

**REGULATION STATUS OF QUARANTINE PESTS OF RICE SEEDS IN THE
ECONOMIC COMMUNITY OF WEST AFRICAN STATES (ECOWAS)**

**Bachabi F^{1*}, Gumedzoe YMD¹, Maroya NG²,
Ayenan MAT³, Saidou A⁴ and Y Sere⁵**



Fatimata Bachabi

*Corresponding author email: f.bachabi@cgiar.org

¹Université de Lomé, Togo BP: 1515, Lomé, Togo

²International Institute of Tropical Agriculture, Ibadan, Nigeria

³West Africa Centre for Crop Improvement, University of Ghana, Legon, Ghana

⁴Université d'Abomey Calavi, Bénin

⁵Agriculture Research, Burkina Faso



ABSTRACT

The ever growing international trade has limited efforts towards the prevention of introduction, spread and establishment of invasive organisms. Non-native pests can cause severe loss of production and lead to restriction in exchange of genetic materials and seed marketing across regions. Regulating pests' movement through quarantine measures and establishment of regional boards has been identified as a way to deal with introduction and expansion of invasive organisms. This review analyzes the different pest regulations in the West African sub-region with a specific focus on the implementation of quarantine measures in rice as a case study. The various regulations related to seed production, certification and marketing, and quarantine regulations in West Africa were analyzed and their enforcement and performance were assessed through comparison to international standards, especially the International Plant Protection Convention (IPPC). Although a regional regulation on seeds and phytosanitary measures has been elaborated, ECOWAS countries are still enforcing their national phytosanitary legislations, which are nearly the same in all West African countries - they all aim at ensuring plant health by applying preventive and curative measures to prevent the introduction and spread of pests in their territory by controlling the import and export of plant materials and disseminating appropriate pest management techniques to boost agricultural production. Most ECOWAS countries are yet to submit their phytosanitary legislation to IPPC to comply with Article VII.2i of the endorsed convention. In addition, the entry points are not well defined and provided to the IPPC according to the Article VII.2d of the convention. When the quarantine list is available, the organisms regulated for each crop species are not stated, posing a real problem not only for rice genetic resource exchanges for research purposes but also for rice seed trade. Efforts and resources should be devoted by each country to research on pests and regulatory mechanisms in order to define, among others, pest status in the region, and to update regularly the quarantine pests list in the West African region.

Key words: Regulatory measures, quarantine pest, rice seed, harmonization, ECOWAS, IPPC



INTRODUCTION

Increased international trade has limited efforts towards the prevention of introduction, spread and establishment of non-native or invasive organisms [1, 2]. Introduced pests threaten food security because they cause severe losses on crops, affect land use and require high economic costs for their control [1, 2]. Non-native pests can cause a total loss of production and soil-borne disease may render agricultural land non-cultivable for a long time. Quarantine measures have been identified as an efficient way to manage pests since, if properly enforced, they prevent the introduction and spread of pests and other invasive organisms [1, 3].

To provide an international framework for the regulation of pest quarantine, guidelines have been elaborated by the World Trade Organization (WTO); Convention on Biological Diversity (CBD); and the International Plant Protection Convention (IPPC). Following these guidelines, many countries have elaborated national phytosanitary measures. In their attempt to facilitate the implementation of these measures at regional level and to avoid the regulations hampering trade, countries have sought to harmonize their phytosanitary measures [1, 4]. The Economic Community of West African States (ECOWAS) Member States have elaborated regional seed regulations pertaining to the production, certification, and marketing of seed as well as measures to prevent the introduction of seed-borne diseases [5]. However, little is known on how the phytosanitary measures are enforced and their implications on seed trade. An assessment of how the quarantine regulations are elaborated and implemented in West African countries will flag issues to be tackled to avoid the export or introduction and spread of invasive pests that may threaten rice diversity and cultivation in the region.

This paper analyzes the different pest regulations in the West African sub-region with a specific focus on the implementation of quarantine measures in regard to rice seeds. The focus on rice seeds is because rice is playing a strategic role in the food security of the populations in the region [6]. Thus, it is of great importance to provide policy makers with information on factors that may limit its production so that appropriate coping strategies are taken.

In this review, we use the word pest to refer to “*any species, strain or biotype of plant, animal or pathogenic agent injurious to plants or plant products*” [7]. Regulated pest or non-native pest is defined as a “pest of potential economic importance to the area endangered and not yet present, or not widely distributed and controlled” [8].

Origin of regulatory measures for quarantine pests in the ECOWAS member countries

West African countries have endorsed the International Plant Protection Convention (IPPC), an international agreement on plant health, which was adopted in 1951, revised in 1997 and entered into force on 2nd October, 2005 [7]. As at May, 8th 2015, (date of last update of the list of contracting parties) the convention has been contracted by 182 parties [9]. The convention aims to protect plants by preventing the introduction and spread of pests. It also covers the direct and indirect damage caused by pests (including



weeds), the means of conveyance, containers, storage structures, land and any object or material liable to convey pests. All contracting countries should establish a national plant protection organization and must make the necessary arrangements for issuing phytosanitary certificates [8]. All West African countries, except The Gambia, have adhered to the IPPC (Table 1). However, adherence to the convention was not done uniformly. For instance Benin, Guinea Bissau and Côte d'Ivoire were the latest to adhere to the convention while Niger, Senegal, and Sierra Leone adhered to it in the 1980s. Recently, regional organizations have started striving towards having seed phytosanitary legislations at the regional level [10]. Thus, the Permanent Inter-state Committee for Drought Control in the Sahel (CILSS) and the West African Economic and Monetary Union (WAEMU) has endeavored to harmonize the national seed and phytosanitary legislations of their member countries. All West African countries are members of at least one of these regional organizations and, to that end, the initiative of harmonizing the regulation was later extended to all West African countries including Chad and Mauritania, which are members of CILSS [11, 12]. However, adoption and implementation of the harmonized regulations is confronted with the wide divergence of national regulations [13].

Inter-African Phytosanitary Council (IAPSC)

The Inter-African Phytosanitary Council (IAPSC) was created to serve as continental frame in terms of phytosanitary regulations. Among other roles, IAPSC has to prevent the introduction and spread of crops and trees pests in Africa, ensure the harmonization of phytosanitary legislation, build the capacity of stakeholders involved in phytosanitary control at national level and disseminate information on sanitary and phytosanitary regulations and their implications on trade of agricultural products [14]. All African Union (AU) members' countries are members of the IAPSC. Although there is no harmonized phytosanitary regulations at the continent level yet, IAPSC is contributing to strengthen the capacity of national plant phytosanitary officials on trans-boundary pests and to update pest in regional economic union or commission such as West African Economic and Monetary Union (WAEMU) [14].

Regional harmonization of seed regulation and phytosanitary control measures

Harmonization of seed laws and phytosanitary control measures to conform to international best practices is regarded as an important factor in promoting a modern and competitive seed industry [15]. It is worth noting that the harmonization of seed regulations in West Africa entails phytosanitary control measures.

A common regulatory framework is expected to reduce the cost of trading seed and encourage economies of scale in seed production. While progress on harmonizing seed regulations can be seen across the ECOWAS community, effective implementation of regional harmonization will require further action at the national level as well as mutual recognition of rules and regulatory systems between countries [16]. The regulation covers eleven major crops, including rice, that are important to food security and trade. Special attention was devoted to rice seed systems and ECOWAS adopted enabling regulations on the roles, organization and functions of the West Africa Seed Committee (WASC) in June 2012 [17]. The WASC was created under the ECOWAS Regulation to implement regulations on seed quality control, certification and marketing. In May



2008, Ministers of the ECOWAS Countries in West Africa, the West and Central African Council for Agricultural Research (CORAF/WECARD) have been major partners in regional harmonization efforts, and have been tasked with implementation of the ECOWAS Regulation. The CORAF/WECARD implementation efforts are focused on the West African Seed Program (WASP) funded by the United States Agency for International Development (USAID).

A major innovation of the ECOWAS Regulation is the establishment of the West African Catalogue for Plant Species and Varieties (West Africa Seed Catalogue). Any variety registered into the national catalogue of a Member State should be registered into the regional catalogue and be freely traded and allowed for multiplication throughout the region without any further registration requirement. The Economic Community of West African States (ECOWAS) differs from other regions in that new varieties only need to be registered in one member country in order to be eligible for entry in the regional catalogue; both COMESA and SADC require registration in two countries in order to be eligible for entry in the regional catalogue. The regional catalogue is essentially a compilation of the national catalogues of individual countries [10].

Different pest control regulations

In the ECOWAS sub-region, the regulatory standards for pest control mainly consist of the establishment of the lists of regulated pests appended to phytosanitary legislation at the national and regional levels.

❖ National Phytosanitary Legislations

National phytosanitary regulations are nearly the same in West African countries. They aim to ensure plant health by applying preventive and curative measures to prevent the introduction and spread of pests in their territories. In addition, they seek to organize and control the import and export of plant materials and to disseminate appropriate pest management techniques to boost agricultural production. However, compliance with the IPPC convention is still a challenge. As per December 4th, 2016, six of the ECOWAS member countries (Table 1), which adhere to the convention, have sent their phytosanitary legislation to the IPPC (<https://www.ippc.int/en/countries/all/legislation/>) The other countries have thus failed to comply with Article VII.2b (*‘Contracting parties shall, immediately upon their adoption, publish and transmit phytosanitary requirements, restrictions and prohibitions to any contracting party or parties that they believe may be directly affected by such measures’*) of the endorsed convention. Moreover, the entry points are not well defined and submitted to the IPPC in accordance with Article VII.2d of the convention. This may hamper a wide dissemination of information on the importation of seeds and other planting materials.

❖ Rice quarantine pests in West Africa

Each West African country has its own rice quarantine pest list is classified according to European and Mediterranean Plant Protection Organization



(EPPO) criteria, where applicable, as either quarantine pests List A₁ (non-quarantine pests not existing present in the region) or List A₂ (quarantine pests existing in the region but not yet widespread) . Some ECOWAS countries, such as Mali, do not even have a list of quarantine pests. They rely on the reference list of quarantine pests not yet introduced into Africa whose import is prohibited

([https://www.ippc.int/en/countries/mali/reportingobligation/2012/12/liste-des-organismes-nuisibles-reglementes-/](https://www.ippc.int/en/countries/mali/reportingobligation/2012/12/liste-des-organismes-nuisibles-reglementes/)). This list does not take into

account quarantine pests existing in the region; for example,

Hirschmanniella oryzae, which is present in Senegal, Niger, Ghana, Sierra Leone, Côte d'Ivoire, Gambia, Nigeria, Guinea [18] but not yet spread over all the West African region (Table 2) [19-22]. Improved communication on pest status in each country would facilitate the exchange of materials and seed trade among countries in the West African region.

In the existing lists of quarantine pests in ECOWAS Member Countries, the scientific names of organisms have been jumbled up and not arranged based on the type of pests, the categories of quarantine and materials for which pests are regulated, as required by the convention in its article VII.1.i [8]. When the quarantine list is available, the organisms regulated for each crop species are not clearly stated and this brings about confusion. It is a real problem, not only for rice genetic resource exchanges for research purposes but also for rice seed trade. A rice seed trader cannot easily distinguish the quarantine pests of rice seed and, consequently, these organisms can be accidentally introduced in a country or the entry of the seed will be delayed through verification for compliance. This will inevitably lead to an inefficient seed system since the delay will generate additional cost for seed importers and even delay sowing for the cropping season. Consequently, the cost of seed for farmers would increase, preventing them from buying improved seeds to increase their production.

❖ Regional Phytosanitary Legislation

Regulation C/REG06/09 of ECOWAS on the harmonization of the organizational framework and operational rules governing the biosafety of plants, animals and food products in the ECOWAS region defines plant health regulation in West Africa. This legislation is based on those of CILSS and WAEMU.

The Permanent Inter-state Committee for Drought Control in the Sahel (CILSS) defines standards for phytosanitary control of seed in a common regulation on plant and seeds for its member countries (TITLE II, Chapters 5 and 6). This provision subjects seeds of all plant species to control at the point of exportation and final destination. Article 54 states that the export of seed is subjected to authorization from the country. Article 55 establishes a phytosanitary inspection and quality control of seed for export and import into the CILSS region. This article provides, in Appendix 10 of CILSS Convention, a list of quarantine pests for the most cultivated and most consumed food in the region. For rice seed, these organisms are viruses (*Rice black streaked dwarf virus* and *Rice*



stunt virus) and fungi (*Tilletia barclayana* syn. *Neovossia barclayana*). The analysis of these provisions by CILSS revealed inconsistency when referring to international standards for phytosanitary measures as defined by IPPC [8]. For example, international standards require that the list of quarantine pests must include the scientific name of the pest, its category as well as any goods or other items that are regulated while CILSS does not include host plants, the scientific names of pests and pest geographical distribution. In addition, this list is not available at the IPPC Secretariat and is not frequently updated to abide by international standards.

The ECOWAS regulatory standards are similar to those of WAEMU. However, as Magalhaes [23] pointed out, Articles 8 (Harmonization), 9 (Risk Analysis) and 10 (Principle of free movement of goods and equivalence) of the ECOWAS Regulation are not included in the WAEMU Regulation.

West African Economic and Monetary Union (WAEMU) standards are summarized in Regulation N°. 7/2007 / CM / UEMOA (WAEMU) related to plants, animals and foods safety in its Member Countries. Both ECOWAS and WAEMU regulations provide lists of quarantine pests and, for the specific case of rice seed, the organisms remain the same. The Economic Community of West African States (ECOWAS)'s pests quarantine list provides per crop species, the scientific name of the pests, their class, distribution, the plant material for which it is regulated, and the requirements for the importation of the concerned material. The structure of the list meets international standards for phytosanitary measures. However, the list is not frequently updated. Therefore, new quarantine pests may not be excluded or included in the list in the light of scientific knowledge. Thus, new pests can establish and spread before costly and often ineffective eradication measures are enforced [1]. In addition, the updating of the quarantine pests list is important to avoid accidental introduction of pests or to prevent unnecessary control at the entry point of seeds. Furthermore, the ECOWAS pest quarantine list is not available yet at the International IPPC secretariat as required by the International Standards for Phytosanitary Measures, which may limit its accessibility.

Requirements for the importation of rice seeds

Pre-regulatory measures for the importation of rice seeds in a regional community or from one regional economic community to another requires compliance with several conditions, which vary from one regional community to another. These conditions pertain to the required documents, specified treatments for seeds lots and other specific requirements. Import Permit and Phytosanitary Certificate are the main documents required in the ECOWAS sub-region. The Plant Import Permit is issued by the importing country whilst the Phytosanitary Certificate is issued by the exporting country and it allows the importation of seeds according to the phytosanitary requirements.

In addition, ECOWAS requires a declaration after inspection that indicates the absence of a pest during on-farm production, any pre-treatment with hot water or with a fungicide, and passage through a quarantine station. In the ECOWAS sub-region, unlike the situation in the Southern Africa Development Community (SADC) [24], the



process of harmonization of regulatory quarantine measures is not yet being implemented in Member Countries. Therefore, the importation of rice seeds between ECOWAS Member Countries still faces barriers owing to the necessity to comply with the regulation in each country. The Plant Quarantine Service (PQS) in each country has defined specified treatments and treatments reference PQS that each seed lot must undergo. The requirements for Phytosanitary Certificate (PC) and Import Permit (IP) and other specific requirements vary from one country to another. The importation of rice seeds into Benin, for example, requires that importers hold the PC and IP, treatment of seeds with an insecticide and fungicide in hot water (53°C for 15 minutes). Upon arrival, the package and the PC of the country of origin should be presented to plant protection officers for verification and validation. However, because of permeability of borders in West African countries, seeds are illegally brought in by some seed dealers and/or farmers without passing by the required checks at entry points (Authors' personal observation). This could be a potential means for pest introduction. Awareness-raising on the importance of check at entry points will help to reduce such practices.

Way forward

Governments can intervene in phytosanitary regulation in different ways especially by providing quarantine services with financial and trained human resources to organize and implement phytosanitary regulations, to carry out research and share information [25]. Harmonization and successful implementation of the regional legislation on pest quarantine is imperative to cope with these challenges. This can be achieved with a real commitment of policy makers in each ECOWAS member country. Trust must be established among phytosanitary regulation agencies in order to accept control and tests done in other member countries of the Community. Currently, most of the countries have weak infrastructural capacity for implementing plant health regulations [26]. Because of the importance of pest control, countries should endeavor to establish well-equipped laboratories for phytosanitary control [25]. Training of regulatory staff and furnishing of laboratories with updated equipment will help to build this trust. Efforts and resources should be devoted to research on pests and regulatory mechanisms in order to define, among others, pest status in the region, regularly update the list of quarantine pests, and make the best of the harmonization in the West African region.

CONCLUSION

The regulatory measures of quarantine pests for plant materials, such as rice seeds, established in West Africa are summarized in national laws and regional regulations governing the protection of plants, animals and food prepared by ECOWAS. The importation of rice seeds within West Africa is subordinated to a phytosanitary certificate and import permit notifying that seeds are free of quarantine pest considered for rice seeds in the country of destination and to the satisfaction of the other specific requirements of each country. Phytosanitary regulation and the list of quarantine pests do not meet international standards. More rigors are advocated in the establishment of the pest quarantine list, which should take into account the directive provided by the IPPC and provide the necessary information related to regulated pests, scientific name, class and distribution. The list should be updated in the light of current scientific



understanding and knowledge and submitted to the IPPC as well. Plant health officers need to be trained and appropriate facilities built in order to exert effective controls.

ACKNOWLEDGEMENT

We would like to thank Dr. Manuele Tamo, Dr. Ajayi Olupomi, Mrs Afolabi Toyin, Dr. Kumar Lava, Dr. Monica Mezzalama, Dr. Marie-Noelle Ndjiondjop, Professor Jeanne Zoundjiekpon for their guidance and comments on the earlier versions of the manuscript.



Table 1: Date of the ratification of the IPPC by countries in West Africa

N°	Country	Date of adherence	Phytosanitary Legislation (see https://www.ippc.int/en/countries/all/legislation/)
1	Benin	October 12, 2010	Yes
2	Burkina Faso	June 8, 1995	Yes
3	Cape Verde	March 19, 1980	No
4	Côte d'Ivoire	December 17, 2004	No
5	The Gambia	Not yet	-
6	Ghana	February 22, 1991	No
7	Guinea	May 22, 1991	Yes
8	Togo	April 2, 1986	No
9	Guinea-Bissau	October 24, 2007	No
10	Liberia	July 2, 1986	No
11	Mali	August 31, 1987	Yes
12	Niger	June 4, 1985	No
13	Nigeria	August 17, 1993	Yes
14	Senegal	March 3, 1975	Yes
15	Sierra Leone	June 23, 1981	No

Source: IPPC [9]

Table 2: Quarantine pests of rice seed in the West African countries

N°	Type of pest	Pest	Country	Type quarantine	References
1	Nematode	<i>Aphelenchoides besseyi</i> (Christie, 1942), <i>Ditylenchus angustus</i> (Butler 1913) (Filipjev 1936)	Benin; Burkina Faso, Côte d'Ivoire, Gambia, Ghana; Mali; Nigeria; Senegal; Sierra Leone; Togo.	EPPO A2	[19; 20] IP / Nigeria IB / 2006/7, République de la Côte d'Ivoire, Arrêté N° 2007 du 10 décembre 1963, fixant les détails d'application du décret n° 63-457 du 7 novembre 1963
		<i>Hirschmanniella oryzae</i> (Breda de Haan, 1902)	Senegal	Exported organisms: list APHIS	[21; 22]
2	Bacteria	<i>Pantoea stewartii</i> subsp. <i>indologenes</i>	Benin, Togo, Côte d'Ivoire, Burkina-Faso, Niger, Nigeria, Ghana, Mali		Personal communication
		<i>Pseudomonas syringae</i> pv. <i>persicae</i> (Prunier, Luisetti & Gardan, 1970; Young, Dye & Wilkie, 1978)	CILSS Member countries	EPPO A2	[19, 20] IP / Nigeria IB / 2006/7
		<i>Xanthomonas oryzae</i> pv. <i>oryzae</i> (Xoo) (Ishiyama 1922)	Benin; Burkina Faso; Mali, Niger; Senegal; Togo;		
		<i>Xanthomonas oryzae</i>	Benin, Burkina		

N°	Type of pest	Pest	Country	Type quarantine	References
		<i>pv.oryzicola</i> (Xoc) (Fang <i>et al.</i> 1957)	Mali, Nigeria; Senegal		
3	Fungi	<i>Monographella albescens</i> (von Thümen) (Parkinson <i>et al.</i> 1981)			
		<i>Pyricularia oryzae</i> (Cavara 1891)	Côte d'Ivoire, Gambia, The Ghana, Guinea, Niger, Nigeria, Senegal, Sierra Leone		
		<i>Tilletia barclayana</i> (Sacc .& P.Syd, 1899)	Sierra Leone, Togo, Nigeria, Benin		
		<i>Rhynchosporium oryzae</i> (Hashioka and Yokogi 1955)	Côte d'Ivoire, Nigeria, Sierra Leone	[19]	
		<i>Balansia oryzae-sativae</i> (Hashioka 1971)	Sierra Leone		
		<i>Entyloma oryzae</i> (Syd and Syd 1914)	Nigeria, Ghana, Sierra Leone	Quarantine	
		<i>Sclerospora oryzae</i> (Brizi 1919) <i>Sclerophthora macrospora</i>	Benin, Nigeria, Sierra Leone	[20]	

N°	Type of pest	Pest	Country	Type quarantine	References
		(Sacc.) <i>Neovossia horrida</i> <i>syn Tilletia barclayana</i> (Takah.1896)			
4	Virus	<i>Hoja blanca</i> (RHBV) (Garcés 1940) Morales & Niessen (1983)	Nigeria, Mali, Niger		
		Rice dwarf virus (RDV) (Takata 1895) and (Fukushi 1934) Rice black streaked dwarf virus (SRBSDV) (Zhou <i>et al.</i> 2004, 2008); (Wang <i>et al.</i> 2010)	All CILSS countries, Nigeria		Annex 10 of CILSS (2006)
5	Insects	<i>Sogatella furcifera</i> (Horváth, 1899)	Benin	Quarantine	

REFERENCES

1. **MacLeod A, Pautasso M, Jeger MJ and R Haines-Young** Evolution of the international oregulation of plant pests and challenges for future plant health. *Food Secur.* 2010; **2**:49–70.
2. **Mumford JD** Economic issues related to quarantine in international trade. *Eur. Rev. Agric. Econ.* 2002; **29**:329–348.
3. **Rodoni B** The role of plant biosecurity in preventing and controlling emerging plant virus disease epidemics. *Virus. Res.* 2009 ; **141**:150–157.
4. **FAO.** Proposition de Projets de Textes Constituant Le Cadre Normatif de La Sécurité Sanitaire Des Animaux, Des Végétaux et Des Aliments de l'Union Economique et Monétaire Ouest Africaine. FAO, Rome, 2006.
5. **ECOWAS.** Draft Implementing Regulation Relating to the Technical Agreements Annexes Defining to the Modalities for Seed Certification et Quality Control of Seed in The ECOWAS. ECOWAS, Abuja, 2013.
6. **Seek PA, Tollens E, Wopereis MCS, Diagne A and I Bamba** Rising trends and variability of rice prices: Threats and opportunities for sub-Saharan Africa. *Food Policy* 2010; **35**:403–411.
7. **IPPC.** International Plant Protection Convention – Reformatted. IPPC, Rome, 2012.
8. **IPPC.** International Plant Protection Convention. IPPC, Rome, 1997.
9. **IPPC.** International Plant Protection Convention. Contracting Partie **Keyser CJ** Ouvrir les marchés au commerce des semences en Afrique, document de travail sur le commerce Africain No. 2, Région Afrique, Banque Mondiale, Washington DC. 2013.
10. **Maroya NG** Bulletin du réseau sur les semences en Afrique occidentale (WASNET). 2006:1–43.
11. **CORAF, USAID and ECOWAS.** Contribution to the CAADP Process. Regional Seed Policy and Famer Access to Quality Seeds in West Africa. 2014.
12. **OECD.** OECD seed schemes: A Synthesis of International Regulatory Aspects that Affect Seed Trade. 2012. Available at <http://www.oecd.org/tad/code/internationalregulatoryaspectsseedtrade.pdf>. Accessed on October, 20th, 2016.
13. **African Union** 5th Steering Committee Meeting and 24th General Assembly of Inter-African Phytosanitary Council , 25-29 April 2011. Addis Ababa, 2011.

14. **Gisselquist D** Harmonization of seed legislation and regulation in CEEC, CIS and Other Countries in Transition. FAO, Rome, 2001. Retrieved from <http://agris.fao.org/agris-search/search.do?recordID=XF2016026232>. Accessed on August, 15th, 2016.
15. **Kuhlmann K** Harmonizing regional seed regulations in Sub-Saharan Africa: A Comparative Assessment. 2015.
16. **Keyser J, Eilita M, Dimithe G, Ayoola G and L Sene** Towards an Integrated Market for Seeds and Fertilizers in West Africa. Working Paper, Report Number 93630, World Bank Group, Washington DC, 2015. Available at <http://documents.worldbank.org/curated/en/886471468119063004/pdf/936300R EVISED00REVISED0FINAL0TO0DC.pdf>. Accessed on August, 15th, 2016.
17. **CABI**. Datasheet *Hirschmanniella oryzae* (rice root nematode). Available at <http://www.cabi.org/isc/datasheet/27867.2016>. Accessed on August, 15th, 2016.
18. **FAO**. International Standards for Phytosanitary Measures, ISPM No. 1 Phytosanitary principles for the protection of plants and the application of phytosanitary measures in international trade, FAO, Rome, 2006.
19. **OEPP/EPPO**. EPPO Standards PM 1/2(22) English. EPPO A1 and A2 lists of pests recommended for regulation as quarantine pests, 2013. Retrieved from <http://www.eppo.org/QUARANTINE.htm>. Accessed on April, 9th, 2016.
20. **Fortuner R** Laboratoire de Nématologie ORSTOM de Dakar : Les Nématodes parasites des racines associés au riz au Sénégal (Haute-Casamance et régions Centre et Nord) et en Mauritanie. *Cah. ORSTOM, ser. Biol*, 1975; **3** : 147-159.
21. **EPPO**. Reporting Service 2005, No. 9. EPPO Standards, 2005. Available at <http://archives.eppo.int/EPPOReporting/2005/Rse-0509.pdf>. Accessed on April, 9th, 2016.
22. **Magalhaes J** Stratégies et cadres régionaux pour les questions sanitaires et phytosanitaires en Afrique. 2010.
23. **SADC**. Technical Agreements on Harmonization of Seed Regulations in the SADC Region. SADC Secretariat, Gaborone, 2008.
24. **Temple ML, Gladders P, Blood-Smyth JA, Crabb J, Mumford JD, Quinlan MM, Makuch Z and SM Mourato** An Economic Evaluation of MAFF's Plant Health Programme. A Report Prepared for MAFF Economics (Resource Use) Division by ADAS Consulting Ltd. and Imperial College of Science, Technology and Medicine. 2000.
25. **Smith JJ, Waage J, Woodhall JW, Bishop SJ and NJ Spence** The challenge of providing plant pest diagnostic services for Africa. *Eur. J. Plant Pathol.* 2008; **121**:365–375.