sativa</i> , <i>Panicum miliaceum</i> , <i>Phaseolus</i> , <i>Secale cereale</i> , <i>Solanum tuberosum</i> , <i>Triticum aestivum</i> , <i>T. turgidum</i> , <i>Vitis vinifera</i> , <i>Vicia faba</i> , <b><i>Zea mays</i></b> | Afghanistan, Albania, Algeria, Argentina, Armenia, Australia, Azerbaijan, Austria, Belarus, Belgium, Bulgaria, Czechoslovakia (erstwhile), Canada, China, Chile, Colombia, Denmark, Egypt, France, Georgia, Germany, Greece, Hungary, Iceland, Iran, Iraq, Ireland, Israel, Italy, Japan, Jordan, Latvia, Lebanon, Libya, Lithuania, Morocco, Netherlands, Norway, New Zealand, Pakistan, Poland, Portugal, Romania, Russian Federation, South Africa, Spain, Sweden, Switzerland, Syria, Tunisia, Turkey, Ukraine, UK, USA, Yugoslavia (erstwhile) | Principal weed of wheat in the UK, France, Germany, Hungary, Iran, Italy, Morocco, Poland and Spain and of barley in Greece, Iran and Spain.<br><br>Acts as an alternate host to a range of pests like Beet yellows virus, Broad bean wilt virus and Potato virus X (CAB International, 2007). |
| 46. | <p><b>*<i>Polygonum lapathifolium</i> L.</b></p> <p><u>Synonyms:</u></p>   | Pale persicaria, pale smartweed                                      | Seed as contamination | <i>Allium cepa</i> , <i>Apium graveolens</i> , <i>Avena sativa</i> , <i>Beta vulgaris</i> , <i>Brassica</i> spp., <i>B. napus</i> var. <i>napus</i> ,  | Afghanistan, Albania, Argentina, Armenia, Australia, Austria, Azerbaijan, Belarus,  | Potentially damaging weed in spring-sown crop.   |



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|     | <i>Persicaria lapathifolia</i> (L.),<br><i>Persicaria nodosum</i> Pers.,<br>Gray,<br><i>Polygonum andrzejowskianum</i> Klokov,<br><i>Polygonum brittingeri</i> Opiz,<br><i>Polygonum incanum</i> F. W. Schmidt,<br><i>Polygonum linicola</i> Sutulov,<br><i>Polygonum nodosum</i> Pers.,<br><i>Polygonum paniculatum</i> Andr.,<br><i>Polygonum tomentosum</i> Schrank,<br><i>Polygonum zaporoviense</i> Klokov | , white smartweed   |                       | <i>Daucus carota</i> , <i>Glycine max</i> , <i>Helianthus annuus</i> ,<br><i>Hordeum</i> , <i>Linum</i> ,<br><i>Medicago sativa</i> ,<br><i>Ornithopus sativus</i> , <i>Oryza sativa</i> , <i>Pisum</i> , <i>Solanum</i> spp.,<br><i>S. tuberosum</i> , <i>Triticum aestivum</i> , <i>Vitis vinifera</i> ,<br><b><i>Zea mays</i></b>       | Belgium, Bulgaria, Canada, Chile, China, Croatia, Cyprus, Czechoslovakia (erstwhile), Denmark, Egypt, Finland, France, Georgia, Germany, Greece, Hungary, Iceland, Indonesia, Iran, Iraq, Ireland, Israel, Italy, Japan, Jordan, Korea (DPR), Korea (Republic), Lebanon, Lithuania, Morocco, Netherlands, New Zealand, Norway, Pakistan, Poland, Portugal, Romania, Russian Federation, Spain, Sweden, Switzerland, Taiwan, Thailand, Tunisia, UK, USA, Yugoslavia | Seeds remain viable for 6-10 years.<br><br>The weed also acts as an alternate host to a number of pests like <i>Cucumber mosaic virus</i> , <i>Rhizoctonia solani</i> and eriophiid mites (CAB International, 2007). |
| 47. | <b>*#<i>Raphanus raphanistrum</i></b><br><br><u>Synonyms:</u><br><i>Raphanus landra</i> Moretti ex DC.,<br><i>Raphanus segetum</i> Clav.  | Wild radish, charlock, jointed charlock, wild turnip, jointed radish, | Seed as contamination | <i>Allium cepa</i> , <i>Avena sativa</i> , <i>Beta vulgaris</i> , <i>Brassica napus</i> var. <i>napus</i> , <i>Daucus carota</i> , <i>Fragaria ananassa</i> , <i>Glycine max</i> , <i>Gossypium</i> spp., <i>Hordeum vulgare</i> , <i>Linum usitatissimum</i> , <i>Medicago sativa</i> , <i>Nicotiana tabacum</i> , <i>Phaseolus</i> spp., | Afghanistan, Albania, Algeria, Argentina, Armenia, Australia, Austria, Azerbaijan, Belarus, Belgium, Bolivia, Bosnia and Herzegovina, Brazil, Bulgaria, Canada, Chile, China, Colombia,  | Bread poisoning' may result when bread wheat is contaminated with large quantities of seeds (CAB International, 2007).<br><br>Ingestion by sheep and cattle may taint  |

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|     |  | runch,<br>white<br>charlock                 |  | <i>Pisum sativum, Saccharum<br/>officinarum, Solanum<br/>tuberosum, Triticum<br/>aestivum, Vitis vinifera,<br/>Zea mays</i> | Croatia, Cyprus,<br>Denmark, Ecuador,<br>Egypt, Estonia,<br>Ethiopia, Finland,<br>France, Georgia,<br>Germany, Greece,<br>Honduras, Hungary,<br>Iceland, Iran, Iraq,<br>Ireland, Israel, Italy,<br>Japan, Jordan, Kenya,<br>Latvia, Lebanon, Libya,<br>Lithuania, Luxembourg,<br>Mexico, Moldova,<br>Morocco,<br>Mozambique,<br>Netherlands, New<br>Zealand, Norway,<br>Paraguay, Peru,<br>Poland, Portugal,<br>Romania, Russian<br>Federation, Slovakia,<br>Slovenia, South Africa,<br>Spain, Sweden,<br>Switzerland, Syria,<br>Tunisia, Turkey,<br>Ukraine, UK, Uruguay,<br>USA, Yugoslavia<br>(erstwhile), Zimbabwe | milk.   |
| 48. | <b>*Richardia brasiliensis<br/>Gomes</b><br><br><u>Synonyms:</u> | Tropical<br>Richardia,<br>Mexican<br>clover |  | <i>Allium cepa, Arachis<br/>hypogaea, Cajanus cajan,<br/>Citrus spp., Coffea<br/>arabica, Glycine soja,</i>                 | Argentina, Australia,<br>Brazil, Cuba, Ghana,<br>Indonesia, Kenya,<br>Malawi, Mozambique,  | Major crop seed<br>contaminant in South<br>Africa and a nuisance<br>in lawns and gardens, |

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|     | <i>Richardsonia brasiliensis</i><br><i>Richardsonia emetica</i> Mart.,<br>(Gomez) Hayne,<br><i>Richardia pilosa</i> Ruia &<br>Pav.,<br><i>Richardia rosea</i> (St Hil.)<br>Schult.,<br><i>Rcihardsonia rosea</i> St Hil.,<br><i>Richardsonia scabra</i> St Hil.,<br><i>Spermacoce hexandra</i> A.<br>Rich. |                                       |                              | <i>Gossypium</i> spp.,<br><i>Helianthus annuus</i> , <i>Hevea</i><br><i>brasiliensis</i> , <i>Medicago</i><br><i>sativa</i> , <i>Oryza sativa</i> ,<br><i>Phaseolus vulgaris</i> ,<br><i>Saccharum officinarum</i> ,<br><i>Solanum tuberosum</i> ,<br><b><i>Zea mays</i></b>                        | Myanmar, Nigeria,<br>South Africa,<br>Swaziland, Thailand,<br>USA, Zambia,<br>Zimbabwe  | and has also invaded<br>and replaced native<br>vegetation.<br><br>It acts as an alternate<br>carrier for <i>Fusarium</i><br><i>roseum</i> and<br><i>Meloidogyne</i><br><i>javanica</i> .     |
| 49. | <b>*<i>Setaria faberi</i></b> Herrm.<br><br><u>Synonym:</u><br><i>Setaria macrocarpa</i> Lucznik   | Giant<br>foxtail                      |                              | <i>Glycine max</i> , <i>Medicago</i><br><i>sativa</i> , <i>Solanum</i><br><i>tuberosum</i> , <b><i>Zea mays</i></b>   | Belarus, Canada, China,<br>Czech Republic, France,<br>Japan, Korea<br>(Republic), Lithuania,<br>Russian Federation,<br>Spain, USA   | One of the most<br>important weeds of<br>the USA maize belt.   |
| 50. | <b>*#<i>Striga hermonthica</i></b><br>(Del.) Benth.<br><br><u>Synonyms:</u><br><i>Buchnera hermontheca</i> Del.,<br><i>Striga hermontheca</i> (Del.)<br>Benth.,<br><i>Striga senegalensis</i> Benth.   | Witchwee<br>d,<br>purple<br>witchweed | Seed as<br>contaminatio<br>n | <i>Eleusine coracana</i> ,<br><i>Eragrostis tef</i> , <i>Hordeum</i><br><i>vulgare</i> , <i>Oryza sativa</i> ,<br><i>Panicum</i> spp., <i>Rottboellia</i><br><i>cochinchinensis</i> ,<br><i>Saccharum officinarum</i> ,<br><i>Sorghum bicolor</i> ,<br><i>S. halepense</i> , <b><i>Zea mays</i></b> | Angola, Benin, Burkina<br>Faso, Burundi,<br>Cambodia, Cameroon,<br>Central African<br>Republic, Chad, Congo<br>Democratic Republic,<br>Congo, Côte d'Ivoire,<br>Egypt, Ethiopia,<br>Gambia, Ghana,<br>Guinea, Kenya,<br>Madagascar, Malawi,<br>Mali, Mauritania,<br>Morocco, Mozambique,<br>Namibia, Niger,<br>Nigeria, Rwanda, Saudi | Responsible for more<br>crop loss in Africa<br>than any other<br>individual weed<br>species.<br><br>All species are<br>prohibited imports to<br>USA and Israel (CAB<br>International, 2007). |

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|-----|----------------------------|--|--|--|---|--|
|     |                            |  |  |  | Arabia, Senegal, South Africa, Sudan, Swaziland, Tanzania, Togo, Uganda, Yemen, Zambia, Zimbabwe  |  |
| 51. | <i>*Thlaspi arvense</i> L. | Pennycress, field pennycress, bastardcress, fanweed, stinkweed |  | <i>Allium cepa</i> , <i>A. porrum</i> , <i>Avena sativa</i> , <i>Asparagus officinalis</i> , <i>Beta vulgaris</i> , <i>Brassica napus</i> var. <i>napus</i> , , <i>Carthamus tinctorius</i> , <i>Cicer arietinum</i> , <i>Daucus carota</i> , <i>Glycine max</i> , <i>Gossypium</i> spp., <i>Helianthus annuus</i> , <i>Hordeum vulgare</i> , <i>Lens culinaris</i> <i>Linum usitatissimum</i> , <i>Medicago sativa</i> , <i>Oryza sativa</i> , , <i>Phaseolus</i> spp., <i>Pisum sativum</i> , <i>Solanum tuberosum</i> , <i>Triticum aestivum</i> , <i>Vicia faba</i> , <b><i>Zea mays</i></b> | Afghanistan, Albania, Argentina, Armenia, Australia, Austria, Azerbaijan, Belarus, Belgium, Bhutan, Bulgaria, Canada, China, Colombia, Czechoslovakia (erstwhile), Denmark, Estonia, Finland, France, Georgia, Germany, Greece, Greenland, Hungary, Iceland, Iran, Ireland, Israel, Italy, Japan, Jordan, Korea (DPR), Korea (Republic), Latvia, Lebanon, Lithuania, Luxembourg, Mongolia, Netherlands, New Zealand, Norway, Pakistan, Poland., Portugal, Romania, Russian Federation, South Africa, Spain, Sweden, Switzerland, Tajikistan, Tunisia, | Prolific seed producer and capable of building up large reserves of seeds in the soil. Seed exhibits long-term dormancy.<br><br>Reported as a contaminant of commercial oilseed (rapeseed) stocks in the USA and may be toxic to cattle. |

|     |  |   |                       |   |   |  |
|-----|--|---|-----------------------|---|---|--|
|     |  |   |                       |   | Turkey, Turkmenistan, UK, USA, Yugoslavia (erstwhile)   |  |
| 52. | <p><b>*#<i>Veronica persica</i> Poir.</b></p> <p><u>Synonyms:</u><br/> <i>Veronica agrestis</i> var. <i>byzantia</i> Sm.,<br/> <i>Veronica buxbaumii</i> Tenore,<br/> <i>Veronica byzantia</i> Sibth. &amp; Sm.,<br/> <i>Veronica tournefortii</i> C. C. Gmel.</p> | Creeping speedwell, common field speedwell, Persian speedwell, bird's eye speedwell, scrambling speedwell | Seed as contamination | <i>Avena sativa</i> , <i>Beta vulgaris</i> , <i>Brassica napus</i> var. <i>napus</i> , <i>Coffea</i> sp., <i>Helianthus annuus</i> , <i>Hordeum vulgare</i> , <i>Linum usitatissimum</i> , <i>Medicago sativa</i> , <i>Nicotiana tabacum</i> , <i>Phaseolus</i> spp., <i>Secale cereale</i> , <i>Triticum aestivum</i> , <i>Vitis vinifera</i> , <b><i>Zea mays</i></b> | Afghanistan, Argentina, Australia, Austria, Belgium, Bhutan, Bolivia, Brazil, Canada, Chile, China, Colombia, Czechoslovakia (erstwhile), Ecuador, Egypt, Finland, France, Germany, Hungary, Iceland, Iran, Israel, Italy, Japan, Jordan, Korea (DPR), Korea (Republic), Lesotho, Mexico, Nepal, Netherlands, New Zealand, Norway, Pakistan, Papua New Guinea, Peru, Poland, Portugal, Russian Federation, South Africa, Spain, Sweden, Switzerland, Turkey, UK, Uruguay, USA | Prolific seed producer, individual plants producing up to 565 capsules with an average of 11.6 seeds per capsule, building a large soil seed bank. |

\*Pest not reported from India, # Pest included in PQ Order 2003, ♦Pest intercepted during quarantine processing

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## *Glossary*

|                                 |  |
|---------------------------------|--|
| <b>Contaminant</b>              | Soil, fungal spores, fruiting bodies, plant debris, live/ dead/ dormant insects/ stages thereof  |
| <b>Endangered area</b>          | An area where ecological factors favour the establishment of a pest whose presence in the area will result in economically important loss ( <a href="http://www.ippc.org">http://www.ippc.org</a> )  |
| <b>Grain</b>                    | A commodity class for seeds intended for processing or consumption and not for planting ( <a href="http://www.ippc.org">http://www.ippc.org</a> )  |
| <b>Interception (of a pest)</b> | The detection of a pest during inspection or testing of an imported consignment ( <a href="http://www.ippc.org">http://www.ippc.org</a> )  |
| <b>Pathway</b>                  | Any means that allows the entry or spread of a pest ( <a href="http://www.ippc.org">http://www.ippc.org</a> )  |
| <b>Pest</b>                     | Any species, strain or biotype of plant, animal or pathogenic agent injurious to plant or plant products ( <a href="http://www.ippc.org">http://www.ippc.org</a> )   |
| <b>Pest risk analysis</b>       | The process of evaluating biological or other scientific and economic evidence to determine whether a pest should be regulated and the strength of any phytosanitary measures to be taken against it ( <a href="http://www.ippc.org">http://www.ippc.org</a> ) |
| <b>Plant debris</b>             | Dried plant parts or pieces thereof other than seed  |
| <b>Plant quarantine</b>         | All activities designed to prevent the introduction and/or spread of quarantine pests or to ensure their official control ( <a href="http://www.ippc.org">http://www.ippc.org</a> ).   |
| <b>Quarantine</b>               | Official confinement of regulated articles for observation and research or for further inspection, testing and/or treatment ( <a href="http://www.ippc.org">http://www.ippc.org</a> ).   |
| <b>Quarantine pest</b>          | A pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled ( <a href="http://www.ippc.org">http://www.ippc.org</a> )                              |
| <b>Seed</b>                     | A commodity class for seeds for planting or intended for planting and not for consumption or processing ( <a href="http://www.ippc.org">http://www.ippc.org</a> )  |
| <b>Seed-borne</b>               | The pest present on, in or along with the seed   |
| <b>Seed-transmitted</b>         | The pest present in or with the seed and transmitted to the next generation of growing seedlings   |
| <b>Stored products</b>          | Stored grain, flour or processed plant products  |

## *Acronyms and Abbreviations*

|                 |   |
|-----------------|---|
| <b>APHIS</b>    | Animal and Plant Health Inspection Service                        |
| <b>APPPC</b>    | Asia and Pacific Plant Protection Commission                      |
| <b>HPV</b>      | <i>High plain virus</i>   |
| <b>EPPO</b>     | European and Mediterranean Plant Protection Organization          |
| <b>FAO</b>      | Food and Agriculture Organization                                 |
| <b>IPPC</b>     | International Plant Protection Convention                         |
| <b>ISPM</b>     | International Standards for Phytosanitary Measures                |
| <b>MCMV</b>     | <i>Maize chlorotic mottle virus</i>                               |
| <b>NBPGR</b>    | National Bureau of Plant Genetic Resources                        |
| <b>NPPO</b>     | North American Plant Protection Organization                      |
| <b>OEPP</b>     | Organisation Européenne et Méditerranéenne pour la Protection des |
| <b>PQ Order</b> | Plant Quarantine Order  |
| <b>PQP</b>      | Potential Quarantine Pest   |
| <b>PRA</b>      | Pest Risk Analysis  |
| <b>USDA</b>     | United States Department of Agriculture                           |
| <b>WSMV</b>     | <i>Wheat streak mosaic virus</i>                                  |
| <b>WTO</b>      | World Trade Organization  |

## *Other Useful References*

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PaDIL                                  Plant                                  Biosecurity                                  Toolbox.  
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