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Exotic Bruchids in Legume Grains Imported from Different Countries

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Abstract: Quarantine examination of 8,38,686 imported seed samples of various legume crops during 2015-2024 revealed presence of exotic bruchids commonly called pulse beetles in 3137 samples which were detected by X-ray radiography. Thirteen exotic bruchid species viz., *Acanthoscelides desmanthi* in *Desmanths* spp. from Colombia, *A. obtectus* in *Phaseolus vulgaris* from Argentina, Colombia Mexico, Peru; *Bruchidius atrolineatus* in *Vigna unguiculata* from Nigeria; *Bruchus affinis* in *Vicia faba* from Afghanistan; *B. dentipes* in *Vicia* spp. from Afghanistan, and Syria; *B. ervi* in Lens spp. from Afghanistan, Chile, Cyprus, Ethiopia, Germany, Greece, Syria, Iran, Iraq, Italy, Jordan, Lebanon, Mexico, Morocco, Russia, Syria and Turkey; *B. nubilis* in *V. faba* from Ukraine; *B. rufimanus* in *V. faba* from Afghanistan, Canada, Spain and Syria; *B. signaticornis* in *L. culinaris* from Syria; *B. tristis* in *Lathyrus odoratus* from Syria; *B. tristiculus* in *V. narborensis* from Portugal; *Callosobruchus rhodesianus* in *Vigna unguiculata* from Nigeria and *C. subinnotatus* in *V. subterranea* from Ghana were intercepted. Many of the pulse beetles were intercepted repeatedly from the same/ different source(s) year after year. All the infested samples were salvaged using suitable disinfestation treatments. None of the intercepted beetles are yet reported from India, and are therefore, of high quarantine significance

Keywords: Bruchids, Exotic, Germplasm, Interception, Legumes, Seed beetles.

INTRODUCTION

ICAR- National Bureau of Plant Genetic Resources (ICAR-NBPGR), New Delhi, India is the nodal agency to undertake quarantine processing of germplasm including transgenic planting material introduced into the country for research purposes both for public and private sectors. Several pulse beetles of great economic significance have been intercepted in imported seed material at ICAR-NBPGR over the years, many of which have yet not been reported from India (Gupta et al., 2010).

The bruchids (Coleoptera: Bruchidae) commonly called seed beetles, belong to a moderate-sized family represented by about 1,600 species in 71 genera found worldwide (Gupta et al., 2011). About twenty species are major pests of legumes in field and/or in storage. *Bruchus* and *Bruchidius* species usually attack only field crops, ovipositing on the young pods. The larvae burrow into the green pods and develop within the seeds. Adults of these species emerge in the store, after the crop has been harvested. Since they produce a single generation and are usually unable to breed further on these dry seeds, they are considered less harmful than genera like *Callosobruchus, Zabrotes, Acanthoscelides, Caryedon*, and some *Bruchidius* species which are able to breed successively, producing many generations on the same stored legumes until the food resources are exhausted. The pulse beetles feed in a wide variety of seeds and cause huge losses to stored grains. Storage species often have a dramatic multiplication leading to over 80% damage within 6-8 months.

The present work is a critical analysis of the samples processed over the previous ten years

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(2015-2024), the pulse beetles intercepted and their level of infestation, the significance of the interceptions and how their interception is a success story in prevention of introduction of such destructive beetles into India.

MATERIALS AND METHODS

Over the past decade, a total of 8,38,686 imported seed samples of various legume crops were processed to detect infestation of insect-pests. All the seed samples were examined visually and under stereo-binocular microscope for any external symptom of insect infestation i.e. holes, rotting, swelling, deformity, etc. or presence of dead or alive insects/ mites, eggs/ egg shells, immature stages, exuviae or excreta thereof. Seed samples belonging to the 340 plant genera known to carry hidden infestation of bruchids and phytophagous chalcidoids were compulsorily subjected to X-ray radiography. A total of 22437 samples of seeds of plant genera of *Abelmoschus, Arachis, Casuarina, Cicer, Eucalyptus, Glycine, Gossypium, Helianthus, Lathyrus, Lens, Leucaena, Medicago, Phaseolus, Pisum, Trifolium, Vicia* and *Vigna* were exposed to X-ray radiography or seed transparency to detect presence of seed beetles. Seeds were arranged on small 12 X 12 cm tray kept over the window in the X ray cabinet and exposed to soft X-ray (Cabinet X-ray Systems, Faxitron Series MX 20, USA) kept at a distance of 60 cm from the source. The seed geometry on the plate was left undisturbed. This is a real-time computer controlled X-ray system; hence the image as visualized on the monitor was saved for removal of seeds suspected to carry infestation from the seed geometry mechanically. Internal infestation in samples of small seeds of *Casuarina, Eucalyptus, Medicago* and *Trifolium* spp. was difficult to detect through X-ray radiography, hence, these were subjected to transparency test by heating in lactophenol-acid fuchsin (Kaura 1959).

The insects were retrieved from the infested seeds either by keeping them at 28+1°C and 60+5% RH or soaking overnight in water. The insect pests thus retrieved were identified on the basis of published identification keys, digitized keys (Gupta et al., 2011) and reference collection at ICAR-NBPGR.

The infested samples were salvaged using mechanical cleaning, X-ray radiography (by removing infested seeds) and fumigation. Seeds found infested through X-ray radiography were salvaged by handpicking the infested seeds from the seed geometry as seen on the developed X-ray film.

RESULTS AND DISCUSSION

The year-wise details of seed samples imported X-rayed and found infested during 2015- 2024 are presented in Table 1. A total of 8,38,686 seed samples were imported of which 22437were subjected to X-ray and 3137 samples showed insect infestation. Exotic seed beetles were intercepted in the infested samples from 25 different source countries. The details of interception of exotic seed beetles, the average % infestation caused by them, hosts on which intercepted, year when imported, per cent infestation and the source/ country of import is presented in Table 2.

More than 85 % of the total samples imported were those of seeds. About 2.5 per cent of the total seed samples subjected to X-ray radiography were infested with bruchids. The percentage infestation varied from 3-100 % in the samples X-rayed during the period. Upon comparing the samples imported vis-à-vis the total infested seed samples by each intercepted seed beetle, it is clear that the maximum number of samples infested were of Lens spp. due to *B. ervi* followed by *Phaseolus* spp. due to *Acanthoscelides obtectus*, followed by *V. faba* due to *B. dentipes* and *B. rufimanus*. However, despite few numbers of samples, 100% average infestation by *B affinis* in *Vicia faba* from Afghanistan and *C. subinnotatus* in *V. subterranean* from Ghana was observed. The average % infestation due to other exotic seed beetles varied from 8-60%.

An analysis of Table 2 indicates that many of these beetles were repeatedly intercepted year after year on the same host and from the same or different source country which is indicative of its pest status there. Four of the pulse beetles intercepted were in material received from ICARDA, Syria, a CGIAR Centre which supplies germplasm material from different source countries. In such a case the infestation could be either from Syria or from the source country of

Table 1: Year-wise details of seed samples processed through X-ray radiography in quarantine

Year	*Seed samples imported*	*Seed samples X-rayed*	*Samples infested with seed beetles*	*Infestation (%)*
2015	87,230	4,598	294	6.48
2016	99,624	2,741	333	12.15
2017	85,615	703	92	13.08
2018	83,527	2,214	216	9.75
2019	1,05,676	2,435	134	5.50
2020	76,907	4,572	219	4.79
2021	64,684	1,480	103	6.95
2022	63,599	1,110	91	8.19
2023	91,523	1,130	91	8.05
2024	80,301	1,454	82	5.64
Total	**8,38,686**	**22437**	**3137**	**8.05 (Average)**

Table 2: Seed beetles intercepted during 2015-2024 in different crops

Insect Pest	*Host*	*% Infested Samples*	*Source/ Country*
Acanthoscelides desmanthi	*Desmanthus* spp.	45.50	Colombia
A. obtectus	*Lathyrus sativus*	12.25	Lebanon
	Phaseolus vulgaris	8.72	Argentina, Colombia, Mexico and Peru
		5.90	Colombia
		10.22	USA
Bruchidius atrolineatus	*Vigna unguiculata*	33.33	Nigeria
Bruchus affinis	*Vicia faba*	100.00	Afghanistan
B. dentipes	*V. faba*	23.07	ICARDA (Syria)
	V. narbonensis	60.00	Afghanistan
B. ervi	*Lathyrus sativus*	15.05	Lebanon
	Lens culinaris	11.00	Afghanistan, Chile, Cyprus, Ethiopia, Iraq, Jordan, Mexico, Syria
		16.10	Chile, Germany, Greece, Iran, Italy, Lebanon, Morocco, Russia, Turkey
	Pisum sativum	12.25	Lebanon
B. nubilis	*V. faba*	38.46	Ukraine
B. rufimanus	*V. faba*	100.00	Syria
		70.00	Canada
		47.05	Spain
B. signaticornis	*L. culinaris*	25.00	ICARDA (Syria)
B. tristis	*Lathyrus odoratus*	39.02	ICARDA (Syria)
	Lens.culinaris	38.08	Lebanon
B. tristiculus	*V. narborensis*	60.00	Portugal
Callosobruchus rhodesianus	*Vigna unguiculata*	55.55	Nigeria
C. subinnotatus	*V. subterranea*	100.00	Ghana

the material which remained undetected due to its hidden nature. Besides, four of the seed beetle species have been intercepted in material received from Afghanistan and Lebanon followed by three species from Syria and two from Mexico and Colombia. In addition, one species each of exotic seed beetle was also intercepted from Argentina, Canada, Chile, Cyprus, Ethiopia, Germany, Ghana, Greece, Iran, Iraq, Italy, Jordan, Morocco, Nigeria, Peru, Portugal, Russian Federation, Spain, Turkey, Ukraine and USA.

Seeds of *Vicia* spp. imported several times over the years were found to be infested by five different species of seed beetles viz., *B. affinis*, *B. dentipes*, *B. nubilis*, *B. rufimanus* and *B. tristiculus*. Three species viz., *Bruchidius atrolineatus*, *Callosobruchus rhodesianus* and *C. subinnotatus* were intercepted on different species of *Vigna*.

Two species viz., *B. ervi* and *B. signaticornis* were intercepted on *Lens* spp. and one species each viz., *Acanthoscelides obtectus* and *B. tristis* on *Phaseolus vulgaris* and *Lathyrus odoratus*, respectively.

All the above intercepted pulse beetles are not yet reported from India and hence are of very high quarantine significance. Had they not been intercepted in quarantine they could have gained entry into the country. All the seed samples infested with pulse beetles were salvaged using various methods viz., mechanical cleaning done by removing infested/ deformed seeds, X-ray radiography and fumigation treatment. Two thousand, eight hundred and nineteen samples found infested through X-ray were salvaged by handpicking the infested seeds from the seed geometry as seen on the developed image of X-ray on the screen and/ or were fumigated with ethylene dichloride-carbon tetrachloride (EDCT) mixture @ 320 mg/ l for 48 h or 640 mg/ l for 24 h at 30°C in an airtight container at normal atmospheric pressure.

CONCLUSION

In view of the interception of several exotic seed beetles of quarantine significance from more than 25 countries in the past ten years it is essential to pay due attention to the regulations and the requirements thereunder. They are especially meant to prevent the entry of such exotic pulse beetle species that could become serious economic threats in India, if they get introduced and find favorable areas where the climatic conditions are suitable for their establishment. Therefore, effective quarantine processing is of paramount importance for the safe exchange of seeds.

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