Pest Risk Analysis (PRA) for grain and seed of Rice, (*Oryza sativa* L.*)* within East African Countries

A Qualitative, Pathway-Initiated Risk Analysis

Adopted by the 39th Meeting of the Council of Ministers held on 28th November, 2019

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Executive Summary

The PRA was initiated by the need to review the national pest lists and develop strategies for reducing Phytosanitary trade barriers in the East African region as well as develop a harmonized regional pest list for rice with a view to developing phytosanitary import conditions for rice that will be applied within the EAC. The objectives of the Regional Pest Risk Analysis were to review national pest lists for rice; develop a harmonized regional pest list, develop a draft regional Pest Risk Analysis (PRA), develop National Quarantine Pest List; and develop Phytosanitary import conditions for rice to be applied within the EAC.

This risk assessment was prepared in 2014 by PRA specialists from five EAC partner states namely, Tanzania, Burundi, Rwanda, Uganda and Kenya (South Sudan did not participate because at that time, it was not yet a member of EAC). It involved comparing and harmonizing pest lists associated with rice from the five countries. This document includes; harmonized regional potential quarantine lists for rice; regional PRA for processed, unprocessed and seed rice and harmonized Phytosanitary import conditions for rice to be applied in the Eastern African Region.

Consequently, the PRA conducted for rice confirmed the presence of quarantine pests of concern in the region. Although most pests were common to the five countries, it was noted that no country in the region was regulating the Regulated Non- Quarantine Pests (RNQP) in rice. In addition, it was felt that, should there be any import of rice into the region, the importing country must alert the regional PRA team to conduct a PRA prior to import of the commodity. The regional PRA for rice was validated by the stakeholders in each of the five countries, reviewed by the technical team and approved by the head of National Plant Protection Organisation (NPPO) in 2019.

A list of pests of phytosanitary importance associated with rice (both processed and unprocessed) in East Africa was developed based on the pest information from the East African NPPOs (except Republic of South Sudan) as well as from the search of both print and electronic sources of information, in accordance with ISPM No. 11 and 21. This list contains 111 pests (2 arachinids, 61 insects, 15 nematodes, 24 fungi, 6 bacteria and 3 viruses). Out of this, Fourteen (14) pests (5 insects, 1 nematode, 4 fungi, 3 bacteria and 1 virus) namely: *Corcyra cephalonica, Rhyzopertha dominica, Trogoderma granarium, Sitotroga cerealella, Tribolium confusum, Aphelenchoides besseyi, Cochliobolus sativus, Sclerophthora macrospora, , Magnaporthe grisea, Alternaria padwickii, Pseudomonas fuscovaginae, Pseudomonas syringae pv. syringae, Xanthomonas oryzae pv. oryzae* and Rice yellow mottle virus (RYMV) were identified to be of quarantine importance. Based on the assessments the import conditions for trade facilitation within the region were developed for seed rice, unprocessed rice or partially processed and milled/polished rice.

Abbreviations

EAC	East African Community
EAPIC	East Africa Phytosanitary Information Committee
FAO	Food and Agriculture Organization
IPPC	International Plant Protection Convention
ISPM	International Standards of Phytosanitary Measures
NPPO	National Plant Protection Organization
PRA	Pest Risk Analysis
RNQP	Regulated Non- Quarantine Pests
SPS	Sanitary and phytosanitary

Definition of Terms

Unprocessed or unhusked rice- This are rice grains which the outermost layer (the husk) has not been removed (Figure 1).

Figure 1: Unprocessed or unhusked rice

Partially processed rice (Brown rice) – This is partly milled rice in which only the outermost layer of a grain of rice (the husk) has been removed. (Figure 2)

Figure 2: Brown rice

Milled or polished rice – This is "hulled or polished rice in which the bran layer underneath the husk and the endosperm have been removed. (Figure 3).

Figure 3: white rice

Seed rice- These are seeds intended for planting and not for consumption or processing. Rice seed in which the outermost layer (the husk) has not been removed and is used for propagation. The seeds must have undergone seed certification process.

Quarantine pest-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

Endangered area - An **area** where ecological factors favour the establishment of a pest whose presence in the **area** will result in economically important loss (see Glossary Supplement 2) [FAO, 1995]

Official control - The active enforcement of mandatory phytosanitary regulations and the application of mandatory phytosanitary procedures with the objective of eradication or containment of quarantine pests or for the management of regulated non-quarantine pests (see Glossary Supplement 1) [ICPM, 2001]

Pest free place of production - Place of production in which a specific pest does not occur as demonstrated by scientific evidence and in which, where appropriate, this condition is being officially maintained for a defined period [ISPM 10:1999]

Pest free area- An area in which a specific pest does not occur as demonstrated by scientific evidence and in which, where appropriate, this condition is being officially maintained [FAO, 1995]

Pest free production site - A defined portion of a place of production in which a specific pest does not occur as demonstrated by scientific evidence and in which, where appropriate, this condition is being officially maintained for a defined period and that is managed as a separate unit in the same way as a pest free place of production [ISPM 10:1999]

Non-regulated pests- Pest that is not a quarantine pest for an area [FAO, 1995]

Regulated non-quarantine pest-A non-quarantine pest whose presence in plants for planting affects the intended use of those plants with an economically unacceptable impact and which is therefore regulated within the territory of the importing contracting party

A **commodity** is a plant or plant product being moved for trade or other purposes

Consignment-A quantity of plants, plant products or other articles being moved from one country to another and covered, when required, by a single phytosanitary certificate (a consignment may be composed of one or more commodities or lots) [FAO, 1990; revised ICPM, 2001]

Pathway -Any means that allow the entry or spread of a pest; could be an imported commodit**y,** a means of transportation or storage, packaging, or other articles associated with the commodity and a natural means of spread (e.g. wind).

A pest -is any species, strain or biotype of plant, animal or pathogenic agent, injurious to plants or plant products" an insect, fungus, bacterium, virus, nematode, invasive plant

PRA-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

PRA area-Area in relation to which a pest risk analysis is conducted [FAO, 1995]. PRA area could be whole country, part of a country or several countries together

Pest Risk Management -is a systematic way of analysing potential mitigation measures to determine which would be most appropriate means by which to minimize the identified risks.

Practically free - Of a consignment, field, or place of production, without pests (or a specific pest) in numbers or quantities in excess of those that can be expected to result from, and be consistent with good cultural and handling practices employed in the production and marketing of the commodity [FAO, 1990; revised FAO, 1995]

1.0. Introduction

The rice PRA has been prepared by the East African Community (EAC) partner states, to examine pest risks associated with importation of rice, *Oryza sativa* within the EAC region. Estimate of risks are expressed in the qualitative terms of high, medium, or low. The risk assessment is “pathway-initiated” in that it is based on the potential pest risks associated with trade with the commodity within the region. This is a qualitative pest risk assessment that expresses risks in terms of High, Medium, or Low. To reduce Phytosanitary trade barriers existing in the Eastern African region there was need to review the national pest lists and develop strategies for reduction of trade barriers as well as develop a harmonized regional pest lists with a view to develop phytosanitary import conditions for the crops that will be applied within the region. This assessment documents risks associated with the movement of processed, unprocessed and rice seed, *Oryza sativa* L within EAC partner states namely: Kenya, Burundi, Rwanda, Tanzania and Uganda.

The national pest lists evaluated by the team developed a consolidated pest list for rice for the region. In order to come up with regional quarantine pest list, all pests associated with the commodity were taken through the Pest Risk Analysis (PRA) process. The process involved categorization of the pests associated with rice (harmonized pest list), giving their distribution in the region, parts of the plant affected and whether the pest can follow the pathway (traded form of the commodity). The pathway considered in this case is the traded forms of rice within the region i.e. rice seed, unprocessed rice and the processed rice. All pests of rice found to be of concern to the region (likely to follow the pathway) were identified for further analysis.

2.0. Risk Assessment - Pest Risk Analysis of pests associated with Rice

Quarantine pests that are likely to follow the pathway on commercial shipment of processed, unprocessed and seed rice traded within the five countries, were subjected to PRA. FAO (1996) defines pest risk assessment as the “determination of whether a pest is a quarantine pest and evaluation of its introduction potential.” Quarantine pest is defined as “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” (FAO, 1996).

The risk assessment is “pathway-initiated” in that it is based on the potential pest risks associated with the commodity as it crosses from one country within the region to the other. Estimate of risks are expressed in the qualitative terms of high, medium, or low. The International Plant Protection Convention (IPPC) of the United Nations Food and Agriculture Organization (FAO), provide guidance for conducting Pest Risk Analyses. The methods used to initiate, conduct, and report this plant pest risk assessment is consistent with guidelines provided by IPPC and FAO. Biological and phytosanitary terms (e.g. introduction, quarantine pest) conform to the Definitions and Abbreviations (Introduction Section) in International Standards for Phytosanitary Measures: Guidelines for Pest Risk Analysis (FAO, 1996). Thus, Pest Risk Analysis should consider the likelihood of introduction of quarantine pests, the consequences and mitigation measures to prevent the introduction and spread of the pests to new areas.

2.1.1. Initiating Event

The PRA was initiated by the need to review the national pest lists and develop strategies for reducing Phytosanitary trade barriers in the Eastern Africa region as well as develop a harmonized regional pest list for rice with a view to developing phytosanitary import conditions for the crop that will be applied within the East African Community.

2.1.2. Assessment of Weed Potential of rice seeds, *Oryza sativa* L.

Rice is already being cultivated in the entire region hence it's not likely to be a weed.

2.1.3. Previous Risk Analysis, Current Status, and Pest Interceptions

A previous PRA report developed by Kenya was used as a reference. However, there are no interception reports on imports of rice within the region.

2.1.4. Pest Categorization–Identification of Quarantine Pests and Quarantine Pests Likely to follow the Pathway

Consolidated list of pests associated with rice, *Oryza sativa* L., that occur in Kenya, Burundi, Rwanda, Tanzania and Uganda are listed in **Table 1.** This list includes information on the presence or absence of these pests in countries, the affected plant part(s), the potential quarantine status of the pest with respect to the region, whether the pest is likely to follow the trade pathway within the region and pertinent references.

The consolidated list contained 111 pests (2 arachinids, 61 insects, 15 nematodes, 24 fungi, 6 bacteria and 3 viruses) which was then taken through a categorization process as per International Standards for Phytosanitary Measures (ISPM) number 11. Pests that were found to be present in all countries were struck out from the lists while those that were not present in all the countries or present in all countries but being regulated in at least one of partner states, were identified and listed for further assessments.

Table 1: Consolidated pest list for Pests associated with Rice (*Oryza sativa* L) in Kenya (KE), Burundi (BU), Rwanda (RW), Tanzania (TZ) and Uganda (UG).

Pest/Organism	**Distribution**	**Parts affected**	**Quarantine status**	**Likely to follow pathway**	**References**
ARTHROPODA					
ARACHNIDA					
Tyrophagus putrescentiae (Schrank): (cereal mite)	KE	Seed	Yes	Yes	CABI/CPC 2005, 2007, 2011.
Tetranychus urticae Koch (two-spotted spider mite)	KE, UG, TZ	Leaves	No	No	CPC, 2007, 2011, 2015, 2018, Bao *et al*, 2001
INSECTA					
COLEOPTERA					
Lasioderma serricorne Fabricius (cigarette beetle)	TZ	Leaves, roots and seeds.	Yes	Yes	CPC, 2007, 2011, 2015, 2018,
Rhyzopertha dominica (Fabricius) (lesser grain borer)	TZ, RW, UG	Seeds	Yes	Yes	CPC, 2007, 2011, 2015, 2018, Wright *et a*l., 1990
Callosobruchus chinensis (Linnaeus, 1758) (Chinese bruchid)	KE, UG, TZ	Seeds	Yes	Yes	CPC, 2007, 2011, 2015, 2018,

Trichispa sericea (Guérin-Meneville) rice, hispid	KE, UG, TZ, BU, RW	Leaves	No	No	*CPC, 2007, 2011, 2015, 2018*, EPPO, 2006
Epilachna similis (Thunberg) (maize ladybird beetle)	KE, UG, RW, TZ	Leaves	No	No	CPC, 2007, 2011, 2015, 2018,
Cryptolestes ferrugineus (Stephens) (rusty grain beetle)	KE	Seeds	No	Yes	CPC, 2007, 2011, 2015, 2018
Cryptolestes pusillus Schönherr (flat grain beetle)	KE, UG, TZ, BU, RW	Kernel, Seeds	No	Yes	CPC, 2007, 2011, 2015,
Sitophilus zeamais Motschulsky: (greater grain weevil)	KE, UG, TZ, BU, RW	Seeds	No	Yes	CPC, 2007, 2011, 2015, 2018,
Carpophilus (dried-fruit beetles)	KE, TZ	Seeds	Yes	Yes	CPC, 2007, 2011, 2015, 2018, Aitken, 1975;
Heteronychus licas (Klug)	KE, UG, TZ	Leaves, Roots, Stems	No	No	CPC, 2007, 2011, 2015, 2018, Le Pelley, 1959
Pachnoda interrupta (Olivier) chafer beetle	BI	Seeds.	yes	Yes	CPC, 2007, 2011, 2015, 2018,
Oryzaephilus mercator(Fauvel) (merchant grain beetle)	KE TZ	Seeds	Yes	Yes	CPC, 2007, 2011, 2015, 2018,
Alphitobius diaperinus (Panzer)	KE, UG	Seeds	No	Yes	CPC, 2007, 2011, 2015, 2018,
Tribolium castaneum Herbst (red flour beetle)	KE, UG, RW, BI, TZ	Seeds	No	Yes	CPC, 2007, 2011, 2015, 2018, Mailu 1996
Tribolium confusum Jacquelin du Val (confused flour beetle)	UG	Seeds	Yes	Yes	CPC, 2007, 2011, 2015, 2018, Mailu 1996,
Trogoderma granarium	TZ	Seeds	Yes	Yes	CABI 2019
Tenebroides mauritanicus Linnaeus (cadelle)	KE, UG, RW, BI, TZ	Seeds	No	Yes	CPC, 2007, 2011, 2015, 2018 Aitken, 1975
DERMAPTERA					
Diaperasticus erythrocephalus (Olivier),	KE, BI	Inflorescence, leaves, seeds	Yes	No	CPC, 2007, 2011, 2015, 2018, Heinrichs, 2004
DIPTERA					
Orseolia oryzivora Harris & Gagné, 1982 African rice gall midge	TZ, UG	Inflorescence leaves and stems.	Yes	No	CPC, 2007, 2011, 2015, 2018, Simon et al, 2016
Diopsis apicalis Dalman rice stem borer	KE	Stem	Yes	No	CPC, 2007, 2011, 2015, 2018,
Diopsis longicornis Macquart syn. *Diopsis thoracica* (stalk-eyed fly)	KE, TZ, BI	Stem	Yes	No	CPC, 2007, 2011, 2015, 2018, , MINAGRIE, 2015
Atherigona orientalis Schiner (pepper fruit fly)	KE UG, TZ	Leaves, Stem Roots,	Yes	No	CPC, 2007, 2011, 2015, 2018,
HEMIPTERA/HOMOPTERA					
Rhopalosiphum maidis (Fitch, 1856) (green corn aphid)	KE, UG, TZ RW, BI	Leaves	No	No	CPC, 2007, 2011, 2015, 2018,
Rhopalosiphum padi Linnaeus (grain aphid)	KE	Leaves	Yes	No	CPC, 2007, 2011, 2015, 2018,

Rhopalosiphum rufiabdominale (Sasaki, 1899) (rice root aphid)	KE, TZ	Roots, stems	Yes	No	CPC, 2007, 2011, 2015, 2018,
Schizaphis graminum Rondani (spring green aphid)	KE, TZ	Leaves	Yes	No	CPC, 2007, 2011, 2015, 2018,
Sitobion avenae (Fabricius, 1775) (wheat aphid)	KE, BU	Leaves, Inflorescence	Yes	No	CPC, 2007, 2011, 2015, 2018, CABI/EPPO, 2004
Tetraneura nigriabdominalis Sasaki 1899 (rice root aphid)	KE, UG, TZ, BU	Leaves	No	No	CPC, 2007, 2011, 2015, 2018,
Cicadulina mbila (Naudé) (maize leafhopper)	KE, UG, TZ	Leaves	Yes	No	CPC, 2007, 2011, 2015, 2018,
Cofana spectra (Distant) (white leafhopper)	UG, TZ	Leaves.	Yes	Yes	CPC, 2007, 2011, 2015, 2018,
Leptoglossus gonagra (Fabricius)	KE, UG, TZ RW, BU	Leaves	No	No	CPC 2007, EPPO, 2006
Peregrinus maidis (Ashmead): (corn plant hopper)	KE, UG, TZ	Leaves, Stems, Roots	No	No	CPC, 2007, 2011, 2015, 2018,
Dimorphopterus	KE, UG, TZ	Leaves, Stems	No	No	CPC 2007, Slater, 1974
Nezara viridula (Linnaeus): (green stink bug)	KE, UG, TZ, BU, RW	Leaves, Stem,	No	No	CPC, 2007, 2011, 2015, 2018,
Saccharicoccus sacchari (Cockerell) (grey sugarcane mealybug)	KE, UG	Leaves, roots and stems.	Yes	No	CPC, 2007, 2011, 2015, 2018,
LEPIDOPTERA			Yes		
Chilo agamemnon Bleszynski (oriental corn borer)	UG	Leaves and stems	Yes	No	CPC, 2007, 2011, 2015, 2018
Chilo partellus (Swinhoe, 1885) (spotted stem borer)	KE, UG, TZ, BI	Leaves, stems	Yes	No	CPC, 2007, 2011, 2015, 2018
Chilo sacchariphagus (Bojer, 1856) (spotted borer)	TZ	leaves, stems	Yes	Yes	CPC, 2007, 2011, 2015, 2018
Parapoynx stagnalis (rice case bearer)	KE UG RW	Leaves.	No	No	CPC, 2007, 2011, 2015, 2018
Marasmia trapezalis (Guenée) maize webworm	TZ	Leaves	Yes	No	CPC, 2007, 2011, 2015, 2018, Heinrichs, 2004
Sitotroga cerealella (Olivier) (grain moth)	KE, TZ, BR, UG, RW	Seeds	No	Yes	CPC, 2007, 2011, 2015, 2018
Pelopidas mathias (Fabricius)	RW, BU	Leaves	Yes	No	CPC, 2007, 2011, 2015, 2018,
Agrotis segetum (turnip moth)	KE, TZ, UG	Leaves, roots and stems.	No	No	CPC, 2007, 2011, 2015, 2018,
Earias insulana Boisduval (Egyptian stem borer)	KE, TZ, BR, UG, RW	Leaves and stems.	No	No	CPC, 2007, 2011, 2015, 2018, EPPO, 2006
Mythimna loreyi (Duponchel) (maize caterpillar)	KE, TZ, UG	Leaves	No	No	CPC, 2007, 2011, 2015, 2018; Le Pelley, 1959;
Sesamia calamistis (Hampson) (African pink stem borer)	KE, TZ, BI, UG, RW	Leaves, Stems, Roots, Seeds, Kernels	No	Yes	CPC, 2007, 2011, 2015, 2018; Farrell, *et al*, 1995; Le Pelley, 1959; Mailu, 1996.
Sesamia cretica (Lederer) (greater sugarcane borer)	KE	Leaves, Stems	Yes	No	CPC, 2007, 2011, 2015, 2018; Le Pelley, 1959

Sesamia nonagrioides (Lefebvre) (Mediterranean corn stalk borer)	KE, TZ, BI, UG, RW	Leaves, Roots	No	No	CPC, 2007, 2011, 2015, 2018,
Spodoptera exempta Walker (black armyworm)	KE, TZ, BI, UG, RW	Leaves, Stems	No	No	CPC, 2007, 2011, 2015, 2018, EPPO, 2006
Spodoptera exigua (Hübner) (beet armyworm)	KE, TZ, BI, RW	Leaves	No	No	CPC, 2007, 2011, 2015, 2018,
Spodoptera littoralis (cotton leafworm)	KE, TZ, BI, UG, RW	Leaves, Stems	No	No	CPC, 2007, 2011, 2015, 2018,; EPPO, 2006
Spodoptera mauritia Boisduval (paddy swarming caterpillar)	UG, TZ	Leaves	Yes	No	CPC, 2007, 2011, 2015, 2018, EPPO, 2006
Melanitis leda ismene Cramer (rice butterfly)	KE	Leaves	Yes	No	CPC 2007, Brakefield & Manders, 1987
Cadra cautella Walker (dried currant moth)	KE	Kernel, Seeds	Yes	Yes	CPC, 2007, 2011, 2015, 2018,
Corcyra cephalonica (Stainton, 1866) (rice meal moth)	TZ, BI	Seeds	Yes	Yes	CPC, 2007, 2011, 2015, 2018, MINAGRIE, 2015
Eldana saccharina Walker, 1865 (African sugarcane borer)	KE, TZ, BI, UG, RW	Stems.	No	Yes	CPC, 2007, 2011, 2015, 2018,
Maliarpha separatella Ragonot (rice, borer, white)	KE, TZ	Leaves, stems	Yes	No	CPC, 2007, 2011, 2015, 2018, Heinrichs, 2004
ORTHOPTERA					
Locusta migratoria (Linnaeus)	KE, TZ, BI, UG, RW	Leaves, Stems, Inflorescence	No	No	CPC, 2007, 2011, 2015, 2018; Le Pelley, 1959
Nomadacris septemfasciata (Audinet-Serville) (red locust)	KE, TZ, BI, UG, RW	Leaves, Stems, Kernel, Seeds	No	Yes	CPC, 2007, 2011, 2015, 2018; Le Pelley, 1959
Oedaleus senegalensis (Krauss, 1877) Senegalese grasshopper	TZ	leaves, seeds	Yes	Yes	CPC, 2007, 2011, 2015, 2018,
PSOCOPTERA					
Liposcelis bostrychophila (Badonnel) (book louse)	KE	Seeds	Yes	Yes	CPC, 2007, 2011, 2015, 2018,
NEMATODA			Yes		
Criconemella De Grisse & Loof (ring nematode)	KE	Stem, Roots, Pods	Yes	No	CPC, 2007, 2011, 2015, 2018, 2019
Aphelenchoides besseyi Christie1942: (rice leaf nematode)	KE, TZ, BR, UG	Leaves, Stems, Inflorescence, Seeds	Yes	Yes	CPC, 2019, CABI, 2012.
Tylenchorhynchus annulatus (Cassidy 1930) Golden 1971 (stunt nematode)	TZ	Leaves, Roots, Stem, Inflorescence	Yes	No	CPC, 2007, 2011, 2015, 2018, CABI/EPPO, 2003
Helicotylenchus dihystera (Cobb) Sher (common spiral nematode)	KE	Roots, Leaves	Yes	No	CPC, 2007, 2011, 2015, 2018,
Helicotylenchus multicinctus (Cobb, 1893) Golden, 1956 (banana spiral nematode)	KE, TZ, BR, UG	Roots	No	No	CPC, 2007, 2011, 2015, 2018,
Helicotylenchus pseudorobustus (Steiner, 1914) Golden, 1956 (spiral nematode)	KE, TZ, UG	Roots	Yes	No	CPC, 2007, 2011, 2015, 2018, CABI/EPPO, 2003

Scutellonema brachyurus Steiner (1938) Andrássy, 1958	KE, TZ, UG	Leaves and roots.	Yes	No	CPC, 2007, 2011, 2015, 2018, CABI/EPPO, 2006
Scutellonema clathricaudatum Whitehead, 1959	TZ	Leaves, roots	Yes	No	CPC, 2007, 2011, 2015, 2018,
Meloidogyne arenaria (Neal, 1889) Chitwood, 1949 (peanut root-knot nematode)	UG, TZ	Leaves, roots	Yes	No	CPC, 2007, 2011, 2015, 2018, CABI/EPPO, 2003
Meloidogyne incognita (Kofoid & White, 1919) Chitwood 1949 (root-knot nematode)	KE, TZ, UG, BI	Leaves, roots	Yes	No	CPC, 2007, 2011, 2015, 2018, , MINAGRI
Meloidogyne javanica (Treub, 1885) Chitwood, 1949 (sugarcane eelworm)	KE, TZ, BI, UG, RW	Leaves, roots	No	No	CPC, 2007, 2011, 2015, 2018, MINAGRIE, 2015
Pratylenchus brachyurus (Godfrey,) Filipjev & Schuurmans Stekhoven (Meadow nematode)	KE, UG	Roots	Yes	Yes	CPC, 2007, 2011, 2015, 2018, Kimenju et al., 1998; CABI/EPPO, 2003, Bafokuzara, 1982
Pratylenchus penetrans (Cobb) Filipjev & Schuurmans Stekhoven, (nematode, northern root lesion)	KE, TZ	Roots	Yes	No	CPC, 2007, 2011, 2015, 2018, Anyango, 1988; CABI/EPPO, 2003; EPPO, 2006
Pratylenchus zeae Graham: (root lesion nematode)	KE, TZ, UG	Roots	No	No	CPC, 2007, 2011, 2015, 2018, CABI/EPPO, 2001
Trichodorus (stubby root nematodes)	KE, TZ, BI	Roots		No	CPC, 2007, 2011, 2015, 2018,
FUNGI/OOMYCETES					
Anamorphic fungi					
Aspergillus flavus Link (Aspergillus ear rot)	KE, TZ, BI, UG, RW	Fruits/pods, Leaves, Roots, Seeds, Stems	No	Yes	CPC, 2007, 2011, 2015, 2018,
Aspergillus niger Tiegh. (collar rot)	KE	Fruits/pods, inflorescence, leaves, roots, seeds, stems,	Yes	Yes	CPC, 2007, 2011, 2015, 2018, Khare, 1985
Curvularia Boedijn [anamorph] (black kernel)	KE, TZ	Inflorescence Leaves Seeds	Yes	Yes	CPC, 2007, 2011, 2015, 2018,
Lasiodiplodia theobromae (Pat.) Griffiths & Maubl. (diplodia pod rot of cocoa)	KE, TZ, UG	Fruits/pods, inflorescence, leaves, roots, seeds and stems.	Yes	Yes	CPC, 2007, 2011, 2015, 2018, CMI, 1985
Macrophomina phaseolina (Tassi) Goid (charcoal rot of bean/tobacco)	KE, TZ, UG	Leaves, Roots, Seeds, Stems,	Yes	Yes	CPC, 2007, 2011, 2015, 2018, CMI, 1985;
Sarocladium oryzae (Sawada) W. Gams & D. Hawksw. (rice sheath rot)	KE, TZ, BU	Inflorescence leaves and seeds.	Yes	Yes	CPC, 2007, 2011, 2015, 2018, CABI/EPPO, 1997; EPPO, 2006
Ustilaginoidea virens (Cke.) Tak. (1896) (false smut)	KE, TZ	Inflorescence and seeds.	Yes	Yes	CPC, 2007, 2011, 2015, 2018, CMI, 1982
ASCOMYCETES			Yes		
Magnaporthe grisea (Hebert) Barr (rice blast disease) Magnaporthaceae	UG, KE, TZ, BI, RW	Inflorescence, leaves, seeds, stems	Yes	Yes	CPC, 2007, 2011, 2015, 2018, , Onaga et al 2015

Magnaporthe salvinii (Catt.) R.A. Krause & R.K.Webster (1972) (stem rot)	KE, UG	Inflorescence, leaves, seeds and stems.	Yes	Yes	CPC, 2007, 2011, 2015, 2018, IMI, 1996
Penicillium digitatum (Pers.) Sacc. (green mould)	KE, TZ	Fruits/pods.	Yes	No	CPC, 2007, 2011, 2015, 2018
Gibberella fujikuroi (Sawada) S. Ito Nectriaceae (bakanae disease of rice)	KE, TZ, UG	Leaves, Stems, Seeds	Yes	Yes	CPC, 2007, 2011, 2015, 2018, CMI, 1990
Gibberella zeae Petch Nectriaceae (headblight of maize)	KE	Leaves, Stem,	Yes	No	CPC, 2007, 2011, 2015, 2018, Kedera et al., 1994; CABI/EPPO, 1998,
Fusarium oxysporum Schlechtendahl (basal rot)	KE, TZ	Leaves, Stem	Yes	No	CPC, 2007, 2011, 2015, 2018,
Gibberella baccata (Wallr.) Sacc. [teleomorph] (collar rot of coffee)	KE	Leaves, Stem, seeds	Yes		CPC, 2007, 2011, 2015, 2018,
Mycosphaerella holci Tehon 1937 (glume blight) Mycosphaerellaceae	TZ	Seed	Yes	Yes	CPC, 2007, 2011, 2015, 2018
Sphaerulina oryzina Hara (narrow brown leaf spot) Mycosphaerellaceae	KE, TZ	Leaves, Stem, seeds	Yes	Yes	CPC, 2007, 2011, 2015, 2018
Cochliobolus carbonum Nelson Pleosporaceae (Helmithosporium leaf blight)	KE, TZ	Leaves, Kernel Seeds	Yes	Yes	CPC, 2007, 2011, 2015, 2018, Farrel *et al.*, 1995; Kedera, 1996
Cochliobolus heterostrophus (Drechsler) Drechsler Pleosporaceae (Maydis leaf blight)	KE, TZ	Leaves, Stems, Inflorescence, Seeds	Yes	Yes	CPC, 2007, 2011, 2015, 2018; Warui, 1984
Cochliobolus sativus (S. Ito & Kurib.) Drechsler ex Dastur Pleosporaceae (root and foot rot)	TZ, KE, UG	Stems, Leaves, Inflorescence, Roots, Seeds	Yes	Yes	CPC, 2007, 2011, 2015, 2018; Cane and Hampton, 1990 Mailu 1996
Cochliobolus miyabeanus (Ito & Kurib.) Drechsler ex Dastur (brown leaf spot of rice) Pleosporaceae	UG, TZ	Inflorescence, leaves, seeds and stems.	Yes	Yes	CPC, 2007, 2011, 2015, 2018, CMI, 1991
Monographella albescens (Thümen) Parkinson, Sivanesan & C.Booth (leaf scald)	TZ	Inflorescence, leaves, roots, seeds	Yes	Yes	CPC, 2007, 2011, 2015, 2018, IMI, 1996; EPPO, 2006
Alternaria padwickii	UG	Seeds	Yes	Yes	CABI 2019
Basidiomycetes					
Thanatephorus cucumeris (Frank) Donk Ceratobasidiaceae	KE, TZ, BI, UG, RW	Leaves, Root, Seeds	No	Yes	CPC, 2007, 2011, 2015, 2018, Allen, 1995,
Corticium rolfsii Curzi: Corticiaceae (collar rot)	KE, TZ, BI, UG, RW	Roots	No	No	CPC, 2007, 2011, 2015, 2018, CMI, 1992,
OOMYCETES					

Sclerophthora macrospora (Sacc.) Thirum., C.G. Shaw & Naras. 1953 (downy mildew)	UG	Inflorescence, leaves, roots, seeds, stems	Yes	Yes	CPC, 2007, 2011, 2015, 2018 CMI, 1986; EPPO, 2006
BACTERIA					
Acidovorax avenae subsp. avenae (Manns 1909) Willems: Comamonadaceae (bacterial leaf blight)	KE, TZ, UG	Leaves, Stems, Roots, Seeds, Inflorescence	Yes	Yes	CPC, 2007, 2011, 2015, 2018, CMI, 1987; EPPO, 2006
GAMMAPROTEOBACTERIA					
Erwinia chrysanthemi (Burkh.) Enterobacteriaceae (bacterial wilt of dahlia)	KE	Leaves, Roots	Yes	No	CPC, 2007, 2011, 2015, 2018,
Xanthomonas oryzae pv. oryzae (Ishiyama 1922) Swings et al. 1990 (rice leaf blight)	TZ	Leaves, seeds	Yes	Yes	CPC, 2007, 2011, 2015, 2018,
Pseudomonas syringae	KE, BI	Leaves, Seeds	Yes	Yes	CPC, 2007, 2011, 2015, 2018,
Pseudomonas syringae pv. syringae van Hall Pseudomonadaceae (bacterial canker or blast (stone and pome fruits))	KE, UG, TZ	Leaves, Inflorescence	Yes	No	CPC, 2007, 2011, 2015, 2018, Schwartz *et al.*, 2005; KEPHIS 2012
Pseudomonas fuscovaginae (ex Tanii et al. 1976) Miyajima et al. 1983 (sheath brown rot)	BI, TZ, RW	Inflorescence, leaves, seeds	Yes	Yes	CPC, 2007, 2011, 2015, 2018, Macapuguay & Mnzaya, 1988; CABI/EPPO, 1997
VIRUSES					
Maize stripe virus (stripe disease of maize)	KE, UG, TZ	Leaves, Inflorescence	Yes	No	CPC, 2007, 2011, 2015, 2018,
Barley yellow dwarf viruses: (barley yellow dwarf)	KE, TZ	Leaves, Stems	Yes	No	CPC, 2007, 2011, 2015, 2018
Rice yellow mottle virus	KE, RW, TZ, UG, BI	leaves, seeds, stems	Yes	Yes	CPC 2007 EPPO, 2006, Ndikumana et at 2012, ISABU, 2016

Below is a summarized list of quarantine pests that are likely to follow the pathway on commercial shipment of processed, unprocessed and seed rice traded within the seven countries (Table 5).

Table 2: Pests associated with rice seed/grain of concern to the region

Pest/Organism	Distribution	Parts affected	Comments
ARTHROPODA			
ARACHNIDA			
Tyrophagus putrescentiae (Schrank): (Cereal mite)	KE	Seed	The pest is found externally on seed, but postharvest processing will eliminate the pest. Import conditions to be stated on plant import permit (PIP) and declared on phytosanitary certificate (PC).
INSECTA			
COLEOPTERA			
Rhyzopertha dominica (Fabricius) (lesser grain borer)	TZ, RW, UG	Seeds	*R. dominica* is pest of several stored products. It is a major pest in wheat and rice.
Callosobruchus chinensis (Linnaeus, 1758) (Chinese bruchid)	KE, UG, TZ	Seeds	Rice is not a major host. *Callosobruchus spp*. is important primary pests of pulses.
Cryptolestes ferrugineus (Stephens) (rusty grain beetle)	KE	Seeds	*C. ferrugineus* is an important secondary pest of cereal grains and nuts, and a common pest of oilseed cakes, dates and other dried fruit, often following infestation by other insects.
Cryptolestes pusillus Schönherr (flat grain beetle)	KE, UG, TZ, BI, RW	Kernel, Seeds	*C. pusillus* is not a quarantine pest in any region. It is a secondary pest of grains; it cannot damage intact grains.
Sitophilus zeamais Motschulsky: (greater grain weevil)	KE, UG, TZ, BI, RW	Seeds	Infestations in rice are damaging, but loss estimates from real, as opposed to laboratory situations, are lacking. Import conditions to be stated on (PIP) and declared on PC.
Pachnoda interrupta (Olivier) chafer beetle	BI	Inflorescence, roots and seeds.	The main host plants are probably sorghum and millet. Transport pathways for long distance movement - Soil, Gravel, Water, Etc.: Eggs, Pupae, Quiescent Adults. Seed is therefore not a major pathway Import conditions to be stated on (PIP) and declared on PC.
Oryzaephilus mercator(Fauvel) (merchant grain beetle)	KE, TZ	Seeds	Rice is not a major host. Import conditions to be stated on (PIP) and declared on PC.
Alphitobius diaperinus (Panzer)	KE, UG	Seeds	Both *A. diaperinus* and *A. laevigatus* are associated with a wide range of stored commodities, especially if they have suffered some mould damage.The pest is not expected to be on certified rice seed and clean rice grain. Import conditions to be stated on (PIP) and declared on PC.
Tribolium castaneum Herbst (red flour beetle)	KE, UG, RW, BI, TZ	Seeds	*T. castaneum* is a widespread pest of non-quarantine significance.in the region. Import conditions to be stated on (PIP) and declared on PC.
Tribolium confusum Jacquelin du Val (confused flour beetle)	UG	Seeds	It is less important in tropical countries (except in produce stored in locally cooler regions, such as high-altitude areas, or on produce recently imported from cooler areas), and is more important in temperate climates, where it is an important secondary pest of flour and cereal products.

Tenebroides mauritanicus Linnaeus (cadelle)	KE, UG, RW, BI, TZ	Seeds	*T. mauritanicus* is of very limited significance as a storage pest. Import conditions to be stated on (PIP) and declared on PC.
Trogoderma granarium	TZ	Seeds	Important pest in the region
LEPIDOPTERA			
Sitotroga cerealella (Olivier) (grain moth)	KE, TZ, BI, UG, RW	Seeds	*S. cerealella* is a major pest of stored grains, causing weight loss to grains by hollowing them out. Its impact is greater in the tropics and subtropics where it attacks grain in the field as well as in storage. The pest is regulated non-quarantine in Uganda and Tanzania.
Sesamia calamistis (Hampson) (African pink stem borer)	KE, TZ, BI, UG, RW	Leaves, Stems, Roots, Seeds, Kernels	This stem borer is an external feeder and not likely to be found in seed.
Cadra cautella Walker (dried currant moth)	KE	Kernel, Seeds	Transport pathways for long distance movement is transported In National and International Grain (CABI,2012) *C. cautella* is an important pest of cereals and cereal products, dried fruit, nuts and cocoa beans. Adults do not feed during their short lives, but stored food is contaminated with dead bodies, frass, excreta and larval webbing.
Corcyra cephalonica (Stainton, 1866) (rice meal moth)	TZ	Seeds	*C. cephalonica* is found in a very wide range of stored food, including whole cereals, processed foods and spices. Although it is capable of feeding on intact grains, *C. cephalonica* performs better on broken and processed grain and is therefore more of a secondary colonizer of stored products. (for seed not expected to be broken but for processed rice import conditions on PIP and declared on PC).
ORTHOPTERA			
Nomadacris septemfasciata (Audinet-Serville) (red locust)	KE, TZ, BI, UG, RW	Leaves, Stems, Kernel, Seeds	*N. septemfasciata* feeds mainly on grasses, especially species with relatively soft and juicy leaves. The locusts defoliate the plants leaving the midribs in species with hard leaves like sugarcane. Not likely to found in seed/grain.
Oedaleus senegalensis (Krauss, 1877) Senegalese grasshopper	TZ	leaves, seeds	*O. senegalensis* defoliate the plants leaving the midribs in species with hard leaves like sugarcane. Not likely to found in seed/grain.
PSOCOPTERA			
Liposcelis bostrychophila (Badonnel) (book louse)	KE	Seeds	*Psocid* damage commodities by direct feeding, resulting in the loss of weight and/or quality the infested commodities. Not likely to found in seed because of seed treatment. For grains: import conditions to be stated on (PIP) and declared on PC.
NEMATODA			
Pratylenchus brachyurus (Godfrey,) Filipjev & Schuurmans Stekhoven (Meadow nematode)	KE, UG	Root, Stem, Seed, Leaves	Amongst the different species of *Pratylenchus* known to attack groundnut, *P. brachyurus* is the most damaging in the warmer regions of the world. It feeds on roots, pegs and shells of mature pods causing severe damage and affecting yield and quality
Aphelenchoides besseyi Christie1942: (rice leaf nematode)	KE, TZ, BR, UG	Leaves, Stems, Inflorescence, Seeds	Reported as seed borne

FUNGI/OOMYCETES			
Anamorphic fungi			
Aspergillus flavus Link (Aspergillus ear rot)	KE, TZ, BI, UG, RW	Fruits/pods, Leaves, Roots, Seeds, Stems	Seed transmission - not recorded from naturally infected seeds Seed treatment: yes Not likely to found in seed which has gone through certification in addition to seed treatment; and in clean grain. Import conditions to be stated on (PIP) and declared on PC.
Aspergillus niger Tiegh. (collar rot)	KE	Fruits/pods, inflorescence, leaves, roots, seeds, stems,	Seed Transmitted Yes Seed Treatment Yes Not likely to found in seed which has gone through certification in addition to seed treatment; and in clean grain. Import conditions to be stated on (PIP) and declared on PC.
Curvularia Boedijn [anamorph] (black kernel)	KE, TZ	Inflorescence Leaves Seeds	The pest does not cause any significant economic impact.
Macrophomina phaseolina (Tassi) Goid (charcoal rot of bean/tobacco)	KE, TZ, UG	Leaves Roots Seeds Stems	*M. phaseolina* rarely produces spores and the main risk of dispersal by non-biotic means is by the contamination of vehicles and packing material with soil containing microsclerotia. *M. phaseolina* has been detected on and within seeds of a wide range of herbaceous and tree species. However, there are few reports of seed transmission to the seedling.
Sarocladium oryzae (Sawada) W. Gams & D. Hawksw. (rice sheath rot)	KE, TZ, BI	Inflorescence leaves and seeds.	*S. oryzae* is externally and internally seed borne. Seed Transmission is not recorded.
Ustilaginoidea virens (Cke.) Tak. (1896) (false smut)	KE, TZ	Inflorescence and seeds.	Though the pest is distribution worldwide, economic importance and seed borne incidence are low while seed transmission is not recorded. Import conditions to be stated on (PIP) and declared on PC.
ASCOMYCETES			
Magnaporthe grisea (Hebert) Barr (rice blast disease) Magnaporthaceae	UG, KE, TZ	Inflorescence, leaves, seeds, stems	Rice blast, because of its greater capacity to reduce yields, is currently the most important disease of rice worldwide. Severe attack can completely destroy rice nurseries and crops at the tillering stage.
Magnaporthe salvinii (Catt.) R.A. Krause & R.K.Webster (1972) (stem rot)	KE, UG	Inflorescence, leaves, seeds and stems.	*M. salvinii* is one of several fungi that can cause discoloration of rice seeds. Seed transmission of M. salvinii has not been reported Import conditions to be stated on (PIP) and declared on PC.
Gibberella fujikuroi (Sawada) S. Ito Nectriaceae (bakanae disease of rice)	KE, TZ, UG	Leaves, Stems, Seeds	The disease is commonly seen in many parts of the region, but the percentage of infection and yield loss is usually small. Import conditions to be stated on (PIP) and declared on PC.
Mycosphaerella holci Tehon 1937 (glume blight) Mycosphaerellaceae	TZ	Seed	*Mycosphaerella holci* infects the grain during development and can lead to severe discoloration and loss of quality. Not likely to be found in certified seed and clean grains. Import conditions to be stated on PIP and declared on PC.

Sphaerulina oryzina Hara (narrow brown leaf spot) Mycosphaerellaceae	KE, TZ	Leaves, Stem, seeds	*C. oryzae* is seedborne, but at a fairly low level of incidence. It also causes a purplish-brown discoloration of the seeds or grain. The disease has a low economic impact. Import conditions to be stated on PIP and declared on PC.
Cochliobolus carbonum Nelson Pleosporaceae (Helmithosporium leaf blight)	KE, TZ	Leaves, Kernel Seeds	*C. carbonum* is commonly seedborne, although levels of infection have not been reported. No seed transmission of the pathogen has been recorded. Import conditions to be stated on PIP and declared on PC.
Cochliobolus heterostrophus (Drechsler) Drechsler Pleosporaceae (Maydis leaf blight)	KE, TZ	Leaves, Stems, Inflorescen ce, Seeds	The pathogen has low economic Importance. Although it is seed transmitted, seed treatments are available. Import conditions to be stated on PIP and declared on PC.
Cochliobolus sativus (S. Ito & Kurib.) Drechsler ex Dastur Pleosporaceae (root and foot rot)	TZ, KE, UG	Stems, Leaves, Inflorescen ce, Roots, Seeds	Diseases caused by *C. sativus* are widespread and serious throughout the world. And therefore, it has been shown to be of high economic importance.
Cochliobolus miyabeanus (Ito & Kurib.) Drechsler ex Dastur (brown leaf spot of rice) Pleosporaceae	UG, TZ	Inflorescen ce, leaves, seeds and stems.	Brown spot is a very common disease of rice worldwide. It can cause considerable yield losses. *C. miyabeanus* is commonly seed borne on rice. Seed Transmission of the pest is not recorded; however, seed treatment is available. Import conditions to be stated on PIP and declared on PC.
Monographella albescens (Thümen) Parkinson, Sivanesan & C.Booth (leaf scald)	TZ	Inflorescen ce, leaves, roots, seeds	*M. albescens* is commonly seed borne, however seed transmitted is not established. Import conditions to be stated on PIP and declared on PC.
Basidiomycetes			
Thanatephorus cucumeris (Frank) Donk Ceratobasidiaceae	KE, TZ, BI, UG, RW	Leaves, Root, Seeds	Yield and economic losses caused by *T. cucumeris* have not been determined in most crops and environments. The pathogen is widespread in the region. Import conditions to be stated on PIP and declared on PC.
OOMYCETES			
Sclerophthora macrospora (Sacc.) Thirum., C.G. Shaw & Naras. 1953 (downy mildew)	UG	Inflorescen ce, leaves, roots, seeds, stems	Infected plants are barren, and small, poorly filled ears from infected plants would be discarded during commercial sorting operations and hence cannot be certified and distributed as seed. Furthermore, its economic importance is low. However, import conditions should be stated on PIP and declared on PC.
BACTERIA			
Acidovorax avenae subsp. avenae (Manns 1909) Willems: Comamonadaceae (bacterial leaf blight)	ET, KE, TZ, UG	Leaves, Stems, Roots, Seeds, Inflorescen ce	The pathogen is distributed worldwide and has low economic importance. Although seed borne incidence is low, seed transmitted, and it is a disease is of minor importance. Nevertheless, seed treatment is available.
GAMMAPROTEOB ACTERIA			
Xanthomonas oryzae pv. oryzae (Ishiyama 1922) Swings et al. 1990 (rice leaf blight)	TZ	Leaves, seeds	Bacterial leaf blight is the most damaging disease of rice and consequently of high economic importance.

Pseudomonas syringae pv. syringae	KE, UG, TZ	Leaves, Seeds	*P. syringae pv. syringae* occurs in many areas, from the tropics to temperate regions. It attacks major crops and the disease is very important in many countries throughout the world and it is noted that economic importance is stated to be moderate. While the pathogen is seed transmitted, seed treatment is not available. Hence any intended importation should be from an area where the pest is known not to occur. In addition, import conditions should be stated on PIP and declared on PC.
Pseudomonas fuscovaginae (ex Tanii et al. 1976) Miyajima et al. 1983 (sheath brown rot)	BI, TZ, RW	Inflorescence, leaves, seeds	Sheath brown rot is widely distributed and considered to be the most important bacterial disease of rice, causing substantial yield losses, reaching 100%, especially above 1800 m. The pathogen is seed transmitted; however, seed treatment has little control. That's why any intended importation should be from an area where the pest is known not to occur. In addition, import conditions should be stated on PIP and declared on PC.
VIRUSES			
Rice yellow mottle virus	KE, RW, TZ, UG, BI	leaves, seeds, stems	RYMV is not transmitted through rice seeds, leaf debris and spikelet contaminants have been implicated in the transmission of the virus. Purity of the seed to be exported or transported to new areas should therefore be emphasized. Insects also transmit the virus. Import conditions to be stated on PIP and declared on PC. It is a regulated non quarantine pest in Rwanda and Burudi

3.2.0: Risk Assessment and pests requiring phytosanitary Measures

The consolidated potential quarantine and regulated non quarantine pest list for rice for the region composed of 14 pests (5 insects, 1 nematode, 4 fungi, 3 bacteria and 1 virus), were then assessed further. Quarantine pests that reasonably can be expected to follow the pathway, *i.e*., be included in shipments of processed, unprocessed and seed rice traded within the five countries, are included on the pest list (Table 6). However, those pests, which may be potentially detrimental to agriculture but were not chosen for further analysis because they are either well established or widespread in the region or associated mainly with plant parts other than the commodity. If they were associated with the commodity, it was not considered reasonable to expect them to remain with the commodity during post harvesting and processing. In addition for the pests that were common in the region and not identified for further assessment, it was agreed that the plant import permit should state clearly the conditions of any intended importation of rice into the region and the commodity should be accompanied by a phytosanitary certificate from the exporting country indicating that the import conditions of the importing country have been met.

Table 3: Pests associated with rice identified for further assessment

	Pest name	Distribution
1	*Rhyzopertha dominica* (Fabricius Lesser grain borer), Bostrichidae	TZ, RW, UG
2	*Tribolium confusum* (Confused flour beetle), Tenebrionidae	UG

3	*Corcyra cephalonica* (Stainton, 1866) (Rice meal moth) Pyralidae	TZ
4	*Sclerophthora macrospora* Verrucalvaceae	UG
5	*Xanthomonas oryzae pv. oryzae* (Rice leaf blight)	TZ
6	*Pseudomonas fuscovaginae* (Bacterial sheath brown rot)	BI, TZ, RW
7	*Trogoderma granarium*	TZ
8	*Aphelenchoides besseyi* (White tip nematode)	KE, TZ, BR, UG
9	*Cochliobolus sativus* (S. Ito & Kurib.) Drechsler ex Dastur (root and foot rot)	TZ, KE, UG
10	*Magnaporthe grisea*/*Pyricularia oryzae* (Rice blast)	UG, KE, TZ
11	*Alternaria padwickii*	UG
12	*Sitotroga cerealella*, Olivier (Grain moth), Gelechiidae	KE, TZ, BI, UG, RW
13	*Pseudomonas syringae pv. syringae* van Hall	KE, UG, TZ
14	Rice yellow mottle virus	KE, RW, TZ, UG, BI

3.2.1 Consequences of Introduction—**Economic/Environmental Importance**

Potential consequences of introduction are rated using five risk elements:

1. Climate-Host Interaction
2. Host Range
3. Dispersal Potential
4. Economic Impact
5. Environmental Impact

These elements reflect the biology, host ranges and climatic/geographic distributions of the pests.

Risk Element 1- Climate-Host Interactions

If a species encounters suitable climate and hosts in the area where it is introduced, the organism may survive and achieve pest status in the new environment. This risk element is evaluated on the minimum number of ecological zones in which the species might achieve pest status. Risk ratings are based on the following criteria:

Low (1): the species is only likely to become established in one zone
Medium (2): the species is likely to become established in two or three zones
High (3): the species is likely to become established in four or more zones

Risk Element 2- Host Range

The risk posed by a plant pest depends on its ability to establish a viable, reproductive population and its potential to injure plants. For arthropods, risk is assumed to be positively correlated with host range. For pathogens, risk is assumed to depend on host range, aggressiveness, virulence and pathogenicity; for simplicity, risk is rated as a function of host range:

Low (1): pest attacks a single species or multiple species within a single genus
Medium (2): pest attacks multiple species within a single plant family
High (3): pest attacks multiple species among multiple plant families

Risk Element 3-Dispersal Potential

A pest may disperse after arriving in a new area. The following items are considered in regard to dispersal potential: reproductive patterns of the pest (*e.g.*, voltinism, biotic potential); inherent powers of movement; factors facilitating dispersal, wind, water, presence of vectors, humans, *etc*.

Low (1): pest has neither high reproductive potential nor rapid dispersal capability
Medium (2): pest has either high reproductive potential OR the species is capable of rapid dispersal
High (3): Pest has high biotic potential, *e.g.*, many generations per year, many offspring per reproduction ("r-selected" species), AND evidence exists that the pest is capable of rapid dispersal, *e.g.*, over 10km/year under its own power; via natural forces, wind, water, vectors, *etc*., or human-assistance.

Risk Element 4-Economic Impact

Introduced pests can cause a variety of direct and indirect economic impacts. These impacts are divided into three primary categories (other types of impacts may occur): lower yield of the host crop, *e.g.*, by causing plant mortality, or by acting as a disease vector; lower value of the commodity, *e.g.*, by increasing costs of production, lowering market price, or a combination; and loss of foreign or domestic markets due to the presence of a new quarantine pest.

Low (1): pest causes any one or none of the above impacts
Medium (2): pest causes any two of the above impacts
High (3): pest causes all three of the above impacts

Risk Element 5 - Environmental Impact

A pest may cause significant, direct consequences to the environment, *e.g.*, cause an ecological disaster or reduce biodiversity. Significance is qualitative and encompasses the likelihood and severity of an environmental impact. A pest is considered to have an environmental impact if: pest is expected to have direct impacts on species by infesting/infecting a listed plant; pest is expected to have indirect impacts on species by disrupting sensitive, critical habitat; introduction of the pest would stimulate chemical or biological control programs."

Low (1): none of the above would occur
Medium (2): one of the above would occur
High (3): two or more of the above would occur.

Table 4: Assessment of introduction and spread

ASSESSMENT OF INTRODUCTION AND SPREAD ***Rhyzopertha dominica*** (Fabricius) (lesser grain borer) **- Insecta –Coleoptera-Bostrichidae**	Rating
Likelihood of entry	
Quantity imported annually There are few rice imports from the region as the region depends mostly on rice from foreign countries.	Low
Survive the post-harvest treatment Manipulation of the temperature, relative humidity, atmospheric composition, sanitation, ionizing radiation and the removal of adult insects from the grain, by seiving or air classification, can eliminate infestations of insects such as R. dominica, or reduce populations to a tolerable level (Banks and Fields, 1995). Insecticides also are used around the world to control stored-grain insect pests (Beeman and Wright), 1990.	Low
Survive shipment The pathogen is found within the seeds and have been reported to survive under different temperatures hence will survive transportation condition. This aspect is rated as high.	High
Not detected at point of entry Larvae and adults damages on seeds are notable by naked eye. Mobile stages of the pest (pupae and eggs) may not be detected at the point of entry. This is rated high since the entire pest stages affect rice seeds.	High
Risk due to use of commodity The imported commodity will be used as seeds for planting or for consumption. Seeds used for planting exhibits high risk that those used for consumption.	High
Likelihood of establishment and spread	
Availability of suitable host Adults and larvae of *R. dominica* feed primarily on stored cereal seed including wheat, maize, rice, oats, barley, sorghum and millet. They are also found on a wide variety of foodstuffs including beans, dried chillies, turmeric, coriander, ginger, cassava chips, biscuits and wheat flour. There are several reports of the lesser grain borer being found in or attacking wood as is typical of other Bostrichidae. R. dominica has been reported to produce progeny on the seeds of some trees and shrubs (acorns, hackberry and buckbrush [Symphoricarpos orbiculatus]), CABI 2007.	High
Availability of suitable vector, if vector transmitted This disease in not transmitted by vectors hence rated low.	Low
Presence of suitable environment *Rhyzopertha dominica* is a serious pest of stored products throughout the tropics. The lowest temperature at which *R. dominica* can complete development is 20°C; at this temperature, the development from egg to adult takes 90 days. The fastest rate of development occurs at 34°C; at this temperature the egg takes 2 days, the larvae 17 days, and the pupae 3 days to complete development. *R. dominica* is unable to complete development between 38 and 40°C. Adults live for 4-8 months. Under optimal conditions of 34°C and 14% grain moisture content, there is a 20-fold increase in the population of *R. dominica* after 4 weeks. It can successfully infest grain at 9% moisture content, but has higher fecundity, a faster rate of development, and lower mortality on grain of higher moisture content, (CABI, 2007).	High
Addition control measures will be required The disease can be control through physical, biological, cultural and chemical methods hence control system currently in use will be able to control the disease. This is rated low	Low
Dispersal potential of pest	Medium

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. *R. dominica* is found mainly in cereal stores, and food and animal feed processing facilities. It has also been trapped using pheromone-baited flight traps several kilometres from any food storage or processing facility (CABI, 2007).	
Assessment of economic impacts	
Economic damage by the pest in the existing geographical range *Rhyzopertha dominica* is a major pest in wheat and rice. The larvae and adults consume the seed. There are three types of costs associated with infestations of *R. dominica*; loss in quantity of seed stored, loss in quality of seed stored and the cost to prevent or control infestations, (CABI 2007)**.**	Medium
Potential economic loss in agriculture in the PRA area Infestation of rice seed by *Rhyzopertha dominica* lowers the seed quality thus affecting yields in the longrun.	Medium
Potential loss associated with non-agricultural crops There are several reports of the lesser grain borer being found in or attacking wood (Potter, 1935), as is typical of other Bostrichidae. *R. dominica* has been reported to produce progeny on the seeds of some trees and shrubs (acorns, hackberry [*Celtis occidentalis*] and buckbrush [*Symphoricarpos orbiculatus*]) (Wright *et a*l., 1990).	Medium

ASSESSMENT OF INTRODUCTION AND SPREAD ***Tribolium confusum*** Jacquelin du Val (confused flour beetle)**- Insecta, Coleoptera Tenebrionidae**	Rating
Likelihood of entry	
Quantity imported annually There are few rice imports from the region as the region depends mostly on rice from foreign countries.	Low
Survive the post-harvest treatment Synergised pyrethrins have been observed to have a repellent effect on *T. confusum* (LaHue, 1966). Chlorpyrifos-methyl and pirimiphos-methyl are effective control agents, and in some experiments have been shown to be more effective than malathion (Sauer, 1992). Lindane is highly toxic to *T. confusum* (Khan, 1983). Resistance to deltamethrin has been demonstrated (Korunic and Hamel-Koren, 1985). Fumigation with methyl bromide or phosphine is effective (Sauer, 1992). Conservation of cereals under nitrogen has been shown to kill all stages of *T. confusum* except for the eggs (Shejbal et al., 1977). Imported seeds are treated with an appropriate insecticide hence reducing the chance of introducing the disease hence rated as low.	Low
Survive shipment The pathogen is found within the seeds and have been reported to survive under different temperatures hence will survive transportation condition. This aspect is rated as high	High
Not detected at point of entry Larvae go through a series of instars while feeding in grain or processed grain products. In whole grain, the presence of grain dust and debris provides a suitable environment for the development of early instars. The adults and larvae are known to feed on grain dust and broken kernels by presence of other grain pests, but not the undamaged whole grain kernels. This is rated low.	Low
Risk due to use of commodity The imported commodity will be used as seeds for planting or for consumption. Seeds used for planting exhibits high risk that those used for consumption.	High

Likelihood of establishment and spread	
Availability of suitable host *T. confusum* is an important pest of many commodities, especially cereals and cereal products, but also dried fruits, nuts, spices and even *Cannabis sativa*. It also has cannibalistic and predatory tendencies. **CABI 2007**	High
Availability of suitable vector, if vector transmitted This disease in not transmitted by vectors hence rated ad low.	Low
Presence of suitable environment *Tribolium confusum* have been reported in several states in the world ranging from Europe to Africa to Asia (CPC 2007). This shows that the pest can survive in a wide enviromental range hence rated as high.	High
Addition control measures will be required The pest can be control through chemical methods hence control system currently in use will be able to control the disease. This is rated low	Low (1)
Dispersal potential of pest Eggs: A total of 4-500 eggs are produced over a period of a few months. Under favorable conditions, eggs hatch in 3-5 days. In such an environment, larvae can develop at moisture contents as low as 8%. Larvae molt 5-11 times, depending on the food source and environment. (CABI, 2007). It is reported to be commonly found in processed grain products, possibly because of its reduced dispersal capabilities: T. confusum is not known to fly, despite the presence of flight wings similar to those of T. castaneum (Sauer, 1992).	Medium
Assessment of economic impacts	
Economic damage by the pest in the existing geographical range T. *confusum* is very similar in its biology, habits and in the products, it attacks to *T. castaneum*. Its economic importance is therefore similar to that species. It is less important in tropical countries (except in produce stored in locally cooler regions, such as high-altitude areas, or on produce recently imported from cooler areas), and is more important in temperate climates, where it is an important secondary pest of flour and cereal products.	Medium
Potential economic loss in agriculture in the PRA area The attack by *Tribolium confusum* on seed has been reported to be important as it affect seed quality leading to poor germination. Planting seed lots with high infection levels can cause significant yield loss. This is rated as medium.	Medium
Potential loss associated with non-agricultural crops *Tribolium confusum* has been found to exist and damage the barks of trees of cedar species. (Malhotra, 1970)	Low

ASSESSMENT OF INTRODUCTION AND SPREAD ***Corcyra cephalonica*** (Stainton, 1866)- (rice meal moth) **Insecta**, **LEPIDOPTERA, Pyralidae**	Rating
Likelihood of entry	
Quantity imported annually There are few rice imports from the region as the region depends mostly on rice from foreign countries.	High
Survive the post-harvest treatment Grain may be protected by the admixture of insecticides. As far as is known, *C. cephalonica* is susceptible to all those insecticides normally used on stored food. The early larval stages of	Low

C. cephalonica were found to be more susceptible to diflubenzuron than more advanced stages (Gupta and Gupta, 1995). The pest hence will not survive the post-harvest treatment.	
Survive shipment The pathogen is found within the seeds and have been reported to survive under different temperatures hence will survive transportation condition. This aspect is rated as high	High
Not detected at point of entry Although it is capable of feeding on intact grains, *C. cephalonica* performs better on broken and processed grain and is therefore more of a secondary colonizer of stored products. The damages on seeds are manifested as external feeding marks and webbings on stored seed.	Low
Risk due to use of commodity The imported commodity will be used as seeds for planting or for consumption. Seeds used for planting exhibits high risk that those used for consumption.	High
Likelihood of establishment and spread	
Availability of suitable host Many stored foods, for example, cereals, cereal products, oilseeds, pulses, dried fruits, nuts, and spices, are known to support infestations of *C. cephalonica*, but it is especially common as a pest of rice and rice products. It is also a major pest in flour mills in the tropics and is common on sorghum and millet in West Africa. It may also be found infesting copra. CABI 2007	High
Availability of suitable vector, if vector transmitted This disease in not transmitted by vectors hence rated ad low.	Low
Presence of suitable environment *Corcyra cephalonica* have been reported throughout the humid tropics, especially in South and South-East Asia. (CPC 2007). *C. cephalonica* also appears to be a more important pest than *Cadra cautella* (Almond Moth) in semi-arid tropical regions, such as sub-Sahalan Africa. C. cephalonica has been observed to develop under conditions of less than 20% RH on sorghum and millet (Russell et al., 1980): this relative humidity is the lower limit for *Cadra cautella*. Clearly *C. cephalonica* gains an advantage by its tolerance of low moisture.	High
Addition control measures will be required The pest can be controlled through chemical methods hence control system currently in use will be able to control the disease. This is rated low	Low
Dispersal potential of pest This pest may be carried all over the world in commodity shipments and can establish itself wherever there is food and where grain moisture and temperature are favourable. (CABI, 2007).	Medium
Assessment of economic impacts	
Economic damage by the pest in the existing geographical range The pest is of moderate economic Importance hence rated as medium.	Medium
Potential economic loss in agriculture in the PRA area The attack by *Corcyra cephalonica* on seed has been reported to be important as it affect seed quality leading to poor germination. Planting seed lots with high infection levels can cause significant yield loss. This is rated as medium.	Medium
Potential loss associated with non-agricultural crops The pest is not reported to affect non-agricultural crops.	Low

ASSESSMENT OF INTRODUCTION AND SPREAD ***Sclerophthora macrospora*** (Sacc.) Thirum. C.G. Shaw & Naras. 1953 (downy mildew) **OOMYCETES, Sclerosporales**	Rating
Likelihood of entry	

Quantity imported annually There are few rice imports from the region as the region depends mostly on rice from foreign countries.	Low
Survive the post-harvest treatment The disease can be reduced by chemical and cultural control. Lines that are resistant to *S. macrospora* have been developed for several hosts.	Low
Survive shipment The pathogen is seed borne hence will survive transportation condition. This aspect is rated as high.	High
Not detected at point of entry *S. macrospora* may be completely or partially systemic in hosts (Semeniuk and Mankin, 1964; Ullstrup, 1970). In maize, mycelium, oogonia and oospores are found in various plant parts (Ullstrup, 1952). Histopathological studies on ragi [*Eleusine coracana*] indicated that the pathogen was present in the roots, stems, floral parts and seeds, causing morphological changes. This increases its chances of being not detected at points of entry.	High
Risk due to use of commodity The imported commodity will be used as seeds for planting or for consumption. Seeds used for planting exhibits high risk than those used for consumption.	High
Likelihood of establishment and spread	
Availability of suitable host Major hosts include: *Avena sativa* (oats), *Eleusine coracana* (finger millet), *Hordeum vulgare* (barley), *Oryza sativa* (rice), *Pennisetum glaucum* (pearl millet), *Saccharum officinarum* (sugarcane), *Sorghum bicolor* (sorghum), *Triticum* (wheat), *Triticum aestivum* (wheat), *Zea mays* (maize) hence rated high.	High
Availability of suitable vector, if vector transmitted This disease in not transmitted by vectors hence rated ad low.	Low
Presence of suitable environment *S. macrospora* has been reported on: Brazil, India, Japan, Republic of Korea, Euorpe, Africa, Central America and Caribean, North America, South America and Oceania. Brazil, India, Japan, Republic of Korea. Excessive soil moisture for 4 weeks and a daily air temperature ranging from 15 to 26°C preceded disease development in Kentucky bluegrass. CABI 2007	High
Addition control measures will be required The disease can be control through cultural and chemical methods. No additional control methods are required. This is rated as low.	Low
Dispersal potential of pest It has been reported that *S. macrospora* is internally and externally seedborne in ragi (*E. coracana*) (CABI, 2007).The pathogen is mainly dispersed by human while in the seeds. This is rated medium	Medium
Assessment of economic impacts	
Economic damage by the pest in the existing geographical range The disease is of moderate economic Importance hence rated as medium.	Medium
Potential economic loss in agriculture in the PRA area It is widespread in the USA, but of no economic importance, although individual fields occasionally experience severe losses. It has been reported in other countries but is considered to be far less important than some of the other downy mildews. CABI 2007	Medium
Potential loss associated with non-agricultural crops *S. macrospora* was shown to be the cause of yellowing and proliferation of shoots in several turfgrass species in the USA (Jackson, 1980).	Low

ASSESSMENT OF INTRODUCTION AND SPREAD ***Xanthomonas oryzae pv. oryzae*** (Ishiyama 1922) Swings et al. 1990 (rice leaf blight) **Bacteria, Gammaproteobacteria, Xanthomonadales**	Rating
Likelihood of entry	
Quantity imported annually There are few rice imports from the region as the region depends mostly on rice from foreign countries.	Low
Survive the post-harvest treatment Bleaching powder (100 µg/ml), copper, streptocycline (100 µg/ml) and zinc sulphate (2%) reduced the intensity of bacterial leaf blight of rice, caused by X. oryzae pv. oryzae, when evaluated as seed treatments in the glasshouse and in the field (Mehra and Thind, 1994). Triphenyltin chloride and 2-hydroxypropyl methane thiosulphonate eradicated X. oryzae pv. oryzae from naturally infected seed (Singh and Rao, 1982).	Low
Survive shipment Results of storage tests with naturally infected rice seeds confirmed that the bacterium could survive for 10 months at room temperature (Singh et al., 1980). Viable bacteria occurred on infected seed stored under natural conditions for 2 months, but after this time no bacteria could be detected (Kauffman and Reddy, 1975). Reddy (1972) states that *X. oryzae* pv. *oryzae* survives for 7-8 months in seed.	High
Not detected at point of entry The pathogen is systemic hence may not be detected at the point of entry.	High
Risk due to use of commodity The imported commodity will be used as seeds for planting or for consumption. Seeds used for planting exhibits high risk that those used for consumption.	High
Likelihood of establishment and spread	
Availability of suitable host Rice is the main crop plant infected by *X. oryzae* pv. *oryzae*. Wild or minor cultivated Poaceae that have been reported as hosts include *Brachiaria mutica, Cenchrus ciliaris, Cynodon dactylon, Echinochloa crus-galli, Leersia spp., Leptochloa filiformis, Oryza spp., Panicum maximum, Paspalum scrobiculatum, Zizania aquatica, Z. palustris,* and *Zoysia japonica* (Li *et al*., 1985; Bradbury, 1986; Valluvaparidasan and Mariappan, 1989; EPPO, 1999). Cyperaceae (sedges) that are naturally infected include Cyperus difformis and *C. rotundus*. CABI 2007.	High
Availability of suitable vector, if vector transmitted This disease in not transmitted by vectors hence rated ad low.	Low
Presence of suitable environment *P. longicolla* have been report in several states in the USA. It has also been reported in Europe and Far East (CPC 2007). This shows that this disease can survive in a wide enviromental range hence rated as high.	High
Addition control measures will be required The disease can be control through cultural and chemical methods hence control system currently in use will be able to control the disease. This is rated low	Low
Dispersal potential of pest *X. oryzae pv. oryzae* is extensively seedborne in rice. Other reports stated that the disease is transmitted by infested seed from one summer season to the next, but the disease cycle is broken if summer seed is sown in the winter season, because the pathogen cannot become established during the cool, dry, winter weather (CABI, 2007).	Medium
Assessment of economic impacts	
Economic damage by the pest in the existing geographical range The disease is of moderate economic Importance hence rated as medium.	Medium

Potential economic loss in agriculture in the PRA area Bacterial leaf blight is the most damaging disease of rice in South and South-East Asia and Japan, particularly since the introduction of dwarf high-yielding varieties. In Japan, where figures are available, up to 400,000 ha may be affected annually, with losses of 20-30% and up to 50%. In Africa, losses of 2.7-41% in grain yield have been found (Awoderu *et al*., 1991). CABI 2007	Medium
Potential loss associated with non-agricultural crops The disease is associated with several weeds but not non- agricultural crops.	Low

ASSESSMENT OF INTRODUCTION AND SPREAD *Pseudomonas fuscovaginae / Pseudomonas fluorescens* biovar II (sheath brown rot)-bacteria	Rating
Likelihood of entry	
Quantity imported annually A large but less frequent consignment of grains is anticipated	High
Survive the postharvest treatment *P. fuscovaginae* was eradicated by heat treatment (65°C for 6 days or water at 55°C for 20 minutes), but the best of the chemical treatments, kasugamycin, only reduced incidence of the pathogen. Heat treatment is used for international exchange and for genetic or basic seed, whereas kasugamycin could be used for commercial certified seed and at the same time offer protection against blast (*Pyricularia oryzae*) at the seedling stage (Zeigler et al., 1987b). *P. fuscovaginae* is Seed transmitted and Seed treatment has little control (CABI, 2010) These treatments are for seed and not grain for consumption hence high likelihood of pest evading the pest management practices.	High
Survive shipment Miyajima (1983) found that the pathogen could be isolated from infected seeds with rusty blotches on their hulls and from rusty, brown rice, but not from seeds with only brown flecks on their hulls. In seeds which had been stored for about 6 months, bacteria were detected at concentrations of 4000-80,000 cells per grain, with 1-2% of these bacteria being P. fuscovaginae. The pathogen could survive in dry grains until the next autumn. P. fuscovaginae is aerobic. The optimal growth temperature is approximately 28°C and no growth occurs at 37°C.	High
Not detected at point of entry The pathogen is systemic hence may not be detected at the point of entry.	High
Risk due to use of commodity The imported commodity will be used as seeds for planting or for consumption. Grains for consumption will be distributed for use in various parts of the country hence high risk of pest escaping to the environment. *P. fuscovaginae* is Seedborne and is seed transmitted. Seeds used for planting exhibits high risk that those used for consumption.	High
Likelihood of establishment and spread	
Availability of suitable host Although its primary host is rice, inoculation studies have shown that *P. fuscovaginae* is pathogenic to wheat, oats, 6-row barley, triticale, maize, perennial ryegrass (Lolium perenne), brome (Bromus *marginatus*), timothy (Phleum pratense), and reed canarygrass (Phalaris arundinacea) (Miyajima et al., 1983). These hosts may serve as reservoirs of inoculum in the field (Webster and Gunnell, 1992). P. fuscovaginae has been found on rice, *Agrostis clavata* and *Poa pratensis* in Japan (Miyajima, 1980a); on rice, maize and sorghum in Burundi (Duveiller et al., 1988, 1989); on rice (Zeigler and Alvarez, 1987b), oats, rye and wheat (Malavolta et al., 1988) in Brazil; and on rice (Zeigler and Alvarez, 1987a), triticale and wheat (Duveiller and Maraite, 1990) in Mexico. Most of these hosts are widely grown in the PRA area.	High

Availability of suitable vector, if vector transmitted This disease in not transmitted by vectors but seed transmitted, hence rated low	Low
Presence of suitable environment Detry et al. (1991a) studied bacterial sheath brown rot on 24 rice cultivars growing in five highland swamps of Burundi at altitudes ranging from 1370 to 1560 m. The severity of the disease was not sufficiently explained by climatic conditions. Bacterial sheath brown rot was widespread in irrigated rice between 1300 and 2000 m elevation in Madagascar. Inhibition of panicle emergence increased with altitude (Duveiller et al., 1990). In Indonesia, the incidence of bacterial sheath brown rot was found to be higher during the dry season. A high level of infection by *P. fuscovaginae* (72.2%) and reduced germination were also recorded in seeds harvested during the dry season. During the wet season, grain from panicles of badly affected plants showed a severe discoloration which could affect the quality of the grain and its nutritional value. This grain could never be used for distribution as seed (Cahyaniati and Mortensen, 1995). The environment in the PRA area is very suitable as it compares with the environment where the pest is reported.	High
Addition control measures will be required Eradication and burning of regrowths and plant litter immediately after harvest, and off-season cultivation of a crop (such as potatoes or lupins (Lupinus sp.)) that is not attacked by the bacterium may be used to control P. fuscovaginae (Rott, 1987). Results of studies with irrigated rice demonstrated the need for cultivars with cold tolerance, early maturity and pest and disease resistance. Antibiotics such as streptomycin, alone or in combination with oxytetracycline, can effectively control sheath brown rot if applied at or a few days after panicle emergence (Webster and Gunnell, 1992). Seed treatment-controlled *P. fuscovaginae* and Pseudomonas oryzicola [P. syringae pv. syringae] on rice in trials in vitro, but the material used was phytotoxic and inhibited germination (Pekhtereva and Marveeva, 1990). Control measures for sheath brown rot of rice, caused by *P. fuscovaginae* and *P. syringae* pv. *syringae*, in Russia (mainly in the Primorskii Krai, Far East) by treatment of seeds with bacteriocides are discussed by Matveeva et al. (1994).	Medium
Dispersal potential of pest *P. fuscovaginae,* which causes sheath brown rot of rice, survives on rice seed at a low level and as an epiphyte on grassy weeds in rice-growing areas (Webster and Gunnell, 1992). The organism is active in irrigated, temperate regions and in rainfed upland rice ecosystems (Cottyn et al., 1994b). Cold-temperature stress is believed to predispose the rice plant to severe attacks of bacterial sheath brown rot. In temperate regions, P. fuscovaginae survives in rice straw only if the straw is stored indoors (Miyajima, 1980a). In the tropics, other host plants and infected seeds harbour the organism; these hosts can serve as a source of primary inoculum (Cottyn et al., 1994b). Secondary infection in the field may occur from a bacterial population that is already present and proliferating on symptomless leaf blades and sheaths. This secondary infection is most severe at the booting stage (Cottyn et al., 1994b). Weeds may harbour *P. fuscovaginae*; the high recovery rate from roots suggests that plant debris in the soil may also serve as an inoculum source (Zeigler et al., 1986). Bacteria were detected at a concentration of 4000-80,000 cells per grain, after storage of rice seeds for about 6 months. If present, P. fuscovaginae comprised 1-2% of the bacteria. The pathogen survived in dry grains until the next autumn at the longest. Disease developed after these infected seeds were sown in sterilized soils (Miyajima, 1983).	High

Assessment of economic impacts	
Economic damage by the pest in the existing geographical range Bacterial sheath brown rot attacks both the mature rice plant and the seedling, causing substantial yield losses in South America (Webster and Gunnell, 1992). Results of studies in Madagascar showed that at altitudes higher than 1500 m, *P. fuscovaginae* is the principal limiting factor in irrigated rice cultivation, with losses reaching 100%, especially above 1800 m (Rott, 1987). Sheath brown rot is widely distributed and considered to be the most important bacterial disease of rice in Hokkaido (Japan) (Tanii et al., 1976). The disease is of moderate economic Importance hence rated as medium.	High
Potential economic loss in agriculture in the PRA area Sheath brown rot is widely distributed and considered to be the most important bacterial disease of rice in Hokkaido (Japan) (Tanii et al., 1976). It may cause substantial yield losses in rice, wheat, sorghum and maize in the PRA area. *P. fuscovaginae* is the principal limiting factor in irrigated rice cultivation, with losses reaching 100%, especially above 1800 m (Rott, 1987). A high level of infection by *P. fuscovaginae* reduces germination especially in seeds harvested during the dry season. During the wet season, grain from panicles of badly affected plants show severe discoloration which could affect the quality of the grain and its nutritional value. Infected grain can never be used for distribution as seed hence negatively affecting the seed industry.	High
Potential loss associated with non-agricultural crops Loss of revenue from seed sale and reduced nutritional value of infected grain.	Low

ASSESSMENT OF INTRODUCTION AND SPREAD *Trogoderma granarium* Everts (khapra beetle).	Rating
Likelihood of entry	
Quantity imported annually Large but less frequent consignments of grains will be imported.	High
Survive the post-harvest treatment *T. granarium* is, as far as is known, susceptible to all the insecticides normally used on stored food. Without food, diapausing larvae may survive about 9 months; with food, they may live for 6 years. In this state of very low metabolic activity, they are extremely resistant to the effects of contact insecticides or fumigants; complete disinfestation may thus be difficult.	High
Survive shipment *T. granarium* may remain hidden deep in the stored food for relatively long periods. The adults rarely, if ever, eat or drink. Females can produce eggs without having fed once emerged from pupae (Hinton, 1945). Larval development in *T. granarium* does not occur at temperatures below 21°C, but can proceed at very low humidity, for example at 25°C and 2% RH.	High
Detected at point of entry? The adults possess wings but have never been known to fly. However, since diapausing larvae are frequently found on movable objects or transport equipment such as sacks and lorries and that they are extremely resistant to the effects of contact insecticides or fumigants; complete disinfestation may thus be difficult. This poses a high risk of being spread to areas of higher economic importance than the area of introduction. Grains for consumption will be distributed for use in various parts of the country hence high risk of pest escaping to the environment/other stored food.	High

Risk due to use of commodity The imported commodity will be used for consumption. Grains for consumption will be distributed for use in various parts of the country hence high risk of pest escaping to the environment/other stored food. Seeds used for planting exhibits high risk than those used for consumption.	Medium
Likelihood of establishment and spread	
Availability of suitable host *T. granarium* has a wide host range. The larvae of *T. granarium* are serious pests of oilseeds, damaged cereals and, to a lesser extent, pulses. The beetle occurs in hot, dry conditions, predictably in areas which, for at least 4 months of the year, have a mean temperature greater than 20°C and an RH below 50%. It is especially prevalent in certain areas of the Middle East, Africa and South Asia, and is also found in certain specialized warm habitats in temperate countries e.g. maltings in the UK (Peacock, 1993).	High
Availability of suitable vector, if vector transmitted This pest is not vectored hence rated low.	Low
Presence of suitable environment The beetle occurs in hot, dry conditions, predictably in areas which, for at least 4 months of the year, have a mean temperature greater than 20°C and an RH below 50%. It is especially prevalent in certain areas of the Middle East, Africa and South Asia, and is also found in certain specialized warm habitats in temperate countries This shows that this pest can survive in a wide environmental range hence rated high.	High
Addition control measures will be required *T. granarium* is, as far as is known, susceptible to all the insecticides normally used on stored food. Diapausing larvae, state of very low metabolic activity, are extremely resistant to the effects of contact insecticides or fumigants; complete disinfestation may thus be difficult. Grain stocks may be fumigated with phosphine or methyl bromide to eliminate existing infestations, but these treatments provide no protection against re-infestation.	Medium
Dispersal potential of pest Larval development in *T. granarium* does not occur at temperatures below 21°C, but can proceed at very low humidity, for example at 25°C and 2% RH. Development is most rapid in hot, humid conditions, taking about 18 days at 35°C and 73% RH. Under these conditions, the average number of larval moults is four for males and five for females, although this is highly variable (Hadaway, 1956). The larvae feed occasionally. Without food, diapausing larvae may survive about 9 months; with food, they may live for 6 years. In this state of very low metabolic activity, they are extremely resistant to the effects of contact insecticides or fumigants; complete disinfestation may thus be difficult. The pupa of *T. granarium* usually remains inside the skin of the final-instar larva. Pupal development is unaffected by humidity and varies in length from 5 days at 25°C to 3 days at 40°C. When the adults have fully emerged, copulation may take place immediately. To aid reproduction, the virgin females secrete a pheromone that attracts unmated males. After copulation, oviposition commences immediately at 40°C and lasts 3-4 days, while at 25°C, there is a pre-oviposition period of 2-3 days, and oviposition may extend over 12 days.	High

Temperatures between 25°C and 40°C seem to have little or no effect on the average number of eggs laid, which is approximately 35 per female. The females die soon after oviposition is complete; the males live 1-4 days longer. Under optimal conditions, *T. granarium* can sustain a rate of increase of 12.5 times per lunar month.	
Assessment of economic impacts	
Economic damage by the pest in the existing geographical range *T. granarium* is a serious pest of cereal grains and oilseeds, and many countries, including the USA, Australia, China, Uganda and Tanzania, have specific quarantine regulations against possible importation. Massive populations of the insect may develop, and grain stocks can be almost completely destroyed. Losses due to T. granarium, sometimes in conjunction with other storage pests, have been reported in the literature. Losses in wheat grain stored in PVC bins after 90 days were 23.06% due to T. granarium, Tribolium castaneum, Sitophilus oryzae and Rhyzopertha dominica compared with 1.73% in fumigated bins (Singh et al., 1994). In a grain silo survey in Iraq between 1977 and 1978, *T. granarium* was present in more than 50% of samples. Infestation levels ranged up to 685 insects/kg grain. The mean percentage of infested grains ranged from 2.5 to 5.7% according to the origin of the wheat. The percentage wheat loss ranged from 3.1 to 6.6 (Al-Saffour and Kansouh, 1979). In Punjab, India, populations of T. granarium varied from 121 to 415 per 500g of wheat in a state survey in 1971-72. The pest damaged 9-14.5% of the grain resulting in 1.04-3.02% weight loss (Bains et al., 1976).	High
Potential economic loss in agriculture in the PRA area T. granarium is a serious pest of cereal grains and oilseeds, which are readily available in the PRA area. Thus, potential economic losses are similar to those in other countries.	High
Potential loss associated with non-agricultural crops Analysis of wheat grain samples containing 5 to 100% *T. granarium*-infested grains showed that levels of protein, gluten, crude fat, ash, reducing and non-reducing sugars, and sedimentation value decreased with increased numbers of damaged grains.	Low

ASSESSMENT OF INTRODUCTION AND SPREAD *Aphelenchoides besseyi* (White tip nematode)	Rating
Likelihood of entry	
Quantity imported annually Large consignment is expected yearly	High
Survive the post-harvest treatment The most effective control of A. besseyi requires seed to be pre-soaked in cold water for 18-24 hours and immersed in water at 51-53°C for 15 minutes. Higher temperatures (55-61°C for 10-15 minutes) are required. Not practical with seed, therefore high chances of survival	High
Survive shipment A. besseyi survived under desiccation at 70°C for 12 h Tsay *et al*. (1998), (CABI, 2012). Therefore, the pest can stay alive during shipment.	High
Not detected at point of entry Not possible to detect at point of entry because it in the seed hence not visible.	High
Risk due to use of commodity	High

The principal dispersal method for *A. besseyi* is seed. It can be transmitted in flood water in lowland rice (Tamura and Kegasawa, 1958). Because the intended use is seed then it can be disseminated to many areas in PRA area therefore the risk is high.	
The principal dispersal method for *A. besseyi* is seed. It can be transmitted in flood water in lowland rice (Tamura and Kegasawa, 1958) but the survival of nematodes in water decreases as temperature increases from 20 to 30°C (Tamura and Kegasawa, 1958). High seeding rates in infected seed beds facilitates local dispersal (Kobayashi and Sugiyama, 1977). CPC2012	High
Likelihood of establishment and spread	
Availability of suitable host Wide host range, hence, the pest can easily spread and establish in PRA area.	High
Availability of suitable vector, if vector transmitted Not vectored.	Low
Presence of suitable environment Climatic conditions are suitable in the region; therefore, the pest can establish and spread in the region.	High
Addition control measures will be required Good control (up to 100%) can be achieved with carbofuran (Martins *et al*., 1976; Ribeiro, 1977)	Low
Dispersal potential of pest The principal dispersal method for *A. besseyi* is seed. It can be transmitted in flood water in lowland rice (Tamura and Kegasawa, 1958) but the survival of nematodes in water decreases as temperature increases from 20 to 30°C (Tamura and Kegasawa, 1958). High seeding rates in infected seed beds facilitates local dispersal (Kobayashi and Sugiyama, 1977). CPC2012	Medium
Assessment of economic impacts	
Economic damage by the pest in the existing geographical range The economic damage of the pest range between 6.6% to 50% in rice fields (Atkins and Todd, 1959; Yamada and Shiomi, 1950; Rahman and Taylor, 1983).	High
Potential economic loss in agriculture in the PRA area The pest has similar potential to cause damage in the PRA area as portrayed in the areas where it is existing.	High
Potential loss associated with non-agricultural crops There is no report on losses in other non-agricultural crops	Low

ASSESSMENT OF INTRODUCTION AND SPREAD *Cochliobolus sativus* (S. Ito & Kurib.) Drechsler ex Dastur (root and foot rot)	Rating
Likelihood of entry	
Quantity imported annually Large consignment is expected yearly	High
Survive the post-harvest treatment The pest can stay alive the post-harvest treatment because it is found in mycelia fragments and in both intracellular and intercellular spaces (CABI 2012).	High
Survive shipment Possible to continue to exist in consignment since the ambient and transport temperatures are amicable for the pest	High
Not detected at point of entry	Medium

A dark brown to black discoloration is observed at the embryo end of infected kernels, though it is difficult to spot and often goes unnoticed because the pest or symptoms are usually invisible. (CABI 2012).	
Risk due to use of commodity There are high chances of the pest being a risk due to it being associated with true seed as a pathway and it is used for propagation then it is expected that the pest will be introduced to many production places in the PRA area.	High
Likelihood of establishment and spread	
Availability of suitable host Host plants and other plants affected are widely distributed in PRA area, therefore the pest can thrive even in the absence of the target host	High
Availability of suitable vector, if vector transmitted The pest is not vectored .	Low
Presence of suitable environment Climatic conditions are suitable in the region; therefore, the pest can establish and spread.	High
Addition control measures will be required Fungicide seed treatment may provide some control of common root rot. Triadimenol and difenoconazole are the most promising in reducing root rot in field plots with high natural infestation by *C. sativus.*	Medium
Dispersal potential of pest An incidence of infection by C. sativus of 90% has been recorded on seed (Cane and Hampton, 1990), The pathogen can survive both in soil and crop residues up to 2 years hence its dispersal is real. It has been shown to be airborne since seed infection was shown to increase with airborne spore population of *C. sativus* (Stevenson, 1981).	High
Assessment of economic impacts	
Economic damage by the pest in the existing geographical range A more recent study using soil fumigation techniques demonstrated grain yield losses of 16-29% in seed from common root rot (Bailey *et al.*, 1997). In Brazil, losses of 19% were estimated in field trials comparing infected with healthy plants. The reduction in yield was attributed to fewer heads per plant and seeds per head, and lower seed weight (Diehl et al., 1983).	Medium
Potential economic loss in agriculture in the PRA area The pest has similar potential to cause damage in the PRA area as portrayed in the areas where it is existing.	High
Potential loss associated with non-agricultural crops There is no report on losses in other non-agricultural crops	Low

ASSESSMENT OF INTRODUCTION AND SPREAD *Magnaporthe grisea/Pyricularia oryzae* (Rice blast)	**Rating**
Likelihood of entry	
Quantity imported annually Large consignment is expected annually.	High
Survive the post-harvest treatment Latent periods require 4-6 days at an optimal temperature of 26-28°C. (Teng *et al.*, 1991). Due to latent stages the pathogen is likely to escape post-harvest treatment like drying.	Medium
Survive shipment	High

It is possible for the pest to survive shipment conditions because the pathogen is in the seed and temperatures during shipment favors the pest.	
Not detected at point of entry The pathogen can only be detected if the rot lesions are on the surface of the seeds, otherwise it would be increasingly difficult to notice	Medium
Risk due to use of commodity The pathogen being associated with true seed used for propagation it is expected that the pest will be introduced to many production places in the PRA area.	High
Likelihood of establishment and spread	
Availability of suitable host *P. grisea* has a wide host range including rice and those from a number of grasses (*Digitaria sanguinalis, Echinochloa crus-galli, Leersia oryzoides*), cereals (*Setaria italica, Hordeum vulgare, Panicum miliaceum, Zea mays*) and *Saccharum officinarum* (Asuyama, 1965). All these hosts are readily available and widely distributed in the PRA area	High
Availability of suitable vector, if vector transmitted The pest is not vectored but seed transmitted.	Low
Presence of suitable environment Climatic conditions are suitable in the PRA area; therefore, the pest can establish and spread. Under humid conditions, abundant conidia are produced on both sides of the leaf, leading to high infestation.	High
Addition control measures will be required Host cultivars that are resistant against leaf and panicle blast have been the most widely used method of disease control (CABI, 2007). Fungicidal control is possible but due to cost limitations, or because of lower or inconsistent disease pressures, this is not usually practiced.	Medium
Dispersal potential of pest Airborne dissemination is the most common dispersal mechanism, although seedborne infection, water-borne conidia and deposition of spores through contact with infected organs can occur (CABI 2012)	High
Assessment of economic impacts	
Economic damage by the pest in the existing geographical range M. grisea is a cause of discoloration and reduces seed and seedling vigor (CABI 2012). Losses of up to 70% have been recorded in fields attacked by neck blast. Blast is considered to be the most serious disease of rice in West Africa, where losses of 3-14% (Sierra Leone) and over 77% (Liberia) have been recorded. In Cote d'Ivoire, grain yield losses of 0.5 to 58.5% have been recorded in farm trials.	High
Potential economic loss in agriculture in the PRA area The pathogen has potential to cause economic losses comparable to those caused by the pathogen in areas where the pest is present	High
Potential loss associated with non-agricultural crops The pest may affect the biodiversity of the PRA area.	Low

ASSESSMENT OF INTRODUCTION AND SPREAD *Sitotroga cerealella*, Olivier (Grain moth), **Gelechiidae**	**Rating**
Likelihood of entry	
Quantity imported annually Large shipments are expected per annum.	High

Survive the post-harvest treatment Plants are attacked at a postharvest stage, although some are also attacked at the fruiting stage (CABI 2007). However, insecticide and fumigation treatments are usually effective against *S. cerealella*.	Low
Survive shipment The rate of development is dependent on temperature. Development is favored at 25°C, although larvae will hatch at temperatures down to 12°C and up to 36°C (CABI, 2007). For this reason, the pest thrives well during shipment.	High
Not detected at point of entry Larvae bore into the grain after hatching, entering kernels primarily in the germ end and its periphery and complete their development in a single grain. Damage is therefore not visible externally until the late stages of the infestation when translucent windows appear in the grain as the larva carves out a chamber beneath the surface of the grain (CABI, 2007).	High
Risk due to use of commodity The rate of development of the pathogen is favored by the climate and the existence of a wide range of hosts in the PRA area poses a high risk by using the commodity	High
Likelihood of establishment and spread	
Availability of suitable host *S. cerealella* is a pest of stored products (grains). *S. cerealella* was found to infest rice, sorghum, maize, pearl millet and the weed *E. colonum* (CABI, 2007). It is possible that the pest can establish and spread due to the proceeds in the PRA area.	High
Availability of suitable vector, if vector transmitted Not vectored	
Presence of suitable environment Climatic conditions are suitable in the PRA area; therefore, the pest can establish and spread. Development has been shown to be favoured at 25°C, although larvae will hatch at temperatures down to 12°C and up to 36°C (Cox and Bell, 1981) and the highest number of eggs are laid at 27°C (155/female).	High
Addition control measures will be required Standard insecticide and fumigation treatments are usually effective against *S. cerealella*. However, S. cerealella appears to have developed some resistance to insecticides such as malathion and phoxim (CABI, 2007). Therefore, to effectively control the pest additional control measures will be necessary i.e. production of the commodity in a pest-free sites	Medium
Dispersal potential of pest One female may lay up to 200 eggs (Dobie *et al.*, 1984). There are about five generations per year in cool areas, but in warmer climates *S. cerealella* is continuously brooded with up to 12 generations per year. Adults are also strong fliers and cross-infestation occurs easily. Hence elevated dispersal potential.	High
Assessment of economic impacts	
Economic damage by the pest in the existing geographical range *S. cerealella* is a major pest of stored grains, causing weight loss to grains by hollowing them out. Its impact is greater in the tropics and subtropics where it attacks grain in the field as well as in storage. An estimated overall yield loss of up to 30% (Singh and Benazet, 1975) can be realized. *S. cerealella* causes a considerable amount of damage to unhusked stored rice (Shahjahan 1974)	Medium
Potential economic loss in agriculture in the PRA area The pathogen has potential to cause similar economic losses as those in the areas where the pest is present.	Medium
Potential loss associated with non-agricultural crops	Low

Being associated with stored products, it is not likely to infest non-agricultural crops.	

ASSESSMENT OF INTRODUCTION AND SPREAD *Pseudomonas syringae pv. syringae*	**Rating**
Likelihood of entry	
Quantity imported annually Large shipments are expected per year based on aggregated small quantities .	High
Survive the post-harvest treatment The pest can stay alive the post-harvest treatment because it is internally borne. There is no known effective seed treatment against the pest.	High
Survive shipment The pest is both internally and externally borne and is able to survive shipment. Considering the conditions under which the consignment shall be shipped as well as short distance. .	High
Not detected at point of entry Infected plant materials are symptomless and therefore not easy to detect at the port of entry. Risk of introduction is therefore high	High
Risk due to use of commodity Rice for consumption have low risk, however, the seed has high risk of introduction.	High
Likelihood of establishment and spread	
Availability of suitable host Rice and beans are produced in all the EAC countries hence probability of establishment is high.	High
Availability of suitable vector, if vector transmitted The pest is not vector transmitted	
Presence of suitable environment climatic conditions in the EAC region are favorable for the pest in most if not all areas where host is grown. It could establish in most countries where host species are grown, especially in areas with a tropical influence	High
Addition control measures will be required The pest will require a range of measures to ensure it is not introduced or spread, this include production of commercial produce on pest free areas or inspection and certification of freedom from the pest.	Medium
Dispersal potential of pest Pollen and bud wood are liable to carry the pest in international trade. Wind and rainwater also aid the dispersal of the weed.	High
Assessment of economic impacts	
Economic damage by the pest in the existing geographical range It attacks major crops, including beans (Phaseolus vulgaris), cowpeas, stone fruits, pome fruits, kiwi fruit and grain sorghum. The diseases caused by this bacterium are very important in many countries throughout the world. For instance, bacterial brown spot occurs wherever beans are grown, and canker diseases of fruit trees caused by P. syringae pv. syringae are widespread and	Medium

may be devastating, causing great losses or requiring much effort to protect plants from them. They cause frost injury to plants, at relatively high freezing temperatures.	
Potential economic loss in agriculture in the PRA area The pest can cause significant loss to the PRA area due to the high exchange of germplasm. Since no effective pest management is known against the pest, the damage can be significant.	Medium
Potential loss associated with non-agricultural crops Loss of market for agricultural produce due to detection of the pest.	Low

Table 5. Summary of the Likelihood of entry

Pest	**Quantity imported annually**	**Survive the post-harvest treatment**	**Survive shipment**	**Not detected at point of entry**	**Risk due to use of commodity**	**Cumulative**
Rhyzopertha dominica	Low	Low	High	High	High	Medium
Tribolium confusum	Low	Low	High	Low	High	Medium
Corcyra cephalonica	High	Low	High	Low	High	Medium
Sclerophthora macrospora	Low	Low	High	High	High	Medium
Xanthomonas oryzae pv. oryzae	Low	Low	High	High	High	Medium
Pseudomonas fuscovaginae	High	High	High	High	High	High
Trogoderma granarium	High	High	High	High	Medium	High
Aphelenchoides besseyi	High	High	High	High	High	High
Cochliobolus sativus	High	High	High	Medium	High	High
Magnaporthe grisea	High	Medium	High	Medium	High	Medium
Sitotroga cerealella	High	Low	High	High	High	Medium
Pseudomonas syringae pv. syringae	High	High	High	High	High	High

Table 6. Summary of the Likelihood of establishment and spread

Pest	**Availability of suitable host**	**Availability of suitable vector, if vector transmitted**	**Presence of suitable environment**	**Addition control measures will be required**	**Dispersal potential of pest**	Cumulative

Rhyzopertha dominica	High	Low	High	Low	Medium	Medium
Tribolium confusum	High	Low	High	Low	Medium	Medium
Corcyra cephalonica	High	Low	High	Low	Medium	Medium
Sclerophthora macrospora	High	Low	High	Low	Medium	Medium
Xanthomonas oryzae pv. oryzae	High	Low	High	Low	Medium	Medium
Pseudomonas fuscovaginae	High	Low	High	Medium	High	Medium
Trogoderma granarium	High	Low	High	Medium	High	Medium
Aphelenchoides besseyi	High	Low	High	Low	Medium	Medium
Cochliobolus sativus	High	Low	High	Medium	High	Medium
Magnaporthe grisea	High	Low	High	Medium	High	Medium
Sitotroga cerealella	High		High	Medium	High	Medium
Pseudomonas syringae pv. syringae	High		High	Medium	High	Medium

Table 7. Summary of the Assessment of economic impacts

Pest	**Economic damage by the pest in the existing geographical range**	**Potential economic loss in agriculture in the PRA area**	**Potential loss associated with non-agricultural crops**	**Cumulative**
Rhyzopertha dominica	Medium	Medium	Medium	Medium
Tribolium confusum	Medium	Medium	Low	Medium
Corcyra cephalonica	Medium	Medium	Low	Medium
Sclerophthora macrospora	Medium	Medium	Low	Medium
Xanthomonas oryzae pv. oryzae	Medium	Medium	Low	Medium
Pseudomonas fuscovaginae	High	High	Low	Medium
Trogoderma granarium	High	High	Low	Medium
Aphelenchoides besseyi	High	High	Low	Medium
Cochliobolus	Medium	High	Low	Medium

sativus				
Magnaporthe grisea	High	High	Low	Medium
Sitotroga cerealella	Medium	Medium	Low	Medium
Pseudomonas syringae pv. syringae	Medium	Medium	Low	Medium

Table 8. Overall summary of the Likelihood of entry, establishment and spread and assessment of economic impact

Pest	**Likelihood of entry**	**Likelihood of establishment and spread**	**Assessment of economic impacts**	**Cumulative**
Rhyzopertha dominica	Medium	Medium	Medium	Medium
Tribolium confusum	Medium	Medium	Medium	Medium
Corcyra cephalonica	Medium	Medium	Medium	Medium
Sclerophthora macrospora	Medium	Medium	Medium	Medium
Xanthomonas oryzae pv. oryzae	Medium	Medium	Medium	Medium
Pseudomonas fuscovaginae	High	Medium	Medium	Medium
Trogoderma granarium	High	Medium	Medium	Medium
Aphelenchoides besseyi	High	Medium	Medium	Medium
Cochliobolus sativus	High	Medium	Medium	Medium
Magnaporthe grisea	Medium	Medium	Medium	Medium
Sitotroga cerealella	Medium	Medium	Medium	Medium
Pseudomonas syringae pv. syringae	High	Medium	Medium	Medium

4.0. Phytosanitary measure for importation of rice (Oryza sativa L

4.1 Importation of true seeds;

Permit shall include the following conditions: -

a) Phytosanitary Certificate (International model or its equivalent) from the exporting country
b) Additional declarations as follows: -
   i. Seed should be declared to have undergone through and met the requirements of an official seed certification scheme which should certify against all quarantine and regulated non quarantine pests
   ii. Seed treatment/dressing with appropriate chemical before dispatch

iii. The seed is from a place/site of production where the pest is known not to occur or the seed is sourced from a crop that was inspected during active growth and found to be free from Quarantine pests including; *Aphelenchoides besseyi*, *Pseudomonas fuscovaginae*, *Pseudomonas syringae pv. syringae Magnaporthe grisea* and *Xanthomonas oryzae pv. oryzae, Sclerophthora macrospora, Alternalia padwickii* and *Cochliobolus sativus*
iv. The seeds should not contain any symptoms/signs of and practically free from live pests

4.2: Importation of unprocessed rice (unhusked)

i. All insects including *Sitotroga cerealella, Tribolium confusum, Corcyra cephalonica, Trogoderma granarium and Rhyzopertha dominica* have been killed by approved insecticide treatment/fumigation with appropriate fumigant

ii. The commodity sourced from a place of production where the pest is known not to occur or sourced from a crop that was inspected during active growth and found to be free from Quarantine pests including; *Aphenchoides besseyi, Pseudomonas fuscovaginae, Pseudomonas syringae pv. syringae, Xanthomonas oryzae pv. oryzae, Sclerophthora macrospora, Alternalia padwickii, Magnaporthe grisea, Cochliobolus sativus* and Rice yellow mottle virus (RYMV).

4.3: Importation of processed rice (Milled and polished)

Permit shall include the following conditions: -

a) Phytosanitary Certificate (International model or its equivalent)
b) Additional declarations as follows: -

i. All insects including *Sitotroga cerealella, Tribolium confusum, Corcyra cephalonica, Trogoderma granarium and Rhyzopertha dominica* have been killed by approved insecticide treatment/fumigation with appropriate fumigant

5.0 Conclusion

The PRA was initiated by the need to review the national pest lists and develop strategies for reducing Phytosanitary trade barriers in the East African region as well as develop a harmonized regional pest list for three crops (Maize, Beans and Rice) with a view to developing phytosanitary import conditions for the crops that will be applied within Eastern Africa. The risk assessment involved comparing and harmonizing pest lists associated with three crops from the five countries. The results were Fourteen (14) pests (5 insects, 1 nematode, 4 fungi, 3 bacteria and 1 virus) namely: *Corcyra cephalonica, Rhyzopertha dominica, Trogoderma granarium, Sitotroga cerealella, Tribolium confusum, Aphelenchoides besseyi, Cochliobolus sativus, Sclerophthora macrospora, Magnaporthe grisea, Alternaria padwickii, Pseudomonas fuscovaginae, Pseudomonas syringae pv. syringae, Xanthomonas oryzae pv. oryzae* and Rice yellow mottle virus (RYMV were found to be of quarantine importance to the region. Based on the assessments, the import conditions for trade facilitation were developed for seed rice, unprocessed rice and milled/polished rice.

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