

Summary

In order to safeguard countries from quarantine risks (insect pests, pathogens, nematodes, parasitic weeds) associated with the movement of germplasm, ICARDA's Germplasm Health Unit (GHU) follows a regulatory and quarantine program working in close collaboration with competent institutions where ICARDA has platforms for crop breeding, germplasm multiplication and evaluation and genetic resources exchange. ICARDA's GHU is responsible for the monitoring, clearance and documentation of safe germplasm movement at the center and share the updated technology with the NPPOs in the host countries and farmers. Thus, to confirm the health status of exchanged germplasms, the GHU conducts different types of diagnostic tests based on the nature of the target pest/pathogen. The following is a list of seed-borne pests of food legumes, cereals, forages and rangelands, in addition to their detection methods applied by ICARDA's GHU (the full procedures of detection methods are available in Kumari *et al.*, 2022a, 2022b):

Crop/Pests	Common name	Pest type	Detection methods* applied by ICARDA's GHU
Chickpea (<i>Cicer arietinum</i>) & its wild relatives			
<i>Alternaria alternata</i>	Alternaria blight	Fungi	Freezing blotter test, Agar plate test
<i>Ascochyta rabiei</i> (= <i>Didymella rabiei</i>)	Ascochyta blight	Fungi	Agar plate test
<i>Botrytis cinerea</i>	Gray mold	Fungi	Agar plate test
<i>Fusarium oxysporum</i> f.sp. <i>ciceri</i>	Fusarium wilt	Fungi	Freezing blotter test, Agar plate test
<i>Callosobruchus maculatus</i>	Cowpea seed beetle	Insect	Visual inspection, floating test
<i>Meloidogyne incognita</i>	Root-knot nematode	Nematode	Nematode extraction test
<i>Cuscuta</i> spp.	Dodder	Parasitic weed	Visual inspection, floating test
Alfalfa mosaic virus	Alfalfa mosaic virus	Virus	ELISA, TBIA
Bean yellow mosaic virus	Bean yellow mosaic virus	Virus	ELISA, TBIA
Cucumber mosaic virus	Cucumber mosaic virus	Virus	ELISA, TBIA
Pea seed-borne mosaic virus	Pea seed-borne mosaic virus	Virus	ELISA, TBIA
Broad bean true mosaic virus	Broad bean true mosaic virus	Virus	ELISA, TBIA
Faba bean (<i>Vicia faba</i>)			
<i>Pseudomonas syringae</i> pv. <i>phaseolicola</i>	Halo blight	Bacteria	Agar plate test followed by slide agglutination test
<i>Xanthomonas axonopodis</i> pv. <i>phaseoli</i>	Common blight	Bacteria	Agar plate test followed by slide agglutination test
<i>Ascochyta fabae</i> (= <i>Didymella fabae</i>)	Ascochyta blight	Fungi	Agar plate test
<i>Botrytis cinerea</i> , <i>B. fabae</i> , <i>B. fabiopsis</i>	Chocolate spot	Fungi	Agar plate test
<i>Colletotrichum lindemuthianum</i>	Anthrachnose	Fungi	Agar plate test

Crop/Pests	Common name	Pest type	Detection methods* applied by ICARDA's GHU
<i>Fusarium</i> spp.	Fusarium wilt	Fungi	Freezing blotter test, Agar plate test
<i>Bruchus</i> spp.	Bean seed beetle	Insect	Visual inspection, floating test
<i>Callosobruchus</i> spp.	Cowpea seed beetle	Insect	Visual inspection, floating test
<i>Ditylenchus dipsaci</i> , <i>D. gigas</i>	Stem nematodes	Nematode	Nematode extraction test
<i>Meloidogyne incognita</i>	Root-knot nematode	Nematode	Nematode extraction test
<i>Orobanch</i> spp. & <i>Phelipanche</i> spp.	Broomrape	Parasitic weed	Visual inspection, floating test
<i>Cuscuta</i> spp.	Dodder	Parasitic weed	Visual inspection, floating test
Alfalfa mosaic virus	Alfalfa mosaic virus	Virus	ELISA, TBIA
Bean yellow mosaic virus	Bean yellow mosaic virus	Virus	ELISA, TBIA
Broad bean stain virus	Broad bean stain virus	Virus	ELISA, TBIA
Broad bean mottle virus	Broad bean mottle virus	Virus	ELISA, TBIA
Cucumber mosaic virus	Cucumber mosaic virus	Virus	ELISA, TBIA
Pea seed-borne mosaic virus	Pea seed-borne mosaic virus	Virus	ELISA, TBIA
Broad bean true mosaic virus	Broad bean true mosaic virus	Virus	ELISA, TBIA
Lentil (<i>Lens culinaris</i>) & its wild relatives			
<i>Ascochyta lentis</i> (= <i>Didymella lentis</i>)	Ascochyta blight	Fungi	Agar plate test
<i>Botrytis cinerea</i>	Gray mold	Fungi	Agar plate test
<i>Phoma medicaginis</i> var. <i>medicaginis</i>	Phoma blight	Fungi	Agar plate test
<i>Colletotrichum lindemuthianum</i> , <i>Colletotrichum truncatum</i>	Anthraxnose	Fungi	Agar plate test
<i>Fusarium oxysporum</i> f.sp. <i>lentis</i>	Fusarium wilt	Fungi	Freezing blotter test, Agar plate test
<i>Stemphylium botryosum</i>	Stemphylium blight	Fungi	Agar plate test
<i>Bruchus lentis</i> , <i>Bruchus ervi</i>	Lentil weevil	Insect	Visual inspection, floating test
<i>Callosobruchus maculatus</i> , <i>Callosobruchus chinensis</i>	cowpea seed beetle	Insect	Visual inspection, floating test
<i>Ditylenchus dipsaci</i>	Stem and bulb nematode	Nematode	Nematode extraction test
<i>Meloidogyne incognita</i>	Root-knot nematode	Nematode	Nematode extraction test
<i>Orobanch</i> spp. & <i>Phelipanche</i> spp.	Broomrape	Parasitic weed	Visual inspection, floating test
<i>Cuscuta</i> spp.	Dodder	Parasitic weed	Visual inspection, floating test
Alfalfa mosaic virus	Alfalfa mosaic virus	Virus	ELISA, TBIA
Bean yellow mosaic virus	Bean yellow mosaic virus	Virus	ELISA, TBIA
Broad bean stain virus	Broad bean stain virus	Virus	ELISA, TBIA
Cucumber mosaic virus	Cucumber mosaic virus	Virus	ELISA, TBIA
Pea seed-borne mosaic virus	Pea seed-borne mosaic virus	Virus	ELISA, TBIA
Broad bean true mosaic virus	Broad bean true mosaic virus	Virus	ELISA, TBIA
Pea (<i>Pisum sativum</i>) & its wild relatives			
<i>Pseudomonas syringae</i> pv. <i>pisi</i>	Bacterial blight	Bacteria	Agar plate test followed by slide agglutination test
<i>Pseudomonas syringae</i> pv. <i>phaseolicola</i>	Halo blight	Bacteria	Agar plate test followed by slide agglutination test

Crop/Pests	Common name	Pest type	Detection methods* applied by ICARDA's GHU
<i>Xanthomonas axonopodis</i> pv. <i>phaseoli</i>	Common blight	Bacteria	Agar plate test followed by slide agglutination test
<i>Curtobacterium flaccumfaciens</i> pv. <i>flaccumfaciens</i>	Bacterial blight	Bacteria	Agar plate test followed by slide agglutination test
<i>Ascochyta pinodes</i> (= <i>Didymella pinodes</i>)	Ascochyta blight	Fungi	Agar plate test
<i>Ascochyta pisi</i>	Leaf and pod spot	Fungi	Agar plate test
<i>Botrytis cinerea</i>	Grey mold	Fungi	Agar plate test
<i>Fusarium oxysporum</i> f.sp. <i>pisi</i>	Fusarium wilt	Fungi	Freezing blotter test, agar plate test
<i>Bruchus pisorum</i>	Pea weevil	Insect	Visual inspection, floating test
<i>Meloidogyne incognita</i>	Root-knot nematode	Nematode	Nematode extraction test
<i>Orobancha</i> spp. & <i>Phelipanche</i> spp.	Broomrape	Parasitic weed	Visual inspection, floating test
Grass pea as food (<i>Lathyrus sativus</i>)			
<i>Curtobacterium flaccumfaciens</i> pv. <i>flaccumfaciens</i>	Bacterial blight	Bacteria	Agar plate test followed by slide agglutination test
<i>Pseudomonas syringae</i> pv. <i>phaseolicola</i>	Halo blight	Bacteria	Agar plate test followed by slide agglutination test
<i>Xanthomonas axonopodis</i> pv. <i>phaseoli</i>	Common blight	Bacteria	Agar plate test followed by slide agglutination test
<i>Ascochyta</i> spp.	Ascochyta blight	Fungi	Agar plate test
<i>Botrytis cinerea</i>	Gray mold	Fungi	Agar plate test
<i>Colletotrichum lindemuthianum</i> , <i>Colletotrichum truncatum</i>	Anthracnose	Fungi	Agar plate test
<i>Fusarium oxysporum</i>	Fusarium wilt	Fungi	Freezing blotter test, agar plate test
<i>Phoma</i> spp.	Phoma blight	Fungi	Agar plate test
<i>Acanthoscelides</i> spp.	Bean weevil	Insect	Visual inspection, floating test
<i>Ditylenchus dipsaci</i>	Stem and bulb nematode	Nematode	Nematode extraction test
<i>Meloidogyne incognita</i>	Root-knot nematode	Nematode	Nematode extraction test
<i>Cuscuta</i> spp.	Dodder	Parasitic weed	Visual inspection, floating test
Alfalfa mosaic virus	Alfalfa mosaic virus	Virus	ELISA, TBIA
Bean yellow mosaic virus	Bean yellow mosaic virus	Virus	ELISA, TBIA
Broad bean stain virus	Broad bean stain virus	Virus	ELISA, TBIA
Cucumber mosaic virus	Cucumber mosaic virus	Virus	ELISA, TBIA
Pea seed-borne mosaic virus	Pea seed-borne mosaic virus	Virus	ELISA, TBIA
Broad bean true mosaic virus	Broad bean true mosaic virus	Virus	ELISA, TBIA
Wheat and its wild relatives			
<i>Pseudomonas syringae</i> pv. <i>atrofaciens</i>	Basal glum rot	Bacteria	Agar plate test followed by slide agglutination test
<i>Pseudomonas syringae</i> pv. <i>syringae</i>	Leaf blight	Bacteria	Agar plate test followed by slide agglutination test
<i>Xanthomonas translucens</i> pv. <i>undulosa</i>	Black chaff, leaf streak	Bacteria	Agar plate test followed by slide agglutination test
<i>Claviceps purpurea</i>	Ergot	Fungi	Visual inspection
<i>Bipolaris sorokiniana</i> (= <i>Cochliobolus sativus</i>)	Spot blotch	Fungi	Freezing blotter test
<i>Fusarium graminearum</i>	Fusarium head blight, leaf blight	Fungi	Freezing blotter test, agar plate test
<i>Magnaporthe oryzae</i> (= <i>Pyricularia oryzae</i>)	Wheat blast	Fungi	Freezing blotter test

Crop/Pests	Common name	Pest type	Detection methods* applied by ICARDA's GHU
<i>Phaeosphaeria nodorum</i> (= <i>Stagonospora nodorum</i>)	Septoria glume blotch	Fungi	Freezing blotter test, agar plate test
<i>Pyrenophora tritici-repentis</i>	Tan spot	Fungi	Freezing blotter test
<i>Tilletia controversa</i>	Dwarf bunt	Fungi	Centrifuge washing test
<i>Tilletia indica</i>	Karnal bunt	Fungi	Centrifuge washing test
<i>Tilletia tritici</i> & <i>Tilletia laevis</i>	Common bunt	Fungi	Centrifuge washing test
<i>Urocystis agropyri</i>	Flag smut	Fungi	Centrifuge washing test
<i>Ustilago tritici</i>	Loose smut	Fungi	Centrifuge washing test
<i>Alternaria</i> spp., <i>Cldosporium</i> spp., <i>Fusarium</i> spp., <i>Cochliobolus sativus</i>	Black point	Fungi	Freezing blotter test, agar plate test
<i>Rhynchosporium commune</i> (= <i>R. secalis</i>)	Leaf scald; Leaf blotch	Fungi	Agar plate test
<i>Rhyzopertha dominica</i>	Lesser grain borer	Insect	Visual inspection, floating test
<i>Sitophilus granarius</i>	Granary weevil	Insect	Visual inspection, floating test
<i>Tribolium castaneum</i>	Red flour beetle	Insect	Visual inspection, floating test
<i>Tribolium confusum</i>	Confused flour beetle	Insect	Visual inspection, floating test
<i>Trogoderma granarium</i>	Khapra beetle	Insect	Visual inspection, floating test
<i>Anguina tritici</i>	Seed gall nematodes	Nematode	Nematode extraction test
<i>Heterodera avenae</i>	Cereal cyst nematode	Nematode	Nematode extraction test
Barley stripe mosaic virus	Barley stripe mosaic virus	Virus	ELISA, TBIA
Wheat streak mosaic virus	Wheat streak mosaic virus	Virus	ELISA, TBIA
Barley and its wild relatives			
<i>Pseudomonas syringae</i> pv. <i>atrofaciens</i>	Basal glum rot	Bacteria	Agar plate test followed by slide agglutination test
<i>Pseudomonas syringae</i> pv. <i>syringae</i>	Leaf blight	Bacteria	Agar plate test followed by slide agglutination test
<i>Xanthomonas translucens</i> pv. <i>undulosa</i>	Black chaff, leaf streak	Bacteria	Agar plate test followed by slide agglutination test
<i>Alternaria</i> spp., <i>Cldosporium</i> spp., <i>Fusarium</i> spp., <i>Cochliobolus sativus</i>	Black point	Fungi	Freezing blotter test, agar plate test
<i>Bipolaris sorokiniana</i> (= <i>Cochliobolus sativus</i>)	Spot blotch	Fungi	Freezing blotter test
<i>Claviceps purpurea</i>	Ergot	Fungi	Visual inspection
<i>Drechslera graminea</i>	Barley stripe	Fungi	Freezing blotter test
<i>Drechslera teres</i> f.sp. <i>maculata</i>	Net blotch	Fungi	Freezing blotter test
<i>Fusarium avenaceum</i> , <i>Fusarium culmorum</i>	Foot & root rot	Fungi	Freezing blotter test, agar plate test
<i>Fusarium graminearum</i>	Fusarium head blight, leaf blight	Fungi	Freezing blotter test, agar plate test
<i>Phaeosphaeria nodorum</i> (= <i>Stagonospora nodorum</i>)	Septoria glume blotch	Fungi	Freezing blotter test, agar plate test
<i>Pyrenophora tritici-repentis</i>	Barley leaf stripe	Fungi	Freezing blotter test
<i>Rhynchosporium commune</i> (= <i>R. secalis</i>)	Barley scald, Leaf blotch	Fungi	Agar plate test
<i>Ustilago hordei</i>	Covered smut	Fungi	Centrifuge washing test
<i>Ustilago nuda</i>	Loose smut	Fungi	Embryo extraction test

Crop/Pests	Common name	Pest type	Detection methods* applied by ICARDA's GHU
<i>Rhyzopertha dominica</i>	Lesser grain borer	Insect	Visual inspection, floating test
<i>Sitophilus granarius</i>	Granary weevil	Insect	Visual inspection, floating test
<i>Tribolium castaneum</i>	Red flour beetle	Insect	Visual inspection, floating test
<i>Tribolium confusum</i>	Confused flour beetle	Insect	Visual inspection, floating test
<i>Trogoderma granarium</i>	Khabra beetle	Insect	Visual inspection, floating test
<i>Anguina tritici</i>	Seed gall nematode	Nematode	Nematode extraction test
<i>Heterodera avenae</i>	Cereal cyst nematode	Nematode	Nematode extraction test
Barley stripe mosaic virus	Barley stripe mosaic virus	Virus	ELISA, TBIA
<i>Ustilago avenae</i>	Loose smut	Fungi	Embryo extraction test
Oat and its wild relatives			
<i>Pseudomonas syringae</i> pv. <i>atriafaciens</i>	Basal glum rot	Bacteria	Agar plate test followed by slide agglutination test
<i>Xanthomonas translucens</i> pv. <i>undulosa</i>	Black chaff, leaf streak	Bacteria	Agar plate test followed by slide agglutination test
<i>Fusarium graminearum</i>	Fusarium head blight, leaf blight	Fungi	Freezing blotter test, agar plate test
<i>Fusarium avenaceum</i> , <i>Fusarium culmorum</i>	Foot & root rot	Fungi	Freezing blotter test, agar plate test
<i>Pyrenophora avenae</i>	Leaf spot	Fungi	Freezing blotter test
<i>Alternaria</i> spp., <i>Cldosporium</i> spp., <i>Fusarium</i> spp., <i>Cochliobolus sativus</i>	Black point	Fungi	Freezing blotter test, agar plate test
<i>Claviceps purpurea</i>	Ergot	Fungi	Visual inspection
<i>Ustilago avenae</i>	Loose smut	Fungi	Embryo extraction test
<i>Trogoderma granarium</i>	Khabra beetle	Insect	Visual inspection, floating test
<i>Anguina tritici</i>	Seed gall nematode	Nematode	Nematode extraction test
Barley stripe mosaic virus	Barley stripe mosaic virus	Virus	ELISA, TBIA
Forage species			
<i>(Lathyrus</i> spp., <i>Medicago</i> spp., <i>Trifolium</i> spp., <i>Vicia</i> spp., <i>Anthyllis</i> spp., <i>Astragalus</i> spp., <i>Biserrula</i> spp., <i>Bituminaria</i> spp., <i>Colutea</i> spp., <i>Coronilla</i> spp., <i>Dorycnium</i> spp., <i>Ebenus</i> spp., <i>Genista</i> spp., <i>Hedysarum</i> spp., <i>Hippocrepis</i> spp., <i>Hymenocarpus</i> spp., <i>Lotus</i> spp., <i>Lupinus</i> spp., <i>Melilotus</i> spp., <i>Onobrychis</i> spp., <i>Ornithopus</i> spp., <i>Scorpiurus</i> spp., <i>Securigera</i> spp., <i>Tetragonolobus</i> spp., <i>Trigonella</i> spp., <i>Tripodion</i> spp., <i>Vigna</i> spp.)			
<i>Curtobacterium flaccumfaciens</i> pv. <i>flaccumfaciens</i>	Bacterial blight	Bacteria	Agar plate test followed by slide agglutination test
<i>Pseudomonas syringae</i> pv. <i>phaseolicola</i>	Halo blight	Bacteria	Agar plate test followed by slide agglutination test
<i>Xanthomonas axonopodis</i> pv. <i>phaseoli</i>	Common blight	Bacteria	Agar plate test followed by slide agglutination test
<i>Ascochyta</i> spp.	Ascochyta blight	Fungi	Agar plate test
<i>Botrytis cinerea</i>	Gray mold	Fungi	Agar plate test
<i>Fusarium oxysporum</i>	Fusarium wilt	Fungi	Freezing blotter test, agar plate test
<i>Phoma</i> spp.	Phoma blight	Fungi	Agar plate test
<i>Acanthoscelides</i> spp.	Bean weevil	Insect	Visual inspection, floating test
<i>Callosobruchus</i> spp.	Cowpea weevil	Insect	Visual inspection, floating test
<i>Ditylenchus dipsaci</i>	Stem and bulb nematode	Nematode	Nematode extraction test
<i>Meloidogyne incognita</i>	Root-knot nematode	Nematode	Nematode extraction test

Crop/Pests	Common name	Pest type	Detection methods* applied by ICARDA's GHU
<i>Orobanch</i> spp.	Broomrape	Parasitic weed	Visual inspection, floating test
<i>Cuscuta</i> spp.	Dodder	Parasitic weed	Visual inspection, floating test
Alfalfa mosaic virus	Alfalfa mosaic virus	Virus	ELISA, TBIA
Bean yellow mosaic virus	Bean yellow mosaic virus	Virus	ELISA, TBIA
Broad bean stain virus	Broad bean stain virus	Virus	ELISA, TBIA
Cucumber mosaic virus	Cucumber mosaic virus	Virus	ELISA, TBIA
Pea seed-borne mosaic virus	Pea seed-borne mosaic virus	Virus	ELISA, TBIA
Broad bean true mosaic virus	Broad bean true mosaic virus	Virus	ELISA, TBIA
Rangeland species <i>(Agropyron spp., Agrostis spp., Brachypodium spp., Bromus spp., Cynodon spp., Dasyphyrum spp., Digitaria spp., Elymus spp., Elytrigia spp., Festuca spp., Lolium spp., Phalaris spp., Phleum spp., Poa spp., Secale spp., Stipa spp., Taeniatherum spp.)</i>			
<i>Pseudomonas syringae</i> pv. <i>atrofaciens</i>	Basal glum rot	Bacteria	Agar plate test followed by slide agglutination test
<i>Pseudomonas syringae</i> pv. <i>syringae</i>	Leaf blight	Bacteria	Agar plate test followed by slide agglutination test
<i>Xanthomonas translucens</i> pv. <i>undulosa</i>	Black chaff, leaf streak	Bacteria	Agar plate test followed by slide agglutination test
<i>Claviceps purpurea</i>	Ergot	Fungi	Visual inspection
<i>Cochliobolus</i> spp.	Spot blotch	Fungi	Freezing blotter test
<i>Fusarium</i> spp.	Fusarium wilt	Fungi	Freezing blotter test, agar plate test
<i>Tilletia</i> spp.	Bunt	Fungi	Centrifuge washing test
<i>Ustilago</i> spp.	Smut	Fungi	Centrifuge washing test
<i>Trogoderma granarium</i>	Khapra beetle	Insect	Visual inspection, floating test
<i>Anguina tritici</i>	Seed gall nematodes	Nematode	Nematode extraction test
<i>Heterodera</i> spp.	Cereal cyst nematode	Nematode	Nematode extraction test
Barley stripe mosaic virus	Barley stripe mosaic virus	Virus	ELISA, TBIA
Wheat streak mosaic virus	Wheat streak mosaic virus	Virus	ELISA, TBIA

* ELISA = Enzyme linked immunosorbent assay; TBIA = Tissue blot immunoassay; Visual inspection = can be by naked eye and/or any magnifying tool.

References

- Kumari, Safaa, Abdulrahman Moukahel and Inaam El Miziani. 2022a. Diagnostic tools validated by ICARDA's Germplasm Health Unit (GHU) for detection of legume seed-borne pests. International Center for Agricultural Research in the Dry Areas (ICARDA), Beirut, Lebanon. <https://hdl.handle.net/10568/126879>
- Kumari, Safaa, Abdulrahman Moukahel and Inaam El Miziani. 2022b. Diagnostic tools validated by ICARDA's Germplasm Health Unit (GHU) for detection of cereal seed-borne pests. International Center for Agricultural Research in the Dry Areas (ICARDA), Beirut, Lebanon. <https://hdl.handle.net/10568/127304>