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Quarantine Regulations for Oil Palm Seeds and Clones from Costa Rica

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Abstract

The oil palm in Costa Rica is free of any known seed-borne pathogen. Nearly 125 million seeds (up to the year 2004) had been exported since 1986 to more than 30 countries all over the world in America, Asia and Africa, without a single interception being reported by the countries of destination. This record is a good indication of the reliability of phytosanitary measures taken, and the seriousness given by ASD de Costa Rica to guarantee both genetic purity and high standards in all phytosanitary aspects.

Many countries where ASD de Costa Rica exports oil palm seeds require strict phytosanitary inspections and certifications from the Costa Rican Government to guarantee that the seeds are free of the pests and diseases indicated by the country of destination. Based on field inspections and laboratory tests, oil palm seeds from Costa Rica have been declared free of all pests and diseases of concern for any country in the world. Pathogens such as *Pseudospiropes* (*Cercospora*) *elaeidis*, *Fusarium oxysporum* f.sp. *elaeidis*, the cadang cadang viroid, the chlorotic ring spot potyvirus and the rubber pathogen, *Mycrociclus ulei* are unknown in Costa Rica.

Oil palm seeds from Costa Rica are produced in areas officially certified pest free by a National Plant Protection Organization (NPPO). ASD de Costa Rica operates under the terms of the Agreement on the Application of Sanitary and Phytosanitary Measures. The certification of shipments of export plant products is regulated by the Costa Rica's Phytosanitary Protection Law No. 7664, its associated regulations, the International Plant Protection Convention (IPPC) and the World Trade Organization (WTO). The seed garden, processing and packing plants and exit points are subject to periodic official inspections, required to get a Phytosanitary Export Certificate.

Introduction

The oil palm in Costa Rica has very few phytosanitary problems of concern, and this is particularly true for the region where ASD of Costa Rica has its oil palm-breeding program, the commercial seed processing unit and tissue culture laboratory to produce commercial clones.

Some oil palm growers in Asia have expressed concern about the risk of introducing certain diseases to the continent through the import of seeds from Tropical America. These worries have stemmed from an unclear presentation in some papers and reports of the real phytosanitary situation of the oil palm in Tropical America, and the indiscriminate use of common names for diseases affecting the crop. The names spear rot, bud rot and derivatives that include the words "lethal" or "fatal", have been used freely to refer to disorders in which the youngest leaves partially or completely rot or desiccate while outer-older leaves remain green. No pathogen has

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been identified as the sole cause of these problems, but there are always environmental factors that have been determined as predisposing the plant to such disorders (Chinchilla & Umaña 1996; Alvarado et al. 1997; Chinchilla & Duran 1998, 1999).

Spear rots are by no means endemic to America, not even those that could cause the death of the palm, since this sometimes occurs even with the most familiar of these rots, "the common spear rot". (Duff 1963; Kovachich 1957; Turner 1981; Watanavanich 1982; Mariau et al. 1992; Chinchilla & Durán 1998, 1999; de Franqueville, 2001). Furthermore, "lethal bud rot" as known in some areas of Tropical America is not necessarily lethal. Tropical America covers more than twelve million square kilometers, a vast territory, which harbors a tremendous diversity of ecosystems. Considering the enormous distances between countries, and their biotic wealth, generalizations may easily lead to erroneous conclusions.

With nearly 125 million seeds (up to the year 2004) exported since 1986 to more than 30 countries all over the world (Table 1), without a single documented interception reported by the countries of destination, it is a good indication of the reliability of these genetic materials and the seriousness given by ASD to guarantee high standards in all phytosanitary aspects.

Table 1. Number of oil palm seeds exported by ASD and estimated of hectares planted in countries of three continents (data up to the year 2004).

Geographic area	Countries	Seeds exported (000's)	Estimated hectares
North America	Mexico, U.S.A.	10,421	61,303
Central America and the Caribbean	Costa Rica, Honduras, Nicaragua, Dominican Republic, Panama, Guatemala	23,386	137,564
South America	Brazil, Ecuador, Colombia, Peru, Surinam, Venezuela	25,492	149,955
Asia	Cambodia, India, Indonesia, Thailand, Myanmar, Singapore	64,598	379,990
Africa	Angola, Cameroon, D.R. Congo, Ethiopia, Gabon, Kenya, Madagascar, Malawi, Sierra Leone, Tanzania, Uganda, Zambia	786	4,624
Total	*32*	*124,684*	*733,435*

Phytosanitary practices in commercial plantations and seed (and clonal) production areas

Commercial plantations

Fortunately, there are only a few diseases affecting the oil palm in Costa Rica, and effective management practices have been developed for the most important ones. Phytosanitary management is basically preventive through proper agronomic practices, and this has been

particularly true for disorders such as bud rot, where incidence and severity are clearly linked to an unfavorable environment, and adverse soil and agronomic practices (Chinchilla & Duran 1998, 1999). The absence of seed-borne diseases in Costa Rica (Chinchilla & Umaña, 1996) is an additional benefit that has made this country a recognized source of oil palm planting materials throughout the world.

The same general phytosanitary practices are applied in both the breeding and commercial fields, but the former receives particular attention given that all precautions must be taken to preserve the highly valuable genetic material and to guarantee high phytosanitary standards in the seeds produced. Disease surveys are systematically done (normally once a month) to record all phytosanitary problems that may appear. A specific code is assigned to each palm that describes its phytosanitary condition: healthy or presenting a particular disease, pest, physiological or genetic disorder, nutrient deficiency or any other conditions worth to note. After each phytosanitary survey, immediate action is taken to treat each palm according to the particular problem found (Table 2).

Surveillance of the plantations in Costa Rica is done following the general principles described by Mckenzie 1977; Morin & Phillipe 1978 and Genty et al. 1978, but local experience and research has also yielded information which is normally used (Chinchilla & Oehlschlager 1992; Rhainds et al. 1993, 1994, 1996; Mexzón et al. 1994, 2003; Mexzón & Chinchilla 1996, 1999; Loría et al. 2000; Chinchilla 2003).

Besides the routine work done by the phytosanitary department (monthly phytosanitary inspections), all regular workers are also instructed to inform managers about any unusual increase in the population of any pest. In the event of an observed apparent increase in the population of a pest, a group of trained people is sent to the area to take a closer look to the potential problem. They are trained workers that write down in special forms all details that have been defined through research as important as to assess the potential damage of that particular pest. Some common information taken is number of eggs, larvae and their sizes, pupae and adults, and observation on natural enemies, such as parasitoids, predators and diseases.

For defoliators, leaf # 17 or 25 of one palm per hectare is thoroughly examined, except for those pests where it has been previously determined that reliable estimates of the population can be obtained by examining just one particular portion of the leaf. In young plantations, the leaves are not cut off, but checked from the ground.

Seed and *ortet* gardens

ASD de Costa Rica has an area of about 430 ha dedicated to oil palm breeding in the South Pacific region of Costa Rica. Nearly 130 ha are planted with *dura* palms, 150 ha are dedicated to progeny trials, and parental *lines*, and the rest are compact palms and clones. The breeding facilities are located within a commercial oil palm plantations of about 8,000 ha. Several breeding trials are planted at semi-commercial scale, particularly to produce new seed varieties and clones, in addition to the area of 430 ha mentioned before.

Selection of palms as parents or *ortets* to produce hybrid seeds or clones, is based on data from field experiments, but the final choice of any particular palm to be used in the program, is only done after a close examination to guarantee that it is a plant free of any abnormality or known pest or disease that may pose any phytosanitary risk.

Selected inflorescences to be artificially pollinated (before its isolation-bagging when they are in leaf axils in position 15-16 on the phyllotaxy) are prepared by removing of spathes and spraying on the exposed inflorescence with a formalin and deltametrin solution, and carbaryl on the peduncle. The entrance of insects or other contaminants inclucing strange pollen into the isolation-bags is prevented by tying with a rubber band a thick cotton pad around the peduncle, and then dusting it with carbaryl. A second layer of cotton also dusted with insecticide is placed around the base of the bagged inflorescence.

Alcohol 95% is used for disinfection of all materials during pollen handling, and pollination. Only inflorescences that start anthesis after 10 days from bagging are pollinated. When ripe, the seed-bunches are cut and taken to the seed processing unit.

Seed processing unit and tissue culture laboratory

Controlled-pollinated seeds receive the first treatment after the mesocarp is removed, by soaking in a fungicide solution. A second fungicide treatment, using a solution with mancozeb and carbendazim, is given after soaking the seeds subsequent to breaking dormancy with a heat treatment. Additional fungicide treatment is given by spraying during the weekly routine checks for germination. This time, several fungicides with different modes of action are weekly applied and rotated to prevent the development of resistant races of any storage fungus.

During the whole process strict selection procedures have been developed to discard all abnormal or damaged seeds, and those contaminated with storage fungi, mainly *Penicillium* sp, which is associated with the brown germ condition.

The germinated seeds ready for export are placed in groups of 102 seeds in plastic bags with urethane foam to prevent physical damage during transit. A final spray with fungicides is given before sealing the bags. Lots to be exported as pre-heated seeds received upon request by some countries a treatment with fungicides and insecticides.

ASD has a modern tissue culture laboratory to clone oil palm. During the final growth stages in the laboratory, the *ramets* are transferred from test tubes into special cellophane bags containing a nutritive solution. These cellophane bags are then sealed to keep the *ramets* growing in an aseptic media until they are planted in the prenursery. For overseas delivery, the cellophane bags are firstly placed in light cardboard boxes, which in turn are packed in sturdy waterproof cardboard boxes.

Table 2. General routine actions taken after detecting some of the most important phytosanitary problems found in oil palm plantations in Costa Rica

Problem	Agent/cause	Action taken				
		Eradication	Pesticide treatment	Trapping	Others	References
Diseases						
Red ring	*Bursaphelenchus cocophilus*	yes	Herbicide to eradicate the affected palm, insecticide in traps for the vector	Yes	IPM, phytosanitary law enforcement	3,4,5,6, 8, 11, 22
Basal wet rot	*Erwinia* sp.*?*	yes	No	No	Improving soil aeration	7, 27
Charcoal basal rot	*Ustulina deusta*	yes	To protect cuts of felled palm	No	Improvement of agronomic practices	4, 9, 27, 28
Basal steam rot	*Ganoderma* sp.	yes	To protect cuts of felled palm	No	Improvement of agronomic practices	4, 27
Anthracnose (nursery)	*Collectrotrichium gloesporioides* and other opportunistic	No	Selective fungicides	No	Balanced fertilization, wider spacing, water management	23, 27
Pests						
America palm weevil	*Rhynchophorus palmarum*	Rarely	Yes (in traps)	Yes	IPM, phytosanitary law enforcement	6, 8, 11, 15, 21, 22
	Opsiphanes cassina	No	Yes (if necessary)	Yes	IPM	7, 13, 16, 17, 24
Bag worn	*Oiketicus kirbyi*	No	Yes (if necessary)	Yes	IPM	17, 18, 25, 26
Physiological disorders						
Dry spear rot	*Specific causes unknown*[a]	No	With surgery	Yes[b]	Balanced nutrition, water management, good soil aeration	10, 14
Crown disease/ Common spear rot	*Specific causes unknown*[a]	No	Occasionally: with surgery	Yes[b]	Balanced nutrition, water management, soil aeration	1, 2, 10, 19, 20

a. Associated with adverse growing conditions: decline-type condition. b. Trapping of palm weevils prevents the attack to the affected plant.

1: Alvarado et al., 1977; 2: Blair, 1970; 3: Bulgarelli et al., 1998; 4: Chinchilla and Richardson, 1988; 5: Chinchilla, 1991; 6: Chinchilla and Oehlschlager, 1992; 7: Chinchilla, 1993; 8: Chinchilla et al., 1995; 9: Chinchilla and Durán, 1998; 10: Chinchilla and Durán, 1999; 11: de Franqueville and Renard, 1990; 12: Kovachich, 1957; 13: Loría et al., 2000; 14: McKenzie, 1977; 15: Mexzón et al., 1994; 16: Mexzón and Chinchilla, 1996; 17: Mexzón and Chinchilla, 1999; 18: Mexzón et al., 2003; 19: Monge et al., 1993; 20: Monge et al., 1994; 21: Oehlschlager et al., 1993; 22: Ohlschlager et al., 2002; 23: Renard and Quillec, 1979; 24: Rhainds et al., 1993; 25: Rhainds et al., 1994; 26: Rhainds et al., 1996; 27: Turner, 1981; 28: Umaña and Chinchilla, 1991.

Practices to meet Costa Rica's official phytosanitary regulations

ASD de Costa Rica operates under the terms of the Agreement on the Application of Sanitary and Phytosanitary Measures (IPPC). This system is applied to exporting firms to guarantee high standards in the phytosanitary monitoring of their product shipments, which has been reflected in the absence of interceptions reported by the countries of destination of ASD's products. The certification of shipments of export plant products is regulated by the Costa Rica Phytosanitary Protection Law (PPL) No. 7664, its associated regulations, the International Plant Protection Convention (IPPC), and the World Trade organization (WTO).

Under the terms of the PPL, the Plant Health Service of the Costa Rica Ministry of Agriculture and Livestock maintains a database with technical and phytosanitary information on companies that export plant products. The registration procedure for inclusion in the data base is regulated by Guide GTE-P-001, Procedure for Registration in the Database of Exporters of Non-Traditional Products and Wooden Packing Crates (Law No. 7664 and GTE-P-001, available athttp://www.protecnet.go.cr). ASD de Costa Rica has been registered in the database since 1989, under registration No. 299, which was last renewed in the year 2002 and expires in the year 2007.

Both the plantation areas and processing and packing plants are subject to periodic visits by Official Plant Health Inspectors. These visits are regulated by Guide GTE-T-002- Standards for Farms and Nurseries of Non-traditional Agricultural Products, and GTE-T003, Standards for Packing Plants of Non-Traditional Agricultural Products. The Health Inspectors make observations, issue recommendations, and if considered necessary, take samples to be sent to official specialized laboratories (plant pathology, nematology , entomology etc.). A copy of the results of each inspection is left in the Official Inspection Book kept by each export company, in which the recommendations are written down. Compliance with these recommendations is mandatory.

Plant Health Officers also carry out inspection and certification of shipments of plant products for export at the exit points, which is a requirement to issue a Phytosanitary Export Certificate. Transportation and packing are also regulated by Guide GTE-O10 Standards for the Packing and Transportation of Non Traditional Agricultural Products, in compliance with both national and international regulations.

ASD's experience meeting quarantine requirements from specific countries

India, Indonesia, Thailand, Zambia, Kenya, Mexico, Honduras and Colombia are examples of countries that require strict phytosanitary inspections and certifications from the Costa Rican Government to guarantee that the oil palm seeds exported are free of the pests and diseases indicated by the country of destination (Table 3). Based on field inspections and laboratory tests, oil palm seeds from Costa Rica have been declared free of the nematode *Bursaphelenchus* (*Rhadinaphelenchus*) *cocophillus*, and its vector, the American palm weevil, *Rhynchophorus palmarum*. On the other hand, the following pathogens have not been known to occur in Costa Rica: *Pseudospiropes* (*Cercospora*) *elaeidis*, *Fusarium oxysporum* f.sp. *elaeidis*, the Cadang cadang viroid, the Chlorotic ring spot potyvirus and *Mycrociclus ulei*. *Phytomonas staheli* (the flagellate associated with sudden wither disease) has not been reported in oil palm in Costa Rica.

Strict phytosanitary requirements have been met by ASD of Costa Rica to export pre-heated seeds to Indonesia. The procedure involves a period of quarantine in Miami after obtaining a Phytosanitary Certificate from the Department of Agriculture of the United States (APHIS). All original packing is destroyed in Miami and seeds are repacked in boxes made in the U.S.

More recently, ASD de Costa Rica has exported compact palm *ramets* to several countries including Malaysia. The phytosanitary requirements of this last country included a Phytosanitary Certificate from an Intermediate Quarantine Station in England, where a group of 4,000 *ramets* was inspected by CABI Bioscience in order to issue the certificate stating that this consignment was free of visually detectable pests and diseases. Bags containing the *ramets* in nutrient solution were repacked into new sturdy cardboard boxes for onward transmission to Malaysia. All requirements of the Crop Protection and Plant Quarantine Services Division of the Department of Agriculture of Malaysia were met by ASD de Costa Rica to successfully bring the oil palm clones into this country.

Real risks of introducing pathogens through seed imports

Previous sections presented a detailed description of regular phytosanitary procedures followed by ASD de Costa Rica to guarantee a high quality product (oil palm seeds and *ramets*), which offer no risk for importing to other countries any known pest or disease for this crop. The following sections briefly presents some details of important diseases found in the Americas, its presence or absence in Costa Rica, and the real risks known for them to be transmitted in seed imports.

Red ring disease

This is a problem of common occurrence in several countries of Tropical America. The disease is caused by the nematode *Bursaphelencus* (*Rhadinaphelencus*) *cocophilus* (Cobb), Boujard, and is transmitted by the American palm weevil, *Rhynchophorus palmarum* L. (Blair 1970), a species restricted to tropical America. Transmission of the nematode by other insects, including *Metamasius hemipterus* has not been proven in Costa Rica (Morales & Chinchilla 1991; Bulgarelli et al. 1998; Chinchilla 1991, 1993). This disease is the most common

pathological problem in oil palm and coconut in the region, and the only disease of any economic concern found in Costa Rica.

An effective management strategy has been developed that can reduce this disease to very low levels (Chinchilla & Oehlschlager 1992; Chinchilla et al. 1993; Oehlschlager et al. 1993, 1995, 2002; Chinchilla 2003). The pathogen is not seed-borne (Blair & Darling 1968; Blair 1970; Schuiling & Dither 1981; Griffith 1987), and all experimental attempts to infect very young oil palm plants have failed. The nematode *B. cocophilus* is an obligate parasite, which means that it cannot be carried in the culture media used to transport *ramets*.

Table 3. Quarantine requirement from several countries met by ASD of Costa Rica to export oil palm seeds from Costa Rica: official statements issued from quarantine authorities in Costa Rica

Country	Official field inspections and laboratory tests declared the seeds free from:	Additional statements	
		In Costa Rica it is not known to occur:	Other statements:
India	*Phytomonas staheli*, *Bursaphelenchus cocophillus*, *Rhynchophorus palmarum*	*Cercospora elaeidis*, *Fusarium oxysporum f.sp. elaeidis*, *Pachymerus nucleorum*, *P. lacerdae*, *P. carda*, *Pemelephila ghesquierei*, *Haplolaimus pararobustus*, Cadang cadang viroid, virus affecting Palmaceae, lethal spear rot	The oil palm seeds were obtained from plants free from crown disease, and the seeds are free from soil and weeds
Indonesia	*Rhynchophorus palmarum*, *Bursaphelenchus cocophilus*, *Cercospora elaeidis*	*F. oxysporum f.sp. elaeidis*, lethal yellowing, *Microcyclus ulei*, *Haplolaimus pararobustus*, *Scutellonema bradys*, Leaf mottle (MLO)	
Thailand	*Phytomonas staheli*, *Bursaphelenchus cocophilus*	*F. oxysporum f.sp. elaeidis*, *Cercospora elaeidis*	The material is not transgenic
Madagascar	*B. cocophilus*, *Phytomonas staheli*	*F. oxysporum f.sp. elaeidis*	
Zambia	*Bursaphelenchus cocophilus*, *Phytophthora palmivora*	*Quadraspidiotus perniciosus* (San José scale), Cadan cadang viroid, root wilt, lethal yellowing, Bronze leaf wilt, bristle top disease	Plants were inspected in the field and found free from pests and diseases, including *Mauginiella scaettae* and *Marasmius palmivorus*. Seeds were free of soil and debris

Kenya	*Bursaphelenchus cocophilus*	*Melittonma insulare*	The seeds were not germinated in soil
Malawi	*B. cocophilus, Phytophthora palmivora*	Cadang cadang viroid, root wilt, leaf scorch, lethal yellowing, bronze leaf wilt, bristle top disease	Plants were inspected in the field and found free from pests and diseases, including *Mauginiella scattae* and *Marasmius palmivorus*
Mexico	*Phytomonas sp. Schyzophyllum commune, Ustulina sp.,Ceratocystes sp.*	*F. oxysporum f.sp. elaeidis*	
Honduras	*B. cocophilus, R. palmarum*	*F. oxysporum f.sp. elaeidis*	
Colombia		*F. oxysporum f.sp. elaeidis*	The material is not transgenic
Peru	*Fusarium longipes*	Cadang cadang viroid	

Sudden wither (Marchitez sorpresiva)

This disease is associated with the presence of the flagellate *Phytomonas* sp. in the phloem of affected palms (Dollet & López 1978). The pathogen is thought to be transmitted by *Lincus* spp. of the Pentatomidae family (Perthius et al. 1985). In Central America, it has been found infecting oil palm along the Northern Caribbean coast of Honduras, scattered in a few small and concentrated areas (Chinchilla & Richardson 1987). Sudden wither has not been found in oil palm in Costa Rica, and the pathogen is not seed-borne: a plant infected by *Phytomonas* will stop bunch development and rot all its bunches rather quickly, even before other symptoms appear. An effective surveillance program, and the use of rather simple management practices reduces this problem to a secondary importance, such as has been observed in Honduras, and other countries in South America, clearly indicating that the phantom created in the past about the destructive potential of this disease has been destroyed.

***Fusarium* wilt (vascular wilt)**

Caused by *Fusarium oxysporum* f. sp. *elaeidis*, is a real soil-borne pathogen (de Franqueville & Renard 1990; Flood 1990), but this is a pathogen unknown in Central America. Up to 1989, vascular wilt had been found in the Ivory Coast, Benin, Nigeria, Cameroon, Zaire, Ghana and Congo, and two particular plantations in America in Brazil and Ecuador (van der Lande 1985; Renard & de Franqueville 1989; Mariau et al. 1992).

Lethal yellowing

This is a coconut disease, associated with a phytoplasma (formerly MLO), and probably transmitted by *Myndus crudus*, a leafhopper. In America the disease is found in Florida, along part of the Gulf of Mexico, Honduras and on some islands in the Caribbean. Oil palm is most probably resistant (may be immune) to this pathogen, and in Honduras, a commercial oil palm plantation has coexisted for several years with LY-infected coconut palms The LY phytoplasma is not seed borne in coconuts. Bud rots in oil palm are definitively not related to lethal yellowing of coconut.

Chlorotic ring spot

This is a nursery disease found in India and Ecuador, and unknown in Central America. There is no indication whatsoever of seed transmission of the implicated poty-virus (Chinchilla 2001).

Conclusions

Costa Rica has a long and reputable tradition exporting agricultural goods. The plant quarantine authorities in Costa Rica are very strict and conscientious of the importance of guaranteeing a safe product for the international market. In the particular case of exports of oil palm seeds, there are more than 16 years of experience, where more than 125 millions seeds have been exported to more than 30 countries in Africa, America and Asia without a single interception reported by the countries of destination. Given this clear record, ASD de Costa Rica (the only exporter of oil palm seeds and clones in the country) continues to operate under the terms of the Agreement on the Application of Sanitary and Phytosanitary Measures, a system applied to ensure the excellence in meeting standards of phytosanitary monitoring and the quality of their product shipments. All these makes us confident to make the asseveration that there is no (known) danger in importing palm diseases through oil palm seed imports from Costa Rica

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