

Interception of insect pests in exotic seed germplasm*

KAVITA GUPTA¹, SHASHI BHALLA², BECHE LAL³, MANJU LATA KAPUR⁴, CHARAN SINGH⁵, RUQUAEYA BANO⁶, SUBADAS SINGH⁷, MANJU THAKUR⁸ and R K KHETARPAL⁹

National Bureau of Plant Genetic Resources, New Delhi 110 012

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The import of small samples of plant/planting material meant for research in various crop improvement programmes is a potential and inadvertent source of introducing exotic pests into new areas which may cause severe damage to crop production and economy of a nation. There are several glaring examples of pests introduced along with imports which have resulted in enormous crop losses over the past several decades (Khetarpal *et al.* 2006).

Several insects and mites of great economic significance have been intercepted at National Bureau of Plant Genetic Resources (NBPGR) from time to time, many of which have yet not been reported from India. NBPGR is the nodal agency to undertake the quarantine processing of germplasm including transgenic planting material introduced into the country for research purposes.

The exotic pests intercepted over the years include *Acanthoscelides obtectus* intercepted in pigeonpea (*Cajanus cajan* L. millsp) introduced from Brazil and Colombia; *Anthonomus grandis* in *Gossypium* spp from USA; *Ephestia elutella* in Macadamia (nuts) and greengram (*Vigna* sp) from USA; *Pachymerus lacerdae* in nuts of *Orbynya phalerata* from Brazil; *Quadrastichodella eucalyptii* in *Eucalyptus* spp from Australia (Khetarpal *et al.* 2006, Gupta *et al.* 2005).

During 2007 and 2008, a total of 171824 samples of exotic seed material of various crops were processed for quarantine. The seed material was inspected by naked eye or with the help of magnifiers for the detection of external symptoms of damage, ie holes, deformity etc. or the presence of dead or alive insects/mites, eggs/egg shells, immature stages, exuviae or excreta thereof.

A total of 2584 samples of seeds of 12 plant genera of *Abelmoschus*, *Arachis*, *Cicer*, *Glycine*, *Gossypium*,

Helianthus, *Lathyrus*, *Lens*, *Medicago*, *Phaseolus*, *Phoenix*, *Pisum*, *Vicia* and *Vigna* known to carry hidden infestation (Bhalla *et al.* 2002) were subjected to X-ray radiography and seed transparency test to detect the presence of bruchids and chalcids. Seeds were arranged on paper kept over the envelope containing the X-ray plate and exposed to soft X-ray radiography at 22 Kv, 3 mA for 15 seconds (Cabinet X-ray System Model 43855A, Faxitron Series, USA) kept at a distance of 30 cm as described by Wadhi *et al.* (1967). Internal infestation in samples of small seeds of *Casuarina*, *Eucalyptus*, *Medicago* and *Trifolium* sp. was difficult to detect through X-ray radiography, hence, these were subjected to transparency test by heating in lactophenol-acid fuchsin as described by Kaura (1959).

The insects were retrieved from the seeds either by keeping the infested seeds at 28±1°C and 60±5% relative humidity or soaking. The insect pests thus retrieved were identified on the basis of identification keys and reference collection at NBPGR.

The quarantine processing of 171 824 samples of imported germplasm revealed infestation in 465 samples including 173 with hidden infestation and pests intercepted during quarantine processing are presented in Table 1. Visual examination revealed insect infestation in a total of 292 samples. The important interceptions include *Pectinophora gossypiella* in cotton (*Gossypium hirsutum* L.) from Israel and *Sitotroga cerealella* in (*T. aestivum*) from South Africa. The storage beetles and weevils intercepted include *Rhizopertha dominica* in wheat, barley, *Triticale* from CIMMYT (Mexico), *Sitophilus zeamais* and *Tribolium castaneum* in maize from Philippines and Thailand, respectively and (Table 1).

Pectinophora gossypiella larvae were intercepted in seeds of *Gossypium* from Israel which were kept under controlled conditions for adult emergence. *P. gossypiella* is an oligophagous pest and has been reported on cotton, okra, Deccan hemp (*Hibiscus cannabinus* [kenaf]) and roselle (*H. sabdariffa*) and few other members of family Malvaceae. It is distributed throughout tropical America, Africa, Asia,

*Short note

¹Senior Scientist (e mail: kavita@nbpr.ernet.in); ^{2,3,4}Principal Scientist (e mail: sbhalla@nbpr.ernet.in, mlata@nbpr.ernet.in, bechelal@nbpr.ernet.in); ⁵Technical Officer T7–8 (e mail: charansingh17@yahoo.co.in); ^{6,7,8}Senior Research Fellow (e mail: ruquayabano@rediffmail.com); ⁹Principal Scientist and Head (e mail: rkk94rk@yahoo.com), Division of Plant Quarantine

Table 1 Insect and pest interceptions in exotic seed germplasm during 2007–08

Insect pest	Host	Source/Country
Visual examination		
<i>Pectinophora gossypiella</i>	<i>Gossypium hirsutum</i>	Israel
<i>Rhizopertha dominica</i>	<i>Triticum aestivum</i> , <i>Hordeum vulgare</i> , <i>Triticale</i>	CIMMYT (Mexico)
<i>Sitophilus zeamais</i>	<i>Zea mays</i>	Philippines
<i>Sitotroga cerealella</i>	<i>T. aestivum</i>	South Africa
<i>Tribolium castaneum</i>	<i>Z. mays</i>	Thailand
Transparency testing		
** <i>Bruchidius trifolii</i>	<i>Trifolium alexandrium</i> , <i>Trifolium</i> spp	Egypt
* <i>Bruchophagus gibbus</i>	<i>T. pratense</i>	USA
X-Ray radiography		
* <i>Bruchus dentipes</i>	<i>Vicia faba</i>	ICARDA (Syria)
<i>B. lentis</i>	<i>Lens culinaris</i>	ICARDA (Syria)
* <i>B. tristis</i>	<i>Lathyrus sativus</i>	ICARDA (Syria)
<i>Callosobruchus analis</i>	<i>L. sativus</i>	ICARDA (Syria)
<i>C. chinensis</i>	<i>L. culinaris</i>	ICARDA (Syria)
* <i>C. subinnotatus</i>	<i>Vigna subterranea</i>	Ghana
Immature stages of bruchids	<i>Gossypium hirsutum</i>	Israel

*pest not yet reported from India, **pest not yet reported on the host in India

Australasia, including subtropical regions, Pakistan, Egypt, USA (Arizona) and Mexico (CABI 2007). *P. gossypiella* is a worldwide pest of cotton and in some regions of the world, it is a key cotton pest and economically very important. But it is a quarantine pest in the USA and Russia (CABI 2007).

Rhizopertha dominica intercepted in wheat is thought to have originated in the Indian subcontinent, but now has a cosmopolitan distribution. It is a serious pest of stored products throughout the tropics, Australia and the USA. It is also found in temperate countries, either because of its ability for prolonged flight or as a result of the international trade in food products. *Tribolium castaneum* intercepted in maize from Thailand has a wide host range and is cosmopolitan in warmer countries. Both the larvae and adults of *T. castaneum* damage the host and cause extensive damage to grains already damaged as a result of handling during harvest. They feed on the germ of the seed and render it unfit for sowing purposes. *Sitotroga cerealella* intercepted in *T. aestivum* from South Africa is found in all warm and tropical parts of the world and may also be found in temperate climate. It is widespread in India. This pest is reported to be carried all over the world in grain shipments and can establish

itself wherever moisture and temperature are favourable. It is a pest of stored products (grains) with a wide host range and is cosmopolitan in distribution (CABI 2007). The seed damage caused by *S. cerealella* is similar to that caused by the rice weevil *Sitophilus oryzae* but can be distinguished by the form of the adult emergence holes on the infested seeds. Some of these pests, like *Sitophilus* spp, *Sitotroga cerealella* and *R. dominica* though already known to occur in the country are important from quarantine point of view because of their economic importance and the possibility of their being a different strain of the species (Wadhi 1980).

The interceptions in samples subjected to transparency testing were bruchid and chalcid, ie *Bruchidius* sp. in *Trifolium alexandrium* and *Trifolium* spp from Egypt and *Bruchophagus gibbus* in *T. pratense* from USA, respectively. *Bruchidius trifolii* reported on *Trifolium* spp from Egypt is not yet reported to be a pest of *Trifolium* spp in India although the genus *Bruchidius* has been reported on other host plants from India. Three species of *Bruchidius* are reported on *Trifolium* spp. from Egypt- *B. alferii*, *B. poupillieri* and *B. trifolii* and none of them are reported from India. *Bruchophagus gibbus* is a phytophagous chalcidoid not yet reported from India but usually infests seeds of *Medicago* and *Trifolium*. There are unconfirmed records from Australia, Azerbaijan, China, Germany and USA (CABI 2007).

The interceptions in samples subjected to X-rays were bruchids, like *Bruchus dentipes* in *Vicia faba* from ICARDA (Syria), *B. lentis* in *Lens culinaris* from ICARDA (Syria); *B. tristis* in *Lathyrus sativus* from ICARDA (Syria); *Callosobruchus analis* and *C. chinensis* in *L. sativus* and *L. culinaris*, respectively from ICARDA (Syria) and *C. subinnotatus* in *Vigna subterranea* from Ghana.

B. dentipes is a pest specific to *V. faba* causing up to 76% damage has been reported from very few countries in Europe (Greece), Asia (Syria and Turkey), and Australia and is yet not reported from India. Infestation ranges from 10 to 90%, depending on location in the Mediterranean region and average about 42%. Gamma irradiation is found effective as a quarantine disinfestation treatment for faba bean seeds infested with *B. dentipes* in Syria (Mansour and Al-Bacheer 1995).

B. lentis is a specific pest of *L. culinaris* and has been recorded as a serious pest in Algeria, Iran, Lebanon and Turkey with infestation level reaching up to 80% and loss of germination up to 100% (Hariri 1981). *B. lentis* is reported from 14 countries including India, but it is univoltine and overwinters in seeds with higher survival, spread and establishment potential and, hence, poses higher quarantine risk (Bhalla *et al.* 2004). Both the above-mentioned bruchids have been repeatedly intercepted in the germplasm imported from various countries (Gupta *et al.* 2005).

B. tristis intercepted in *Lathyrus sativus* from ICARDA, Syria is yet not reported from India. Not much is known about its biology and life-cycle except that it has been reported on

Calycotome spp, *Lens* spp, *Pisum* spp, *Ulex* spp and *Vicia* spp from Algeria, Canary Islands, Crete, Cyprus, France, Greece, Italy, Malta, Sicily, Spain, Syria, Turkey, USA, USSR (erstwhile).

Callosobruchus subinnotatus intercepted in *Vigna subterranea* from Ghana has been reported on *Rhynchosia* sp. and *V. subterranea* from parts of Africa and is yet not reported from India. High mortality of different developmental stages of *C. subinnotatus* has been reported due to simulated solar heat in bambara groundnut, (*Vigna subterranea*) seeds. (Lale and Vidal, 2000). While studies on modified atmosphere revealed that pupae of *C. subinnotatus* are most tolerant to modified atmospheres (hypercarbic and hypoxic) than adults (Mbata et al. 2000). Adult polymorphism is also recorded among its populations by Appleby and Credland (2001).

C. chinensis and *C. analis* although reported from India pose a quarantine risk during import due to their high economic significance and possibility of presence of new strains (Applebaum et al. 1968). New strains or biotypes are also included in the category of pests according to the latest definition of 'pest' by IPPC (<http://www.ippc.int/IPP/En/standards.htm>). New strains having greater physiological adaptability pose a higher degree of risk. The introduction of a mutant strain of such species in a new and climatically suitable environment could trigger off a population explosion.

Some of the pests intercepted although already known to occur in the country are important from quarantine point of view because of their economic importance and the increasing number of strains of the species (Wadhi 1980).

All the infested seed samples were salvaged using various methods, viz mechanical cleaning done by removing infested/deformed seeds, X-ray radiography, fumigation treatment. One hundred and seventythree samples found infested through X-ray were salvaged by handpicking the infested seeds from the seed geometry as seen on the developed X-ray film. Two hundred and ninetytwo infested samples of *Hordeum vulgare*, *Triticum aestivum*, *T. durum* and *Triticale*, were fumigated with ethylene dichloride- carbon tetrachloride (EDCT) mixture @ 320 mg/l for 48 hr or 640 mg/l for 24 hr at 30°C in an airtight container at normal atmospheric pressure and 73,533 samples were given prophylactic fumigation.

The importance of plant quarantine is clearly indicated by the interception of several economically important quarantine pests not yet reported from India (Khetarpal et al. 2006). The hidden nature of the infestation of several pests and their being repeatedly intercepted warrants proper detection and salvaging of infested material for pest-free release of germplasm for crop improvement programmes.

SUMMARY

Quarantine examination of 1,71,824 exotic seed samples of various crops during 2007–08 revealed infestation of insect

pests in 465 samples including 173 with hidden infestation. Several pests were intercepted including storage beetles and weevils intercepted include *Rhizopertha dominica* in *Triticum aestivum*, *Hordeum vulgare*, *Triticale* from CIMMYT (Mexico), *Sitophilus zeamais* and *Tribolium castaneum* in *Zea mays* from Philippines and Thailand, respectively. Pests detected through X-ray radiography include seed chalcid (*Bruchophagus gibbus* authority) in (*Trifolium pretense* authority) from USA and bruchids not yet reported from India like *Bruchidius trifolii*, in *Trifolium alexandrium* and *Trifolium* spp from Egypt; *Bruchus dentipes* in *Vicia faba* from ICARDA (Syria); *B. tristis* in *Lathyrus sativus* from ICARDA (Syria); and *C. subinnotatus* in *Vigna subterranea* from Ghana. All the infested samples were salvaged using suitable treatments.

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